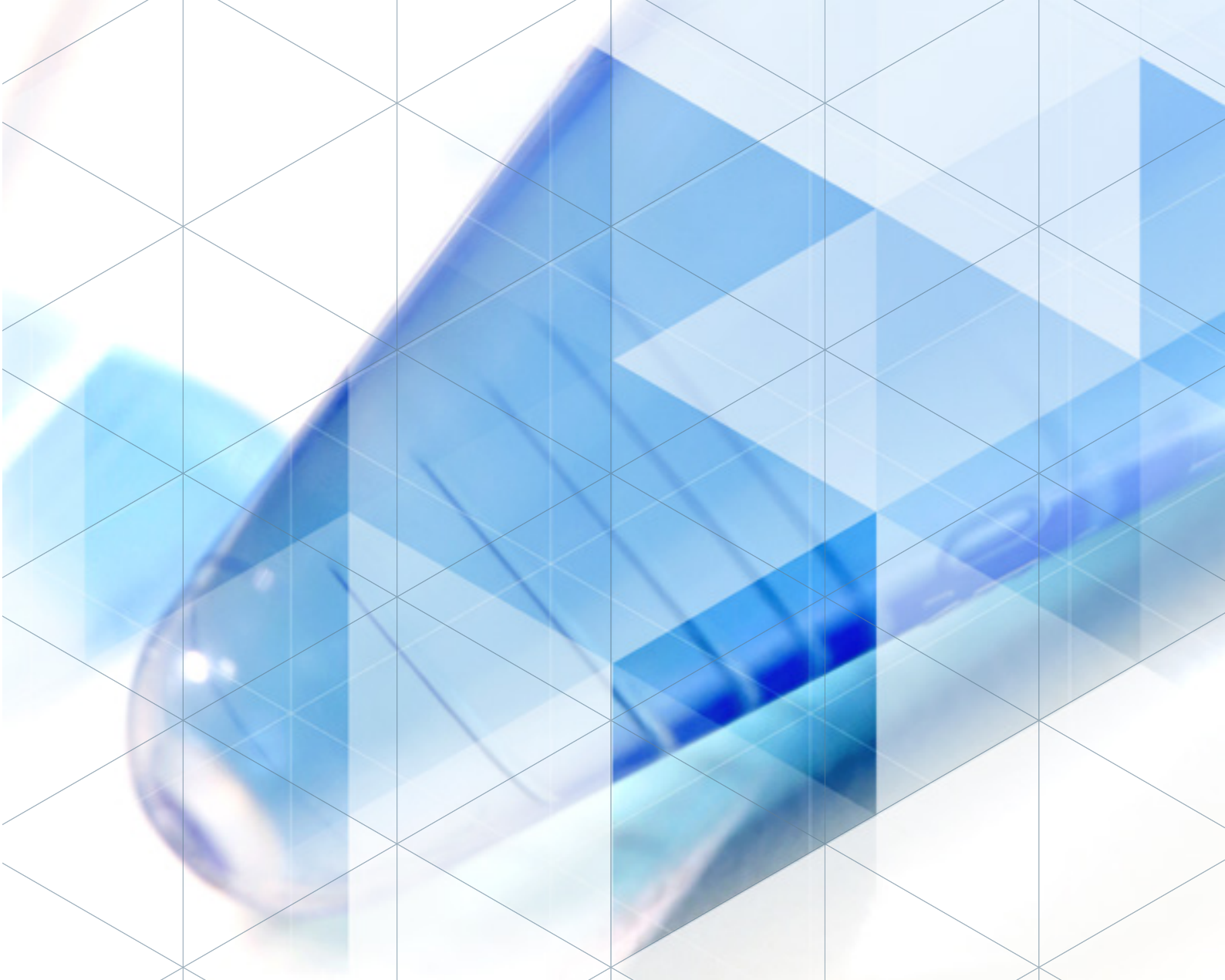


CENTRE FOR CANCER BIOMEDICINE ANNUAL REPORT 2015

CONTENTS

The next generation in cancer research

One of the first challenges the CCB executive group received from its Scientific Advisory Board was how to promote the success of the next generation of cancer researchers. Research training has indeed been a core activity in CCB, and the centre´s ambitious goal was to graduate 50 PhD candidates during the 10-year Centre of Excellence period. Now it is clear that this milestone will be reached in the Spring of 2016 - 1 1/2 year ahead of schedule. We would like to congratulate all those talented young scientists who contributed to CCB´s research in such an excellent way. We would also like to thank all CCB scientists who have been taking active part in training of PhD and Master students, as part of CCB´s advanced course in Cancer Biology at the University of Oslo, as teachers at other courses, or by active supervision. CCB has sponsored as many as five 20%-positions as professors or associated professors at the University, which contributes strongly to the University´s research based training of cancer researchers and at the same time provides valuable teaching experience for some of CCB´s junior scientists.

CCB´s focus on research training implies efforts to ensure high level and quality of the training. The centre´s PhD/MSc course has received excellent ratings from students from both the Medical Faculty and the Faculty of Mathematics and Natural Sciences, and CCB´s PhD students have been contributing to truly ground-breaking research. In 2015, this is best illustrated by CCB PhD Sigrid Bratlie Thoresen, who received His Majesty The King´s gold medal for best thesis at the Faculty of Medicine. Several other excellent PhD theses were defended by CCB´s PhD students in 2015, including a thesis by Marina Vietri in Harald Stenmark´s group, who was first author of a Nature paper uncovering the mechanism of nuclear envelope sealing during mitotic entry and its importance in genome maintenance. Another Nature paper from the same group, led by CCB project leader Camilla Raiborg, established a novel mechanism for endosome positioning and showed its importance for protrusion outgrowth. These two papers received worldwide attention, including commentaries in leading journals such as Nature, Science and EMBO Journal. A number of additional examples of excellent CCB papers in 2015 are provided throughout this report.

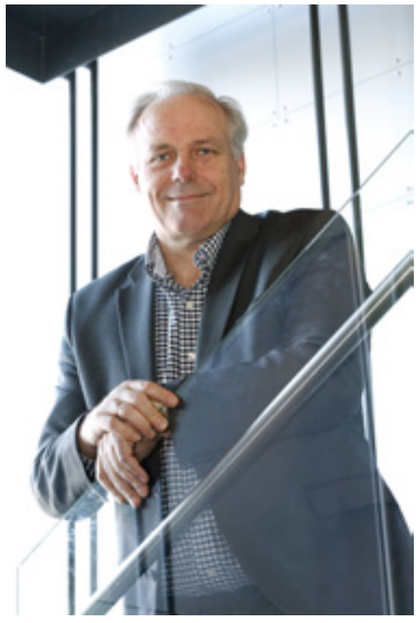
We are proud of the many awards and honours young talents as well as senior scientists have received during the CCB period. Last year, Kaisa Haglund, was honoured with Anders Jahre´s Nordic Prize for younger medical scientists, and Guro E. Lind was awarded Dr. Ragnar Mørk´s Prize for excellent cancer research. Guro was one of 20 young scientists (under the age of 38 years) selected among 160 applicants from all disciplines as founders of the Young Academy of Norway. Guro was appointed as the first chair of the Academy, an initiative by the Norwegian Academy of Science and Letters to make a forum for the elite among young Norwegian scientists. Among CCB´s more senior scientists, CCB director Harald Stenmark received the Research Council´s "Møbius" prize for outstanding research, and the successful research at CCB and the centre´s promotion of young scientists were highlighted by the award committee.

Representing 23 nationalities, CCB provides a training ground for cancer researchers coming from all over the globe, which ultimately promotes international cancer research. This is in harmony with the strategies of the centre´s host institutions, the University of Oslo and Oslo University Hospital. The latter institution is crucially important for providing the infrastructure and clinical know-how into CCB´s internationally successful translational research. Furthermore, CCB´s translational research continues to contribute to the clinical implementation of novel translational research findings.

Once more we would like to thank our host institutions, our co-workers, clinical associates, national and international collaborators and sponsors for a joint effort that has contributed to CCBs continuous advancement of cutting-edge cancer research.

Director Harald Stenmark
Co-director Ragnhild A. Lothe

Greetings from our hosts



IVAR P. GLADHAUG

Head of Institute of Clinical Medicine
University of Oslo

Since its inauguration in 2007, CCB has been one of the very top scientific centres at the Institute of Clinical Medicine and at the University of Oslo at large. Situated in the core of the Norwegian clinical cancer community, CCB has fully realised its declared vision: to discover novel mechanisms and principles that will be relevant to future cancer management. By joining basic cancer research and translational research the centre has succeeded in the publication of a remarkable number of top-quality research papers. The University of Oslo further acknowledges the significant contribution of CCB to the training of PhD students and future cancer scientists. This, in the long term, will become a major legacy of this centre.

SIGBJØRN SMELAND

Head of Division of Cancer Medicine
Oslo University Hospital

The concept of a cancer centre is to achieve highest quality in patient treatment based on a strong research platform. Within this framework, the importance of centres of excellence, in addition to their strong scientific contribution, is to serve as vehicles for research. This is particularly true in the case of CCB, always at the international forefront. During the last year, the contribution in basic cell biology and translational research has been exceptional, resulting in publications in the top rated journals. OUH and the Division of Cancer Medicine aim to be a leading cancer centre in Europe. This is achievable with centres such as CCB, due to the exceptional quality of their scientists and collaborative skills.

Greetings from the board

The CCB board - from left: Karl-Erik Gierckskу, Ole M. Sejersted, Hilde Irene Nebb, Svein Stølen

Chairperson
Hilde Irene Nebb

2015 has been an active year that is underlined by the high quality and research excellence members of this centre hold. CCB provides an optimal setting for frontline research that fosters excellence not only among senior scientists but also among the younger researchers. One can mention several papers published in high impact journals among them two Nature papers from CCB director Harald Stenmark's group that has attracted worldwide attention. Further, the "Møbius" prize that Harald Stenmark received from The Norwegian Research Council for outstanding research and the prestigious Anders Jahre´s Nordic Prize for young medical scientists that Kaisa Haglund received. Guro E. Lind was awarded Dr. Ragnar Mørk´s Prize for excellent cancer research, while PhD Sigrid Bratlie Thoresen, received His Majesty The King´s gold medal for best PhD thesis at the Faculty of Medicine, University of Oslo.

As chairperson of the board and Deputy Dean of Research at Faculty of Medicine I am proud to be a part of this centre that is a clear example of how good leadership, a clear scientific vision and focus on research quality can build research environments of top class.

MONTHLY REVIEW 2015

SELECTED PUBLICATIONS:

Danielsen SA, Lind GE, Kolberg M, Høland M, Bjerkehagen B, Sundby Hall K, van den Berg E, Mertens F, Smeland S, Picci P, Lothe RA. (2015) **Methylated RASSF1A in malignant peripheral nerve sheath tumors identifies neurofibromatosis type 1 patients with inferior prognosis** Neuro Oncol. 17(1):63-9.

A prognostic biomarker for NF1 patients with MPNST
Methylation analysis of *RASSF1A* in MPNSTs and benign neurofibromas revealed that 60% of the malignant tumors and none of the benign specimens were methylated, thus strongly indicative of a cancer specific event. More importantly, silencing of the tumor suppressor gene through promoter methylation predicts poor prognosis for patients with the hereditary disorder Neurofibromatosis type 1, independent of clinical risk factors such as tumor size and metastasis at time of diagnosis. These patients will probably benefit from an extended follow-up protocol and adjuvant treatment.

Eikenes ÅH, Malerød L, Christensen AL, Steen CB, Mathieu J, Nezis IP, Liestøl K, Huynh JR, Stenmark H, Haglund K. (2015) **ALIX and ESCRT-III Coordinately Control Cytokinetic Abscission during Germline Stem Cell Division In Vivo** PLoS Genet. 11(1):e1004904.

Cytokinesis in multicellular tissues
Abscission is the final step of cytokinesis that involves the cleavage of the intercellular bridge connecting the two daughter cells. In this paper, Eikenes, Malerød and colleagues show that ALIX and the ESCRT-III component Shrub are required for abscission in a living metazoan tissue. Using the *Drosophila* female germline stem cell (fGSC) division as model, the authors showed that loss of ALIX or Shrub function in fGSCs leads to delayed abscission. The authors conclude that ALIX and ESCRT-III coordinately control abscission in Drosophila fGSCs and that their complex formation is required for accurate abscission timing in GSCs *in vivo*.

MEDIA COVERAGE:

Supercomputing reveals the genetic code of cancer
Cancer researchers must use one of the world's fastest computers to detect which versions of genes are only found in cancer cells. Every form of cancer, even every tumour, has its own distinct variants.

"This charting may help tailor the treatment to each patient," says Associate Professor Rolf I. Skotheim, who is affiliated with the Centre for Cancer Biomedicine and the Research Group for Biomedical Informatics at the University of Oslo, as well as the Department of Molecular Oncology at the Norwegian Radium Hospital, Oslo University Hospital.

Skotheim's research group is working to identify the genes that cause bowel and prostate cancer, which are both common diseases. There are 4,000 new cases of bowel cancer in Norway every year. Only six out of ten patients survive the first five years. Prostate cancer affects 5,000 Norwegians every year. Nine out of ten survive.

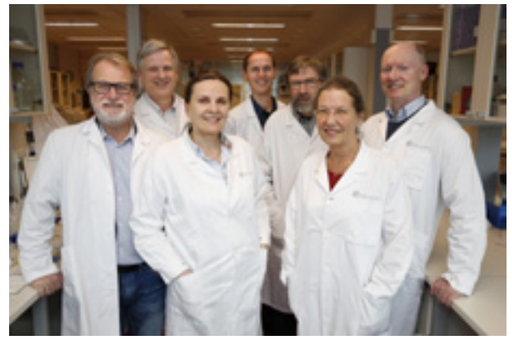
www.apollon.uio.no | Supercomputing reveals the genetic code of cancer

Two popular science dissemination contributions by CCB scientists
CCB's PhD student Åsmund Husabø Eikenes has contributed with a new article in the Norwegian newspaper Aftenposten about the recurring questions: What does it take to solve the cancer riddle? And why do I get cancer?

In her blog on www.forskning.no, postdoc Sigrid Thoresen from CCB writes about whether cancer is a question of good or bad luck?

www.aftenposten.no/viten | Kvifor får nettopp du kreft?
www.forskning.no | Kreft: Et spørsmål om flaks eller uflaks?

