Biocomplexity Faculty Search,
c/o Theresa Dawson,
Department of Physics,
Indiana University
bioc@indiana.edu

COPY of Letter, November 26 2004

RE: DR. ALEXEI BOULBITCH

Dear Search Committee,

I am writing to support the application by **Dr. Alexei Boulbitch** for appointment to a Faculty Position. I am a colleague of Dr. Boulbitch, I have known him since he joined Professor Erich Sackmann's group, and I was an external referee for his *Habilitations* Thesis.

General. Dr. Boulbitch comes from what I think of as the "Landau" school of theoretical physics: superbly trained in analytical mathematical physics, an excellent grounding in both classical and quantum physics, and an ability to draw analogues. He has had to be ingenious and entrepreneurial to advance to where he now is. He is a pleasant man with a dry sense of humour and the ability to make subtle jokes in English – an accomplishment that should not be dismissed lightly. His English, though slightly accented, is excellent and he speaks clearly and not quickly. He is a careful thinker, especially where scientific matters are concerned. He has built up his own small research group, as part of the very large Biophysics conglomerate, at the Technical University of Munich in Garching where he collaborates closely with various experimental groups. He is fully able to conceive, develop and run a research program involving undergraduates, graduate students and postdoctoral fellows. **I would expect such a program to be highly original and to operate in close collaboration with experimental groups in different disciplines**, both at your university and elsewhere.

In the last year, he has become involved with our computer simulations of a bead moving through a polymer-water system in order to understand its viscoelastic properties. One of his students is doing his Ph.D. thesis on this topic.

Dr. Boulbitch works well with people. He is quietly friendly and ambitious but not pushy. His voice and sentiments are, to my knowledge, always reasonable though he stands up firmly for what he thinks is true or right. He has inherited the sharp humor of his Russian background and the, sometimes cynical, wit of his minority group. I have never heard him disparage other people, except, possibly, certain world leaders and offensive politicians.

Research. Dr. Boulbitch has shown considerable acumen in choosing to work, most recently, in a **multidisciplinary field** that is increasing in importance: that of **biological, and particularly bacterial, surfaces and how they react to interactions with the outside world.**

Below, I shall address Dr. Boulbitch's involvement in a major initiative – funded in 2003 - the (Canadian) Advanced Food and Materials Network (AFMnet) which has created a multidisciplinary group to study bio-materials with a view to applying the results of basic research to food, social policy and other areas of economic importance.

Dr. Boulbitch's work on the mechanical properties of bacterial surfaces, will have to be taken into account by the work of this group when the mechanical properties of biofilms are studied, modelled and utilized. His work on adhesion will have ramifications for research on

bacterial adhesion. In his work he has, for example, established collaborations with biochemists and microbiologists. In what follows I give one detailed example of his contributions and briefly mention two others.

Dr. Boulbitch has shown that, in many cases, (see below for his comments on the effects of microtubules), in considering the response of a bacterial surface to a localized applied force, one may restrict ones attentions to *local* responses. He has shown that an applied mechanical force is "shielded" by the complexities of cell structure in the neighbourhood of the point of application. This *might* be thought of as analogous, though not mathematically similar, to the shielding of an electric charge by ions in an aqueous solution. This result enables one to ignore the possibilities of non-local responses "far" from the point of application and, thereby, reduces the difficulty of relating measured responses to calculated response functions. Here, "far" means distances large compared to the characteristic lengths over which coherent motion can take place. This is an important result and by no means trivially-obvious: I have been present at meetings, in Dr. Boulbitch's absence, where this result has been discussed with more feeling than mathematical rigor. He does point out, however, that, if the force is applied at a microtubule (which could possess a persistence length much greater than the characteristic coherence lengths of the surrounding cell medium) then the force could be transmitted over the greater distance.

His analyses of cell responses to localized forces applied either by tips of atomic force microscopes or via magnetic beads are all new and provide a fundamental contribution. A third area to which Dr. Boulbitch has contributed is that of complex adhesion: adhesion between membranes containing a variety of adhesion elements.

In the last couple of years, Dr. Boulbitch has entered the area of computer simulation to model and study mesoscopic systems. He, together with his student, Nikita ter-Oganessian, and I are collaborating on using dissipative particle dynamics to model paramagnetic beads being driven through dense polymer solutions in order to understand their viscoelastic properties. This work has identified three dynamical regimes, has explained the experimental work of Erich Sackmann's student, J. Uhde, and has been complemented by some fine theory on the part of Dr. Boulbitch. Three papers have been written and Dr. Boulbitch is planning future work along these lines.

Amongst the authors of his papers, Dr. Boulbitch had generally been the principal – and, in some cases, the only – theorist.

Finally, Dr. Boulbitch has been a driving force at the Technical University of Munich in stimulating experimental work on bacterial surfaces. **He interacts well – and sympathetically – with experimentalists from various disciplines** and has been quick to learn of the substantial practical difficulties in obtaining meaningful data from complex biological systems.

Dr. Boulbitch's research involvement with Canada. I am a sub-theme leader in the new Canadian Network of Centres of Excellence (announcement on November 4 2003), the Advanced Food and Materials Network, AFMnet. This major multidisciplinary operation (involving, e.g., theoretical physicists, microbiologists, food scientists, nutritionists, lawyers, ethicists and others) will have extensive interactions with researchers outside Canada. I have been responsible for putting together a core group of researchers who are able to carry out mathematical modelling and computer simulation of biological systems in complex environments. I chose Dr. Boulbitch to be the person who will provide analytical mathematical expertise to our group.

Teaching. I have heard and seen Dr. Boulbitch lecture on a number of occasions to independent researchers and to students, and I have been struck by **how well he presents the essence of relatively complicated mathematical physics to students (and faculty) who might possess only an introductory knowledge.** Some lecturers achieve this by a simplification that, at times, crosses over into the incorrect. One might be surprised how often this happens particularly when people are attempting to explain, in simplified ways, aspects of quantum theory. In Dr. Boulbitch's case, although he finds ways to simplify the mathematical physics of the phenomenon that he is explaining, his explanations have been correct. As a teacher, his quiet, low-key presentations and his dry wit, together with his amusing mouse cartoons, have been well-thought out and are effective. This should be appreciated in the context that many mathematical physicists are good teachers only of other mathematically-inclined scientists.

Dr. Boulbitch's teaching techniques were, for me, unexpected and I was so impressed that I tried to get him to visit our university for four months - in order to do research - but on the understanding that he would teach an advanced undergraduate physics course. At a predominantly undergraduate university (though the best – according to the polls – in Canada), the quality of teaching is a very sensitive issue - no department can risk the wrath of their Dean by importing lecturers from off-shore unless they are very good indeed. Both I and our Chair were confident that Dr. Boulbitch would be an excellent choice to teach our (theoretically-oriented) courses to Physics students.

In summary: **Dr. Boulbitch is a very good teacher, able to convey, correctly and in attractive ways, an understanding of complex physics.**

In conclusion **I recommend Dr. Boulbitch very highly.** If you need any more information, please do not hesitate to contact me.

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