

**January 14, 2004**

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 Sir/Madam,

It is my great pleasure to write a letter of recommendation for Dr. **Ha Youn Lee**, who is seeking a faculty position at Indiana University. For your information, I was Ha Youn Lee's Ph.D. thesis advisor.

Ha Youn joined our statistical physics graduate program in 1993 after finishing her undergraduate study in Physics Education with Magna Cum Laude and I was very very happy during the period to have such an intelligent and strongly motivated and able student.

During her graduate program, Ha Youn worked on various subjects in statistical physics, such as surface growth and sputtering models, evolution dynamics of interacting species, population dynamics and most importantly, the traffic flow.

Her Master's thesis (with Prof. Moo Young Choi) was on  $1/f$ -noise features in a traffic flow model. After she started her Ph.D. program, I agreed to supervise her since her husband was also doing Ph.D. with Prof. Choi and we thought it is better for them to have diversity. In the early stages of her Ph.D., Ha Youn worked on several subjects broadly termed as "complex systems". Then, in the later stage, she concentrated on the traffic flow research collaborating with Dr. Hyun-Woo Lee, a postdoc in mesoscopic theory.

We have 3 major papers in this field. The first one (PRL 81, 1130) makes it clear that the synchronized flow Boris Kerner found is not due to inter-lane interactions as the name suggests, but is due to the external perturbation from on-ramps, thereby emphasizing the important role of inhomogeneities and Hopf bifurcation. Also, we proposed that a new traffic state, the Recurring Hump state, is what Kerner is seeing in his data. In the second (PRE 59,5102), the concept of phase diagram is successfully

applied to the traffic states using a model equation and various states are characterized. Also importance of the concept of the metastability is expounded. These two papers are reviewed by Helbing and Treiber in Science (v282, 3042) and by Chowdhury et al in Physics Reports (v329, 199) and are cited frequently. The third one (PRE 62, 4737) is an experimental paper. Ha Youn actively sought an access to real traffic data and succeeded in opening a channel with engineers. So, she was able to obtain a set of data that can display clear spatio-temporal structures. The data are used to characterize various traffic states for a highway with one effective on-ramp and the phase diagram is obtained empirically. This is the first time, we believe, where actual traffic data are used to test applicability of physical concept of phase diagram to traffic flow. Some of the features of the traffic states Ha Youn found here are not reproduced by present theories, providing future challenges. These works have been presented in several workshops and conferences either by Ha Youn herself or by collaborators.

In all of these works, Ha Youn played the most active role and thus is the first author in these papers. In a way, my interest in traffic flow theory started due to Ha Youn's initiative. She is also actively involved with Professor Schreckenberg's group in Duisberg due to her short visit to Germany under a Korea-Germany bi-national student fellowship. That is how she published a JPA paper with Prof. Schreckenberg who is the leading researcher in the field of cellular automata traffic theory and its practical implementations.

Before she got into these activities, she worked on two biologically motivated problems. The first one is on a population dynamics model where she studied the relation between mutation and polymorphism. Her model could reproduce several features found in real data. To undertake this project, she took a graduate course in genetics. Moreover, she formulated and successfully finished the project almost by herself. My role was just to provide occasional comments and constructive criticism. This is summarized in a PRE paper (PRE 57, 4842, 1998). Also, in collaboration with Prof. Choi, she worked on a biological evolution model utilizing the concept of entropic sampling algorithm developed by Jooyoung Lee and others working in Monte Carlo Methods of statistical mechanical systems (JPA 30, L749, 1987). In these projects, Ha Youn's expertise in computational methods and programming was essential: she is good at computational skills too.

I may not be in a position to tell you about her recent research on biological physics with Profs. Mehran Kardar, David Stroud and Michael Deem, but as can be seen from her CV, Ha Youn has transformed to a very promising biological physicist. Considering her intelligence and strong motivation for research, it is no surprise that she is showing strong record as a versatile and mature theoretical physicist. With such broad research experiences, I have no doubt that she will continue to be productive in any area of research, especially in the theoretical biological physics, and will make important contributions in whatever subjects she chooses to indulge. Also, I should add that she is mature, easy to work with and will be a welcome addition in any community.

In summary, I strongly recommend Dr. Ha Youn Lee to you without hesitation. If you have any further questions, please do contact me.

Sincerely yours,

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Professor and Head

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