James L. Hanssen

Clock Development Division
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Education

Ph.D., University of Texas at Austin, Austin, Texas
Physics, August 2004
Specialty: Experimental atomic physics, laser physics

B.A., Rice University, Houston, Texas
Physics and Mathematics, May 1998
Cum Laude

Professional and Research Experience

Research Physicist, Clock Development Division, US Naval Observatory, Washington, District of Columbia
Supervisor: Dr. Christopher Ekstrom
September 2008 – Present

Atomic Clock Research and Development Experience

- Constructed laser-cooled rubidium fountain clocks. Upgraded design during construction phase.
- Characterized fountain clocks by analyzing data to determine short-term, medium-term, and long-term stability.
- Optimized fountain clocks for peak performance using knowledge of atomic physics.
- Contributed to studies of local position invariance (LPI) using rubidium fountain and other atomic clock data.
- Designed, procured, and started construction of optical cavity based local oscillator for improved performance of rubidium fountains.
- Investigated and made recommendations on designs for future optical clocks including trapped ion standards, neutral atom standards, and molecular standards.
- Developed optical sources and fiber optic systems for next generation optical clocks.
  - Led design, construction, and characterization of fiber based optical frequency combs.

        - Designed low noise microwave dividers.
        - Led design and construction of cavity stabilized fiber lasers for use as narrow linewidth local oscillator in future optical clock.
    - Evaluated and characterized short-term and long-term performance of ultra-stable crystal oscillators.
    - Improved long-term behavior of ultra-stable crystal oscillators by designing and building sealed containers to control temperature, humidity, and pressure.
    - Represented US Naval Observatory at international and national conferences and presented results of research done in the Clock Development Division.
    - Represented US Naval Observatory as a subject matter expert on atomic and optical clocks for the DARPA QuASAR, PULSE, μPNT, and STOIC programs.

Time and Frequency Transfer Research and Development Experience

- Led effort to design and build amplitude modulated (AM) two-way, compensated time and frequency transfer fiber links.
    - Links had stabilities of ~1e-14 at one second and integrated down as ~$1/\tau$ out to a day.
    - Links were tested in laboratory settings as well as on urban fiber networks.
- Designed coherent (optical phase stabilization) two-way, compensated frequency transfer fiber links.
- Developed computer programs and hardware to acquire and analyze low phase noise frequency transfer fiber links.
- Led effort to construct one-way, two-color, compensated microwave-over-fiber frequency transfer link with performance better than $5x10^{-16}$ at one day.
- Developed novel schemes for one-way time and frequency transfer over fiber based on AM to PM conversion.
- Collaborated with SP Technical Research Institute of Sweden on passive time transfer using SONET frame headers.
- Investigated transfer of time and frequency through modern fiber optic networks using coherent transceivers. Coordinated coherent transceiver research currently being done at Draper Laboratories.
- Evaluated commercial fiber time and frequency hardware (PikTime, ATS6501/6511, White Rabbit) for suitability for local and external time and frequency transfer requirements.
- Modified and improved commercial fiber time and frequency hardware to extend reach from ~10km to over 200km.
- Participated in collaboration between NIST, USNO, DHS, and CenturyLink to use PTP over Gigabit Ethernet for time and frequency transfer over long haul networks between NIST-Boulder and USNO-AMC.
- Collaborated with JHU-APL to adapt free space optical (FSO) communication links to support time and frequency transfer.

Programmatic and Administrative Experience

- Drafted Program Protection Plan and Security Class Guide for CTD.
- Contributed to the creation of 1144's with DISA and ARL in support of CTD. Created financial structure for funds to be transferred between agencies.

- Led effort in conjunction with DISA to establish an operational fiber optic time and frequency transfer link between USNO-DC and USNO-AMC.
- Guided programmatic details for JHU-APL FSO time transfer effort.
- Drafted technical and programmatic whitepapers and presentations for classified DOD-CIO work.
- Represented USNO at the PTTI R&D sub-working group.
- Interacted on behalf of USNO with various agencies and groups.
  - Government – DOD-CIO, DISA, NRL, ARL, DARPA, ONR, NIST, IC, etc.
  - Industry – Microsemi, Raytheon, etc.
  - Academia – MIT, CU-Boulder, Caltech, etc.
- Managed administrative roles for Clock Development Division in acting division chief assignment. Coordinated end of year budgeting for division. Represented division at TS update briefs.
- Drafted statement of work for Draper research effort on coherent transceivers. Coordinated transfer of research funds to Draper via Navy SSP BOA. Monitored research and development work performed at Draper.
- Oversaw multiple purchasing and contracting activities including MIPRs to ARL, DISA, and Navy SSP, large OPN purchase, FISC purchases, and credit card purchase requests.