HIGHLIGHTS:



The CCB PI group 2015

Group leader Rolf I. Skotheim awarded one-year PI position in CCB for 2015
CCB congratulates Rolf I. Skotheim with a one-year PI position for 2015.

Increased focus on career development for young scientists in CCB
As part of CCBs strategy for supporting career development of young scientists, the PI group decided in 2012 to announce an internal call for a one-year PI position in CCB for a young scientist every year from 2013 to 2017. We congratulate Rolf I. Skotheim with being awarded the 2015 PI stipend.

Nanoparticle review from Kirsten Sandvig's group among the most cited articles in Nano Today
Nano Today (impact factor 18.4) publishes on their homepage a list of the most cited articles in the journal since 2010. This list now shows the review article "Endocytosis and intracellular transport of nanoparticles. Present knowledge and need for future studies" by Tore Geir Iversen, Tore Skotland and Kirsten Sandvig at the Institute for Cancer Research to be number 3 on this ranking.

INNOVATION:

UK patent application filed January 2015
Cancer biomarkers
Llorente A, Skotland T, Øverbye A, Sandvig K.
Serial No.: INVEN-14257.

SELECTED PUBLICATIONS:

■ Phuyal S, Skotland T, Hessvik NP, Simolin H, Overbye A, Brech A, Parton RG, Ekroos K, Sandvig K, Llorente A. (2015) **The ether lipid precursor hexadecylglycerol stimulates the release and changes the composition of exosomes derived from PC-3 cells** J Biol Chem. 290(7):4225-37.

Importance of membrane lipids in exosome biology
Ether lipids constitute a considerable proportion of membrane lipids, and their absence causes several diseases. In this paper Phuyal and coauthors have investigated how alterations in the cellular levels of these lipids affect the release and/or molecular composition of exosomes. Interestingly, cells containing higher levels of ether lipids release more exosomes. Furthermore, these exosomes have a different lipid composition, in particular the levels of ether lipids were highly increased compared to control cells, but also the protein composition was different. These studies highlight the importance of lipids in exosome biology where they may be important to modulate exosome stability, transport and/or function.

■ Kolberg M, Høland M, Lind GE, Ågesen TH, Skotheim RI, Sundby Hall K, Mandahl N, Smeland S, Mertens F, Davidson B, Lothe RA. (2015) **Protein expression of BIRC5, TK1, and TOP2A in malignant peripheral nerve sheath tumours - A prognostic test after surgical resection** Mol Oncol. 9(6):1129-39.

High risk patients identified by immunohistochemical profile
Malignant peripheral nerve sheath tumours (MPNST) are rare cancers with poor outcome. Matthias Kolberg and co-workers analysed 67 patient samples in order to identify molecular characteristics of tumours from the patients with the highest risk of relapse after initial treatment. 17q is the most commonly gained chromosomal region in MPNST, and the three 17q genes *BIRC5*, *TK1*, and *TOP2A* were all found to be independent prognostic markers on the gene expression level, as well as on the protein level. A combined immunohistochemical test of the three markers identified patients with inferior prognosis even after assumed curative surgery, and this test may prove useful for selection of patients for more aggressive treatment and new clinical trials.

MEDIA COVERAGE:

■ **Together against cancer**
A supplement on different topics related to cancer was distributed with the Norwegian newspaper Dagbladet in February 2015. CCB was represented by Professor Ragnhild A. Lothe and colleagues featuring colorectal cancer and the collaborative work of researchers and clinicians.

■ **Personalized cancer treatment**
The supplement Innovation and Research was distributed with the Norwegian newspaper Aftenposten in February 2015. CCB research was represented by Associate Professor Rolf I. Skotheim describing the importance of genomic research for better personalized cancer treatment.

FORUMS:

■ **The Postdoctoral Forum**
Since 2009, we have hosted a regular forum for postdoctoral researchers (postdocs, researchers and project group leaders) working at the CCB, which includes approximately 60 scientists spread over 10 groups. In 2014, we expanded the postdoctoral forum to include all postdocs, researchers and project group leaders at the Institute for Cancer Research (ICR) and the Institute for Cancer Genetics and Informatics (ICGI). This has not only considerably increased the size of the forum and attendance to each meeting, but has also improved the discussions following presentations.

The forum is aimed at improving scientific interactions between scientists and awareness of each other's work and expertise, and by this we hope to facilitate collaborations between the different groups at the Institute. The format of the forum usually involves two speakers from different departments who succinctly and comprehensibly describe their project with emphasis on aspects where input from the audience is desired. In addition, we have in 2015 hosted seminars on more general topics like "How to get published", "Writing good grant proposals" and "Graphical representation of research data".

In 2015 we have arranged 5 meetings, characterized by excellent presentations and active discussions. We aim to host 4-5 postdoctoral forums in 2016, and hope to initiate more interactions between the scientists of CCB, ICR and ICGI as such, with the overall aim to generate new and fruitful collaborations across research groups.

The CCB Postdoctoral Forum committee
Catherine, Manohar, Marthe, Sabine, Anders, Thea Kristin, and Ellen Margrethe

SELECTED PUBLICATIONS:

Olsen TK, Panagopoulos I, Meling TR, Micci F, Gorunova L, Thorsen J, Due-Tønnessen B, Scheie D, Lund-Iversen M, Krossnes B, Saxhaug C, Heim S, Brandal P. (2015) **Fusion genes with ALK as recurrent partner in ependymoma-like gliomas: a new brain tumor entity?** Neuro Oncol. 17(10):1365-73.

ALK fusions in ependymal tumors
Thale Kristin Olsen and colleagues wanted to determine whether chromosomal rearrangements led to the formation of fusion genes in ependymomas. RNA sequencing revealed two tumors harboring rearrangements of the ALK oncogene. In one case, this was caused by a t(2;14) translocation, and in another, it was caused by an interstitial deletion in the short arm of chromosome 2. These findings were supported by PCR, FISH and immunohistochemistry. This is the first time ALK fusions have been described in brain tumors. The finding is of potential great clinical interest, as there are currently two ALK inhibitors in clinical use.

SEMINARS:

Seminar March 3rd
Antoni Wiedlocha, PhD, Group leader, Department of Molecular Cell Biology and CCB, Institute for Cancer Research, The Norwegian Radium Hospital | **Inhibition of Hsp90 potentiates anti-leukemic effect of cytarabine *in vivo***

Camilla Raiborg, PhD, Assistant Group Leader, Department of Molecular Cell Biology and CCB, Institute for Cancer Research, The Norwegian Radium Hospital | **Contacts between the endo- and exocytic pathways in control of endosome positioning and cellular protrusions**

Seminar March 26th
CCB minisymposium on Centrosome and Cilia Biology:

Prof. Tim Stearns, Department of Biology, Stanford University | **Cilia, Centrosomes and Cell Polarity**

Prof. Rachel Giles, Department of Nephrology and Hypertension, UMC Utrecht | **Are cystic kidneys (replication) stressed out?**

MEDIA COVERAGE:

TV interview with CCB Co-director about cancer genomics and future treatment
The Norwegian Cancer Genomics Consortium arranged their second cancer genomics conference at Losby outside Oslo on the 11-12th of March. Leading researchers and clinicians from Norway gathered to discuss future cancer treatment. TV2 interviewed Ragnhild A. Lothe and Ola Myklebost about the successful conference.

INNOVATION:

US Patent Application and International Patent Application filed March 2015
Prostate cancer markers and uses thereof
Llorente A, Skotland T, Sandvig K.
Serial No.: INVEN-32448/US-3/PCT.

SELECTED PUBLICATIONS:

■ Raiborg C, Wenzel EM, Pedersen NM, Olsvik H, Schink KO, Schultz SW, Vietri M, Nisi V, Bucci C, Brech A, Johansen T, Stenmark H. (2015) **Repeated ER-endosome contacts promote endosome translocation and neurite outgrowth** Nature. 520(7546):234-8.

The endoplasmic reticulum in regulation of endosome positioning and cellular protrusions

The endoplasmic reticulum (ER) makes contact with various other cellular organelles including endosomes. Camilla Raiborg and co-workers now show that the ER protein Protrudin makes contact with the small GTPase RAB7 and phosphatidylinositol 3-phosphate on late endosomes (LEs). This allows transfer of the microtubule motor protein Kinesin-1 from Protrudin to the motor adaptor FYCO1 on LEs. Thus repeated ER–LE contacts promote microtubule-dependent translocation of LEs to the cell periphery and their subsequent fusion with the plasma membrane to induce outgrowth of cellular protrusions. These findings open up for further studies on cancer related processes that involves endosomal signalling and cell migration/invasion.

HIGHLIGHTS:

■ Nature article from Camilla Raiborg: Formation of cellular protrusions

In a recent paper in Nature, project leader Camilla Raiborg and her co-workers in Harald Stenmark´s group show an unexpected connection between endosomes (organelles involved in protein import into cells) and the endoplasmic reticulum (ER, organelle involved in protein export) in formation of cellular protrusions.

Formation of cellular protrusions

The authors find that a protein called Protrudin forms contact sites between ER and endosomes, and when such sites are formed, the endosomes are loaded with a motor that makes them migrate from the cell centre to the cell periphery. Here, they fuse with the cell membrane, and this induces formation of cellular protrusions.

– What is the importance of cellular protrusions?
In this paper we show that the mechanism we have identified promotes the outgrowth of neurites - precursors of nerve fibers - in nerve cells. This is interesting because mutations in Protrudin and its interacting proteins are associated with hereditary spastic paraplegias, a group of neurodegenerative diseases. Our findings could shed light on the causes of these enigmatic diseases.

– Is there any link to cancer?
Cancer cells use protrusions called invadopodia to break through the extracellular matrix so that they can invade other tissues. It is plausible that Protrudin and its interactors play a role in invadopodia formation, and we are planning to investigate this. If our hypothesis is correct, this could provide us with new targets for cancer therapy.

– Are there other implications of the new findings?
In certain specialized cell types, fusion of endosome-like organelles with the cell membrane have important physiological functions. An interesting example is cytotoxic T cells, which kill virus-infected cells and tumour cells. Protrudin is expressed at high level in such cells, so we would now like to investigate the possibility that the new mechanism we have identified might play a role in immunity.

See also Selected Publications on this page (Raiborg C et al.)

Commentary article:
Krauß M, Haucke V. EMBO J. 2015 Apr 9.
A grab to move on: ER-endosome contacts in membrane protrusion formation and neurite outgrowth.

www.forskning.no | Nervetrådenes hemmelighet avdekket

■ Acquisition of light sheet microscopy for long term volumetric live cell imaging

Microscopy of living cells is a fine balance between the need to gather enough information of a cellular process and the limitation that cells are very sensitive to fluorescent light and that excessive illumination triggers non-physiological behavior or simply kills the cell.

Standard epifluorescence microscopy excites fluorophores not only right at, but also above and below the focal plane. This generates out-of-focus fluorescence which degrades the final image. Moreover, even if only a small region is in focus, the whole sample is illuminated, leading to phototoxicity and, ultimately, cell death. While confocal microscopy or deconvolution microscopy can generate sharp images by rejecting or mathematically removing out-of-focus light, they still illuminate the whole sample, effectively limiting the information that can be recorded from a cell without damaging it.

To avoid these problems, single plane illumination microscopy (SPIM) uses orthogonal illumination with a thin sheet of light, which does not excite out of focus regions of the sample. This results in both sharp images and no light exposure of areas outside of the focal plane. By this, photobleaching is reduced by several orders of magnitude. Moreover, by acquiring multiple views of the same sample, an improved axial resolution can be achieved.

The recently installed diSPIM microscope system – the only one of its kind in the Nordic countries - allows imaging of small and medium sized samples (e.g. single cells, small multicellular organisms, cysts and organoids). By acquiring two orthogonal views of the specimen, it allows to reconstruct high resolution images with equal resolution (330nm) in all three dimensions. This is effectively double the Z resolution of a confocal microscope. It combines extremely fast acquisition - capturing complete multicolor 3D volumes within seconds - with low doses of light exposure, allowing it to follow cellular processes in 3D for long time periods. As such, its capabilities are currently unmatched by any commercially available microscope system.

The acquisition of this microscope is funded by the University of Oslo's programme for research infrastructure.

DISSERTATIONS:

Åsmund Husabø Eikenes – PhD
Novel regulators of cytokinesis in vivo
Faculty of Medicine, University of Oslo, April 2015

SELECTED PUBLICATIONS:

■ Andresen K, Boberg KM, Vedeld HM, Honne H, Jebsen P, Hektoen M, Wadsworth CA, Clausen OP, Lundin KE, Paulsen V, Foss A, Mathisen Ø, Aabakken L, Schrumpf E, Lothe RA, Lind GE. (2015) **Four DNA methylation biomarkers in biliary brush samples accurately identify the presence of cholangiocarcinoma** Hepatology. 61(5):1651-9.

DNA methylation biomarkers detect cholangiocarcinoma

Up to 20% of patients with primary sclerosing cholangitis (PSC) develop the deadly disease cholangiocarcinoma, cancer of the bile ducts. Diagnosing this malignancy is particularly challenging. In a collaborative effort between CCBs group of Epigenetics and the Norwegian PSC Research Center, DNA methylation analyses of a large series of biliary brush samples identified a high performance biomarker panel with 85% sensitivity and 98% specificity. The molecular analyses outperformed conventional brush cytology, however, combining both modalities detected a high 94% with 96% specificity. These findings are promising for the development of a DNA methylation-based test for monitoring PSC patients for cholangiocarcinoma development.

■ Njølstad TS, Trovik J, Hveem TS, Kjæreng ML, Kildal W, Pradhan M, Marcickiewicz J, Tingulstad S, Staff AC, Haugland HK, Eraker R, Oddenes K, Rokne JA, Tjugum J,Lode MS, ENITEC Network/MoMaTEC Study Group, Amant F, Werner HM, Salvesen HB, Danielsen HE. (2015) **DNA ploidy in curettage specimens identifies high-risk patients and lymph node metastasis in endometrial cancer** Br J Cancer. 112(10):1656-64.

DNA ploidy predicts lymph node metastasis in endometrial cancer

In a collaboration project between Helga Salvesen's group at Haukeland University Hospital and Håvard Danielsen's group, Tormund S. Njølstad and colleagues evaluated the prognostic value of DNA ploidy in preoperative curettage specimens from 785 endometrial carcinoma patients in the Molecular Markers in Treatment of Endometrial Cancer (MoMaTEC) multicentre trial. They found that non-diploid DNA status was an independent predictor of lymph node metastasis among patients with FIGO stage I-III and a predictor of shorter disease-specific survival. The results indicate that DNA ploidy can be of interest preoperatively to identify high-risk patients for tailored surgical treatment.

