- Skip to content
- skip to menu

Search

Search Search ok

You are here :

CNRS > Media > The Hidden Talents of Chemistry > AROUND THE WORLD

Press > CNRS international magazine

Print

Table of contents

The Italian Paradox

Statistics on scientific research in Italy reveal a striking contradiction. While the country's R&D ressources significantly lag behind those of other major economies, its output, in terms of scientific publications, is not only one of the most prolific in the world, but also highly recognized in several fields.
In recent years, Italy's annual R&D spending, has averaged around 1.13% of GDP, compared with a European Union average of 1.84% (2004-2006). With 51%, the public sector is the largest contributor to R&D funding, compared to the private sector's 48%–an uncommon occurrence in major world economies.
The country counts an average of just 3.4 researchers per 1000 people employed, against 8.2 in France. Yet between 1998 and 2008, Italy produced 371,205 scientific publications, putting the country in eighth position worldwide and fourth in Europe. The predominant fields are medical science, space science, mathematics, and physics.
Over this same period, Italian publications were the seventh most cited internationally (4.16 million) particularly in the fields of molecular biology and genetics, immunology, space science, and neuroscience and behavior–illustrating researchers' proficiency in these fields.
Young Italians have been the second most successful scientists in obtaining European Research Council grants, awarded on highly selective criteria of scientific excellence and creativity.
R&D organization and funding are essentially directed by the Ministry for Education, Universities, and Research (MIUR) in consultation with the scientific community, local government, and private enterprise. MIUR-led research policy is set in three-year plans, called the National Program for Research (PNR). Applied sciences receive almost half the annual research spending, while the rest is evenly split between development and basic research.
The country's 61 public and 26 private universities, comprising a total of 1.8 million students, employ 67,000 researchers and receive about 30% of all state R&D spending.
In addition to overseeing university research, the MIUR also manages most major research agencies, including the National Research Council (CNR, the largest Italian research organization with approximately 4000 researchers), the energy and environment agency (ENEA), and the national institutes of mathematics (INdAM), astrophysics (INAF), and nuclear and particle physics (INFN).
In 2007, foreign cooperation projects accounted for almost 40% of the 45,241 Italian scientific publications produced. France was the second most active partner (after the US), involved in 3363 co-publications, half of which with CNRS, mostly in physics (39%), space science (30%), chemistry (16%), and fundamental biology (12%). Conversely, Italy was the fourth most active partner in CNRS co-publications. This close collaboration is illustrated in the almost 5000 CNRS research trips to Italy in 2008. Furthermore, Italians make up the largest foreign contingent among CNRS researchers.

The numerous informal transalpine collaborations are a breeding ground for a large number of structured cooperation projects between CNRS and Italy.

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At the Cumae site near Naples, researchers are unearthing a wall of a mausoleum dating back to the first century BC.

Three European Associated Laboratories (LEAs) were launched in chemistry, knowledge systems, and nuclear physics–the latter involving the Normandy-based Spiral 2 particle accelerator in collaboration with nine other international teams. Other international cooperations involve 18 European/International Research Networks (GDREs/GDRIs) mainly in human and social sciences, mathematics, and chemistry, and 13 International Projects for Scientific Cooperation (PICS) in space science, chemistry, biology, and physics. Mathematics, in which Italy and France have long histories of excellence, is the subject of three GDREs linking CNRS and INdAM, involving around 600 researchers from both countries.
Besides, under a 1971 bilateral agreement (renewed in 2007), CNRS and the CNR fund short-term exchan-ges between partner laboratories, involving between 30-40 researchers from each country every year.
Among major projects, CNRS went into partnership with the INFN in 1994 to build and operate a gravitational wave detector called VIRGO, based at the European Gravitational Observatory near Pisa (see box).

© IN2P3/EGO-VIRGO/CNRS Photothèque

One of VIRGO's many ultra-high vacuum tubes. VIRGO, located near Pisa (Italy) is expected to detect gravitational waves.

Three CNRS laboratories (IN2P3) and two from the INFN (Frascati and Catania) currently collaborate in the design and construction of modular components for a powerful electro-magnetic calorimeter, ALICE EMcal, based at the Large Hadron Collider at the European Laboratory for Nuclear Research (CERN). The project, which also includes three US labs, will study interacting matter at extreme energy densities, with the hope of observing the formation of quark-gluon plasma, a new phase of matter.
Since 2003, CNRS has also been involved in a major Franco-Italian project for developing X-ray Photo Emission Electron Microscopy (XPEEM) at the Trieste synchrotron facility ELETTRA. The studies using the XPEEM microscope significantly strengthened ties between French and Italian research into X-ray microscopy. This instrument is scheduled to be transferred to the French synchrotron SOLEIL in 2010.

