UPPSALA
UNIVERSITET

CELSIUS–LINNÉ
LECTURES 2016

Thursday 18 February,

the traditional Celsius-Linné lectures will be held in

THE SIEGBAHN HALL,
THE ÅNGSTRÖM LABORATORY

14.00 – CELSIUS LECTURE

Photovoltaic Conversion of Black-Body Radiation to Electricity: Solar and Non-Solar

ELI YABLONOVITCH

15.30 – LINNÉ LECTURE

Wizardry with Light

LENE VESTERGAARD-HAU

Celsius Lecture

Photovoltaic Conversion of Black-Body Radiation to Electricity: Solar and Non-Solar

Eli Yablonovitch
Professor, Dept. of Electrical Engineering & Computer Sciences, University of California, Berkeley, USA



A new scientific principle has produced record-breaking solar cells. The 28.8% single-junction solar efficiency record, by Alta Devices Inc., was achieved by recognizing the importance of extracting luminescent emission. This is exemplified by the mantra: "A great solar cell also needs to be a great LED". It was essential to remove the original semiconductor substrate, which absorbed luminescence, and to replace it with a high reflectivity mirror. The solar efficiency record crept up as the rear reflectivity behind the photovoltaic film was increased, 96% reflectivity -- 97% -- 98% luminescent reflectivity;-- each produced a new world efficiency record.

Such high rear reflectivity can revolutionize thermo-photovoltaics, the direct conversion of thermal radiation to electricity. Selective reflection of sub-bandgap radiation, permits step-function spectral control of the unused infrared photons, for the first time. This enables conversion from heat to electricity with >50% efficiency. Such a lightweight "engine" can provide power to electric cars, aerial vehicles, spacecraft, homes, and stationary power plants.

Eli Yablonovitch is Director of the NSF Center for Energy Efficient Electronics Science (E3S), a multi-University Center headquartered at Berkeley. In his photovoltaic research, Yablonovitch introduced the 4(n squared) light-trapping factor ("Yablonovitch Limit") that is in worldwide use, for almost all commercial solar panels. Yablonovitch introduced the idea that strained semiconductor lasers could have superior performance due to reduced valence band (hole) effective mass. With almost every human interaction with the internet, optical telecommunication occurs by strained semiconductor lasers. He is regarded as a Father of the Photonic BandGap concept, and he coined the term "Photonic Crystal". The geometrical structure of the first experimentally realized Photonic bandgap, is sometimes called "Yablonovite". His startup company Ethertronics Inc., has shipped over one billion cellphone antennas. He has been elected to the NAE, the NAS, and as Foreign Member, UK Royal Society. Among his honors is the Buckley Prize of the American Physical Society, and the Isaac Newton Medal of the UK Institute of Physics.

Linné Lecture

Wizardry with Light

Lene Vestergaard-Hau
Mallinckrodt Professor of Physics and of Applied Physics, Harvard University, USA



Light pulses are slowed to bicycle speed, 25 km/hour, in clouds of ultra-cold atoms. This is 50 million times lower than the light speed in vacuum. In the process, a light pulse spatially compresses by the same large factor, from 1 km to only 0.02 mm, and the pulse can then be completely stopped and later restarted. From here, we take matters further: stop and extinguish a light pulse in one part of space and revive it in a completely different location. In the process, the light pulse is converted to a perfect matter copy that can be stored – put on the shelf – sculpted, and then turned back to light. The storage time can be many seconds, and during this time, light could – under normal circumstances – travel back and forth to the Moon several times over. The observations represent novel paradigms for powerful information processing, and for control and inter-conversion of light and matter.

Lene Vestergaard Hau is the Mallinckrodt Professor of Physics and of Applied Physics at Harvard University. Prior to joining the Harvard faculty in 1999, she was a senior scientist at the Rowland Institute for Science in Cambridge, Massachusetts, and holds a Ph.D. in Physics from University of Aarhus, Denmark. In 1999, Hau led a team who succeeded in slowing a pulse of light to 15 miles per hour, and later, in 2001, they brought light to a stop. She is a 2001 MacArthur Fellow, and was elected to the American Academy of Arts and Sciences, the Royal Swedish Academy of Sciences, and the Royal Danish Academy of Sciences and Letters. She is a Fellow of the American Association for the Advancement of Science and of the American Physical Society and is the recipient of numerous awards, including Harvard University's Ledlie Prize, the Ole Roemer Medal, awarded by the University of Copenhagen, and the Richtmyer Memorial Lecture Award. In 2010, she was appointed a National Security Science and Technology Faculty Fellow by the U.S. Secretary of Defense, and was named "World Dane", thus becoming one of only three Danes to have been elected for this honor. In 2011, she was named Distinguished Alum of Aarhus University, and in 2012 was named "Thomson Reuters Citation Laureate" in the field of physics by Thomson Reuters.

The Celsius and Linné Honorary Lectures are arranged annually by the Faculty of Science and Technology in memory of Anders Celsius and Carl von Linné (Linnaeus), world-renowned professors of Uppsala University.

Anders Celsius was appointed professor of Astronomy at Uppsala University in 1730 at the age of 28. He established the first professional astronomical observatory in Uppsala around 1740. His scientific activities included work on celestial mechanics, studies on comets and satellites, pioneering contributions to stellar photometry, to geodesy and to geophysics. He discovered that auroræ caused magnetic disturbances and he invented the temperature scale that bears his name. Anders Celsius died in 1744.

Carl von Linné was appointed professor of Medicine at Uppsala University in 1741 at the age of 34. Linné had already in 1735 declared that the two most important tasks in natural history were "classification and naming" (divisio et denominatio). His Systema naturæ was published in 1735 at Leiden. Here we meet his permanent contribution to science, the naming practice, the binary nomenclature or binomial system. Linné founded the Royal Academy of Sciences, now responsible for the Nobel Prize awards, and of which he became the first president. He died in 1778.