

Department of Physics, University of Rome, “La Sapienza”
Piazzale Aldo Moro 5, 00185 Roma Italy
phone: +39 333 65 210 79 fax: +39 06 4957 697
e-mail: francesco.guerra@roma1.infn.it



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To the President of the Selecting Committee – Selezione pubblica per il reclutamento di n. 1 Professore di ruolo di seconda fascia, GSD/Settore Concorsuale 01/A4 – Settore scientifico disciplinare MAT/07, presso il Dipartimento di Scienze di Base e Applicate per l’Ingegneria - Facoltà di Ingegneria Civile e Industriale, Sapienza Università di Roma, CODE: 2023PAE006

Re: Presentation letter on behalf of the candidate **Adriano Barra**

Dear President,

With this letter it is my intention to report about my opinion on the scientific personality of **Adriano Barra**, the relevance of the results he obtained, and the contribution he can give to the host Institution. I consider a great honour to contribute in this way to the activities of the Selecting Committee.

I do not hesitate to declare that, among all young researchers, italian and foreigner, whom I have been in contact with, Adriano Barra is the one who mostly impressed me, for his scientific capabilities, and the strength of his personality.

Dr Barra earned the “Laurea” degree in Physics at the University of Rome “La Sapienza”, by defending a research Thesis with the title “Principi variazionali per i vetri di spin in campo medio” (“Variational principles for mean field spin glasses”), developed under my supervision.

Impressed by his personality, I strongly urged him to enlarge his formation by participating to a Phd Program in some outstanding international Institution. In fact, he was admitted to King’s College, University of London, where he earned the PhD in Applied Mathematics with the Thesis “Mean field spin glasses: exact results”, under the supervision of Peter Sollich and Ton Coolen.

Then he received post-doctoral positions at the Universities of Bologna and Rome “La Sapienza”, and won a grant in the national program FIRB “Futuro in Ricerca di Base” (“Future in basic research”), with a project “Meccanica statistica di reti linfocitarie sottopercolate” (“Statistical Mechanics of sub-percolated lymphocitary networks”), acting as national coordinator, and local coordinator for the “Sapienza” group. During this time he enjoyed

a position of “ricercatore a tempo determinato” (“temporary researcher”).

After the end of the FIRB program, he was appointed as researcher at the University of Salento in Lecce, and then won a competition as Associate Professor.

The research activity of Adriano Barra spans over a very large spectrum of arguments and methods, really impressive for the young age, and includes, among other things, Statistical Mechanics of Complex Systems, Spin Glasses, Immune System Networks, Neural Networks and Artificial Intelligence, Methods and Mathematical Models for Statistical Mechanics, Methods and Mathematical Models for Medicine, Economy, and Quantitative Sociology.

In all these fields he obtained results of absolute relevance at the international level. He was always the key element for the development of research.

I only mention here his formulation of “dreaming” neural networks, which allow the forgetting of spurious memories and the reinforcing of pure ones, and the development of powerful techniques based on the theory of dynamical systems, in particular with the exploitation of Partial Differential Equations, mostly of the type Hamilton-Jacobi, Burgers, Fourier, for the analysis of the free energy in spin glasses, even when more species are involved. A rigorous, yet quite simple, quantitative control is then reached even in the region where replica symmetry is broken.

These methods have made possible to generalize the Parisi theory to the case of multi-species models. A new “zigurat structure” is introduced, in order to describe the replica symmetry breaking scheme. This idea stimulated further important research, particularly by Dmitry Panchenko.

Great interest and deep possibilities of application characterize his far reaching project to apply the probabilistic methods of statistical mechanics for complex systems, in order to build concrete models for the properties of the immune system, in a form ready for experimental verification. On these subjects Adriano Barra has established fruitful collaborations with the Ton Coolen group at King’s College, and groups of Biologists and Physicians in the Rome area.

Recent results, of great conceptual depth and relevance for application, concern the possibility of “parallel processing” in neural networks of hierarchical Hopfield type, and “scale free”, and allow the study of topological properties of hierarchical networks, with high degree of clustering and modularity.

Adriano Barra emerges as a true leader in the development of research, always proposing new ideas and techniques, and pushing his collaborators, young and less young, toward useful concrete results.

Moreover, he is a great creator and planner of research programs, able to attract conspicuous funds, as shown for example, by the success of the FIRB grant, where he has been principal investigator, and the consistent funding achieved by the King’s College group, where Adriano Barra is the external leader of a sub-project. Even his recent achievements at the University of Salento are extremely remarkable.


As far as the teaching activity is concerned, Adriano Barra has shown a constant high level of performance, and an admirable generosity to cope with the necessities, even beyond his strict institutional duties. His relations with Collegues and students are the best. He acted as supervisor of many research Thesis for the “Laurea” degree, and for the doctoral program.

Moreover his organizational abilities are exceptional. He can coordinate the efforts of people, with different formation and experience, toward common objectives, related to research and teaching. His recent activity at the University of Salento is really impressive. He was able to build, and direct, the activities of a valid research group, involved in a variety of research topics, both in basic problems, and applied subjects. Moreover, he acted very efficiently for the establishment of new teaching experiences, as for example the M.I.A. (Matematica per l’Intelligenza Artificiale) Corso di Laurea Magistrale in Matematica at the University of Salento.

In conclusion, I believe that Adriano Barra can give a strategic relevant contribution to the research, teaching and organization activities of the host Institution.

I am ready to provide additional information if necessary.

With my best regards and wishes



Francesco Guerra
Professor of Theoretical Physics
(Emeritus)
Department of Physics
(past Director 1995-2001)
University of Rome “La Sapienza”