MEDIA COVERAGE:

■ Rolf Skotheim interviewed about supercomputer sequencing

In the May issue of the Pathologist, CCB's Rolf I. Skotheim, leader of the Genome Biology Group at Oslo University Hospital, was interviewed about the use of supercomputing to process enormous amounts of raw data.

Together with their collaborators at the University of Oslo, Skotheim's group studies the genetics of cancer. Their focus is on RNA transcription errors, particularly those that are involved in prostate and bowel cancers. "There are two main problems that can occur in transcription – either too much of it, which leads to the production of excessive levels of the given protein, or mistakes in it, which leads to RNA with the wrong composition of base pairs," says Skotheim. "One such mistake can result in fusion genes, hybrid stretches of nucleic acids where sections of two separate genes are erroneously joined. Fusion genes are commonly found in cancer cells, but can also be present in healthy tissue. In our case, we have been able to identify several fusion genes present only in prostate or colorectal cancers – which we may be able to use as biomarkers to determine the presence and severity of disease, or to offer patients future targeted treatment opportunities. Our aim is to identify and characterize those and other critical genes involved in cancer development."

■ Popular science dissemination by CCB's Hilde Lie Erling

Hilde Lie Erling, Head of Section for Interphase Genetics, Institute for Cancer Genetics and Informatics at Oslo University Hospital, has contributed with an article on her blog on forskning.no. Here is a short summary:

DNA ploidy using digital image technology presents a strong and versatile prognostic marker for several cancer types. Measuring the total amount and organization of the chromatin in cancer cell nuclei, we are able to classify and separate aggressive tumours from the less aggressive ones. Aneuploid cells contain abnormal DNA amounts in a disorganized state, which is correlated to aggressive cancer. DNA ploidy results can help clinicians decide on the appropriate treatment for each patient, ensuring that aggressive cancers are treated immediately, while overtreatment of indolent cancers can be avoided.

www.forskning.no/blogg | Cellekjernen røper kreftutviklingen

HIGHLIGHTS:

■ Åsmund Eikenes publishes in Nature's careers column

Åsmund Eikenes from Harald Stenmark's lab at the department of Molecular Cell Biology, Centre for Cancer Biomedicine, has published an article in the careers column of the May 6th edition of Nature (journal impact factor 42.4). The article is entitled "Visual maps bring research to life".

Storytelling techniques

In the short essay, Åsmund Eikenes argues that scientists could benefit from actively using techniques from storytelling to improve their scientific work.

One example is what he calls "Storymapping" - arranging microscope images, graphs, models and preliminary figure panels into a dynamic story as a research project develops. The visual overview of the project's status allows the researcher to identify strengths, weaknesses and new directions for the research project at an early stage.

Storymapping contributes to the manuscript writing process, as it allows the researcher to keep a clear focus on the questions and answers that guide the narration of the work.

www.nature.com/naturejobs | Visual maps bring research to life
www.forskning.no/blogg | På trykk i Nature – Storymapping

DISSERTATIONS:

Gro Nilsen – PhD
Statistical learning in genomics: Uncovering patterns and groups in high dimensions
Faculty of Mathematics and Natural Sciences, University of Oslo, May 2015

SELECTED PUBLICATIONS:

Vietri M, Schink KO, Campsteijn C, Wegner CS, Schultz SW, Christ L, Thoresen SB, Brech A, Raiborg C, Stenmark H. (2015) **Spastin and ESCRT-III coordinate mitotic spindle disassembly and nuclear envelope sealing** Nature. 522(7555):231-5.

Nuclear envelope dilemma solved

During cell division, the nuclear envelope breaks down to enable segregation of chromosomes by the mitotic spindle apparatus. Nuclear envelopes are then reformed around the daughter nuclei and the mitotic spindle is disassembled by a mechanism that has not been known. Vietri and co-workers have discovered that the ESCRT machinery accumulates at nuclear envelope holes that are intersected by microtubules. Here, ESCRT proteins recruit an enzyme, Spastin, which severs microtubules. The remaining holes in the nuclear envelope are then sealed by the membrane-remodeling activity of the ESCRTs. Impairment of this process compromises nuclear envelope integrity and leads to DNA damage, placing the ESCRT machinery as an essential factor for safeguarding the genome during mitotic exit.

Fiskvik I, Beiske K, Delabie J, Yri O, Spetalen S, Karjalainen-Lindsberg ML, Leppä S, Liestøl K, Smeland EB, Holte H. (2015) **Combining MYC, BCL2 and TP53 gene and protein expression alterations improves risk stratification in diffuse large B-cell lymphoma** Leuk Lymphoma. 56(6):1742-9.

Alterations in MYC, BCL2 or TP53 identify a subgroup of DLBCL with dismal prognosis

While the survival of diffuse large B-cell lymphoma (DLBCL) has improved with modern intensive therapy, approximately 30 % of the patients are not cured. It is therefore of interest to identify patients with poor prognosis. We examined genetic aberrations combined with analyses of protein expression of MYC, BCL2 and TP53 in biopsies from sixty-seven patients with high-risk DLBCL participating in a prospective multicenter study. Sixteen patients had alterations in MYC, BCL2 and/or TP53 genes or high protein expression. This group had impaired overall (p = 0.008) and progression-free survival (p = 0.036), and identified 70% of all deaths observed. Such patients are candidates for alternative therapeutic strategies.

MEDIA COVERAGE:

Popularized article on big data and genomics - associated challenges for personalized cancer medicine

Tons of data are being generated from genome sequencing projects all over the world, and the opportunities for collecting relevant information and building a solid knowledge base are beyond imagination.

In a cover story in the magazine Meta, published by UNINETT Sigma2, Bjarne Johannessen and Rolf I. Skotheim from the Department of Molecular Oncology, Institute for Cancer Research, and Centre for Cancer Biomedicine, write about challenges and opportunities as medicine enters the era of big data.

Meta | From numbers and sequences to personalized cancer treatment

The long road to success

Postdoc Sigrid Bratlie Thoresen from Harald Stenmark's group has written an entertaining and interesting article, The long road to success, published by the Norwegian Broadcasting Corporation (NRK) where she goes through the process leading up to the two recent Nature publications from the Stenmark group - an achievement comparable to winning several olympic gold medals, as Thoresen puts it metaphorically.

www.nrk.no/ytring | Den lange veien til suksess

Media coverage of the national competence building project in nanomedicine

The national competence building project in nanomedicine "Biodegradable nanoparticles in cancer diagnosis and therapy", headed by Professor Kirsten Sandvig, was recently highlighted both in the Norwegian magazine Vitenskap & Historie as well as on the homepage of The Research Council of Norway. Forskning.no published a somewhat different version of the article.

Vitenskap & Historie | Nanopartikler mot kreft
www.forskningsradet.no | Vil ha høyere kvalitet på nanomedisinen
www.forskning.no | Ny kreftmedisin med nanopartikler gir færre bivirkninger

HIGHLIGHTS:

Nature article from Marina Vietri: Sealing holes in the nuclear envelope as a mechanism to protect the genome

In a recent article in Nature, published on-line 3rd June, PhD student Marina Vietri and her co-workers in Harald Stenmark's group at Centre for Cancer Biomedicine and Institute for Cancer Research have uncovered a new cellular mechanism that contributes to keep our genome intact.

About the publication | During cell division, the nuclear envelope breaks down so that duplicated chromosomes can be separated by the microtubule-containing spindle apparatus. Upon completion of this process, in anaphase, new nuclear envelopes are formed around the two daughter nuclei, and the mitotic spindle is disassembled by a mechanism that has not been known. Vietri and her co-workers noticed that certain subunits of a protein complex known as endosomal sorting complex required for transport (ESCRT) accumulate around the reforming daughter nuclei in anaphase. This observation made them uncover a mechanism whereby ESCRT proteins coordinate nuclear envelope sealing and mitotic spindle disassembly. The ESCRT proteins are recruited to points in the reforming nuclear envelope that are intersected by microtubules. Here, they recruit an enzyme, Spastin, that severs microtubules. The remaining holes in the nuclear envelope are then sealed by the membrane-healing activity of the ESCRT proteins.

Vietri and co-workers also addressed what happens if this process goes wrong. By interfering with normal ESCRT functions during anaphase, the researchers observed that DNA becomes damaged, so evidently the novel mechanism of spindle disassembly and nuclear envelope sealing is important for keeping our genome safe.

Because genome instability is strongly connected to cancer development, it will now be interesting to examine which roles the ESCRT machinery plays in preventing cancer.

This paper has been dedicated commentary articles in both of the world's most influential scientific journals, Nature and Science. This is very unusual for cell biological papers and illustrates the impact of the findings by the Norwegian research group.

Nature - News & Views:
Cell biology: Nuclear dilemma resolved, Brian Burke, Nature. 2015 Jun 11;522(7555):159-60.

Perspective - Cell Biology:
An ESCRT to seal the envelope, Wesley I. Sundquist, Katharine S. Ullman, Science. 2015 Jun 19;348(6241):1314-5.

See also Selected Publications on this page (Vietri M et al.)

www.nrk.no/viten | Norske forskarar har avdekka mysterium bak celledeling
www.apollon.uio.no | Proteinet som vokter arvematerialet

INNOVATION:

DOFI no 15217 submitted June 2015
Lipid species in urinary exosomes as biomarkers for prostate cancer
Llorente A, Skotland T, Sandvig K.

DISSERTATIONS:

Idun Fiskvik – PhD
Prognostic tumor related factors in diffuse large B-cell lymphomas
Faculty of Medicine, University of Oslo, June 2015

MASTER DEGREES:

Dorthea Gjølberg
M.Sc. in Molecular Biosciences
The SW480 and SW620 cell lines as a model system for studying epithelial to mesenchymal transition (EMT) in colorectal cancer
Faculty of Mathematics and Natural Sciences, University of Oslo, June 2015

Christian Holst Bergsland
M.Sc. in Molecular Biosciences
New insights into the regulation of the gap junction protein connexin43 by the E3 ubiquitin ligase Nedd4-1
Faculty of Mathematics and Natural Sciences, University of Oslo, June 2015

HIGHLIGHTS:

Microscopy infrastructure funded by the Norwegian Research Council

The Norwegian Advanced Light Microscopy Imaging Network (NALMIN), coordinated by CCB director Harald Stenmark, has been funded by 49.5 MNOK by the Research Council of Norway. This is good news for Norwegian researchers who use light microscopy in their studies.

The vision of the Norwegian Advanced Light Microscopy Imaging Network is to provide Norwegian researchers with the most advanced light microscopy technology to image biologically and biomedically important molecules at high to ultra-high resolution in systems ranging from microorganisms and cell cultures through plants and small animals.

GOING ABROAD:

Visit to the Irish lab at Vanderbilt University, Nashville

We visited the Irish Lab at Vanderbilt University in Nashville, USA, during the summer of 2015. The Irish Lab uses single-cell technologies and computational approaches for cancer and immunology research. The collaboration between our labs has been very fruitful as it has resulted in co-author publications and also important expertise in e.g. the field of mass cytometry (CyTOF), a technology which is now being introduced at The Radium Hospital here in Oslo.

During our stay we were introduced to new applications related to mass cytometry as well as newly developed computational analysis tools. We also shared our experience in *in vitro* signaling assays and the stay was an overall great opportunity for knowledge exchange, to facilitate connections and for initiating new collaboration projects. We can highly recommend the experience of visiting other labs to build and extend the international collaborative network, to learn cutting edge technologies and to get new perspectives and ideas for research projects.

Kanutte Huse (postdoc) and Sarah Göthberg (PhD student), members of the Smeland group

MEDIA COVERAGE:

Interview in weekly magazine on big data in cancer biomedicine

Modern genome technologies can give in-depth analysis of cancer cells that until recently was merely science fiction. However, this generates enormous amounts of data points, and CCB researchers at the Department of Molecular Oncology, Institute for Cancer Research, meet these heavy computation challenges with informatics experts and supercomputers. This development in cancer research was the topic of an interview with associate professor and group leader Rolf I. Skotheim in the weekly magazine Vi Menn this summer.

Vi Menn Vitenskap & Historie | Med tungdata og enorme beregningsmuligheter er biologi og medisin i ferd med å endres

SELECTED PUBLICATIONS:

■ Bruun J, Kolberg M, Ahlquist TC, Royrvik E, Nome T, Leithe E, Lind GE, Merok MA, Rognum TO, Bjorkoy G, Johansen T, Lindblom A, Sun XF, Svindland A, Liestol K, Nesbakken A, Skotheim RI, Lothe RA. (2015) **Regulator of chromosome condensation 2 identifies high-risk patients within both major phenotypes of colorectal cancer** Clin Cancer Res. 21(16):3759-70.

Novel prognostic biomarker for colorectal cancer

Bruun and colleagues performed genetic analyses of cancer-critical mismatch-repair genes in independent patient series and found that a mutation in the cell cycle gene regulator of chromosome condensation 2, RCC2, can identify high-risk stage II patients with the microsatellite instability phenotype. This finding was explored and validated functionally. Furthermore, protein expression was shown to stratify clinically important patient groups in a large consecutive patient series. Hence, RCC2 risk stratification can potentially guide clinical decision making for a large number of colorectal cancer patients. Importantly, the mutation assay and the protein expression assessment can be done rapidly by cost-effective routine technologies.

■ Kavaliauskiene S, Skotland T, Sylvänne T, Simolin H, Klokk TI, Torgersen ML, Lingelem AB, Simm R, Ekroos K, Sandvig K. (2015) **Novel actions of 2-deoxy-D-glucose: protection against Shiga toxins and changes in cellular lipids** Biochem J. 470(1):23-37.

Novel actions of 2-deoxy-D-glucose

2-deoxy-D-glucose (2DG), a structural analogue of glucose, has been shown to improve the efficacy of several cancer chemotherapeutic agents. Kavaliauskiene and colleagues investigated the effects of 2DG on intracellular transport and cellular lipids, studies which are of great importance when predicting the effects of 2DG combined with other therapeutic agents. By analysing more than 200 individual lipid species, it was discovered that 2DG changes cellular lipid composition and becomes incorporated into glycosphingolipids. In addition, 2DG was found to affect intracellular transport of Shiga toxin. These findings reveal new aspects of how 2DG affects basic cellular functions and suggest new clinical applications of 2DG.

