Physics of matter in Italy: 1945-1965

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Introduction: general.

Italian historians of physics have increasingly turned their research interests toward the physics of past century. In December 1997, in a one-day meeting held in Bologna, several historians from Bologna, Palermo, Pavia and Roma took up the decision of devoting a fraction of their studies to the development of physics in Italy after the second world war. A second meeting, held in September 1998 after the Conference "*Una difficile Modernità: tradizioni di ricerca e comunità scientifiche in Italia (1890-1940)* [1], reaffirmed the commitment of the previous year.
On March 2000, an enlarged group of researchers presented to the *MIUR* (then *MURST*, Ministero dell'Università e della Ricerca Scientifica e Tecnologica) a research project entitled "*Il Novecento della Fisica Italiana*" that has been positively judged but not financed for "lack of funds". Finally, in 2001, the main lines of the same research project entered a larger one entitled "*Storia della Fisica e dell'Astronomia in Italia nell'Ottocento e nel Novecento: Fonti, Temi e Contesto Internazionale*" and has been financed within it.

Introduction: particular.

In the recent past, my co-workers and I have been studying some aspects of the development of physics in Italy in the nineteenth and twentieth centuries. As indispensable research tools, we have made up three databases that are now available on-line at the site of the *Archivio di Storia della Fisica* (*ASF*): http://fisicavolta.unipv.it/asf . The first one concerns all the papers published in *Il Nuovo Cimento* from 1855 to 1944; the other two, the papers published in the *Philosophical Magazine* and in the *Journal de Physique* in the crucial period ranging from 1896 to 1910. These databases have been used in a series of studies [2].
In 1987, Fausto Fumi, Guido Tagliaferri and the writer organized in Pavia a Conference on the *Origins of Solid State Physics in Italy* characterised by the presence of the physicists who gave relevant contributions to the development of this research field in Italy and of some outstanding foreign physicist like André Guinier, Nevill Mott and Freder-

ick Seitz. The Proceedings of that Conference, published by the Italian Physical Society, constitute a precious source for every historical reconstruction [3].
More recently, Antonio Casella has studied the development of the *Società Italiana per il Progresso delle Scienze* founded in 1907 by Vito Volterra [4]; and, with Guido Lucchini, has published a volume on Graziadio (father) and Moisé (son) Ascoli, a glottologist and a physicist, respectively [5]. Their story constitutes a significant case in the scientific development in Italy.
Therefore, when we decided to begin the study of the development of the physics of matter in Italy, we could rely on some good backgrounds.

1. What are we talking about?

By "physics of matter" we intend the "physics of the aggregate states of matter: atoms, molecules, solids and liquids" as in the definition that can be found in the first issue of the journal published by the *Gruppo Nazionale Struttura della Materia* (*GNSM*) of the *Consiglio Nazionale delle Ricerche* (*CNR*) starting on October 1966 [6]. This definition reflects more the state of organisation of physical research in Italy than the needs of consistent classifying criteria: the "physics of condensed matter" should concern only solids and liquids (in which, the behaviour of a statistically significant number of atoms or molecules plays a structural role); the addition of atoms and molecules (the constituents of solids and liquids) is clearly due to particular institutional histories.

3. Tools

As for the previous work, we have set up some research tools. We have created a new database concerning the papers published in *Il Nuovo Cimento* from 1946 to 1960: as the others, this database is now available on-line. We have acquired, thank to the kind donation by Gilda Olivelli Giulotto, Giulotto's archive consisting of more than two thousand letters and several documents, mainly concerning the research policy. Giulotto's archive is being digitalized in PDF format and will be soon available on-line (owing to privacy limitations, part of the correspondence will not be displayed). Finally, we have realised (up to now) 17 interviews with physicists.

4. Preliminary studies

The first results of our research have been already published [7]. This book deals with the physics of matter, the interviews of the physicists, the theoretical physics between Milano and Pavia and the physics teaching at Universities and high schools. In the following, we simply collect some basic points.

4.1 The context.

After the second world war, the international context of scientific research appeared profoundly changed: the defeat of nazism and fascism and the war damages had favoured the passage of the economic and scientific leadership on the other side of the Atlantic; the huge effort made by the United States for the production of the fission bomb has shown how efficient can be a research based on a planned mixing of basic, applied research and technology; the shock provoked by the nuclear bombing of Hiroshima and Nagasaki had again emphasized the necessity of a reflection on the aims of Science and of its applications. The start of the cold war and the consequent search for new weapons had dramatically increased the interest of governments in the military and peaceful applications of the new technologies and had spurred the development of research programs of unprecedented economic commitments often affordable only through international cooperation.
The problems that Italy had to face in order to achieve the scientific and technological background necessary for the country's development were, therefore, complex and difficult: the war damages and the overall weakness of scientific institutions made the task even more arduous.
These are, more or less, the closing words I used in *Il Nuovo Cimento-Novant'anni di Fisica in Italia (1855-1944)* [8]. They depict a context that is easily noticeable in the reminiscences of the physicists. However, these same words miss a fundamental point: the enthusiasm with which scientists and common people came back to their jobs and gave their contribution to the reconstruction of the country.

