

In memory of Beppe Nardulli (1948-2008)

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(ricevuto il 19 Settembre 2009; pubblicato online il 6 Ottobre 2009)

1. – The scientist

Before starting with the scientific sessions of IFAE 2009, we would like to remind our colleague and close friend Beppe Nardulli, who passed away on June 2008 at the age of 60. This meeting of the IFAE (*Incontri di Fisica delle Alte Energie*) series is particularly appropriate for such a memorial: indeed, before the IFAE series of meetings, another series, named *Incontri di Fisica del Lep*, was organized in Italy during the eighties and the nineties of the last century, and the 1994 edition was held in Bari (*BALEP—April 1994*) having Beppe as one of the main organizers.

Beppe Nardulli got his degree in Physics at the Bari University in 1973, and in the same Institution he became associate Professor, and then full Professor in Theoretical Physics. His research activity concerned many different topics, from the phenomenology of High-Energy Physics to the strong interactions in extreme conditions of temperature and density, to the Physics of neural networks with technological applications. He was author of more than 200 scientific papers, and in this long list of contributions one can recognize the most important ones in the theory of hadronic systems comprising heavy quarks, and in the analyses of the phase diagram of QCD at low temperature and high and intermediate chemical potential.

In the first case, Nardulli exploited the symmetries of Quantum ChromoDynamics holding in the infinite heavy quark (charm and beauty) mass limit and in the chiral limit for the light (u, d and s) quarks, defining an effective chiral Lagrangian for heavy and light mesons; such a Lagrangian describes strong interactions among effective meson fields and their couplings to electromagnetic and weak currents, including symmetry-breaking terms. The effective theory is able to describe heavy mesons of both negative and positive parity, light pseudoscalars, as well as light vector mesons, and represents an important theoretical tool to interpret the wealth of measurements carried out, *e.g.*, at the flavour factories and at the hadron colliders [1].

Many studies were devoted by Beppe to the phase diagram of QCD, mainly in the region of low temperature and large chemical potential, where the phenomenon of color superconductivity occurs [2]. In particular, he studied inhomogeneous superconductivity: this effect arises when the species participating in the pairing phenomenon have different Fermi surfaces with a large enough separation. In such conditions it could be more favorable for each of the pairing fermions to stay close to its Fermi surface and for the Cooper pair to have a nonzero total momentum (unlike the usual BCS state). In this state the gap varies in space, the ground state is inhomogeneous, and a crystalline structure



Fig. 1. – Beppe Nardulli (Bari, 2007).

might be formed, a situation considered for the first time by Fulde and Ferrell, and by Larkin and Ovchinnikov in 1964 (LOFF state). The spontaneous breaking of the space symmetries in the vacuum state is a characteristic feature of this phase, and is associated with the presence of long-wavelength excitations of zero mass. This situation is of interest for QCD at high density and low temperature, where many different phases of the LOFF type can be present, and has been described by Nardulli using the language of the effective field theories.

2. – The teacher and the organizer

Beppe devoted many efforts to the teaching activity, in particular of Quantum Mechanics, Statistical Mechanics and High-Energy Physics, preparing and delivering lectures that were greatly appreciated by students and by colleagues as well. The two volumes of the book *Meccanica Quantistica: Principi, Applicazioni* [3] are popular among the Physics students, and provide a basis for the first approach to research. Under Nardulli's advice more than 20 degree theses were prepared during the years, and about 15 PhD theses in High-Energy Theoretical Physics and Statistical Mechanics. Beppe followed his students in critical phases of their scientific (and human) training, acting as a teacher, as a mentor and as a friend (fig. 1). Eight of his former students are now researchers in various Institutes, and one is full professor at the Bari University.

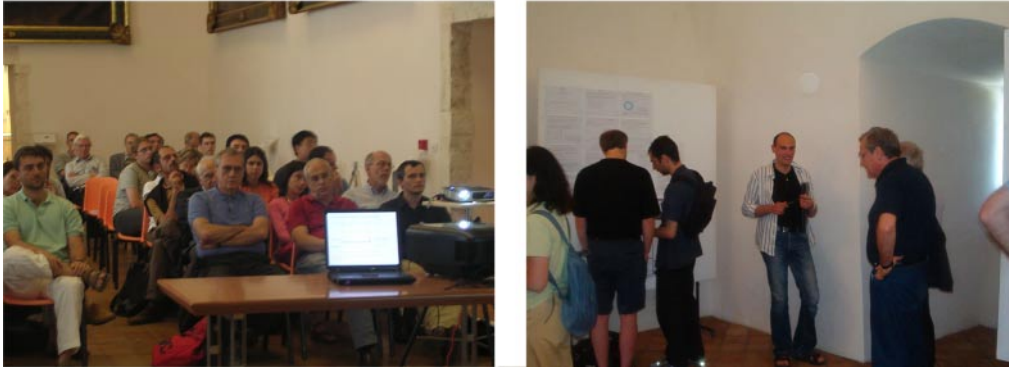


Fig. 2. – During one of the QCD@Work workshops.

With the aim of promoting exchanges with scientists coming from the main international Institutions, Nardulli promoted, together with other colleagues in Bari, the workshop series *QCD@Work*, organized in small Apulian towns, Martina Franca in 2001 and 2007, and Conversano in 2003 and 2005 [4] (fig. 2). The idea was also to provide young students with the possibility of actively contributing to the scientific discussions after having presented their own results to highly qualified audiences.

Another important achievement was the TIRES (*Tecniche Innovative di Ricostruzione ed Elaborazione dei Segnali*) Excellence Center at the Physics Department of Bari University. Beppe continuously had in mind the idea of promoting interdisciplinary research, involving people with different experiences to make common research, sharing knowledge and skills. In particular, he focused on the research in Physics technologies applied to the elaboration of images, with main attention to medicine and biology. The occasion to start with this exciting experience was a call of the Italian Ministry of University and Research in 2000, and the project of the Bari team was the only one led by a physicist approved and funded in Italy in that occasion. Since then, many physicists, biologists and medical doctors have been involved in the Center activities, together with a large number of undergraduates students and postdoctoral fellows, and two international conferences have been organized in Bari [5].

3. – The pacifist

In 1986 Beppe Nardulli was one of the promoters of USPID (*Unione Scienziati per il Disarmo*) and one of the first national secretaries of this association aimed at coordinating in Italy the activity of the scientists in favour of peace and disarmament. Since then, meetings, seminars, newspaper articles, public discussions have been continuously organized to promote the issue of peace, and of the removal and destruction of weapons. In Bari, this activity was at the origin of the constitution of the CIRP (*Centro Interdipartimentale di Ricerche sulla Pace*), a Center belonging to the University of Bari devoted to the formation of specialized operators in various sectors of the International Cooperation. Nardulli was one of the main organizers of the 57th Pugwash Conference, held in Bari in October 2007; through his tireless efforts in organizing and fundraising, the conference was a successful international event.

4. – The friend

Beppe was a friend for us, and his passing away in a so early age represents an irreparable loss for all of us and for the other communities he associated with. Concluding this memorial talk, it is appropriate to quote a sentence by Raoul Gatto, the great old scientist of the Italian Physics Community:

Beppe Nardulli's thought and action were continuously inspired to a sort of constructive altruism. He always aimed at acting positively and with justice in favour of research, university and society.

This is the image of Beppe we want to keep with us.

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