Postdoctoral Researcher, Electron Physics Group, National Institute of Standards and Technology, Gaithersburg, Maryland

Supervisor: Dr. Jabez McClelland

September 2004 – September 2006, January 2007 – September 2008

- Performed first magneto-optical trapping of atomic erbium
- Designed, built, and characterized cavity stabilized laser for narrow-line cooling of atomic erbium
- Developed a new source for use as a high brightness focused ion beam
- Analyzed characteristics of source based on laser-cooled atoms
- Designed and constructed electrostatic lens for creating focused ion beam
- Performed experiments to characterize source, demonstrated performance superior to state of the art ion sources
- Presented results at international conferences, industry meetings, and internal NIST meetings

Optical Scientist, Optical Air Data Systems, Manassas, Virginia

Supervisor: Philip Davison

September 2006 – December 2006

- Designed, built, and tested fiber optic LIDAR systems for use in helicopters.
- Performed laser safety tests on LIDAR systems, certified systems as Class 1 eye safe

Doctoral Research, University of Texas at Austin, Austin, Texas

Advisor: Dr. Mark Raizen

December 1999 – August 2004

- Designed, constructed, and performed modern atomic and optical physics experiments for the study of ultra-cold atomic physics. Experiments utilized a Bose-Einstein Condensate (BEC) as a reservoir for the extraction of individual ground state atoms. Work has potential application to quantum computation.

Skills

Laboratory: optical system design and construction; fiber optics; electrostatic lens design and construction; experience with lasers, electro-optics, and acousto-optics; analog and digital electronics design and construction; experience with radio frequency electronics and hardware; microwave synthesis chain design and construction; phase locked loop design and construction; design and construction of ultra-high vacuum systems; mechanical design and fabrication; computer automation and data acquisition.

Theoretical: Knowledge of advanced mathematics, numerical methods, and applications of mathematics to physical systems and engineering problems. Strong theoretical problem solving skills.

Computer: Proficient with IDL, IGOR, Stable32, Matlab, Mathematica, SIMION 7.0, MiniCAD, Solid Designer, Autodesk Inventor, LabView, Windows, Microsoft Office.

General: Excellent oral and written communication skills for both technical and non-technical audiences. Worked alone and within small groups to achieve experimental goals.

Publications

M. Weiss, L. Cosart, and J. Hanssen, "Ethernet Time Transfer through a U.S. Commercial Optical Telecommunications Network," *Proceedings of the 46th Annual Precise Time and Time Interval(PTTI) Systems and Applications Meeting* (2014).

C. R. Ekstrom, J. L. Hanssen, T. B. Swanson, J. Taylor and S. Peil, "Cold-Atom Clocks as Part of a Timing Ensemble," *Frequency Control Symposium (FCS), 2014 IEEE International* (2014).

S. Peil, J. L. Hanssen, T. Swanson, J. Taylor, and C. R. Ekstrom, "Evaluation of long term performance of continuously running atomic fountains," *Metrologia*, **51**, 263-269 (2014).

J. L. Hanssen, J. A. Taylor, and C. R. Ekstrom, "Time and Frequency Transfer Over an Electronically Compensated Fiber Link," *Proceedings of the 45th Annual Precise Time and Time Interval(PTTI) Systems and Applications Meeting* (2013).

S. Peil, S. Crane, J. L. Hanssen, T. B. Swanson, and C. R. Ekstrom," Tests of Local Position Invariance Using Continuously Running Atomic Clocks," *Phys. Rev. A* 87, 010102(R), (2013).

S. Peil, J. L. Hanssen, T. B. Swanson, S. Crane, and C. R. Ekstrom, "Performance and Applcations of an Ensemble of Atomic Fountains," *Proceedings of the 44th Annual Precise Time and Time Interval(PTTI) Systems and Applications Meeting* (2012).

J. L. Hanssen, C. R. Ekstrom, S.-C. Ebenhag, and K. Jaldehag, "Evaluation of Time Transfer Units for Time and Frequency Transfer in Optical Fibers Utilizing a Passive Technique based on SONET/SDH," *Proceedings of the 44th Annual Precise Time and Time Interval(PTTI) Systems and Applications Meeting* (2012).

