THE NORWEGIAN ACADEMY OF SCIENCE AND LETTERS

DRAMMENSVEIEN 78, OSLO
THURSDAY, SEPTEMBER 22, 17:30

The BIRKELAND Lecture 2016

CORONAL LOOPS FOLLOWING AN ERUPTION ON JAN. 15, 2012. COURTESY NASA/SDO AND THE AIA SCIENCE TEAM

PROFESSOR ERIC PRIEST:

St Andrews University, Scotland

– Our Dynamic Sun

No registration. Free admission

Organizing committee:

Professor Jan A. Holtet, Department of Physics, University of Oslo
Professor Alv Egeland, Department of Physics, University of Oslo
Øyvind Sørensen, Chief Executive, the Norwegian Academy of Science and Letters
Svein Flatebø, Senior Adviser, Yara International ASA
Pål Brekke, Senior Advisor, Norwegian Space Centre

The Birkeland Lecture is open for everybody.
There is no registration. Free admission.

For more information about the Birkeland Lecture 2016:
Anne-Marie Astad
Information Officer
The Norwegian Academy of Science and Letters
Phone: + 47 22 12 10 92
E-mail: anne.marie.astad@dnva.no

A list of former Birkeland lecturers is found on
http://www.dnva.no/artikkel/vis.html?tid=44857

UiO : Universitetet i Oslo

Det Norske Videnskaps-Akademi

Norsk Romsenter
NORWEGIAN SPACE CENTRE

YARA

The Birkeland Lecture

The first Birkeland Lecture was given in Oslo in 1987 by the Nobel Laureate Hannes Alfvén. The lecture was a joint venture by the University of Oslo, the Norwegian Academy of Science and Letters and the Norwegian company Norsk Hydro. In 2004 Yara ASA took the place of Norsk Hydro and since 2005 the Norwegian Space Centre has been a partner in this cooperation. The Birkeland Lecture is above all an endeavor to honor the great Norwegian scientist and entrepreneur Kristian Birkeland. However, it has also given the organizers an opportunity to invite to Oslo many outstanding scientists within the field of geophysical and space research, areas which were central in Kristian Birkeland's own research.

Except for the year 1993, when the lecture was presented in Tokyo, and in 1998, when a mini-seminar was organized at the Norwegian Embassy in Tokyo, the lectures have been given in Norway, most of them at the Academy's premises in Oslo. Some years seminars have been arranged in connection with the lectures, e.g. in 1993 when the lecture was a part of a "Joint Japanese – Norwegian Workshop on Arctic Research", in 1995 when the lecture was a part of a seminar on Norwegian environmental research, and in 2001 when the lecture was given in connection with a workshop on Norwegian space research, with emphasis on the Cluster satellite programme.

Yara's Birkeland Prize in Physics and Chemistry

In 1905, Kristian Birkeland's research formed an basis for the foundation of the world's first company to manufacture fertilizer on an industrial scale, Norsk Hydro.

Birkeland was a visionary scientist with the ability and commitment to carry out large scale projects in the laboratory and the field, to follow up with theoretical studies, and to see the application of his results. Today Yara carries this heritage forward and takes great pride in being part of the effort to improve food security. A company's continued success depends upon its ability to innovate. To honor the innovative spirit of its cofounder, Yara established the Birkeland Prize in Physics and Chemistry in 2009.

Yara's Birkeland Prize will be awarded to a Ph. D. candidate from a Norwegian university who has carried out a scientific study that is in accordance with the innovative mind of Kristian Birkeland. The prize has an emphasis on the environment and technology, and encourage research across traditional borders. The prize will alternate between physics and chemistry, with chemistry in odd-numbered years and physics in even-numbered years. The award ceremony will take place in connection with the Birkeland lecture.

This portrait of Professor Kristian Birkeland was painted by Asta Nørregaard in 1906.

PROFESSOR ERIC PRIEST

St Andrews University, Scotland

Professsor Priest has for 32 years been a full professor of mathematics at St Andrews University, where he has built up the Solar Magnetohydrodynamics (MHD) Group of 8 tenured faculty and 21 postdoctoral and postgraduate students. He had previously been appointed lecturer at St Andrews after doing a PhD with TG Cowling.

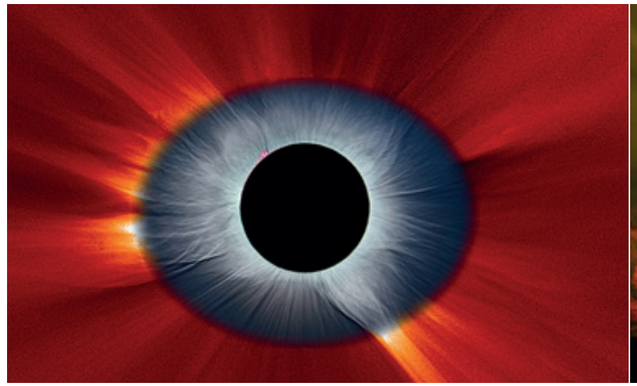
When first arriving at St Andrews, he expected to stay 2 years, but fell in love with this beautiful, historic town on the East Coast of Scotland. Each summer, his creativity has been re-stimulated by visiting the USA for research with colleagues such as Terry Forbes or Dana Longcope.

