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Biocomplexity Faculty Search Committee  
c/o Prof. Rob de Ruyter van Steveninck  
Biocomplexity Institute  
Indiana University  
Swain Hall West 117  
Bloomington, IN 47405-7105

Dear Professor de Ruyter van Steveninck,

I would like to take this opportunity to recommend **Andy Lau** for an assistant professorship in theoretical condensed matter\biophysics. Andy completed his doctorate with our group at UCSB. He is a marvelous self-starter who already has a substantial array of accomplishments. I believe him to be an exceptional candidate.

Andy is well trained in theoretical condensed matter physics. He is smart, works hard, and is enthusiastic. His research in Santa Barbara focused on several areas related to charged membranes. His first problem was to investigate the renormalization of the area/surfactant, i.e. the membrane structure, when an oppositely charged object adsorbs onto a charged membrane. He showed that large, of order of 100%, changes might be expected. He carried out this study using the mean field Boltzmann-Poisson equation very quickly with minimal assistance from me. This convinced me that he had the ability to do theory.

Lau then moved on to the more challenging problem of considering amphiphilic fluid membranes with mobile charges. In particular, at the Debye-Hückel level, he showed that the charge fluctuations lead to a

spontaneous bending of the membrane signaled by the addition of a non-analytic (logarithmic) term in the Helfrich Hamiltonian. This may well provide a possible underlying physical mechanism for the spontaneous vesicle formation found in amphiphilic bilayers by the Kaler and Zasadzinski groups several years ago. At low temperatures, the charge density fluctuations may freeze into a two-dimensional Wigner crystal as first discussed by Rouzina and Bloomfield in the context of DNA condensation. They discussed the attractive forces between two "2D Wigner crystals" in terms of the classical short-range electrostatic force. Andy showed that quantum zero point fluctuations add a long-range power law attraction analogous to but different than the Casimir effect with a modified exponent associated with the unusual 2d plasmon dispersion relation. While the prefactor of this power law is weak, it overwhelms the short-range classical interaction at distances of the order of the Wigner crystalline lattice parameter. Andy then explored the temperature induced decoupling of two parallel phase locked Wigner membranes. This involves understanding and applying the Halperin-Fisher work on defect induced melting of 2d Wigner crystals.

In his last research before completing his thesis, Andy used an extremely clever variational ansatz coupled to a one-loop fluctuation calculation to predict a first order condensation transition for counterions at a charged surface as a function of a control parameter such as temperature, counterion valence, etc. This is a novel result that provides the strong charge regulation required for the Rouzina-Bloomfield mechanism for DNA condensation.

After leaving Santa Barbara, Lau spent a year with de Gennes' group at the College de France where he worked on spreading of latex particles. Then he moved on to a post-doc at Penn where he has been collaborating with Tom Lubensky and Randy Kamien on a variety of problems including microrheology, nematic networks, and continuing some work on electrostatics. More recently, Andy has been exploring dynamical systems associated with biological energy input in the context phosphate hydrolysis. I believe that you will receive a more detailed analysis of his work at Penn.

Lau was an exceptional graduate student. He is bright, diligent, works efficiently, and understands a lot of physics. He interacts well both with other theorists and experimentalists; has a pleasant outgoing personality. Andy has developed a broad experience in both soft and hard condensed matter. He is clearly in a highly productive mode. His research has

significant impact on several areas of current research activity in soft condensed matter physics/biophysics. Andy is likely to develop into a world-class physicist who will have major impact. He is ready to start a group of his own. I give him my strongest support.

Sincerely yours,

Philip Pincus

A handwritten signature in black ink, appearing to be 'PP' or similar initials, written in a cursive style.