4.2 The research funding

Soon after the war, Enrico Amaldi, recognised Fermi's heir, set out to reorganise the cosmic rays and nuclear research: the early constitution in Rome, on October 30, 1945 of the *Centro di Fisica nucleare e delle particelle elementari* of *CNR* is a clear indication of how Amaldi was perfectly aware of the tasks he had to deal with. This was the starting point of a process that has profoundly modelled the funding policy of (physical) research in Italy along the second half of the past century [9, 10, 11].
On the other hand, the physicists who, for local traditions and/or personal choices leaned towards the physics of matter did not have a clearly recognisable research stream behind their shoulders. This original handicap explains why the physicists of matter had to find their paths among many cultural and organisational difficulties. For an example of the institutional difficulties, compare the date of birth of the *INFN* (Istituto Nazionale di Fisica Nucleare) dedicated to particles and nuclear physics with that of *GNSM* (Gruppo Nazionale di Struttura della Materia): 1951 and 1964, respectively. However,

this comparison may be misleading: as a matter of fact, the more significant dates are those of 1971 and 1994, respectively: they are the dates in which the *INFN* and the neo-born *INFM* (Istituto Nazionale per la Fisica della Materia) acquire complete organisational and financial autonomy: the funds are given to the two structures directly from the government. This complete autonomy has been recently (2001) acquired also by the astrophysicists through the foundation of the *INAF* (Istituto Nazionale di Astrofisica). The steps, taken in the sixties, that lead to the complete autonomy of the *INFN*, had a disrupting impact on the research policy: by an (ir)resistible process of imitation they have produced the multiplication of research structures whose financial support is the result of a direct bargain with the government, without any control by the scientific community. It is not a case that, the *CNR*, the National Council of Research, has progressively lost its basic role of maintaining a reasonable equilibrium in the funds distribution among the various scientific disciplines and is nowadays in big troubles, worsened by a government policy that under-valuates the role of scientific research in the development of the country and seems completely unaware of the recent history of the Italian research system.

4.3 A polycentric development

After the second world war, the physics of matter developed in Italy in many centres: the research topics have been the product of local traditions, individual orientations and links with foreign researchers (table I).

Table I. Research topics. Only the principal research arguments have been reported.

Where	When (starting year)	Physicists	Topics	Links
Pavia	1946	Luigi Giulotto	Nuclear magnetic resonance	
Roma	1946	Daniele Sette	Fluids and ultrasonic spectroscopy	
Torino	1947	Giorgio Montalenti	Ferromagnetism	
Roma	1947	Piergiorgio Bordoni	Elastic and anelastic properties at low temperatures	MIT
Pisa	1950	Adriano Gozzini	Microvawes physics	
Milano	1952	Fausto Fumi, Giorgio Bassani, Paolo Tosi	Solid state theory	Urbana, Bristol, Cambridge

Pavia	1952	Gianfranco Chiarotti Paolo Camagni	Color centrers in alkali halides	Urbana
Genova	1954	Giovanni Boato	Inert gases	Chicago
Frascati	1955	Giorgio Careri	Low temperature physics	Leiden
Milano	1955	Roberto Fieschi	Color centrers in alkali halides	Leiden
CISE	1955	Elio Germagnoli	Various properties of solids	
Palermo	1955	Ugo Palma, Beatrice Vittorelli	Electron paramagnetic resonance	MIT
Ispra	1959	Paolo Camagni Alfonso Merlini	Imperfections in solids	
Roma, Ispra	1959	Giuseppe Caglioti, Antonio Paoletti, Francesco P. Ricci	Neutron diffraction	Chalk River, Brookhaven, MIT
Roma	Late fifties	Daniele Sette	Semiconductors	
Genova	1960	Giovanni Boato	Superconductivity	
Pavia	1960	Gianfranco Chiarotti	**Semiconductors**	**Urbana**

The connections between researchers from the various places grew up slowly: a fundamental role has been played by the Congresses of the Italian Physical Society (*SIF*) and the Varenna Schools (founded by *SIF* in 1953). During the *SIF* Congress held in Bari in 1963, a group of researchers constituted a "permanent forum" named *GISM* (Gruppi Italiani di Struttura della Materia) aimed at "promoting the development of researches on atomic and molecular physics and on the physics of the aggregate states of matter". On November 22 of the same year, a delegation of *GISM* met in Rome the President of *CNR* Giovanni Polvani and Edoardo Amaldi. Polvani suggested to set up a *CNR* group dedicated to the physics of matter. The group was formally established by *CNR* on December 17, 1964. The budget of the group (now *GNSM*, Gruppo Nazionale di Struttura della Materia), in the following three years, is shown in table II.

