Frascati National Laboratory

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1 Introduction

The LNF is the largest (for number of employees) and the first built of the INFN national laboratories. The INFN was funded, in the fifties of last century, to give Italy its first particle accelerator and the site to locate this infrastructure was chosen to be Frascati. Since these early days, the LNF has always been involved in two main activities: building and operating particle accelerators, designing and constructing particle detectors.

The LNF site stands on a surface of 135.178 m^2, 25.000 of which are indoor and include offices, laboratories, and workshops.

At LNF are hosted the following facilities:

- DAΦNE, an e^+e^- collider operating at the Φ energy (1020 MeV), able to deliver instantaneous luminosities $2x10^{32}cm^{-2}s^{-1}$, a world record at this energy.
- a synchrotron radiation facility (DAFNE Light) with lines in the X, UV, and infrared regions, extracted in parasitic or dedicated mode, from the intense photon emission of DAΦNE.
- a Beam Test Facility (BTF), with two beam lines providing electron/positron or photon beams mainly for detector calibration purposes.
- SPARC_LAB, a facility that combines a linear accelerator (SPARC) and a 200 TW laser (FLAME). This is an infrastructure for R&D in the field of new technologies for particle acceleration like FEL, PWFA and Terahertz radiation. SPARC_LAB is the seed for the new infrastructure EUPRAXIA.
- SCF LAB, a laboratory equipped for Space Simulation. It characterizes devices that are to be sent in spatial missions.
- DDG-Lab, the infrastructure of the Detector Development Group, that since 1985 has been performing R&D, design, and construction of classical and innovative gaseous detectors for large high energy physic experiments.
- COLD (CryOgenic Laboratory for Detectors), the site where research is conducted on super-conductors, magnetic materials and related systems using magnetic and electric transport tools with cryogenic equipment's able to study the dynamic behavior of these materials under conditions of extreme temperature and magnetic field.
- NEXT (Nanoscience EXperiments for Technologies), a laboratory that synthesizes and studies nanostructured carbon materials.
- assembling halls, mechanical workshops, a Computer Center, and an Electronics Laboratory suited for complex and challenging enterprises in many fields of fundamental research.

- eight clean rooms (class ISO 6 8), three connected to DAFNE Light, SPARC_LAB and SCF_LAB, and the others equipped for the construction of different kind of particle detectors, for a total area of 400 m^2.

The year 2022 was rich of success for the experiment carried out at LNF and in other research center, moreover important results has been obtained in the field of particle acceleration techniques and in the improvements of our infrastructures, we describe the most significative in the following.

In December the third data taking period of the PADME@BTF experiment came to an end. The goal of PADME is to search for signals of new particles responsible for dark matter, the Run III was devoted instead to verify the existence of a new particle, X17, with a mass of approximately 17 MeV/c2 observed by a nuclear physics experiment conducted at the ATOMKI laboratory of Debrecem, Hungary. If PADME will observe signals from the X17 particle, these will finally be the first incontrovertible evidence of new phenomena that cannot be explained by the Standard Model.

The first commissioning test of QUAX has been successfully performed at LNF. QUAX is an experiment devoted to the search of dark matter in the form of axions exploiting the interaction between the axion and the magnetic field. Due to very low signal the cavity should be kept at temperatures close to the absolute zero.

The New Small Wheels, of the ATLAS experiment was successfully installed and commissioned after 10 years of construction work. In May-July 2022 first splashes were driven by LHC and current has been observed by the detector. Moreover, the LNF researchers contributed with leading roles to the construction, integration, and commissioning of many experiments all around the world.

Important progress has been done on the field of new acceleration techniques and the construction of new infrastructures.

The SPARC_LAB research team at the Frascati National Laboratory has recently demonstrated that the plasma-based acceleration technique allows to obtain a high-quality particle beam, comparable to the beams produced in traditional accelerators. The electron bunches injected in the plasma contained in a 3 cm long capillary has been accelerated with gradient of ~ 1.2 GV/m, the high quality of the accelerated beam can drive a free-electron laser (FEL) by generating coherent light pulses in the infrared range. This important result also represents a milestone towards the realization of the EUPRAXIA infrastructure, the first research infrastructure addressed to users, based on plasma acceleration capable to reach a beam energy of 1.1 GeV. All this as been discussed in the EUPRAXIA_PP kick-off meeting in Frascati.

The construction and the commissioning of the new facility TEX (TEst stand for X-band) has been completed. TEX is devoted to study of the radiofrequency (RF) in X-band and, in general, to the development of all the technologies and systems related to a particle accelerator. The X-band (11.994 GHz) is at present the most advanced RF technology, with demonstrated capability of providing accelerating gradients up to 100 MV/m and beyond. TEX consist of assembly and measurement laboratories. A bunker for high power testing to characterize accelerating structures and validate them for the operation for future particle accelerators is also available. The facility is open to external users.

We were also very active in seeking for fund from external agency, European Commission, Regione Lazio and so on, and we participate to many projects funded by the Italian Ministry of Research (MUR) in the PNRR scheme.

