

Raphael Blumenfeld

Polymers and Colloids

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Professor J. G. Eggers
Department of Mathematics
University of Bristol
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Dear Professor Eggers,

Re: Lectureship in Applied Mathematics, ref. 9789

This letter accompanies my application for the Lectureship position in Applied Mathematics. I am a theoretical physicist working on soft condensed matter and statistical physics. In the past few years I have been working on fundamental understanding of stress transmission and yield of granular media and cellular systems. Together with Professor Robin C. Ball from Warwick University I have recently derived a first-principles theory for the stress equations in two dimensional isostatic systems, a theory that I believe I can extend to three dimensions. More recently I have shown that the theory can be coarse-grained to macroscopic scales and that it explains the frequently observed force chains. I am currently working with Prof. Bob P. Behringer from Duke University in North Carolina on an experimental test of the theory and its prediction concerning the trajectories of the force chains. I have also carried out an experiment, together with Professors Robin C. Ball and Sir Sam F. Edwards, which revealed the important role that the isostatic stress transmission plays in the understanding of most granular systems both statically and dynamically. In an ongoing collaboration with Professor Sir Sam F. Edwards I am working on the application of a statistical mechanical formalism to vibrated granular packings. I have managed to show last year that most of these results have direct applications to cellular solids. Most significantly, I have shown that conventional elasticity is redundant in the latter and that the new theory has the potential to resolve several long-standing problems in the field of solid foams, including arching effects and structure-property relations in irregular foams. I have written recently a couple of proposals that aim to exploit these developments. I expect that this work could fit in nicely with the activity in the department. Prior to this line of research I have done theoretical work on disordered magnetic and polymeric

systems, making several contributions on transport properties of strongly non-linear and disordered materials, dynamics of line curves in three-dimensions and relations between such dynamics and emergence of stripes in magnetic systems, and the behaviour of long molecules when pulled by an atomic force microscope.

I have been fortunate to work in good groups: Cavendish Laboratory, Princeton University and Los Alamos National Laboratory, which left me with a useful network of good collaborators from engineering, chemistry and biology. I enjoy working both individually and in collaboration and I have done quite a bit of both. I regard collaborative multidisciplinary work exciting and find that this mode of operations is well suited to my broad range of interests. I have been prolific in my publications, as evidenced by the ISI Science Citation Index which on a recent check has registered 850 citations, and I have a good number of papers that are in a draft form simply because of lack of time.

I held two non-academic positions since my PhD: One of a research scientist in Cambridge Hydrodynamics Inc, an R&D company for fluid codes based in Princeton NJ and led by Professor Steve A. Orszag, who was at Princeton University at the time. The other position was of a project leader with Molecular Simulations Inc (now called Accelrys) in Cambridge UK, where my duties consisted of building a group of mesoscale simulations of polymeric systems and leading the development of software such as Mesodyn and Dissipative Particle Dynamics (DPD). Both these projects brought in revenues in excess of several million US Dollars.

I believe that my teaching skills benefit from my broad background. I have done some frontal teaching (problem solving classes and a course on percolation theory) and for several years I have been supervising part I-III students in a variety of subjects, including dynamic systems, mathematical concepts, structure and properties of condensed matter, and statistical mechanics. In Los Alamos I supervised a summer student, who later went on to become a postdoc and then staff member there. I acted as a viva examiner to students from physics and chemistry and was a specialist subject reviewer in the Teaching Assessment Exercise carried out by the Quality Assurance Agency.

I regard your department very highly and would be delighted if I were to be offered this post. Enclosed please find my curriculum vitae, publication list and the coordinates of three referees.

Yours Sincerely,

Raphael Blumenfeld