Table II. Funds given to *GNSM* by *CNR*. In millions Lire. Multiply by 15 for getting the values in Lire 2001.

Year	GNSM	Year/1965	CNR	GNSM/CNR (%)
1965	470	1	21000	2,24
1966	610	1,27	26000	2,35
1967	792	1,62	32000	2,47

This is a good example of the role that can be played by a national structure in charge of coordinating the research projects of the country. Without this investment by *CNR*, the take off of the physics of matter in Italy would have been much more difficult.

4.4 The physics.

The treatment of this subject goes beyond the scope of this paper. The interested reader is invited to look at references [2i, 3,7,11,12].

5. What next?

The study of the development of physics in Italy after the second world war is going on. The volume of reference [7] will be followed by another one, planned for the mid of 2004.

Appendix.

Besides the already quoted on-line Archive *Archivio di Storia della Fisica* (*ASF*) (http://fisicavolta.unipv.it/asf/), it is worth recalling the volumes series *Percorsi della Fisica* (http://fisicavolta.unipv.it/percorsi/collana.htm) in which seven volumes have already been published.

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References

[1] A. Casella, A. Ferraresi, G. Giuliani, E. Signori (Eds.), *Una difficile Modernità: tradizioni di ricerca e comunità scientifiche in Italia (1890-1940)*, Pavia, 2000.

[2] Among them: a) S. Galdabini, G. Giuliani, 'Physics in Italy between 1900 and 1940: the universities, physicists, funds and research', *Historical Studies in the Physical and Biological Sciences*, 19, (1988), 115-136; b) S. Galdabini, G. Giuliani, 'Magnetic field effects and dualistic theory of metallic conduction in Italy (1911-1926): cultural heritage, creativity, epistemological beliefs, and national scientific community', *Annals of Science*, 48, (1991), 21-37; c) G. Giuliani, P. Marazzini ,'The italian physics community

and the crisis of classical physics: new radiations, quanta and relativity', *Annals of Science*, 51 (1994), 355 – 390; d) G. Giuliani, *Il Nuovo Cimento - Novannt'anni di Fisica in Italia: 1855-1944*, Pavia (1996), pp. 159; e) I. Bonizzoni, G. Giuliani, 'La Fisica dello stato solido in Italia: prodromi (1890 - 1940) e primi sviluppi (1946 - 1960)', *Atti del IX Convegno Orlandini, La Fisica nella Scuola*, XXXII, 3, (1999), 160-168; f) G. Giuliani, F. Passera, 'La Fisica in Italia: 1890-1940', in ref. 1, 177-196.

[3] G. Giuliani (ed.), *The origins of solid state physics in Italy: 1945-1960*, Bologna, 1988.

[4] A. Casella, 'Di un acerbo progresso: la SIPS da Volterra a Bottai', in ref. [1], pp. 37-90.

[5] A. Casella, G. Lucchini, '*Graziadio e Moisé Ascoli-Scienza, cultura e politica nell'Italia liberale*, Pavia 2002.

[6] 'Breve presentazione di un importante settore della ricerca fisica', *Notiziario G.N.S.M.*, I, 1, Ottobre 1966, p. 1.

[7] G. Giuliani (ed.), *Per una storia della fisica italiana (1945-1965), I – fisica della materia, fisica teorica, insegnamento della fisica*, Pavia, 2002.

[8] Ref. 2d. p. 135.

[9] G. Battimelli, M. De Maria and G. Paoloni in: G. Battimelli (Ed), *L'Istituto Nazionale di Fisica Nucleare. Storia di una comunità di ricerca*, Bari, 2001.

[10] A. Casella, 'La politica della ricerca scientifica: due interventi di L. Giulotto', in ref. 7, pp. 81-109.

[11] I. Bonizzoni, G. Giuliani, 'La nascita della fisica della materia: 1945-1965', in ref. 7, 1-34, pp. 27-34.

[12] I. Bonizzoni, 'Le interviste', in ref. 7, 110-192.