

**Professor John L. “Jan” Hall  
2005 Nobel Prize in Physics  
Visit: September 3 – 5, 2008**

*Sponsored by the Department of Physics, OpTeC, Spectrum Lab,  
Dean of Letters and Science, Vice President for Research, and  
Procrastinator Theater - ASMSU*

Dr. John L. Hall was awarded the 2005 Nobel Prize in Physics, sharing this honor with Theodor W. Hänsch of the Max-Planck-Institute (Garching, Germany) and Roy J. Glauber of Harvard University. They were recognized "for their contributions to the development of laser-based precision spectroscopy, particularly the optical frequency comb technique." Using a laser instrument called “the optical frequency comb,” scientists now can rapidly measure the frequency of other laser light sources with extraordinarily high precision. There are many implications for fundamental physics and international standards of measurement, and there are many broader applications in Science, Metrology (the branch of science and technology that deals with accurate measurements of all types, international standards, and with the system of measurements) and, most recently, in Diagnostic Medicine.

Dr. Hall will be meeting with students and visiting laboratories and student research projects in the Department of Physics, Electrical and Computer Engineering, OpTeC, and Spectrum Lab.

Dr. Hall has visited MSU several times in the past, and his advice and expertise have strongly impacted programs in laser frequency stabilization in Physics, ECE, and Spectrum Lab at MSU and local optical companies.

Host: Rufus Cone  
Individual discussions and lab tours by appointment.  
Contact Rufus Cone, [cone@montana.edu](mailto:cone@montana.edu) x6175.

**Physics 200 Class** 11:00 – 11:50 AM, Thursday, September 4, 2008, SUB Ballroom D

"Bull session" offering students an informal opportunity to discuss with Jan about life in science, beginning with an informal biography, leading to questions and answers on wide-ranging topics including experiences as a student, finding a way through the job market, motivations, and interests.

MSU undergraduates, graduate students, and interested faculty are invited to attend this special session of PHYS 200 Research Programs in Physics.

**OpTeC Reception** 3:10 PM – 5 PM, Thursday, September 4, 2008, SUB 275

Informal discussions of optical and laser research.

**Physics Colloquium** *The Optical Frequency Comb - a remarkable tool for Metrology, Science, and Medical Diagnostics*

Prof. John L Hall  
JILA, University of Colorado and NIST  
Boulder CO 80309-0440  
<http://jilawww.colorado.edu/hall>

4:10 PM, Friday, September 5, 2008, new **SUB Procrastinator Theater**.

**CLS Reception** hosted by College of Letters and Science, at 5 PM following the Colloquium in the SUB Leigh Lounge

**Colloquium Abstract**

The *Optical Frequency Comb* concept and technology exploded in 1999-2000 from the synthesis of advances in independent fields of Laser Stabilization, UltraFast Lasers, and NonLinear Optical Fibers. The Comb was developed first as a method for optical frequency measurement, enabling a thousand-fold advance in optical frequency measurement, and searches (in the 17th digit) for time-variation of physical "constants." The Comb methods also empower enhanced time-domain control, with broad applications in spectroscopy, metrology, and the extension of nonlinear optics into the XUV range and beyond. A comb-excited Cavity Ringdown measurement allows massively multiplex spectroscopy, sensitively, to detect disease-marker molecules within human breath. In Comb-based length metrology, the incredible resolution is accessible ALONG WITH intrinsic resolution of the integer fringe question: two great applications will be control/calibration of next-generation interferometric planet-finder missions, and cold-start dimensional metrology for accurate photolithography of large semiconductor wafers.

**Brief Curriculum Vitae**

John L. Hall was born in 1934 in Denver, Colorado, and earned his PhD.(1961) degree from Carnegie Tech (now Carnegie Mellon University). He had 44 good years of research at the National Institute of Standards and Technology (NIST), working in laser technology, opto-electronic development and precision measurement. He is now NIST Senior Fellow Emeritus, Adjoint Professor of the University of Colorado, and an Adjoint Fellow of JILA (formerly the Joint Institute for Laboratory Astrophysics), a cooperative institute of NIST and the University of Colorado-Boulder. Known as a preeminent laser experimentalist and innovator, Dr. Hall has contributed significantly to the evolution of the laser from a laboratory curiosity into one of the fundamental tools of modern science. He is known also for his training and mentoring of new generations of inspired physicists, several now being star researchers themselves.

Hall's work has concentrated on improving the precision and accuracy with which lasers can produce a specific frequency, and the stability with which they can hold that frequency. He has helped to develop a broad range of laser advances in fields such as precision spectroscopy for

physical and chemical analysis, new tests of fundamental physical "laws", measurement and redefinition of the speed of light, and other refinements in time and length metrology. These advances are represented by more than 240 publications and 11 US patents, and have been recognized by more than 20 Awards and Prizes from professional societies, and his employer. He has received a number of Honorary degrees, and became a member of the French Légion d'Honneur in 2004.

Dr. Hall was awarded the 2005 Nobel Prize in Physics, sharing this honor with Theodor W. Hänsch of the Max-Planck-Institute (Garching) and Roy J. Glauber of Harvard University. This recognition was awarded "for their contributions to the development of laser-based precision spectroscopy, particularly the optical frequency comb technique." The optical frequency comb can rapidly measure the frequency of another laser with extraordinarily high precision, and has many broader applications in Science, Metrology and, most recently, in Diagnostic Medicine.

### **Resources**

**Nobel Lecture:**

[http://nobelprize.org/nobel\\_prizes/physics/laureates/2005/hall-lecture.html](http://nobelprize.org/nobel_prizes/physics/laureates/2005/hall-lecture.html)

**Nobel Lecture:** Rev. Mod. Phys. **78**, 1279 (2006) (17 pages)

<http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=RMPHAT00078000004001279000001&idtype=cvips&gifs=yes>

**John Hall's JILA Home Page:**

<http://jilawww.colorado.edu/hall/>

**Popular article:** *Rulers of Light*, by Steven Cundiff, Jun Ye and John Hal, Scientific American (April, 2008) pp. 74–81

[http://jilawww.colorado.edu/YeLabs/pubs/scienceArticles/2008/sArticle\\_2008\\_04\\_OpticalFrequency.pdf](http://jilawww.colorado.edu/YeLabs/pubs/scienceArticles/2008/sArticle_2008_04_OpticalFrequency.pdf)