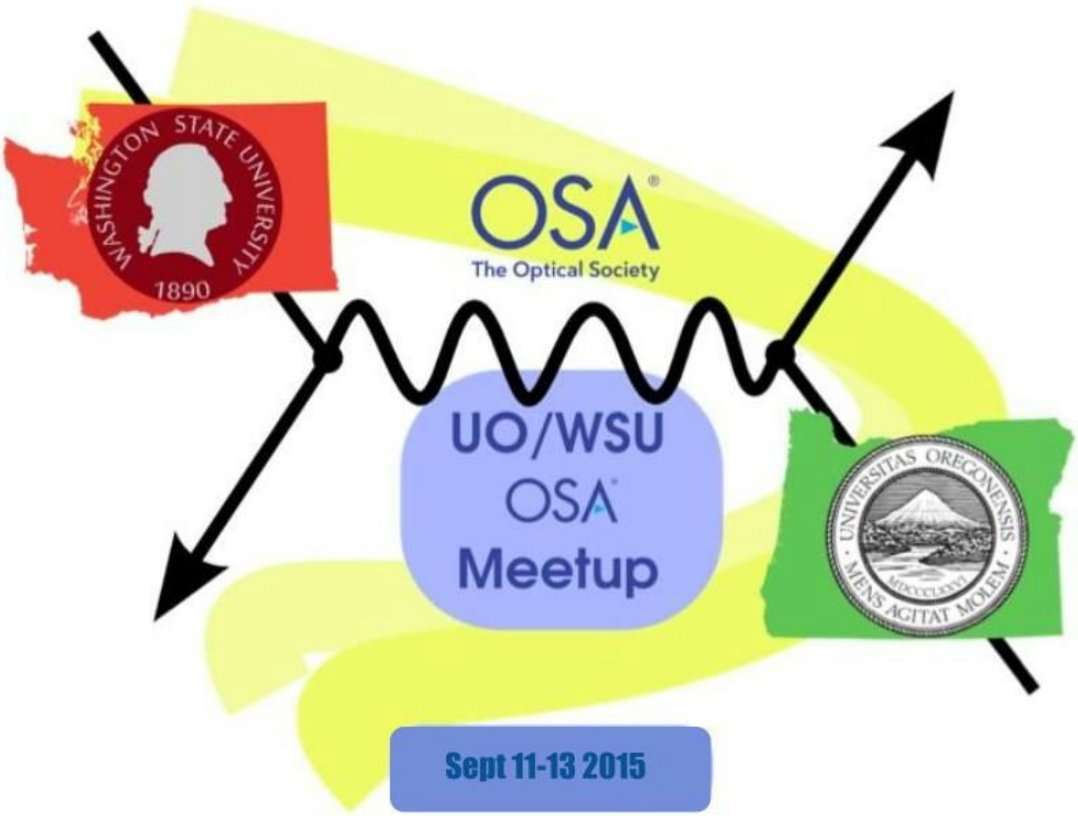

WASHINGTON STATE UNIVERSITY
1890
OSA
The Optical Society
UO/WSU
OSA
Meetup
UNIVERSITAS OREGONENSIS
MENS AGITAT MOLEM
Sept 11-13 2015

SEPT. 12 SCHEDULE

Start time	Speaker or activity
9:00 AM	Breakfast with discussion led by WSU OSA/SPIE president
9:50	Opening remarks
10:00	Ryan Murray[1]
10:20	Timothy Daniel[1]
10:40	Rudy Resch[2]
11:00	Coffee break
11:15	Brian Hake[2]
11:35	Thomas Bersano[1]
11:55	Lunch
1:20 PM	Sean Mossman[1]
1:40	Roger Smith[2]
2:00	Carl Brannen[1]
2:20	Coffee break
2:35	Institute for Shock Physics tour
3:50	Coffee break
4:05	Xin Tao[1]
4:25	Andrea Goering[2]
4:45	Wes Erickson[2]
5:05	Coffee break
5:20	Directed discussion
6:20	Closing remarks; discussion of evening activities

[1] WSU student
[2] UO student

ABSTRACTS

Solute-Solute Interactions, or: it turns out it's really hard to make good ternary alloys.

Ryan Murray[1]

Perturbed angular correlation (PAC) of gamma rays can discriminate among local environments of probe atoms in solids. Internal fields in solids exert torques on nuclear moments: a magnetic field exerts a torque on the magnetic dipole moment while an electric field gradient exerts a torque on the electric quadrupole moment. These nuclear hyperfine interactions lead to frequencies of precession of probe nuclei that are proportional to the internal fields and are characteristic of the probe's lattice location. This technique has been used in the past at WSU to study point defects in solids, site preferences of impurities in compounds, and jump frequencies of PAC tracer atoms in solids. In this talk, I will first describe the physics of PAC spectroscopy. Then I will discuss my current goal of measuring solute-solute interactions in intermetallic compounds, including data from measurements that we have attempted thus far. Finally, I will share recent measurements of solute-solute interactions in metals, which I hope to use as a starting point for further measurements in intermetallics.

Magnetic excitation and identification of flexural modes of a circular plate

Timothy Daniel[1]

A spatially localized, oscillating, magnetic field was used to induce resonant vibrations in an aluminum circular plate without direct mechanical contact. Experiments were done with the plate in air, at a free surface, and fully submerged in water. This allowed the effect of fluid loading on the plate's spectrum to be examined for both the fully loaded and half loaded case. Since the magnetic field is spatially localized, identification of the mode shapes is possible by scanning the source along the target and measuring the varying response of the plate. Additional experiments were done with an open-ended fluid filled copper circular cylinder in which both resonant frequencies and mode shapes were identified. Both targets responded at twice the oscillation frequency of the applied field [B. T. Hefner and P. L. Marston, J. Acoust. Soc. Am. 106, 3340-3347 (1999)]. The response corresponds to the oscillation frequency of the Maxwell stress associated with combined applied field and induced eddy-current field. Excitation of both plate and cylinder was found to be measurable with a steady state and a tone burst source. [Work supported by ONR.]