■ Sveen A, Kilpinen S, Ruusulehto A, Lothe RA, Skotheim RI. (2015) **Aberrant RNA splicing in cancer; expression changes and driver mutations of splicing factor genes** Oncogene. 2015 Aug 24. [Epub ahead of print].

Review of aberrant splicing in cancer

The splicing process is commonly disrupted in cancer. In this review in the journal Oncogene, Sveen and co-workers provided an overview of the current knowledge of cancer-associated aberrant splicing, resulting both in functional and non-functional end-products, and acting on both a genome-wide scale and more specifically on individual cancer-critical genes. Based on large-scale gene expression and somatic mutation data across cancer types, the authors also described cancer-associated patterns of dysregulation of splicing factors, the executors of the splicing process. Although not more frequently mutated than other protein-coding genes, the splicing factors were found to be more frequently targeted by predicted cancer-critical mutations.

MEDIA COVERAGE:

■ Chronicle on personalised cancer medicine in Aftenposten

On the 12th of August, Norway's largest newspaper Aftenposten printed a chronicle on personalized cancer medicine entitled "Should every cancer patient become their own research project?"

CCB Co-director Ragnhild A. Lothe and the leader of the National Cancer Genomics Consortium (NCGC), professor Ola Myklebost, and colleagues from the NCGC point out that in "personalized medicine", cancer patients remain the largest and increasing group that may benefit most from new treatment strategies.

The authors emphasize the importance of increase in national clinical trials and participation in high quality international studies for the benefit of the Norwegian cancer patient and to strengthen the Norwegian professional development and research.

Aftenposten | Bør hver kreftpasient bli et eget forskningsprosjekt?

SEMINARS:

The annual CCB seminar September 21st-22nd

The annual seminar in CCB was arranged at Hotel Farris Bad in Larvik. A record number of CCB members participated in this two day event where scientific presentations and discussions were the focus of attention. The seminar program included talks on

- Intra-individual genetic heterogeneity in colorectal liver metastases – associations with patient survival
- Cell cycle defects and genome instability in cancer genome evolution: tipping the balance
- Unravelling a complex cancer transcriptome by high-throughput sequencing
- New targets for treatment of malignant peripheral nerve sheath tumors
- Validation of novel epigenetic biomarker for automatic prognostication across cancer types
- Precursor cells in lymphoma and myeloma, implications for diagnosis and therapy
- Challenges during the innovation path
- Development of novel chimeric antigen receptors (CAR) to treat B-cell malignancies
- Exosomes: Biology and clinical applications in cancer
- Challenges along innovation paths for cancer biomarkers.

This CCB gathering is of great importance to our Centre, and it is the perfect way to boost the common CCB spirit.

MEDIA COVERAGE:

Kreftlex helps coping with cancer

A supplement on "Women's health" distributed with the Norwegian newspaper Dagbladet on the 21st of September features an article about Kreftlex, a Norwegian internet encyclopedia on cancer, aimed at patients and their loved ones, developed at the Institute for Cancer Genetics and Informatics, headed by Håvard Danielsen, at Oslo University Hospital. The article focuses on the fact that knowledge increases the sense of coping for cancer patients as well as for relatives.

INNOVATION:

UK patent application No 1504569.3,
submitted September 2015
Tissue sample analysis technique
Danielsen H.

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SELECTED PUBLICATIONS:

■ Øverbye A, Skotland T, Koehler CJ, Thiede B, Seierstad T, Berge V, Sandvig K, Llorente A. (2015) **Identification of prostate cancer biomarkers in urinary exosomes** Oncotarget. 6(30):30357-76.

Prostate cancer biomarkers in urinary exosomes
Exosomes, nanovesicles released by cells to the extracellular environment, have recently appeared as a novel source of non-invasive cancer biomarkers since they bear tumour-specific molecules that can be measured in biological fluids. In this work, the proteome of urinary exosomes was analyzed by mass spectrometry to identify potential prostate cancer biomarkers. In total, 31 samples of urinary exosomes from healthy male donors and prostate cancer patients were analyzed. Interestingly, at 100% specificity, 17 of these proteins displayed individual sensitivities above 60% thus showing the potential of using urinary exosomes in the diagnosis and clinical management of prostate cancer.

HIGHLIGHTS:

■ **CCB's Guro E. Lind is appointed the first leader of the Young Academy of Norway**
Norway is in the process of establishing the Young Academy of Norway (Akademiet for yngre forskere). The first call for members was issued earlier this year and nearly 160 young researchers applied. Twenty of them are now becoming the founding members of the Young Academy of Norway. Guro E. Lind, head of the Epigentics group at the Department of Molecular Oncology at the Institute for Cancer Research, is appointed the first leader of the Academy.

www.ous-research.no | Presenting the Young Academy of Norway
www.forskerforum.no | Overveldende respons for ungt akademi
www.dnva.no | Akademiet for yngre forskere etableres (The Norwegian Academy og Science and Letters)

■ **Major breakthroughs at the Norwegian Centres of Excellence highlighted by the Research Council of Norway**
The Research Council of Norway has published an article about the major breakthroughs so far in 2015 at the different Centres of Excellence in Norway.
Important steps in cancer research
The Centre for Cancer Biomedicine is mentioned in particular for its recent important findings which have led to two Nature articles in 2015.

www.forskningsradet.no | Store gjennombrudd ved SFF'ene

DISSERTATIONS:

Audun Sverre Myrset Kvalvaag – PhD
Shiga toxin: Uptake and transport in cancer cells
Faculty of Mathematics and Natural Sciences, University of Oslo, October 2015

SELECTED PUBLICATIONS:

■ Hoff AM, Johannessen B, Alagaratnam S, Zhao S, Nome T, Løvf M, Bakken AC, Hektoen M, Sveen A, Lothe RA, Skotheim RI. (2015) **Novel RNA variants in colorectal cancers** Oncotarget. 6(34):36587-602.

Novel high-throughput method for RNA variant identification

Andreas Hoff, Bjarne Johannessen and co-workers analyzed exon-level expression data from 202 colorectal cancers for patterns characteristic of fusion genes. Fusion genes are important drivers in several cancer types, and the downstream fusion partner commonly have elevated expression only in the 3'-end of the gene. A novel protocol, combining rapid amplification of cDNA ends and high-throughput sequencing, RACE-seq, was developed to study the underlying transcripts. This led to discovery of several novel transcript structures. In particular, a read-through fusion transcript, *KLK8-KLK7*, and a novel transcript variant of *S100A2* were found overrepresented in colorectal cancer samples as compared to healthy samples.

■ Danielsen HE, Pradhan M, Novelli M. (2015) **Revisiting tumour aneuploidy - the place of ploidy assessment in the molecular era** Nat Rev Clin Oncol. 2015 Nov 24. [Epub ahead of print].

Aneuploidy as a prognostic marker in common cancers

Aneuploidy, an inevitable result of chromosome instability, is characterized by abnormal DNA content in tumor cells, which can be detected and quantified by using cytometric methods such as flow and image cytometry. In order evaluate the usefulness of these economical and robust methods in the molecular era, Danielsen et al. reviewed the prognostic importance of ploidy analysis in common carcinomas (breast, endometrium, ovary, uterine cervix, oesophagus, colon and rectum, lung, prostate and bladder). The evidence supports that ploidy is an independent prognostic marker in patients with node-negative invasive breast, early stage endometrioid endometrial, early stage ovarian, prostate, and colorectal cancers.

■ Thorvaldsen TE, Pedersen NM, Wenzel EM, Schultz SW, Brech A, Liestol K, Waaler J, Krauss S, Stenmark H. (2015) **Structure, Dynamics and Functionality of Tankyrase Inhibitor-induced Degradasomes** Mol Cancer Res. 13(11):1487-501.

Elucidating the mechanisms of tankyrase inhibition

Thorvaldsen and co-workers have explored the fact that tankyrase inhibitors, which are potential therapeutics in WNT-dependent cancers, induce cytoplasmic puncta (degradasomes) consisting of components of the signal-limiting WNT/β-catenin destruction complex. They demonstrate that the signaling component β-catenin is rapidly turned over in highly dynamic degradasomes upon tankyrase inhibition and provide a direct mechanistic link between degradasome formation and reduced WNT signaling in colorectal cancer cells. These findings have implications for further studies on tankyrase inhibitors as prospective cancer drugs.

HIGHLIGHTS:

■ CCB's Tor Espen Thorvaldsen with cover story in Molecular Cancer Research

PhD student Tor Espen Thorvaldsen, together with postdoc Nina Marie Pedersen and their co-workers in Harald Stenmark's group at Institute for Cancer Research and Centre for Cancer Biomedicine, have published a cover story in the November 2015 issue of Molecular Cancer Research.

In their study they find that the Tankyrase-induced degradasomes are dynamic assemblies that function as scaffolds for rapid turnover of the signaling component β-catenin, and they use super-resolution and electron microscopy to characterize the degradasomes as heterogenous protein structures in the cell. See also Selected Publications on this page (Thorvaldsen TE et al.)

DISSERTATIONS:

Andreas Midbøe Hoff – Phd
Identification of novel fusion genes and transcript variants in cancer
Faculty of Medicine, University of Oslo, November 2015

Marina Vietri – PhD
Closing the gap – ESCRT-III orchestrates nuclear envelope sealing
Faculty of Medicine, University of Oslo, November 2015

SELECTED PUBLICATIONS:

■ Eikenes ÅH, Malerød L, Lie-Jensen A, Sem Wegner C, Brech A, Liestøl K, Stenmark H, Haglund K. (2015) **Src64 controls a novel actin network required for proper ring canal formation in the Drosophila male germline** Development. 142(23):4107-18.

Regulation of germ cell development

In many organisms, germ cells develop in groups that are interconnected via ring canals (RCs) as a result of incomplete cytokinesis. In this paper, Eikenes and colleagues uncovered that tyrosine phosphorylation contributes to controlling RC diameter during development. Using the model organism *Drosophila melanogaster*, the authors showed that the kinase Src64 controls an actin network on the outside of the RC, dependent on the Rac/SCAR/Arp2/3 pathway. Phosphorylation of RCs is also important for proper germ cell development, independent of its role in RC regulation.

■ Hoff AM, Alagaratnam S, Zhao S, Bruun J, Andrews PW, Lothe RA, Skotheim RI. (2016) **Identification of Novel Fusion Genes in Testicular Germ Cell Tumors** Cancer Res.76(1):108-16.

Fusion genes in testicular cancer

Andreas Hoff and co-workers have by use of high-throughput RNA sequencing technology discovered the first fusion genes present in testicular germ cell tumors. The fusion genes *RCC1-HENMT1* and *RCC1-ABHD12B* and also a transcript variant of ETV6 were highly expressed in poorly differentiated histological subtypes of testicular cancers. Absent expression in more differentiated subtypes of testicular cancers, as well as observations from an in vitro differentiation assay, demonstrated that the transcripts are markers of pluripotency in a malignant setting. The fusion genes are as such candidate biomarkers of malignant progression.

PRIZES/AWARDS:

■ OUS awards to CCB's Marina Vietri and Camilla Raiborg for outstanding original scientific articles

In December six research prizes were awarded to scientists from Oslo University Hospital. CCBs Marina Vietri and Camilla Raiborg were among the prize winners. Both Vietri and Raiborg are members of Harald Stenmark's group.

Prizes for excellent research articles

The prizes were presented by Bjørn Erikstein, managing director of Oslo University Hospital, at a ceremony taking place on the 11th of December. We are happy to congratulate both postdoc Marina Vietri and senior scientist Camilla Raiborg with Excellent Original Article Awards of 50,000 NOK each.

HIGHLIGHTS:

■ Prof. Kirsten Sandvig awarded INNO INDIGO grant for work with biodegradable nanoparticles

CCB's principal investigator Prof. Kirsten Sandvig recently received a new grant for work with biodegradable nanoparticles through INNO INDIGO which is an innovation-driven initiative for the development and integration of Indian and European research.

New collaborations

The goal of the new project is to develop biodegradable nanoparticles for cancer therapy (breast and colorectal). The work in Oslo will include testing of the nanoparticles on cells and in animal models, in close collaboration with Gunhild Mælandsmo, Kjersti Flatmark and Tore Skotland. The nanoparticles will be produced by groups in India and Belgium; the group in Belgium will also perform in vivo studies.

www.ous-research.no | Sandvig received INNO INDIGO grant for work with biodegradable nanoparticles

■ Two innovation projects in CCB funded by the Norwegian Cancer Society and the Research Council of Norway

Before Christmas the Norwegian Cancer Society and the Research Council of Norway distributed 56 million NOK to various innovation projects. Products that cancer patients are in need of will be developed by these projects. TTOs (Technology Transfer Offices) and Inven2 are project leaders for the majority of these projects.

Alicia Llorente's project: Urinary exosome test for improved prostate cancer management

This project's objective is to use new markers to develop a better diagnostic test for detecting prostate cancer from urine samples. The biomarkers will be adapted to an immunoassay format to provide a more specific, more sensitive first indication of prostate cancer than the currently used PSA test. Earlier detection of prostate cancer could save millions of lives worldwide, while an improved diagnostic test could substantially reduce the number of unnecessary biopsies and treatments.
www. kreftforeningen.no | Oppdager kreft i urinprøver

Guro E. Lind's project: BladMetrix - a novel urine test for early detection and monitoring of bladder cancer

Bladder cancer is a common form of cancer and one of the most expensive cancers to treat. This project aims to find the best combination of biomarkers detectable in urine, and to confirm that the test is better than existing diagnostic methods. The result could be a new, non-invasive test to detect early stages of bladder cancer with high reliability, and which may also be used for post-treatment monitoring.
www.forskningsradet.no | New methods for diagnosing and treating cancer

DISSERTATIONS:

Sigmund Brabrand – PhD
Bilateral testicular germ cell cancer – Molecular and clinical aspects
Faculty of Medicine, University of Oslo, December 2015

RESEARCH GROUPS AND ASSOCIATED GROUPS

Cellular membrane dynamics

Cancer is a disease characterized by uncontrolled proliferation and migration of specific cell types of the body. Stenmark's research group therefore studies cellular pathways that either prevent or promote conversion of normal cells into cancer cells. Of special interest are pathways that control cellular membrane dynamics such as intracellular traffic, autophagy (cellular self-consumption) and cell division.

