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To whom it may concern,

This letter is in support of Dr. Jan Karbowski who is applying for a position. Karbowski previously was a Research Assistant Professor in the Department of Mathematics where he both taught and conducted research with me. I have known him for about seven years having first met him at a Gordon Conference on Theoretical Biology. After spending two years as a Postdoctoral Fellow with Nancy Kopell, he began working with me at Pitt. First let me say that Karbowski is a very smart guy and has a first rate intellect. He has the broad knowledge that comes with a background in theoretical physics. He is fluent in stochastic differential equations, statistical physics methods, and programming (necessary for checking theoretical results valid only in some limit). His current interests are in theoretical neuroscience where he has done some nice work on a variety of problems. He worked with Nancy Kopell on generalizations of a problem that she and I had studied which concerned the ability of neurons to synchronize in the presence of delays. Kopell and I looked at a pair of networks. Karbowski considered an arbitrary system with sparse coupling. To do this, he introduced a novel form of the integrate-and-fire model which has properties which are much more like those of realistically modeled neurons. The model:

$$\tau \frac{dV}{dt} = I + |V|$$

a is a simplification of the "quadratic integrate and fire model" which is derived directly from biophysical neurons in certain limits. He is now using this model to study the role of gap junctions in synchronizing heterogeneous populations of neurons which also have synaptic inhibition. In his work with Kopell, he showed that inhibitory doublets and triplets both helped to enhance synchrony in these networks.

We have written two papers together. In our first paper (on which Karbowski did most of the work, including the writing), we looked at the effects of spike time plasticity on the ability of neurons to synchronize in a large randomly coupled network. Specifically, we looked at a network of simple phase models with random intrinsic frequencies. With fixed coupling strengths, the network may phase-lock but it fails to synchronize. We introduced plastic coupling strengths which evolve according to the relative spike times of the pre- and post-synaptic phases of the oscillators. We showed that under fairly general conditions, the weights will stably approach a steady state in which the oscillators are synchronized.

Our second paper concerned the formation of distinct cortical regions using molecular markers and gradients of competing chemicals. Our goal was to explain some recent experimental results of Grove and others. We were able to explain, not only her work, but several other results and made some non-obvious predictions about the kinds of double maps that are possible when new sources are available.

In addition to our joint work, Karbowski has also worked on questions about the optimal wiring in cortex. He uses scaling arguments to show that there is a tradeoff between minimizing axon length and minimizing the cost of information transfer. This work was published in Physical Review Letters

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and he also extended it to include more cortical anatomy.

I have not had too many opportunities to hear Karbowski give a lecture or teach his class. He gave a series of lectures on information theory which were very clear and well-organized. He taught calculus here at Pitt for several terms and his students seemed to do well on the departmental final exam. He gave one of the departments first courses in Stochastic Differential Equations which he developed himself. There was a great deal of interest in it.

I think Karbowski is very motivated to pursue neuroscience as a career – he spent a month of dorm life at the Marine Biological Lab in order to learn more. He picks up new ideas and methods very quickly; he presented a clever analysis of the effects of synaptic modification on Fisher information as his project in the MBL course.

As for his personality and ability to work with others, I have had no problems working with him. He is somewhat aloof but that may be more out of shyness than any intrinsic arrogance. He is a generally personable guy once you get to know him. He is smart, independent and has at his command a large variety of computational and theoretical tools. I recommend him with enthusiasm.

Sincerely,



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