In addition, we organized and hosted thirteen scientific conferences and many events for general public.

2 Organization

The LNF personnel, at the end of 2022, consisted of 309 units of personal, 29 of which have a fixed term contract, 53 fellows plus 322 associate members. Among these, there are university and PhD students, young post-Docs and employees from universities or other research institutions. Associate members work alongside staff members and likewise take part in the laboratory's activities. Tab. 1 shows the distribution of the LNF personnel among the different profiles.

	Staff	Temp.	Tot.
Researcher	71	0	71
Engineer	73	5	78
Administrative	34	10	44
Technician	102	14	116
Tot.	280	29	309

Table 1: Snapshot of the LNF personnel at Dec. 2022.

Fig. 1 shows the organization chart of the laboratory. The structure consists of services that respond directly to the Director, and three divisions (Research division, Accelerator division and Technical division) that also consist of different services. The laboratory also has a Scientific Committee composed by eminent international scientists that help the Director in shaping the research program. They meet twice a year and deliver recommendations regarding the scientific activities of the laboratory.

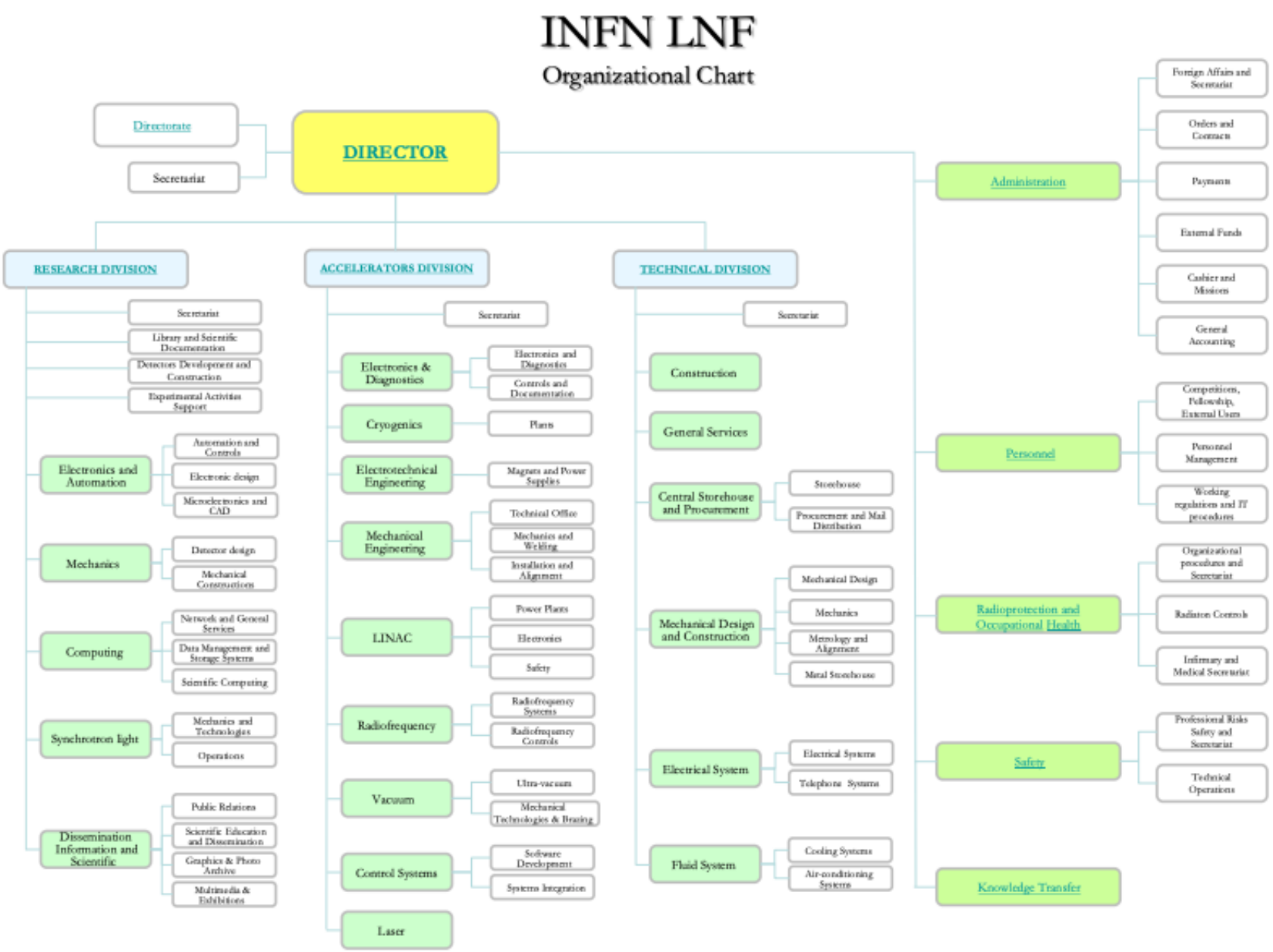

Fig. 1 Organization chart of the laboratory