The group consists of more than 20 members with research backgrounds in medicine, biology, biochemistry and biotechnology. Researchers in the group are specialists in microscopy, and the group hosts regional core facilities in confocal microscopy, electron and super-resolution microscopy. Most of the research is done with normal and cancerous cells that are grown in tissue culture flasks, but some group members also use the fruit flies as model organisms for studies of tumour suppression and carcinogenesis. The group collaborates extensively with CCB groups that specialize in analyses of human tumour samples.

RAGNHILD A. LOTHE GROUP

Cancer genetics

The group has 23 members, including 7 post docs/scientists, 7 PhD students and 7 research assistants/engineers with formal education and research experience in genetics, cell biology, bioinformatics and medicine.

We study the aetiology of selected solid tumors arising in cells that originate from different germ layers, to gain novel knowledge of molecular paths across malignancies. We combine patient-oriented and biological studies using human specimens and in vitro models applying amongst others multilevel genomics. Our current main projects: 1) genomic tumor heterogeneity in colorectal cancer 2) high throughput drug sensitivity and resistance screens of CRC cells and malignant peripheral nerve sheath tumour cells 3) ubiquitin system in intercellular communication.

Our goal is to transfer novel biomedical knowledge into improved patient stratification and treatment. Lothe is a partner in the Norwegian cancer genomics consortium (www.cancergenomics.no), a national collaboration towards improved personalized cancer medicine. Group members have ongoing collaborative projects with the CCB groups, clinical associates and with the Finnish Inst for Molecular Medicine, University of Oxford, University of Porto, MD Anderson, Vall d'Hebron Institute, SAGE Bionetwork.

ERLEND SMELAND/
JUNE MYKLEBUST GROUP

Lymphoma biology

The group consists of 13 members with research background in medicine, biology, biochemistry and biotechnology. Our research is focused on B-cell lymphoma, a heterogeneous group of malignancies originating from B cells of the immune system. Although new therapeutic approaches have highly improved overall survival, some types are still considered incurable. We aim to develop novel therapeutic strategies including immunotherapy, and to identify predictive biomarkers for therapy response.

The lab has a strong translational focus, with 2 ongoing exome sequencing projects to identify recurrent mutations associated with therapy relapse. We use advanced flow cytometry and cutting edge mass cytometry (CyTOF) to characterize tumor microenvironment composition as well as tumor cell heterogeneity in patient samples. We also utilize these techniques to test efficacy of small molecule drugs, and have established lymphoma xenograft mouse models for testing of new drugs *in vivo*. The molecular biology expertise has been strengthened with establishment of CRISPR/Cas9 genome editing to create gene knockout models. The lab has extensive collaboration with the lymphoma program at the hospital, other groups in CCB and milieus at NCI, Stanford, and Vanderbilt.

Intracellular transport

Sandvig's group, counting 17 members plus master students, works on mechanisms of endocytosis, intracellular transport and secretion. Uptake of receptors and ligands and correct intracellular sorting are crucial for maintenance of a normal differentiated phenotype. In some of our studies we use protein toxins such as ricin and Shiga toxin, which are well established as markers for studies of membrane traffic, and which can be used as agents in cancer diagnosis and therapy.

Our expertise is also applied to investigate uptake of nanoparticles, and in 2013 we obtained a five year grant from the Norwegian Research Council to build national competence in nanomedicine. This project, "Biodegradable nanoparticles in cancer diagnosis and therapy", headed by Sandvig, involves collaboration with ten other Norwegian groups working in academia, research institutes, hospitals and industry. We also characterize exosomes from prostate cancer cells and patients with the goal of detecting lipid and protein biomarkers.

Our research spans all the way from basic to translational medicine, including innovation, and the projects aim at increasing our knowledge about intracellular transport and biomarkers in order to provide a rational basis for diagnosis, treatment and prevention of disease. The group has extensive national and international collaboration.

Large scale genomic instability

Cancer is a disease characterized by heterogeneity and genomic instability. Danielsen's research group is therefore developing high throughput methods for detection and characterization of large-scale genomic instability (chromatin structure and DNA ploidy), based on high-resolution digital microscopy and advanced image analysis.

The group consists of 15 members with background in medicine, biology, mathematics, and computer science. They are studying archival material at the time of diagnosis from cancer patients with proper clinical follow-up and known prognosis. Several methods; such as IHC, FISH, DNA Ploidy, Tissue Micro Array, as well as original methods developed in the group (Nucleotyping, 3D-reconstruction, ImmunoPath and MicroTracker) are used in an attempt to reveal and understand the 3-dimensional organisation of chromatin, and how this organisation controls gene expression. They are engaged in the search for new diagnostic and prognostic markers among these methods and results, and are running clinical validation studies on large series of colorectal, breast, prostate and gynaecological cancers with a minimum of 5, and up to 20, years of clinical follow-up, with emphasis on disease-free survival.

The aim is to improve cancer treatment by the identification of better prediction and prognosis of the outcome among these patients.

The statistical analysis unit

The complexity of the data sets produced by modern high throughput technologies makes extraction of information a true challenge. Our research unit therefore aims at supporting the activity of CCB groups by providing data analysis, with a focus on high throughput data. The unit has worked and published together with all CCB groups.

The statistical analysis unit at CCB is part of Biomedical Research Group at the Department of Informatics at the University of Oslo, with competence focused on statistical genomics and bioinformatics. Our philosophy is to work in close interaction with biomedical research groups and also to obtain own competence in the application areas. Typically, projects initially focus on a concrete biomedical problem, we then try to solve the statistical challenges in a broader context and finally to develop easy-to-use software tools. Examples of tools include software for copy number estimation, including allele-specific analysis, and for estimating the number of clusters in a data set.

Genome biology

The Genome biology group studies how genomes and transcriptomes are altered in cancer cells by using both computational biology and wet-lab based approaches. The research aim is to identify and characterise genes that are critical for development of cancer. Such genes may serve as diagnostic or prognostic biomarkers and also as targets for molecularly tailored therapy. The projects are mainly focused on prostate, testicular, and colorectal cancers.

Mutation analyses in cancer clearly benefit from knowing which genes and variants that are actually being expressed, and whether they are present in any particular isoform at the RNA or protein level. In this line, the group has particularly specialized in RNA-level analyses. Recent publications from the group have provided evidence of several novel transcripts, including fusion transcripts. An interdisciplinary set of competences is required to perform meaningful genome-scale cancer research. As such, personnel in the group have their basic education across the disciplines of biology, informatics, and medicine.

HEADED BY
SVERRE HEIM

Cytogenetics group

Heim's research group studies the chromosomal aberrations of cancer cells. The research is done in parallel with diagnostic analyses of leukemias and solid tumors. Of the 16 people involved in research, only seven (five PhD-students, one student, and one technician) do so full-time. The remainder do diagnostic work half of the time.

The research begins by finding specific cytogenetic aberrations in various cancers. Then we take the investigation to the molecular level searching for the corresponding changes of genes and DNA primary structure. We have succeeded in all our three main research areas: 1) Gynecologic tumors; 2) Brain tumors; and 3) Analyses of rare tumor-specific translocations.

Our unique area of expertise is the culturing and chromosome analysis of neoplastic cells. We also have extensive experience with fluorescence in situ-based analyses and the search by molecular means for fusion genes brought about by chromosomal translocations. Our approach by combining the two screening techniques G-band karyotyping and next generation sequencing to this end is novel and has led to the discovery of several cancer-specific fusion genes during the past year.

HEADED BY
GURO E. LIND

Epigenetics group

Cancer is the result of an accumulation of genetic as well as epigenetic changes. In the group of Epigenetics we are focusing our research on DNA methylation alterations in various cancer types, and colorectal cancer in particular. Our aim is to identify epigenetic biomarkers with clinical impact, including markers for early detection and monitoring of cancer. Simultaneously we aim at analyzing and understanding the underlying biology of these aberrations and how they affect the cancer development.

In the group we are integrating large-scale analyses, including methylome sequencing, with detailed analyses of candidate genes using various quantitative and qualitative methods. We are primarily working with patient material, in close collaboration with clinical partners. Relevant cancer cell lines are also studied, representing in vitro models for particular cancer types, which allows for a modification of the epigenome.

The group is actively working with innovation and has several established collaborations within CCB and the Institute for Cancer Research.

HEADED BY
ANTONI WIEDLOCHA

Protein internalization and signaling group

The fibroblast growth factors (FGFs) and FGF receptors (FGFRs) constitute a fundamental system for cell-to-cell communication, the so-called FGF-signaling system and exert a powerful combination of biological effects. Therefore, imbalances in FGF/FGFR signaling homeostasis contribute to the essential hallmarks of cancer.

The growth factors are frequently and abundantly expressed in various tumors and are recognized as key mediators of the epithelial-mesenchymal communication/transition, tumor cell survival, migration/metastasing and neoangiogenesis as well as stress-induced agents causing rescue of tumor tissues during/after therapy. On the other hand in some circumstances the FGF regulated signaling network contributes to tumor suppression.

The interest of FGF-induced signaling as a promising target for cancer therapy has systematically been increasing. We have been focusing on (i) how FGFs/FGFRs signaling can contribute to development of the malignant phenotype of different types of cancer when it is deregulated. (ii) Role of FGF-signaling in tumor cell migration and metastasis formation, and (iii) finding new potential molecular targets in FGF-regulated malignant processes that would be beneficial in cancer therapy.

PROSTATE CANCER

KAROL AXCRONA
MD, PhD, Head of Department of Urology, Akershus University Hospital, Lørenskog

Prostate cancer is the most diagnosed cancer in Norway accounting for approximately 5,000 new cases yearly. Every fifth cancer death amongst men is prostate cancer and many patients' quality of life is affected by side effects from treatments for this cancer. However, the tools used today to diagnose and treatment stratify patients suitable for radical treatment are still quite limited.

We have now entered an era in which gained knowledge of e.g. genes, gene function, immunology that has been acquired during the last decades, has started to be implemented in the clinics. Scattered reports on implementation of personalized medicine in prostate cancer have come in the literature. We believe that molecular biological approaches will be necessary to deepen understanding of biological behavior and development of prostate cancer to tailor prostate cancer treatment and to choose the right treatment for the right patient.

The CCB has the crucial tools for bringing molecular biology and molecular biological thinking into the clinics. Urologists also do believe that much of the future treatment of our patients will be dependent on prevention and optimal treatment stratification of patients, i.e. based on gained knowledge from the lab. Our key partners in the translational genomics collaboration within the CCB are Professor Ragnhild A. Lothe and Associate Professor Rolf Skotheim.

COLORECTAL CANCER

ARILD NESBAKKEN
Professor, MD, Senior Consultant, Department of Gastrointestinal Surgery, Oslo University Hospital

The last 10 years we have had close collaboration with Professor Ragnhild Lothe and her team in CCB in a translational research program on colorectal cancer, and we study the development of this common cancer from genetic disposition, precursor lesions to metastatic disease. Diagnostic, prognostic, predictive and monitoring biomarkers are studied in both the primary bowel cancer and in metastases to the liver. The colorectal and liver surgeons are engaged in consecutive inclusion of all new patients, registration of comprehensive clinical datasets and high quality biobanking. We now have TMA from 1500+ and fresh frozen tumor samples from 700+ primary tumors and 800+ samples from colorectal liver metastases.

The contributions of dedicated and competent colorectal and liver surgeons, pathologists, radiologists and oncologists are essential. Clinical and molecular data must be integrated and joint efforts from clinicians and molecular biologists are necessary in the interpretation and presentation of the results. We have managed to create a true translational team who share knowledge and ideas in ongoing and new projects. Funding through CCB, OUS focused research area, KG Jebsen centre and "Toppforsk" is essential.

Several promising biomarkers now undergo validation in larger national and international series. We are aiming at implementing our research in clinical practice and have REK approval for clinical trials which will be started this year.

The cooperation with CCB and all the members of this multidisciplinary team is excellent.

LYMPHOMA

HARALD HOLTE
MD, PhD, Senior Consultant, Department of Medical Oncology and Radiotherapy, Oslo University Hospital, Head of Lymphoma Treatment Programme and Lymphoma Research Group

My connection to CCB as the head of The Lymphoma Research Group is mainly through the fruitful collaboration with researchers at Department of Immunology. Presently, we have joint projects through Post Docs and PhD students studying tumor microenvironment and tumor genetic aberrations with impact on patient outcome. We have access to tumor material from researcher initiated prospective clinical studies, and the idea is to improve future protocols through our findings. One such study will be initiated later this year.

Lymphoma is one of the prioritized tumors of the National Cancer Genomics Consortium and we are presently performing exome sequencing on lymphomas. These studies will hopefully lead to better treatment of the heterogenous T-cell lymphoma entity and better understanding of why some B-lymphomas – and not others - become therapy resistant.

I appreciate the opportunity given to me to be a clinical associate with the CCB and hope that my clinical background and interest in translational research can further strengthen - beyond the lymphomas - the excellent research performed by CCB.

CCB director Harald Stenmark received the Research Council of Norway's Award for Outstanding Research

We congratulate Harald Stenmark with the Møbius award - the annual prize for excellent research from the Research Council of Norway. The prize amounts to 1 mill. NOK and was awarded on September 23rd in Oslo Concert Hall.

Outstanding cancer research
Prize winner Harald Stenmark is one of Norway's most preeminent cancer researchers. Professor Stenmark has made important discoveries related to the regulation of cell growth and cell division, mechanisms for uptake and transport of proteins in cells, and how these processes involve cell signaling processes. The prizewinner has also contributed substantially to scientists' understanding of cellular breakdown. For many years, Harald Stenmark has been a leading international researcher in these highly competitive areas. He is a team-builder who has established fruitful, high-calibre research collaboration at the local, national and international level. The jury also emphasized the professor's leadership qualities and his ability to foster young researcher talents and support their career development.

- www.forskningsradet.no/en | Research Council awards to cancer researcher, lawyer and bioeconomy company
- www.dagbladet.no | Norske forskere har avslørt nervetrådenes hemmelighet og celledelingens mysterium
- www.dagensmedisin.no | Ny prestisjepris til kreftforsker
- www.uniforum.uio.no | Kreftforsker får pris for fremragende forskning

Harald Stenmark | Photo: Alexander Hagstadius.