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Transduction of nanomechanical motion using luminescence from field emitting carbon nanotubes
Rudy Resch (Benjamin Aleman Lab)[2]
Normal electronic methods pose many problems when trying to measure high frequency signals on the nanoscale. One way to circumvent these issues is to use a photonic signal generated natively by a nanoscale object. Carbon nanotubes undergoing field emission have been shown to generate such a signal that is, in theory, related to their position. These nanotubes are ideal for investigating this regime as they exhibit high resonant frequencies and are naturally nanoscale objects. Coupled with their low mass and other physical and electronic properties, this system offers the potential to be an incredibly sensitive sensor for many processes at the nanoscale.

Resonantly Enhanced Sensing in a Ring Interferometer
Brian Hake (Miriam Deutsch Lab)[2]
Integration of a resonant system within a phase sensitive detection scheme can extend its sensing capabilities due to the intensity and phase behavior on resonance. While one output port is highly sensitive to nonreciprocal phenomena and robust to reciprocal fluctuations, the complementary output can be used to simultaneously monitor reciprocal drifts. This principle will be demonstrated using surface plasmon resonance as a model system.

Velocity Measurements in Plane-Wave Shock Experiments using the Velocity Interferometry System for Any Reflector
Thomas Bersano[1]
Rankine and Hugoniot developed their shockwave equations in the 1880s. Their formalism requires accurate measurement of the shockwave velocity and particle velocity in a sample material. In the 20th century experimentalists developed various ways to acquire these measurements, but it took until the 1970s to develop a robust optical system: the Velocity Interferometry System for Any Reflector (VISAR). At its core, the VISAR is a Wide Angle Michelson Interferometer (WAMI). The VISAR has additional polarized beams to reduce its sensitivity to the intensity variations of the input signal. These polarizers also eliminate the phase uncertainty observed in WAMI systems. The VISAR can be adjusted to have a time resolution on the order of picoseconds and is now an indispensable diagnostic system for shockwave research.

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Quantum graphs as molecular stick figures for nonlinear optics

Sean Mossman[1]

Quantum graphs are pseudo-1D mathematical structures, which allow for the investigation of the fundamental character of geometry and topology of quantum mechanical systems. Here we show how one can make a naïve model of charge transfer along an organic molecule and show what structure characteristics are the best for nonlinear optical responses.

The generation and verification of two-photon Fock states with spatially multiplexed detectors

Roger Smith (Mike Raymer Lab)[2]

I will discuss current experiments in our lab involving the creation of multi-photon Fock states via spontaneous four-wave mixing and proper characterization of quantum states of light using thresholding detectors with non-unity efficiencies.

Grand Unification using Density Matrices

Carl Brannen[1]

The mainstream approach to grand unification has been through quantum field theory. In this talk we propose that density matrices may also be used for grand unification and that they have some advantages over quantum field theory. While quantum field theory is suitable for situations where the particle count changes, if our interest is in the unification of the elementary fermions, we can analyze their propagators and the propagators involve single particles only.

Density matrices are members of an algebra; that is, they include a natural multiplication as well as addition. Therefore instead of modeling a GUT as a set of spinors with a symmetry relation, we can model the GUT as a choice of quantum algebra. Since density matrices conveniently model temperature, we can use temperature scaling to define the infrared fixed points by that scaling. The quantum algebra then defines the observed particles, their symmetry and their representations. This invites an attempt to understand the Standard Model by looking for quantum algebras that give its particle content.

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Phase Transition in Two-Dimensional Semiconductor In_2Se_3 for Phase Change Memory Applications

Xin Tao[1]

We report, for the first time, the fabrication of single-crystal In_2Se_3 thin layers and the studies of crystalline-crystalline ($\alpha \rightarrow \beta$) phase transformations, as well as the corresponding changes of the electrical properties in these thin layers. Particularly, using electron microscopy and correlative *in situ* micro-Raman and electrical measurements, we show that, in contrast to bulk single crystals, the β phase can persist in single-crystal thin layers at room temperature (RT). Specifically, the β phase has an electrical resistivity about 1-2 orders of magnitude lower than the α phase. Furthermore, we find that the temperature of the $\alpha \rightarrow \beta$ phase transformation increases by as much as 130 K with the layer thickness decreasing from ~ 87 nm to ~ 4 nm. For these In_2Se_3 thin layers, the accessibility of the β phase at RT, with more distinct electrical properties than the α phase, provides the basis for multi-level phase-change memories in a single material system.

Plasmonic Light Trapping for Organic Photovoltaics

Andrea Goering (Miriam Deutsch Lab)[2]

Light trapping in thin organic photovoltaic films can boost efficiency while reducing material inputs, increasing throughput, and, in some cases, improving stability. Nanoplasmonic approaches to light trapping take advantage of the strong near-fields at the interfaces between metals and dielectrics, using geometric and material parameters to tune spectral, angular, and polarization responses. Additionally, nanoporous metallic architectures can be used to replace indium tin oxide (ITO) as a transparent conducting electrode. I explore a solution-processable, disordered plasmonic material system for its application to several nanoplasmonic strategies.

Single Atom Dynamics in an Optical Molasses

Wes Erickson (Dan Steck Lab)[2]

Our lab uses a specialized magneto-optical trap to trap single atoms in order to probe general aspects of dynamic quantum systems. This talk is an overview of the generalized central limit theorem and how it applies to the non-Gaussian diffusive properties of a single atom wandering in an optical lattice.

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