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Prof. James A. Glazier
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Dear James,

I am writing in support of Prof. Greg Huber for a professorship in your department. Over the many years I have know Greg it has been my good fortune to be a mentor and colleague of his in the areas of nonlinear dynamics, pattern formation, and biological physics. From 1997-2000 Greg was a postdoc in my group at the University of Arizona, and we have continued to work together since.

Greg is definitely not an orthodox physicist, both in taste and technique. His output varies from flashes of brilliance to periods of quiet. He is not a person destined simply to churn out paper after paper exploiting some technique that he latches on to early in his career, and he will definitely not follow the crowd or dictates of some aging luminaries. He is perhaps one of the most original thinkers I have ever met, and in the right environment he will do awesome work.

While Greg spent much of his postdoc time here working on two problems in biological physics, he also worked quite closely with Douglas Hofstadter on some purely number-theoretic problems related to Fibonacci sequences. Such is the breadth of Greg's interests and strengths that he can with incredible ease deal with such diverse research topics as these.

The primary focus of his work with me was the unorthodox elasticity of bacterial flagella. Recent studies have revealed the details of two competing crystal structures assumed by flagellin, the protein building block of flagella, corresponding to helices of opposite chirality. Both local and distributed torques can change the conformation of flagella; during swimming these motors episodically reverse direction, and the resultant torques can induce transformations between these states, while uniform flow past a pinned flagellum may also induce such chirality inversions. To begin to understand these phenomena, we, together with my graduate student Charles Wolgemuth and Prof. Alain Goriely from the Applied Math department, proposed a generalization of ordinary linear elasticity theory able to describe "bistable helices," objects which can display helicity of two competing signs. Primarily under Greg's guidance, we established the general form of the coupled dynamics of twist and bend degrees of freedom for an arbitrary twist energy functional and were able to make again some very nice arguments for the velocity of twist "fronts" between bistable states, in nice agreement with experimental measurements. Greg (in his usual insightful way), came up with a wonderful geometric argument for what we now term "Hotani's rule," a relationship between the angle formed by coexisting, concatenated helices of opposite hand and the curvature and torsion of the individual segments. This has laid the foundation for a wide range of investigations and has directly motivated a number of experiments we are undertaking in the lab.

A secondary focus of his work was the deformations of vesicles under point forcing. This has arisen in various experiments by Fygenson and collaborators, who have polymerized microtubules inside lipid vesicles and studied the sequences of shapes as a function of microtubule length. Greg and my other (now former) postdoc Tom Powers undertook a series of calculations which examined the interplay of membrane bending elasticity, induced tension, and geometric constraints to unravel the relationship between "poking" force and vesicle shape. Greg saw in this problem a wealth of interesting physics, well before others.

Greg's more recent work in biological physics, in collaboration with Berg's group at Harvard and the Brown group is really very interesting. It addresses the nature of passive scalar advection near and by "bacterial carpets," surfaces to which a layer of bacteria are attached whose flagellar motion stirs the fluid. As a dynamical system it is extremely interesting, but it also has practical (microfluidic) applications and touches on the collective hydrodynamics of bacterial suspensions that a number of groups (my own included) are now studying. And of course Greg continues his fascinating forays into more mathematical subjects.

Greg's postdoctoral position here at the University of Arizona involved teaching one course per year, and he did a fantastic job. I have rarely seen a physics teacher bring such unique historical perspectives, clever mathematical insights, and hands-on demonstrations as Greg brought to his various classes. One example will suffice to illustrate my point. During one of his classes the issue of nonuniform convergence of a series arose. By a very long and laborious search, Greg discovered a fascinating series of letters in Nature between various luminaries of the previous century on what we now call Gibbs phenomena in series (e.g. the oscillations near the origin in a finite Fourier series approximation of a step function). He copied the whole set for the class and used it to illustrate a number of key aspects of the scientific method (precision in meaning, free and open discussion of controversy), as well as the particular mathematical points. As a member of my group and of the physics department as a whole Greg was tireless as a sounding board for undergraduate and graduate students, postdocs, and other faculty. He was very influential in training two of my graduate students, and remarkably good at attracting a whole spectrum of interesting visitors to the department. Although I have not visited him at UMass, I am confident he has played the same role there. Thus, besides the obvious scientific qualities he would bring to a position in your department, he will also energize the place with his infectious enthusiasm.

With very best wishes,

Ray

Raymond E. Goldstein
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and Applied Mathematics
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