Ragnar Mørk legacy prize 2015 to Guro E. Lind

Dr. Ragnar Mørk's legacy prize 2015 went to CCB's group leader Guro E. Lind.

The Dr. Ragnar Mørk's legacy prize of NOK 200,000 is annually given to scientists affiliated to the Norwegian Radium Hospital, who have obtained important results within the field of cancer research. The ceremony took place on November 20th in the Research Building at the Radium Hospital. Guro E. Lind gave a lecture about the research activities that has earned her the award.

Guro E. Lind receives the prize for her outstanding research on cancer epigenetics, which has led to identification of several novel biomarkers in colorectal cancer, bladder cancer, ovarian cancer, lymphoma and cholangiocarcinoma. These biomarkers may form the basis for diagnostic tests for early detection of cancer.

Guro E. Lind | Photo: Terje Heiestad

The Jahre prize for young medical researchers 2015 to Kaisa Haglund

CCB's project leader Kaisa Haglund received the Anders Jahre's prize for young medical researchers for 2015.

The prize is awarded to Haglund in recognition of her outstanding scientific work on cellular mechanisms regulating cell division and cancer development. Haglund shares the prize with Professor Pernilla Lagergren from Karolinska Institutet. The prize sum is NOK 400,000.

Anders Jahre's Awards for Medical Research honor research of outstanding quality in basic and clinical medicine. The prizes are awarded by the University of Oslo and are among the largest within Nordic biomedical research. The award ceremony took place on October 15th.

Kaisa Haglund | Photo: Øystein Horgmo

H.M. the King's Gold Medal 2015 to Sigrid B. Thoresen

Sigrid Bratlie Thoresen, postdoc in CCB, was awarded His Majesty the King's Gold Medal 2015 for the best PhD thesis at the Faculty of Medicine at the University of Oslo.

Sigrid's PhD thesis, entitled "Novel regulators of the cell division cycle", identifies and characterizes novel regulators of the cell cycle and discusses the importance of such regulators in preventing cancer. The main work in her PhD thesis, published in the prestigious journal Nature Cell Biology, concerns a novel protein called ANCHR, which is a key component of a cellular checkpoint that monitors that chromosomes are cleared from the bridge between two daughter cells before the two cells are finally separated through cleavage of the bridge. In the absence of ANCHR, this checkpoint does not work, which results in cells with abnormal chromosome numbers, a condition associated with carcinogenesis. This work has obtained considerable attention internationally.

The Medal was awarded at a Prize Ceremony at the Annual Celebration of the University of Oslo on September 2nd.

Sigrid Bratlie Thoresen | Photo: Øystein Horgmo

SUPERVISION

PhDs in CCB

Research training is indeed a core activity in CCB, and the centre´s ambitious goal to graduate 50 PhD degrees during the 10-year Centre of Excellence period will be reached in the spring of 2016 – one and a half year ahead of schedule. We would like to congratulate all 49 talented young scientists who have contributed to CCB´s research in such an excellent way since fall 2007.

2015

Sigmund Brabrand
Bilateral testicular germ cell cancer – Molecular and clinical aspects
Main supervisor: Gustav Lehne

Andreas Midbøe Hoff
Identification of novel fusion genes and transcript variants in cancer
Main supervisor: Rolf I. Skotheim

Marina Vietri
Closing the gap – ESCRT-III orchestrates nuclear envelope sealing
Main supervisor: Harald Stenmark

Audun Sverre Myrset Kvalvaag
Shiga toxin: Uptake and transport in cancer cells
Main supervisor: Kirsten Sandvig

Idun Fiskvik
Prognostic tumor related factors in diffuse large B-cell lymphomas
Main supervisor: Harald Jr. Holte

Gro Nilsen
Statistical learning in genomics: Uncovering patterns and groups in high dimensions
Main supervisor: Ole Christian Lingjærde

Åsmund Husabø Eikenes
Novel regulators of cytokinesis in vivo
Main supervisor: Kaisa Haglund

2014

Annette Bentsen Håvik
Untangling the web of molecular changes in brain tumors: Molecular characterization of gliomas
Main supervisor: Sverre Heim

Santosh Phuyal
Composition and cellular release of exosomes from cancer cells
Main supervisor: Alicia Llorente

Nagham Theres Asp
Regulation of ErbB2 and ErbB3 growth factor receptors in human breast cancer
Main supervisor: Kirsten Sandvig

Nicole Bethge
DNA methylation alterations in B-cell lymphoma
Main supervisor: Erlend Smeland

Torunn Sletten
Role of intracellular FGF1 interaction partners, and HSP90 as a therapeutic target in FGFR1 driven malignancy
Main supervisor: Antoni Wiedlocha

Kaja Beate Nyquist
Gene-level consequences of new cancer-specific chromosomal rearrangements
Main supervisor: Francesca Micci

Sigrid Bratlie Thoresen
Novel regulators of the cell division cycle
Main supervisor: Harald Stenmark

Marianne Aarstad Merok
Genetic and clinical prognostic markers for colorectal cancer
Main supervisor: Arild Nesbakken

Marianne Brodtkorb Eide
Integrative genomic and clinical analysis of follicular lymphoma
Main supervisor: Erlend Smeland

Jarle Bruun
Biomarkers with functional and clinical impact on colorectal cancer
Main supervisor: Ragnhild A. Lothe

Marthe Løvf
Detection of fusion genes and novel RNA variants in cancer
Main supervisor: Rolf I. Skotheim

2013

Torfinn Nome
Novel RNA variants in colorectal cancer identified by deep sequencing
Main supervisor: Rolf I. Skotheim

Catherine Sem Wegner
Regulation of the endocytic pathway and receptor sorting by phosphoinositides and ESCRTs
Main supervisor: Andreas Brech

Olav Erich Yri
Germline genetic polymorphisms and morphological grading in malignant lymphomas: Impact on susceptibility and patient outcome
Main supervisor: Harald Jr. Holte

Jonas Bergan
Investigation of membrane dynamics in cancer cells by following Shiga toxin
Main supervisor: Kirsten Sandvig

Deeqa Ahmed Mohamed Ali
DNA methylation alterations in colorectal cancer and their potential as biomarkers
Main supervisor: Guro E. Lind

Kim Andresen
Novel epi-markers in cholangiocarcinoma and their clinical potential
Main supervisor: Guro E. Lind

Angela Oppelt
Novel regulators of cell migration
Main supervisor: Jørgen Wesche

2012

Viola Hélène Lobert
Identification of novel regulators of epithelial polarity and cell migration
Main supervisor: Harald Stenmark

Ane Hansen Kjenseth
Posttranslational modification of the tumor suppressor protein connexin43 – implications for cell communication and cancer
Main supervisor: Edgar Rivedal

Maren Bakkebø
Transforming growth factor - superfamily signaling and its role in B-cell lymphoma
Main supervisor: Erlend Smeland

Anne Berit Dyve Lingelem
Intracellular transport of Shiga toxin and ricin
Main supervisor: Kirsten Sandvig

Manohar Pradhan
DNA ploidy and DNA index in endometrial carcinoma
Main supervisor: Bjørn Åke Risberg

Antonia Sagona
Regulation of cytokinesis and its consequences for human health
Main supervisor: Harald Stenmark

Trude Holmeide Ågesen
Genetics of colorectal cancer: new insights to early onset and to prognostication of disease
Main supervisor: Ragnhild A. Lothe

Anita Sveen
The transcriptome and prognosis in stage II and III colorectal cancer
Main supervisor: Rolf I. Skotheim

Hanne-Sofie Spenning Dahlback
Cytogenetic and molecular cytogenetic analyses of brain tumours
Main supervisor: Sverre Heim

2011

Stine Aske Danielsen
Molecular markers of colorectal cancer and their clinical potential
Main supervisor: Ragnhild A. Lothe

Kanutte Huse
The role of bone morphogenetic proteins in normal and malignant lymphocytes
Main supervisor: Erlend Smeland

Lina Rodahl
Regulators of endosome dynamics in cell signalling and disease
Main supervisor: Harald Stenmark

Solveig Sirnes
The connexin gene family in cell communication and cancer
Main supervisor: Edgar Rivedal

2010

Marianne Berg
Genomics of colorectal carcinomas from young and elderly patients
Main supervisor: Ragnhild A. Lothe

Helge Roar Brekke
New insights into the biology of Malignant Peripheral Nerve Sheath Tumors identify biomarkers for disease outcome
Main supervisor: Ragnhild A. Lothe

Wanja Kildal
DNA ploidy as a prognostic marker in selected gynecological malignancies
Main supervisor: Håvard E. Danielsen

Yan Zhen
Intracellular trafficking and signaling of fibroblast growth factor 1 and its receptor
Main supervisor: Antoni Wiedlocha

2009
Ingrid Roxrud
Endocytic trafficking of membrane proteins. Mechanisms in human disease
Main supervisor: Harald Stenmark

Audrun Utskarpen
Endocytosis and retrograde transport of Shiga toxin and ricin
Main supervisor: Kirsten Sandvig

Terje Cruickshank Ahlquist
Novel genetic and epigenetic alterations in colorectal tumors and their potential as biomarkers
Main supervisor: Ragnhild A. Lothe

Ellen Margrethe Haugsten
Endocytosis and intracellular transport of FGF1 and the FGF receptors
Main supervisor: Sjur Olsnes

Sigrid S. Skånland
Mechanisms in intracellular transport of toxins
Main supervisor: Kirsten Sandvig

Susanne Stuffers
The role of ESCRT proteins and phosphoinositides in MVE biogenesis, endocytic trafficking and disease
Main supervisor: Andreas Brech

2008
None

2007 (from 1 September)
Karine Lindmo
Regulation and function of autophagy in Drosophila melanogaster
Main supervisor: Harald Stenmark

Master degrees in CCB

We would like to congratulate all master students supervised in CCB so far with their degrees.

2015
Dorthea Gjølberg
The SW480 and SW620 cell lines as a model system for studying epithelial to mesenchymal transition (EMT) in colorectal cancer
Main supervisor: Edward Leithe

Christian Holst Bergsland
New insights into the regulation of the gap junction protein connexin43 by the E3 ubiquitin ligase Nedd4-1
Main supervisor: Edward Leithe

2014
Heidi Dietrichson Pharo
Quantitative methylation-specific PCR - optimization and application
Main supervisor: Guro E. Lind

Lars Mørland Knudsen
Role of the endolysosomal and autophagosomal pathways in degradation of the gap junction protein connexin 43
Main supervisor: Edward Leithe

Gro Kummeneje Presthus
DNA methylation super negatives - identification of a new subgroup of colorectal cancer
Main supervisor: Guro E. Lind

Ane Brenna
Identification of novel epigenetic masterkeys in cancer - with potential diagnostic value
Main supervisor: Guro E. Lind

Karin Svensson
The role of evectin-2 and its binding partner PS in toxin transport
Main supervisor: Kirsten Sandvig

Inger Oulie
Transport of biodegradable nanoparticles in cells: Uptake, intracellular transport, degradation and toxicity
Main supervisor: Tore Geir Iversen

Linn Kymre
Structure-function relationship of Shiga toxins; Role of the A-subunit in complex stability and endocytosis
Main supervisor: Kirsten Sandvig

Max Zachrisson Totland
Regulation of the gap junction protein connexin 43 by the E3 ubiquitin ligases Smurf1 and -2
Main supervisor: Edward Leithe

Marte Petersen-Øverleir
Tools for ESCRT protein studies - Visualising the invisible
Main supervisor: Camilla Raiborg

Ida Seim Jakobsen
Exosome release. Role of PIKfyve and ERM proteins
Main supervisor: Kirsten Sandvig

2013
Therese Pedersen
Differential effects of Bone Morphogenetic Proteins (BMPs) in human memory B cells
Main supervisor: June H. Myklebust

Chloé Beate Steen
ALix controls cytokinesis in vivo.
Main supervisor: Kaisa Haglund

Lise K. Bollum
Effects of Bone Morphogenetic Proteins (BMPs) in Human B Lymphocytes
Main supervisor: June H. Myklebust

Karolina Cyll
A new protocol for preparation of samples for image cytometry. An improved and reproducible Hedley's method for preparation of monolayers from paraffin-embedded tissue for cytometric DNA ploidy analysis.
Main supervisor: Monica Jenstad

Anne Grete Gargul
In vitro studies of nanosized iron oxide particles
Main supervisor: Kirsten Sandvig

2012
Shiva Dahal-Koirala
Regulation of the gap junction protein connexin 43 during mitosis.
Main supervisor: Edward Leithe

Ane Hoel Høiseth
Sorting Nexin 4 mediates chromosome congression
Main supervisor: Camilla Raiborg and Hilde Abrahamsen

Minna Kihlström
The effect of radixin on the retrograde transport of Shiga toxin and ricin
Main supervisor: Kirsten Sandvig

Ina Andrassy Eilertsen
New insights into the regulation of the tumor suppressor proteins PTEN and connexin 43 by post-translational modifications
Main supervisor: Edward Leithe

2011
Bjarne Johannessen
Identification of cancer-specific transcripts by computational analysis of genome-scale expression data at exon resolution
Main supervisor: Rolf I. Skotheim

Hege Marie Vedeld
DNA methylation biomarkers for colorectal cancer detection: CDO1, DCLK1, ZNF331 and ZSCAN18
Main supervisor: Guro E. Lind

Peter Eide
HECT E3 ubiquituin ligases in regulation of colon cancer cell growth and mitogenic signaling pathways
Main supervisor: Edward Leithe

Andreas Hoff
Transcript variation and protein expression in testicular germ cell tumours
Main supervisor: Sharmini Alagaratnam

Carl-Martin Nymark
Cell context-dependent differences in interaction with Shiga toxin
Main supervisor: Kirsten Sandvig

Simona Lukoseviciute
The regulation of Gb3 biosynthesis in cancer cells: Implications for membrane dynamics
Main supervisor: Kirsten Sandvig

Audun Sverre Kvalvaag
The role of ERM proteins in binding and intracellular transport of Shiga toxin
Main supervisor: Kirsten Sandvig

2010
Santosh Phuyal
The role of lipids in the release of exosomes from the human prostate cancer PC-3 cell line
Main supervisor: Kirsten Sandvig

Maren Høland
Prognostic value of protein markers in malignant peripheral nerve sheath tumours
Main supervisor: Matthias Kolberg

Tone Aase Fykerud
Regulation of the gap junction protein connexin43 by members of the Nedd4 E3 ubiquitin ligase family
Main supervisor: Edward Leithe

Ieva Ailte
The role of SNX8 in Retrograde Transport of Shiga Toxin2
Main supervisor: Kirsten Sandvig

Deeqa Ali
Identification of novel epigenetic biomarkers in colorectal cancer, GLDC and PPP1R14A
Main supervisor: Guro E. Lind

Marianne Guriby
New epigenetic biomarkers examined for added value in lymph node diagnostics of colon cancer
Main supervisor: Terje Ahlquist

2009
Anne Cathrine Bakken
Exon specific biomarkers in cancer: Experimental validation of exon microarray data from colorectal and testicular cancers
Main supervisor: Rolf I. Skotheim

Kristine Ingrid Sundet
The role of ERM proteins in endocytosis and intracellular transport of Shiga toxin and ricin
Main supervisor: Kirsten Sandvig

Gro Nilsen
A comparative study of existing and novel methods for estimating the number of clusters in a data set
Main supervisor: Ole Christian Lingjærde and Ørnulf Borgan

Daniel J. H. Nebdal
Presenting overrepresented words
Main supervisor: Einar Rødland

2008
Marthe Eken
Identification of cancer-specific transcripts: With emphasis on the hunt for fusion genes in colorectal cancer
Main supervisor: Rolf I. Skotheim

Jarle Bruun
Effect of Connexin 43 transfection on growth characteristics of the human colon adenocarcinoma cell line HT29
Main supervisor: Edgar Rivedal

Hilde Honne
Identification of novel epigenetic biomarkers in colorectal cancer
Main supervisor: Guro E. Lind

TEACHING

Course in Advanced Cancer Biology

Since 2011, an inter-faculty CCB associated course in advanced cancer biology has been offered to master and PhD students at the Department of Biosciences (IBV), the Faculty of Mathematics and Natural Sciences, and the Medical Faculty, at the University of Oslo. The initiative for such a cross-faculty course in cancer biology was taken by the Co-director, Ragnhild A. Lothe, and designed together with Guro E. Lind. Lind was recruited as a professor at the University of Oslo and has developed the course into highly successful trans-disciplinary research based education.