A series of archaeological and historical studies into the ancient Greek colonies in southern Italy led by the CNRS Naples-based Centre Jean Bérard, affiliated to the Ecole Française de Rome, have also meant close collaboration with researchers from Naples' Federico II and Orientale universities, and with Italy's Superintendence of Archaeological Heritage.
Finally, the Concordia research station in Antarctica, operated by French (IPEV) and Italian (PNRA) polar research programs, is one of just three international inland Antarctica bases. At an altitude of 3233 meters, the surrounding atmosphere and long nights make it an exceptional site for astronomy–yet in a rather harsh environment. Concordia has hosted several joint studies by CNRS (INSU) and INAF, and a European project for deep ice core drilling (EPICA) in partnership with ENEA and INFN. This provided the first data on greenhouse gas evolution over the past 800,000 years, and furthered the understanding of the mechanisms of rapid climate change.

Jason Brown

Looking back with virgo
Jointly financed by CNRS and INFN, the VIRGO gravitational wave detector is a Michelson laser interferometer made up of two perpendicular arms, each three kilometers long.
Operational since May 2007, VIRGO is expected to detect the presence of gravitational radiation produced by supernovae explosions or from the merging of cosmic binary systems (black holes or neutron stars). It is capable of “observing” thousands of galaxies and weakly luminous bodies at a distance of up to 300 million light years, thanks to its extreme sensitivity that allows measuring variations in the path of a laser beam to the order of one hundredth of a billionth the size of an atom. “Gravitational waves are a consequence of Einstein's theory of general relativity,” explains Benoît Mours from LAPP.[1] “If a mass is accelerated, it will radiate deformations of space which will spread around. These are called gravitational waves.” To test this theory, VIRGO's data will be analyzed in conjunction with those provided by similar detectors in the US and Germany. So far, however, gravitational waves have not yet been detected and VIRGO, like its international counterparts, will be made significantly more sensitive. Beyond this fundamental test, VIRGO is intended to become a permanent observatory to further astrophysics and cosmology research, with the potential of directly capturing information about the first moments of the Universe.
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In figures
> 59 million inhabitants (2008)
> 82,489 researchers (2005)
> 16.835 billion euros spent on R&D in 2006 (1.13% of GDP)
> 4856 CNRS missions to Italy in 2008
> 1706 scientific co-publications with CNRS in 2007

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Top

Back issues of CNRS Magazine

COVER STORY

The Hidden Talents of Chemistry

EDITORIAL

FRENCH RESEARCH NEWS

- CNRS Turns 70

LIVE FROM THE LABS

- Teaming Up Against Diabetes
- Nanosized Memory
- Out of Africa
- A Mandible that Speaks Volumes
- A Better Outlook for Breast Cancer Patients
- Cloaking Ourselves from Disaster
- Closing in on Intermediate-sized Black Holes
- Elephants Started Small
- First Global Map of Ammonia Sources
- Incivilities : Who Reacts ?
- Memories of the Future
- Origins of the Solar System Revisited
- Future Collisions in the Solar System
- A Fungus that Decontaminates Soil
- Marine Life Survey
- Catherine Marry, sociologist
- In brief

IN IMAGES

- Gustave Eiffel, Master of Iron

AROUND THE WORLD

- Computing Better Engines
- Pablo Gluschankof
- Valentina Emiliani
- The Italian Paradox
- Grants/Fellowships
- Working in a french lab, practical information

INNOVATION

- Gaming Your Way to Better French
- Microfluidics Shrinks Fuel Cells
- A New Weapon against Prions

CNRS NEWSWIRE

- Knowledge on All Scales
- Spiral 2 Weaves its International Web
- Exploring the Soil's Genetic Biodiversity
- International cooperation
- Prize
- In brief
- CNRS in Brief

AMAZING IMAGES

- Optical Nanosource

CNRS OFFICES ABROAD

- CNRS offices abroad

Main menu

- Media
  - Press releases
  - CNRS international magazine
  - Archives
- Press Contacts
- Photo Library
- Video Library

Secondary menu

- Directories
- Key words
- Other web sites
- Français