As an applied mathematician in solar physics, he has broad interests in science, as well as communicating the philosophy, vitality and importance of science to a wider public. He is also committed to supporting and mentoring young researchers and expanding public awareness.

Awards include: being elected a member of Norwegian Academy of Sciences & Letters (1994), a Fellow of the Royal Society (2003) and the Rosseland Lecturer in Oslo (2006); and being awarded the Hale Prize of the American Astronomical Society (2002), the Gold medal of the Royal Astronomical Society (2009), and an Honorary D Sc at St Andrews (2013).

He has been on many national and international committees including: being co-chair of PPARC's Science Committee, responsible for the UK astronomy and particle physics research programme; being on the European Space Agency's Space Science Advisory Committee. Currently he is chair of the Fachbeirat for the Max-Planck-Institute for Solar System Science in Goettingen.

He has written over 460 journal papers, edited 15 books and written 4 research monographs notably *Solar Magnetohydrodynamics* (1982), *Magnetic Reconnection* (with T Forbes, 2000) and *Magnetohydrodynamics of the Sun* (2014). His main topics have been magnetic reconnection, coronal heating, solar prominences and solar flares.



An composite image of the corona during a solar eclipse on March 9, 2016, with white light images from the ground and from space (LASCO C2 on SoHO). (Courtesy J Vinga, R Wittich, S. Koutchmy and the LASCO consortium on SoHO.)

A solar prominence erupting at about 1500 km/s on Aug 31, 2012. The image is a composite of 304 and 171 Å wavelength bands form the Atmospheric Imaging Assembly (AIA) on the Solar Dynamics Observatory (SDO). (Courtesy NASA/SDO and the AIA science team.)

PROFESSOR ERIC PRIEST, St Andrews University, Scotland

– Our Dynamic Sun

The Sun, an object of worship for early civilisations, is the main source of light and life on Earth and of our space weather, with many subtle effects on our environment. Furthermore, on the Sun we can view in exquisite detail many cosmical processes that occur across the universe in more distant and exotic environments.

This lecture will introduce you to the Sun and its dynamic phenomena, some of which create changes in Near-Earth space whose study was pioneered by Birkeland. The lecture will aim to show how our understanding of many aspects of the Sun has been revolutionized over the past few years by current spacecraft observations and models. It will also describe major puzzles that remain.

The Sun is in the plasma state, the fourth state of matter, which behaves completely differently from the other three states that surround us on Earth (solids, liquids and gases). The main difference lies in the subtle, intimate, nonlinear interaction between the magnetic field and the plasma, described for many purposes by *magnetohydrodynamics*. Indeed, many dynamic phenomena on the Sun are driven by the magnetic field since, in the outer atmosphere (or corona), it represents by far the largest source of energy.

The interior of the Sun, revealed by solar seismology, possesses a strong shear layer at the base of the convection zone, where sunspot magnetic fields are generated. But a small-scale dynamo is also operating near the surface of the Sun, generating magnetic fields that thread the lowest layer of the solar atmosphere, *the photosphere*, in a turbulent convective state.

Above the photosphere lies the highly dynamic fine-scale *chromosphere* and beyond that the rare *corona* at high temperatures exceeding one million degrees K. Magnetic mechanisms for heating the corona (an intriguing puzzle) will be described. One suggestion involves wave motions and another the formation of intense sheets of current where dissipation of magnetic energy is rapid.

Other puzzles include the structure of giant flux ropes, known as prominences, which have complex fine structure. Occasionally, they erupt and produce huge ejections of mass and magnetic field *(coronal mass ejections)*, which can disrupt the space environment of the Earth. When such eruptions originate in active regions around sunspots, they are also associated with *solar flares*, where magnetic energy is converted to kinetic, heat and fast particle energy.

Science and Innovation

In 2012 a new section was added to the traditional Birkeland Lecture, an introductory lecture under the thematic umbrella "Science and Innovation".

This year's lecture ***From the North Sea to Mars – high-voltage plasma applications*** will be given by ***Brage W. Johansen***, CEO Zaptec AS.

Johansen studied Computer Science at NTNU, Technology Management at NHH, and has university studies in astronomy, philosophy and psychology. Since 2000 he has been in management positions for technology projects/ventures. Highlights include being head of Statoil Hydrogen and responsible for design and construction of Norway's first commercial hydrogen station. As head of Statoil New Technology, his department invested in 20+ external companies/inventions. He has been VP Strategy of International Research Institute in Stavanger (IRIS). The last ten years he has worked with the space sector to find ways for Norwegian industry to deliver to space industry and to transfer technologies from space to Norwegian industries. He is the cofounder of the "think-tank" Think Outside The Planet and Space & Energy. Now he is the CEO for Zaptec AS.

Zaptec, founded November 2012, has a patented core technology which is a super compact and super efficient electronic transformer. It outperforms transformers up to 10 times its weight and volume, and uses up to 100 times less copper and iron. Such small transformers have numerous of applications. Zaptec's first products were made to charge electric cars, and first line of products are now delivered to Renault Group. Zaptec is devoted to high voltage and plasma, and explores the possibilities to use high voltage plasma to crush stone and sterilize water. Zaptec is currently funded by European Space Agency and supported by NASA to develop a plasma drill for searching for water & life on Mars.