

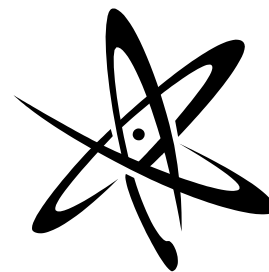
University of Washington • Department of Physics

PHYSICS COLLOQUIUM

Raymond Chiao (UC Merced)

“Experiments at the interface of quantum mechanics and general relativity: The interaction of gravitational waves with coherent quantum matter”

Seminars



Nov 3rd-7th

Monday, November 3rd, 2008

4:00 PM, Ronald Geballe Auditorium, Rm. A-102

Abstract: The interaction of charged, macroscopically coherent quantum systems, such as a pair of charged superconducting spheres, with both electromagnetic (EM) and gravitational (GR) waves, will be considered. When the charge-to-mass ratio of a pair of identical superconducting spheres is adjusted so as to satisfy the "criticality" condition $Q/M = (4\pi\epsilon_0 G)^{1/2}$ where ϵ_0 is the permittivity of free space, and G is

Newton's gravitational constant, the gravitational force of attraction will be balanced against the electrostatic force of repulsion between the two spheres. At criticality, when these two spheres in a given pair of charged superconducting spheres undergo simple harmonic motion relative to each other, they will radiate equal amounts of quadrupolar GR and EM radiations.

The superconducting spheres possess an energy gap (the BCS gap) separating the ground state from all excited states. The quantum adiabatic theorem then implies that the quantum phase everywhere inside the superconductors, in their linear response to both kinds of weak incident electromagnetic and gravitational radiation fields, whose frequencies are less than the BCS gap frequency, such as at microwave frequencies, will remain single-valued at all positions and times. This linear response of these coherent quantum systems leads to hard-wall boundary conditions at the surfaces of the spheres, in which both the incident EM and GR radiation fields will undergo specular reflections at the surface of these superconducting spheres. Therefore the scattering cross-sections for both kinds of radiation fields will be on the order of $\sigma = \pi a^2$, where a is the radius of the spheres, when the radius a is comparable to, or larger than, the microwave wavelength. The distance separating the two spheres in a given pair of spheres will also be assumed to be comparable, or larger than, the microwave wavelength. Under these circumstances, the scattering cross-sections of pairs of charged superconducting spheres for both EM and GR radiations at microwave frequencies will be nonnegligible.

At sufficiently low temperatures with respect to the BCS gap, all dissipative degrees of freedom of the spheres will be frozen out by the Boltzmann factor. Then at criticality, by time-reversal symmetry there will be an equipartition of both kinds of incident radiation, so that the scattering cross-section is the same for the time-reverse process as for the time-forward process. This implies that a Hertz-like experiment, i.e., a transmitter-receiver experiment, in which GR waves are generated at the emitter or transmitter by incident microwaves incident on two charged superconducting spheres at criticality, and detected at the receiver or detector by another two charged superconducting spheres at criticality, should be experimentally feasible to perform.

Tuesday, November 4th, 2008

Particle Theory Seminar

2:30 PM, Rm. C-421, PAT

Piotr Surowka, Jagiellonian University

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Tuesday, November 4th, 2008

Astrobiology Seminar

2:30 PM, Rm. A-118, PAA

Joshua L. Banfield, UW Earth & Space Sciences

“A complex compositional and aqueous history of Mars”

Nuclear Theory Seminar

4:00 PM, Rm. C-520, PAT

Peter Sauer, Leibniz University Hannover

“Few-Nucleon Reactions: The Inclusion of Coulomb and the Effect of Many-Nucleon Forces.”

Condensed Matter & Atomic Seminar

4:00 PM, Rm. C-421, PAT

David Jones, University of British Columbia

“The continuing evolution of femtosecond frequency combs (abs) “

Thursday, November 6th, 2008

Final Exam

1:30 PM, Rm. 178 (Conference Room), CENPA

Sky Kilo Lani Sjue, UW Physics

“The Electron-Capture Branch of ^{100}Tc and Neutrino Physics”

Astronomy Colloquium

4:00 PM, Rm. A-102, PAA

Gibor Basri, University of California, Berkeley

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