J. L. Hanssen, S. G. Crane, and C. R. Ekstrom, "One-Way Two-Color Fiber Link for Frequency Transfer," *Frequency Control Symposium (FCS), 2012 IEEE International* (2012).

S. Peil, S. Crane, J. L. Hanssen, T. B. Swanson, and C. R. Ekstrom, "An Ensemble of Atomic Fountains," *Frequency Control Symposium (FCS), 2012 IEEE International* (2012).

J. L. Hanssen, S. G. Crane, and C. R. Ekstrom, "One-Way Temperature Compensated Fiber Link," *Frequency Control and the European Frequency and Time Forum (FCS), 2011 Joint Conference of the IEEE International* (2011).

S. Peil, S. Crane, J. L. Hanssen, T. B. Swanson, and C. R. Ekstrom, "Measurements with Multiple Operational Fountain Clocks," *Frequency Control and the European Frequency and Time Forum (FCS), 2011 Joint Conference of the IEEE International* (2011).

J. L. Hanssen, Christopher R. Ekstrom, and Warren F. Walls, "High Performance Oscillator Evaluation," *Frequency Control Symposium, 2009 Joint with the 22nd European Frequency and Time forum. IEEE International* **181,** pp 20-24 (2009).

J. L. Hanssen, S. B. Hill, J. Orloff, and J. J. McClelland, "Magneto-Optical Trap-Based, High Brightness Ion Source for Use as a Nanoscale Probe," *Nano Lett.* **8**, 2844 (2008).

A. J. Berglund, J. L. Hanssen, and J. J. McClelland, "Narrow-line Magneto-optical Cooling and Trapping of Strongly Magnetic Atoms," *Phys. Rev. Lett*. **100**, 113002 (2008).

J. L. Hanssen, J. J. McClelland, E. A. Dakin, and M. Jacka, "Laser Cooled Atoms as a Focused Ion Beam Source," *Phys. Rev. A* **74**, 063416 (2006).

J. L. Hanssen, E. A. Dakin, and J. J. McClelland, "Using Laser Cooled Atoms as a Focused Ion Beam Source," *J. Vac. Sci. Technol*. B **24**, 2907 (2006).

J. J. McClelland and J. L. Hanssen, "Laser cooling without repumping: A magneto-optical trap for erbium atoms," *Phys. Rev. Lett*. **96**, 143005 (2006).

C.-S. Chuu, F. Schreck, T. P. Meyrath, J. L. Hanssen, G. N. Price, and M. G. Raizen, "Direct Observation of Sub-Poissonian Number Statistics in a Degenerate Bose Gas," *Phys. Rev. Lett*. **95**, 260403 (2005)

T. P. Meyrath, F. Schreck, J. L. Hanssen, C.-S. Chuu, and M. G. Raizen, “Bose-Einstein Condensate in a Box,” *Phys. Rev. A* **71**, 04160(R) (2005).

H. Y. Ban, M. Jacka, J. L. Hanssen, J. Reader, and J. J. McClelland, “Laser Cooling Transitions in Atomic Erbium,” *Opt. Express* **13**, 3185 (2005).

T. P. Meyrath, F. Schreck, J. L. Hanssen, C.-S. Chuu, and M. G. Raizen, “A High Frequency Optical Trap for Atoms Using Hermite-Gaussian Beams,” *Opt. Express* **13**, 2843 (2005).

J. L. Hanssen, V. Milner, T. P. Meyrath, and M. G. Raizen, “Real-Time Control of Atomic Motion Using Feedback,” Coherence and Quantum Optics VIII pages 233-240 (2003).

V. Milner, J. L. Hanssen, W. C. Campbell, and M. G. Raizen, “Optical Billiards for Atoms,” *Phys. Rev. Lett*. **86**, 1514 (2001).

J. L. Hanssen, C. F. Martin, and P. Nordlander, “Dynamics of Rydberg Atoms Near Metal Surfaces in the Presence of an Electric Field,” *Surf. Sci*. **423**, L271 (1999).

J. L. Hanssen and W. Wilcox, “Lyapunov Exponents for the Intermittent Transition to Chaos,” *Int. J. Bif. Chaos* **9**, 657 (1999).

Patents

“Magneto-optical Trap Ion Source” – Patent number: US 7709807

Personal Information

DOB: December 4, 1975
POB: Port Arthur, Texas
Citizenship: United States of America
Active TS/SCI Security Clearance