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Boston University
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111 Cummington Street
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April 22, 2012

Dr. David Sheinberg,
Search Committee Chair,
Department of Neuroscience,
Brown University Providence, RI

Dear Dr Sheinberg,

It's a pleasure to write on behalf of Stephanie Jones, who is being considered for an Assistant Professor position in Computational Neuroscience. Your ad states that you are looking to hire one who addresses fundamental issues of neural information processing; can yield insight into neurologic or psychiatric disorders; can bridge areas of research within the community; and work collaboratively with clinicians, mathematicians, and neuroscientists. I believe that Steph is an ideal candidate in all of these domains: She is deeply immersed in fundamental questions of sensory information processing, her work has direct clinical application, and she is remarkably entrepeneurial and highly successful as a collaborator. Further, she is a leader in a key area—using advanced computational models to gain a detailed understanding of macroscopic electrophysiological signals recorded in humans. Such signals are critical to understanding human information processing, and her approach provides a unique opportunity to link this activity back to details of circuit dynamics.

I was Steph's PhD advisor in the Mathematics Dept. at Boston University. Steph was a highly productive graduate student, publishing 4 papers with me from her thesis. Her research at the time entailed developing small neural network models and using geometric singular perturbation theory analysis to study various properties of rhythms in these models. Among her studies was an investigation of rhythmic activity in the central pattern generating motor networks of the crayfish swimmeret system. Steph worked closely with experimental physiologist Brian Mulloney at UCSD Davis and discovered that neighboring motor segments could maintain stable phase lags despite changes in swimming speeds due to the dynamical structure of the local oscillators combined with differences in coupling strength between neighboring ganglia (Jones, Mulloney et al. 2003 *J. Neurosci*., Jones and Kopell 2006 *J. Math Biology*); the modeling guided the experiments of Mulloney, which validated the models. In addition, Steph studied synchronization properties in simplified models of cortical networks. She found that alpha (7-14Hz) frequency rhythms in cortex were dependent on specific intrinsic cellular mechanisms and driving inputs and that these mechanisms could control the ability of the network to synchronize across space (Jones et al. 2000, *J. Computational Neurosci.).* Working closely with a postdoc in my lab at that time David Pinto (Dave worked jointly Barry Connors at Brown), Steph studied how cortical networks could transition among frequencies (alpha-beta-gamma transitions) via changes in parameters mimicking attention and acetylcholine, and how these changes specifically altered synchronization properties in the network (Pinto, Jones, et al.. 2003, *J. Computational Neurosci.).* This work gave her an excellent preparation for her later work, and the deep intuition about dynamical systems that is needed to model complex neurological phenomena.

When Steph graduated, she decided to shift closer to experimental neuroscience and moved to the excellent environment of the Martinos Center for Biomedical Imaging. While no longer Stephanie's mentor, I stayed in close contact with her and was a consultant on her NIH K25 award (which she received in her first round of submission), in which she was trained in the methods of MEG/EEG and multi-modal neural imaging. She took on the challenging problem of developing a detailed biophysical model of cortical circuitry while running and analyzing her own MEG/EEG experiments, and succeeded extremely well. <u>She has now become the leader of those using biophysically principled models to bridge the gap between non-invasive measures of human electrophysiology and the underlying neural dynamics</u>. In her groundbreaking work with Chris Moore, she has also been been modeling the effects of optogenetic manipulations of networks to tease out the roles of different type of interinterneurons in the dynamics of the networks.

Steph's recent research on sensory cortex has led to novel and highly creative predictions on the thalamocortical origin of mu-rhythms (~ 10 and 20 Hz), a set of important motor-related patterns that are not well understood. These predictions depended explicitly on her detailed computational modeling work combined with her training and expertise in MEG physics; with this knowledge she was able to accurately reproduce MEG current dipole signals with simulated intracellular current flow pyramidal neurons. She also made insightful predictions on the origin of changes in the MEG signals with tactile detection, attention and healthy aging. She is now applying her ideas to the development of pathological beta frequency oscillations in Parkinson's disease (PD), testing the thesis that this rhyhtm is thalamocortically based. For this work, in collaboration with Chris Moore, she won a NSF Collaborative Research in Computational Neuroscience grant, an award that is extremely competitive. She is also collaborating with Wael Assad of Brown medical School on related ideas applied to deep brain stimulation, now a standard (but not understood protocol) for treating PD. Her expertise and interest in PD makes her a natural collaborator for the groups at Brown working on issues of motor control.

Steph's current work includes a multitude of other neuroscience topics. One is a paper recently published on neural rhythms and attention. She and collaborators hypothesize that neural rhythms help to facilitate communication among parts of the brain, a theme I believe is critically important. She is finding ways to test and explore this hypothesis, via experiments and modeling. She has collaborations with Cathy Kerr on mindfulness and attentional modulation, and interactions with others at Brown, including Michael Frank and Jerome Sanes. She has an ongoing collaboration with Ellen Grant and Yoshio Okada of Children's Hospital, focusing on computational modeling and imaging to study neuropathologies in children; she and collaborators have submitted a grant proposal for this work. She also is doing the extremely important work of developing methodology to bridge modeling scales, including a more detailed understanding of what an LFP really measure. Another aspect of such development concerns the marriage of detailed biophysical models and probabilistic models; I have long felt that joining the techniques and concepts of these two ways of thinking is critical, but very few people are attempting this.
The success of Steph's independent research program is evident in her many recent publications and her success in obtaining funding, as well as the large number of colalborators she has attracted.

I believe that Steph will be an excellent teacher at Brown. She won a a Albert A Bennet teaching award from Boston College, for excellence in mathematics teaching at BC . At BU, she served as a graduate teaching fellow in Differential Equations courses and received excellent reviews. She also worked as a textbook production assistant, creating problems and solutions for development of a differential equations textbook by Devaney, Blanchard. She successfully taught a semester of Multivariate Calculus to undergraduate and graduate students, as part-time faculty instructor at Boston College. She was involved in several high school outreach programs with Bob Devenay during her time at BU, including Mathematics

Field Days, in which she twice lectured successfully to large groups of high school students and teachers. She also ran a mathematics workshop every year for high school age girls who visited BU labs to learn about opportunities in the sciences through a program called “Pathways Days for Young Women.” Recently, she was an invited speaker at a mini-symposium on brain rhythms and cognition, and gave a spectacular talk.

Finally, Steph continues to be a leader. About 4 years ago, I started the Cognitive Rhythms Collaborative, a group of about 2 dozen labs in the greater Boston areas interested in mechanism and functions of brain dynamics. Steph has been a key player and executive committee member (one of 6). She was an important contributer to the proposal to NSF that now supports the CRC, and continues to be a force in the running of the CRC.

Steph has an excellent background in dynamical systems, and a track record in using this background in innovative and scientifically important ways. Her training at the Martinos Center has provided her with new tools and involvement with cutting edge scientific questions. She has clearly established herself as an independent faculty level researcher who is ready for an Assistant Professor position. For the position now open at Brown for a computational neurscientist, I can’t think of a more qualified person, nor anyone more likely to take advantage of, and add to, the currently rich environment at Brown.

Sincerely,

Nancy Kopell
William Fairfield Warren Distinguished Professor
Boston University