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

Dear Prof.de Ruyter van Steveninck:

This is a very positive letter of recommendation for Shengli Zou, who has applied for a faculty position in your department.

Shengli has been a postdoc in my group for little more than 1.5 years, and in this time he has accomplished a huge amount, with 10 papers published or submitted and several others in the works. In addition, Shengli's efforts have led to his receiving an award from our nanoscience center, and being named DuPont Postdoctoral Fellow. Thus his brilliance has been recognized by people other than me.

Shengli's accomplishments here are even more remarkable when one realizes that Shengli worked in a completely different field as a graduate student. This performance confirms what I suspected from his work with Joel Bowman, which is that Shengli is extraordinarily talented and productive.

Shengli's work here has primarily focused upon nanomaterials, and in particular the optical properties of metal nanoparticles (gold, silver) that are in a variety of complex environments. Such particles have found exciting applications in the last few years in chemical and biological sensor applications. He started out with a study of the extinction spectra of nanoparticle arrays, where he quickly solved a problem concerned with the long range coupling between particles that settled an important question in the interpretation of some recent experiments in Van Duyne's group. Then he did two studies in collaboration with Van Duyne concerning the spectra of particles that are coated with as much as 25 layers of self assembled alkane thiols. The Van Duyne group had been sitting on some data for nearly a year as there were some trends in the results that were both surprising and counterintuitive. To tackle this problem, Shengli wrote a unique program that enables direct simulation of the experiment. The gratifying outcome of these studies was that Shengli solved the problem, showing that local hot spots around the particle surfaces control the short range effect of the layer dielectric constant on extinction spectra, while the long range effect is determined by the average effect of plasmon excitation on the dynamic electric fields around the particles. This work has since led to an additional paper (joint with Van Duyne) that is concerned with nonspecific binding effects on the interactions of proteins with SAM-coated silver particles, and another project is mostly done concerning the interaction of dye molecules with silver particles.

Shengli's most original project has been concerned with the optical properties of nanoparticle arrays. Although my group had already studied related problems earlier, Shengli found a new direction of research in this field, and quickly he produced an important result, demonstrating that localized plasmon modes can couple with delocalized photonic modes to produce extremely narrow collective resonances for particles that are spaced by close to the plasmon wavelength. These are probably the narrowest lines we've ever seen in calculations, and we are currently working with the Van Duyne group to see how these might be used in optical sensing applications. Shengli has also been active in methods development, having discovered a new way to combine multipole fields around particles in an array to give a fast approximate solution to light interacting with more than 10,000 particles. We hope to use this soon to study collective excitation effects in particle arrays.

Shengli also got involved in two optics projects that do not involve metal nanoparticles. One of these is concerned with whispering gallery mode resonances in glass spheres, and how these can be used for sensing applications. The other involves the use of electrodynamics methods to determine the index of refraction function that corrects aberration in spherical (and other) lenses. In both projects Shengli has developed software for light scattering calculations with unusual capabilities, including a version of Mie theory that works for 1 cm size particles. Several people have told me that they thought this version of Mie theory was impossible, but Shengli proved them wrong.

Shengli has not been happy with just doing these projects, so recently he has gotten involved in modeling molecular self-assembly processes using new molecular dynamics codes that he has developed. In this code he developed a new approach for "smoothing" a molecular dynamics potential so that global minima can be found without getting stuck in local minima. In addition, he wrote the code for parallel execution using the MPI protocol.

Shengli has advised two summer REU students each summer he has been here. He did a terrific job on this, and these students had productive experiences that have led or will eventually lead to papers. From this I've learned that Shengli has the people skills needed for a teaching position.

Overall I would rate Shengli is the best faculty candidate among the 15 postdocs that I am working with currently in my group or Ratner's. He has quickly risen to the top of my group in research productivity and creativity. He has a very matter-of-fact personality, but is in fact always thinking things through and is usually well ahead of me on projects. His English is not perfect, but his spoken English is quite easy to understand.

Sincerely,

George C. Schatz