Extracts from student evaluations:
"This course was really amazing, I loved it. It is the reason why I chose the University of Oslo for my Erasmus semester and I am fully satisfied. The various teachers, the site visits....everything was made for us to enjoy it and learn as much as possible"

"The lecturers were all very motivated and the lectures very interesting. I especially liked that there were researchers and doctors so that theory and practice were combined"

"Overall one of the best courses I've had"

CCB researchers have contributed with lectures on the following courses during 2015

EMBO Practical Course: Advanced electron microscopy for cell biology
Bordeaux, France, Spring 2015
Lecturer fra CCB: Andreas Brech

MBV1010: Cell biology and genetics
Faculty of Mathematics and Natural Sciences, University of Oslo, Spring 2015
Lecturer from CCB: Andreas Brech

MBV2020: Laboratory course in Biochemistry and Molecular Biology
Faculty of Mathematics and Natural Sciences, University of Oslo, Spring 2015
Lecturer from CCB: Ieva Ailte Hjelseth

MBV3010: Advanced cell biology
Faculty of Mathematics and Natural Sciences, University of Oslo, Spring 2015
Lecturer from CCB: Tor Erik Rusten

MBV3020: Molecular Genetics and Developmental Biology
Faculty of Mathematics and Natural Sciences, University of Oslo, Autumn 2015
Course responsible: Francesca Micci
Responsible for Cancer Biology and Cell Cycle section: Ragnhild A. Lothe,
Lecturers from CCB: Edward Leithe, Stine A. Danielsen, Tor Erik Rusten, Thale Kristin Olsen, Lene Elisabeth Johannessen

MBV4030: Laboratory methods in cellular biology
Faculty of Mathematics and Natural Sciences, University of Oslo, Autumn 2015
Lecturers from CCB: Andreas Brech, Tor Erik Rusten

MBV4110: Electron microscopy
Faculty of Mathematics and Natural Sciences, University of Oslo, Spring 2015
Lecturer from CCB: Andreas Brech

MBV4160/9160: Advanced Cancer Biology
CCB associated course offered to master students at the Department of Biosciences (IBV), The Faculty of Mathematics and Natural Sciences, and to PhD students at the Medical Faculty, University of Oslo, Spring 2015
Course responsible: Guro E. Lind
Lectures from CCB: Guro E. Lind, Alicia Llorente, Anita Sveen, Arild Nesbakken, Edward Leithe, Jillian Wise, Kanutte Huse, Karol Axcrona, Kay Schink, Marthe Løvf, Mathias Kolberg, Nina Marie Pedersen, Rolf I. Skotheim, Sharmini Alagaratnam, Stine Aske Danielsen, and Tor Erik Rusten

MBV4240/9240: Biochemical Mechanisms in Intracellular Transport
Faculty of Mathematics and Natural Sciences, University of Oslo, Autumn 2015
Course responsible: Kirsten Sandvig
Lecturers from CCB: Kirsten Sandvig, Harald Stenmark, Alicia Llorente, Maria L. Torgersen, Antoni Wiedlocha

MBV4260: Advanced Immunology
Faculty of Mathematics and Natural Sciences, University of Oslo, Autumn 2015
Lecturer from CCB: Sébastien Wälchli

MF9010E: Introductory Course to the Medical PhD programme
Faculty of Medicine, University of Oslo, Spring 2015.
Lecturer from CCB: Harald Stenmark

MF9110BTS: PhD school, Molecular Biology Research Course
Biotechnology Centre of Oslo, University of Oslo, Autumn 2015
Lecturer from CCB: Tor Erik Rusten

MF9120BTS: Molecular Medicine Research Course, NCMM
Faculty of Medicine, University of Oslo, Autumn 2015
Lecturers from CCB: Guro E. Lind, Anita Sveen

MF9170: Flow cytometry in Medical Research and Diagnostics
Faculty of Medicine, University of Oslo, Spring and Autumn 2015
Lecturer from CCB: June H. Myklebust

MF9180: Mechanisms of cellular signal transduction
Faculty of Medicine, University of Oslo, Autumn 2015
Lecturer from CCB: Kay Oliver Schink

MOL8006: Receptor Signalling and Trafficking
Faculty of Medicine, Norwegian University of Science and Technology, Trondheim, Spring 2015
Course responsible: Harald Stenmark
Lecturers from CCB: Fergal O'Farrell, Jørgen Wesche

PBL Course, 3rd semester, Medical Biochemistry
Faculty of Medicine, University of Oslo, Spring and Autumn 2015
Lecturer from CCB: June H. Myklebust

PBL Course, 9th semester, Gynecology, Obstetrics, and Pediatrics
Faculty of Medicine, University of Oslo, Spring and Autumn 2015
Lecturer from CCB: Sverre Heim

TEACHERS

CCB has sponsored as many as five 20%-positions as professors or associated professors at the University of Oslo, which contributes strongly to the University's research based training of cancer researchers and at the same time provides valuable teaching experience for some of CCB's junior scientists.

Professors or associated professors in 20% positions financed by CCB (from left): June H. Myklebust, Guro E. Lind, Francesca Micci, Rolf I. Skotheim, Andreas Brech

PUBLICATIONS

- TOTAL NUMBER OF CCB PUBLICATIONS IN 2015: **70 PUBLICATIONS**
- NUMBER OF PUBLICATIONS IN HIGH IMPACT JOURNALS (IMPACT FACTOR > 9): **7 PUBLICATIONS** (10 %)
- NUMBER OF PUBLICATIONS WITH CCB SCIENTISTS AS CORRESPONDING AUTHOR: **47 PUBLICATIONS** (67 %)
- NUMBER OF COLLABORATION PUBLICATIONS WITH CLINICIANS AND PATHOLOGISTS: **38 PUBLICATIONS** (54 %)
- NUMBER OF PUBLICATIONS WITH INTERNATIONAL PARTNERS: **27 PUBLICATIONS** (39 %)

PUBLICATIONS 2015:

Agostini A, Panagopoulos I, Andersen HK, Johannesen LE, Davidson B, Tropé CG, Heim S, Micci F. (2015) **HMGA2 expression pattern and TERT mutations in tumors of the vulva** Oncol Rep. 33(6):2675-80.

Andresen K, Boberg KM, Vedeld HM, Honne H, Jebsen P, Hektoen M, Wadsworth CA, Clausen OP, Lundin KE, Paulsen V, Foss A, Mathisen Ø, Aabakken L, Schrumpf E, Lothe RA, Lind GE. (2015) **Four DNA methylation biomarkers in biliary brush samples accurately identify the presence of cholangiocarcinoma** Hepatology. 61(5):1651-9.

Aure MR, Jernström S, Krohn M, Vollan HK, Due EU, Rødland E, Kåresen R; Oslo Breast Cancer Research Consortium (OSBREAC), Ram P, Lu Y, Mills GB, Sahlberg KK, Børresen-Dale AL, Lingjærde OC, Kristensen VN. (2015) **Integrated analysis reveals microRNA networks coordinately expressed with key proteins in breast cancer** Genome Med. 7(1):21.

Barzenje DA, Cvancarova Småstuen M, Liestøl K, Fosså A, Delabie J, Kolstad A, Holte H. (2015) **Radiotherapy Compared to Other Strategies in the Treatment of Stage I/II Follicular Lymphoma: A Study of 404 Patients with a Median Follow-Up of 15 Years** PLoS One. 10(7):e0131158.

Bassarova A, Trøen G, Spetalen S, Micci F, Tierens A, Delabie J. (2015) **Lymphoplasmacytic lymphoma and marginal zone lymphoma in the bone marrow: paratrabecular involvement as an important distinguishing feature** Am J Clin Pathol. 143(6):797-806.

Blaker YN, Brodtkorb M, Maddison J, Hveem TS, Nesheim JA, Mohn HM, Kolstad A, Geisler CH, Liestøl K, Smeland EB, Holte H, Delabie J, Danielsen H. (2015) **Computerized image analysis of the Ki-67 proliferation index in mantle cell lymphoma** Histopathology. 67(1):62-9.

Blix ES, Kildal AB, Bertelsen E, Waage A, Myklebust JH, Kolstad A, Husebekk A. (2015) **Content of endothelial progenitor cells in autologous stem cell grafts predict survival after transplantation for multiple myeloma** Biol Blood Marrow Transplant. 21(5):840-7.

Borge KS, Nord S, Van Loo P, Lingjærde OC, Gunnes G, Alnæs GI, Solvang HK, Lüders T, Kristensen VN, Børresen-Dale AL, Lingaas F. (2015) **Canine Mammary Tumours Are Affected by Frequent Copy Number Aberrations, including Amplification of MYC and Loss of PTEN** PLoS One. 10(5):e0126371.

Brabrand S, Johannessen B, Axcrona U, Kraggerud SM, Berg KG, Bakken AC, Bruun J, Fosså SD, Lothe RA, Lehne G, Skotheim RI. (2015) **Exome sequencing of bilateral testicular germ cell tumors suggests independent development lineages** Neoplasia. 17(2):167-74.

Bruun J, Kolberg M, Ahlquist TC, Røyrvik EC, Nome T, Leithe E, Lind GE, Merok MA, Rognum TO, Bjørkøy G, Johansen T, Lindblom A, Sun XF, Svindland A, Liestøl K, Nesbakken A, Skotheim RI, Lothe RA. (2015) **Regulator of chromosome condensation 2 identifies high-risk patients within both major phenotypes of colorectal cancer** Clin Cancer Res. 21(16):3759-70.

Buchtova M, Chaloupkova R, Zakrzewska M, Vesela I, Cela P, Barathova J, Gudernova I, Zajickova R, Trantirek L, Martin J, Kostas M, Otlewski J, Damborsky J, Kozubik A, Wiedlocha A, Krejci P. (2015) **Instability restricts signaling of multiple fibroblast growth factors** Cell Mol Life Sci, 72 (12), 2445-59.

Dale Rein I, Solberg Landsverk K, Micci F, Patzke S, Stokke T. (2015) **Replication-induced DNA damage after PARP inhibition causes G2 delay, and cell line-dependent apoptosis, necrosis and multinucleation** Cell Cycle. 14(20):3248-60.

Dale Rein I, Stokke C, Jalal M, Myklebust JH, Patzke S, Stokke T. (2015) **New distinct compartments in the G2 phase of the cell cycle defined by the levels of γH2AX** Cell Cycle. 14(20):3261-9.

Danielsen SA, Lind GE, Kolberg M, Høland M, Bjerkehagen B, Sundby Hall K, van den Berg E, Mertens F, Smeland S, Picci P, Lothe RA. (2015) **Methylated RASSF1A in malignant peripheral nerve sheath tumors identifies neurofibromatosis type 1 patients with inferior prognosis** Neuro Oncol. 17(1):63-9.

Drießen S, Berleth N, Friesen O, Löffler AS, Böhler P, Hieke N, Stuhldreier F, Peter C, Schink KO, Schultz SW, Stenmark H, Holland P, Simonsen A, Wesselborg S, Stork B. (2015) **Deubiquitinase inhibition by WP1130 leads to ULK1 aggregation and blockade of autophagy** Autophagy. 11(9):1458-70.

Du H, Liang Z, Zhao S, Nan MG, Phan Tran LS, Lu K, Huang YB, Li JN. (2015) **The Evolutionary History of R2R3-MYB Proteins Across 50 Eukaryotes: New Insights Into Subfamily Classification and Expansion** Sci Rep. 5:11037.

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About CCB

Centre for Cancer Biomedicine was established in September 2007 as a Centre of Excellence appointed by the Research Council of Norway with the University of Oslo as host institution. Our Centre is located at the Norwegian Radium Hospital, Oslo University Hospital. A consortium agreement regulates cooperation between the University of Oslo and Oslo University Hospital with the intention to make conditions favourable for fulfilling the scientific aims and strategic plans of CCB.

RESEARCH GROUPS

CCB consists of seven research groups and three associated groups embracing an average of approx. 150 people in 2015.

As part of CCBs strategy for supporting career development of young scientists, the PI group decided in 2012 to announce an internal call for a one-year PI position in CCB for a young scientist every year from 2013 to 2017. For 2015, we congratulate Rolf I. Skotheim with being awarded the PI stipend, and we welcome him as the seventh member of the PI group.

The seven research groups are headed by Prof. Harald Stenmark, Prof. Ragnhild A. Lothe, Prof. Kirsten Sandvig, Prof. Erlend Smeland, Prof. Håvard Danielsen, Prof. Knut Liestøl, and Ass. Prof. Rolf I. Skotheim.

Three independent groups are associated with CCB. These are the groups of Antoni Wiedlocha PhD, Prof. Guro E. Lind, and Prof. Sverre Heim.

Co-director Ragnhild A. Lothe, Director Harald Stenmark, and Administrative coordinator Anette Sørensen

MANAGEMENT

The day-to-day management of CCB is performed by Director Harald Stenmark, Co-director Ragnhild A. Lothe, and Administrative coordinator Anette Sørensen. The Centre management reports to the CCB board.

SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board supports our Centre with valuable input on strategy and science which helps us achieve our goal of becoming one of Europe's leading centres for cancer research.

The SAB members are:
Professor Manuel Sobrinho-Simões | Head of Department of Pathology, Medical Faculty of Porto & Director, Institute of Molecular Pathology and Immunology of the University of Porto (IPATIMUP), Portugal

Professor Marja Jäättelä | Head of research unit Cell Death and Metabolism, Danish Cancer Society Research Center, Copenhagen, Denmark

Professor Olli Kallioniemi | Director, Institute for Molecular Medicine Finland (FIMM), Nordic EMBL Partnership for Molecular Medicine, University of Helsinki & Director, Academy of Finland Centre of Excellence in Translational Genome-Scale Biology, Helsinki, Finland.

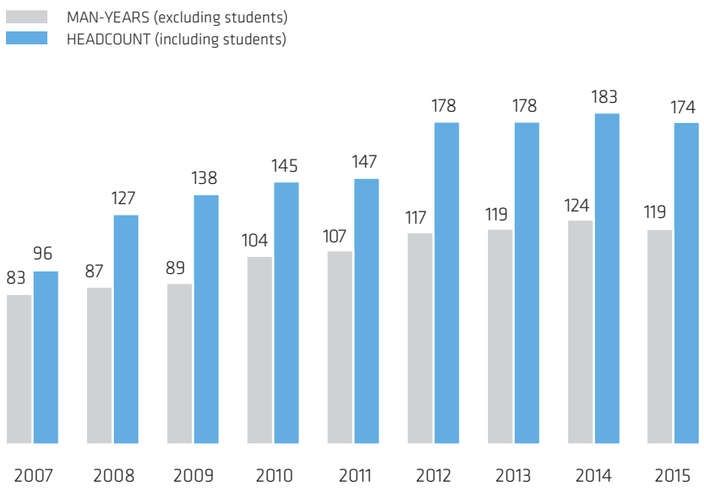
Professor David J. Kerr | Professor of Cancer Medicine, Nuffield Department of Clinical and Laboratory Sciences, University of Oxford, UK

VISITING PROFESSORS

CCB has three professors associated to the Centre.

Professor Manuel Teixeira | Portugese Oncology Institute, Porto, Portugal
Professor Marco Novelli | University College London Hospitals, UK
Professor Jan Delabie | University Health Network, Toronto, Canada

Facts and figures 2015



CCB STAFF – DEVELOPMENT IN MAN-YEARS/HEADCOUNT

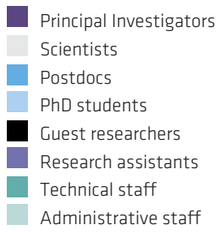
The total number of people registered in the centre in 2015:

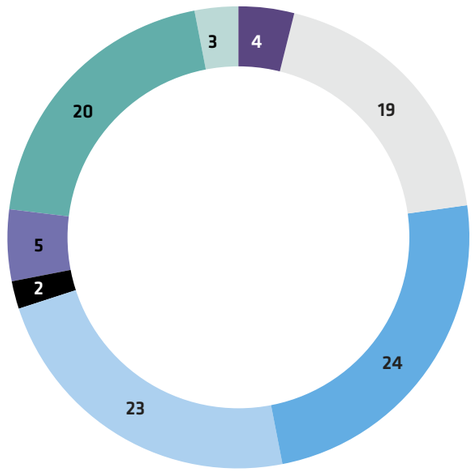
Man-years, excluding students: 119
Headcount, including students: 174

CCB currently houses 23 different nationalities.

CCB STAFF CATEGORIZED BY POSITION IN % OF TOTAL MAN-YEARS

CCB staff equals 119 man-years in 2015. The pie chart shows the categorization of our staff by position. In addition 9 master students were hosted by CCB in 2015.





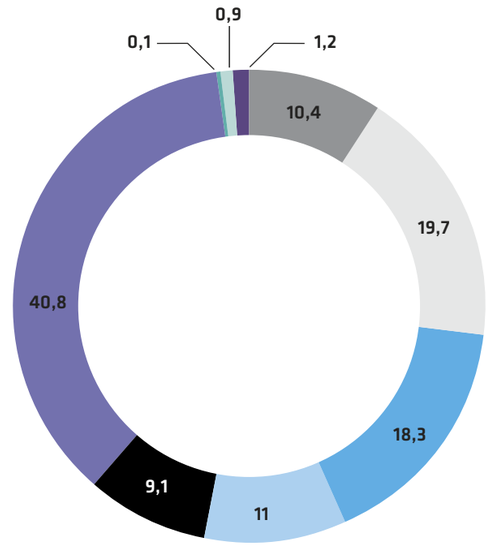
FUNDING IN MNOK

The total funding for 2015 is 111.5 MNOK excluding in-kind contributions from our two host institutions. The funding situation for CCB continues to be stable and the centre has succeeded to obtain sufficient financial resources to implement all its planned activities.

CCB's Centre of Excellence funding from the Research Council of Norway amounts to 11 MNOK, including 0.2 MNOK in Gender Equality funding.

This year other funding from the Research Council of Norway is showing a remarkable increase from 2.9 MNOK in 2014 to 10.4 MNOK in 2015.

CCB's international funding includes a Polish-Norwegian Research Fund grant.



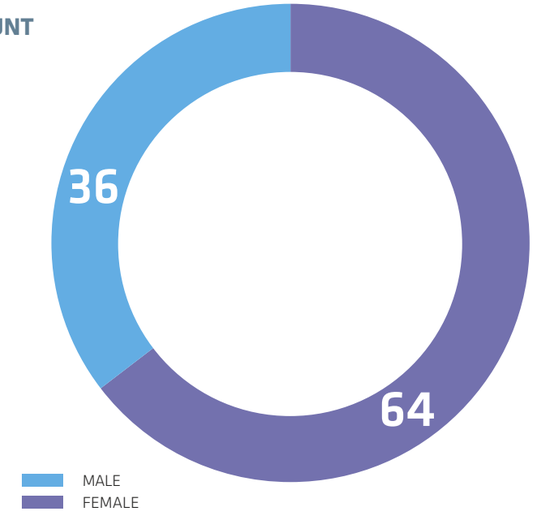
GENDER DISTRIBUTION IN % OF TOTAL HEADCOUNT

Gender balance
The gender balance in CCB is 64% women and 36% men among our total staff. Approximately the same percentages account for the postdoc category as well as for the PhD student category. However, for the highest scientific categories our male colleagues constitute the majority (principal investigators 71% men, scientists 55% men).

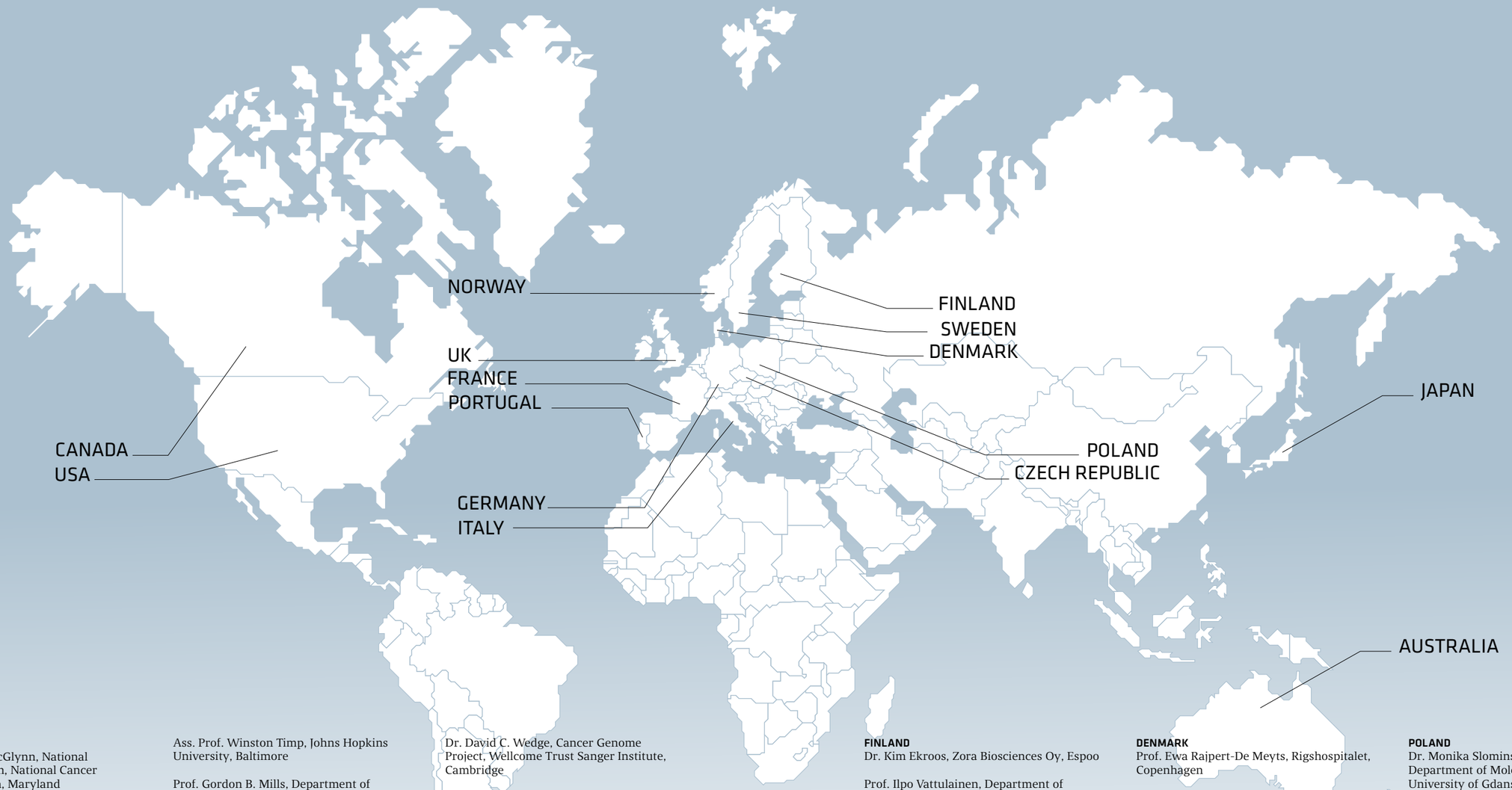
Gender equality actions
CCB actively supports the promotion of talented female scientists through various means where the overall strategy is to create predictability and continuity, and thereby motivating women to stay in their current career path.

CCB's focus on gender equality is in line with the gender equality policy of our host institution, the University of Oslo.

Working with gender equality is a strategic choice for CCB. Our Centre obtained a grant earmarked gender equality actions from the Research Council of Norway (RCN) totaling 3.1 MNOK for 2013-2016. These funds have financed two transition grants for female scientists of one year duration each. The purpose of this transition grant was to enable the grant holder to improve her foundation for independent funding. Furthermore, CCB finances 2 assistant professor positions of 3 years' duration with support from the mentioned RCN grant.



Another gender equality action is CCB's continued financial support to female candidates for EMBO's Laboratory Management Courses for Postdocs or for Independent Group Leaders. These courses are offered to four candidates every year, preferably to female candidates. However, in all fairness, several men have attended these CCB financed courses as well.



USA
Prof. Katherine McGlynn, National Institutes of Health, National Cancer Institute, Bethesda, Maryland

Prof. Katherine Nathanson, University of Pennsylvania, Philadelphia

Ass. Prof. Ash A. Alizadeh, Division of Oncology, Stanford University School of Medicine, California

Prof. Ronald Levy, Division of Oncology, Stanford University School of Medicine, California

Ass. Prof. Jonathan M. Irish, Department of Cancer Biology, Vanderbilt University, Nashville, Tennessee

Ass. Prof. Joshua Brody, Director of Lymphoma Immunotherapy Program, Mount Sinai School of Medicine, New York

Dr. Louis M. Staudt, Head of the Lymphoma and Leukemia Molecular Profiling Project (LLMPP), National Cancer Institute, Bethesda, Maryland

Prof. David Bilder, University of California, Berkeley, California

Prof. Tom Kirchhausen, Department of Cell Biology, Harvard Medical School, Boston

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UK
Prof. Peter Andrews, University of Sheffield, Sheffield

Prof. Jim Norman, Beatson Institute for Cancer Research, Glasgow

Prof. Marco Novelli, University College London, London

Dr. Peter Van Loo, Cancer Genome Project, Wellcome Trust Sanger Institute, Cambridge

Dr. David C. Wedge, Cancer Genome Project, Wellcome Trust Sanger Institute, Cambridge

Dr. Oscar Rueda, Cancer Research UK Cambridge Institute, Cambridge

Prof. Carlos Caldas, Cancer Research UK Cambridge Institute, Cambridge

Prof. David Kerr, Nuffield Division of Clinical Laboratory Sciences, University of Oxford, Oxford

Prof. Ian Tomlinson, Molecular and Population Genetics Laboratory, The Wellcome Trust Centre for Human Genetics, University of Oxford, Oxford

Dr. Tobias Zech, Institute of Translational Medicine, University of Liverpool, Liverpool

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Dr. Serena Nik-Zainal, Wellcome Trust Sanger Institute, Cambridge

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Danielsen, Håvard	P.I., professor	Danielsen	Norway	Oslo University Hospital	Dr. Philos
Danielsen, Stine Aske	Postdoc/Scientist	Lothe	Norway	Oslo University Hospital	PhD
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Gjølberg, Dorthea	Master student	Lothe	Norway	University of Oslo	

NAME	POSITION	GROUP	NATIONALITY	EMPLOYER	ACADEMIC TITLE
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NAME	POSITION	GROUP	NATIONALITY	EMPLOYER	ACADEMIC TITLE
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