

# Newsletter Interview

## TEN YEARS OF TIFPA



*Interview with Francesco Pederiva, professor at the University of Trento and INFN researcher, director of TIFPA*

2014-2024: TIFPA, the Trento Institute for Fundamental Physics and Applications, one of three INFN National Centres, is celebrating its first ten years of work on 28 February. Established by four partners, INFN, the University of Trento, the Bruno Kessler Foundation, and the Provincial Company for Health Services (APSS) of Trento, TIFPA has become one of the main research centers in the area establishing fruitful collaborations with local scientific institutions and entities. From fundamental research

to applications of physics technologies, TIFPA is strongly engaged in many of today's leading sectors and is collaborating on INFN's main international projects. From the space sector to quantum technologies, to gravitational waves, from silicon sensors to proton therapy: talking with its director, Francesco Pederiva, we traced the history of TIFPA, considering its main lines of scientific research and activities, and also its future.

### **TIFPA has its origins and its home in INFN: why was TIFPA founded? In response to which needs and with which goals? What role does it have within INFN?**

TIFPA was founded to give a common home to the research and technological development activities that concerned INFN and that took place in Trentino. Before the founding of TIFPA, the presence of INFN consisted of a group connected to the Padua division, alongside of which there were joint initiatives with the Bruno Kessler Foundation (FBK) and an interest in founding the new proton therapy centre right in Trento. The advent of new lines of research in the field of space physics then provided the impetus to solidify INFN's presence with the establishment of a scientific and technological centre, the TIFPA. The centre consists of four partners: the University of Trento, FBK, the Provincial Agency for Health Services (APSS) of Trento, and INFN. The desire was to create a centre that could act as a hub for all these activities and where fundamental research was combined with the necessary technological developments. Examples include the field of sensors, quantum technologies, the field of artificial intelligence, and with important applications at a social level too, like the development of new techniques for cancer therapies with proton irradiation. In this sense, TIFPA distinguishes itself from the conventional format of the INFN Division and embraces a wider context. Members might also come from third parties (APSS, FBK) and from different university departments, while TIFPA maintains its main axis in fundamental physics, both experimental and theoretical, at the heart of INFN's mission. TIFPA is a place for cross-fertilization where it is easy to quickly activate research groups with diverse expertise to respond to some of the challenges of physics today. Right now, we are working on renewing the framework agreement and

implementing agreements that will expire at the end of October with work done side by side with the representatives of the four partners in the permanent joint committee.

### **What are the main research sectors and scientific projects in which TIFPA is engaged?**

TIFPA currently covers activities relating to all five of the INFN National Scientific Committees. There is a strong component active on detecting gravitational waves on Earth, with the Virgo experiments and, in the future, the Einstein Telescope, as well as with the leading group of the LISA mission recently taken on by ESA, the European Space Agency. These experiments place Trento in a significant position in this sector. Then, there are astroparticle physics activities, with the groups active in the AMS experiment for detecting antimatter in space and the Limadou project, which aims to give a new perspective to the analysis of so-called "space weather", including seeking connections with large seismic events. As far as regards the activities in technological development and applications, on the other hand, the research in the field of FLASH techniques in proton therapy must be mentioned. This is a paradigm in which the application of higher doses of radiation in much shorter times is employed, and it seems it may have promising developments in the clinical field. In addition, the collaboration with FBK is strong, both in terms of R&D activity in the field of sensors (also connected to developing devices for the ATLAS experiment, the Large Hadron Collider of CERN) and in the field of developing apparatuses for quantum sensing and quantum simulation (QUBIT and DARTWARS experiments). In the area of experimental nuclear physics, we are on the front-line of antimatter experiments that are run at CERN, with the LEA-AEgIS group that is working on the generation of positrons. Finally, we have a large theoretical group that covers various fields, from cosmology to numerical gravitation, from nuclear physics to fundamental aspects of quantum mechanics, to biophysics, moving through the development of algorithms and paradigms for quantum computing. The relationship with ECT\*, the European Centre for Theoretical Studies in Nuclear Physics and Related Areas, is especially important to TIFPA and INFN. This represents an asset as far as regards the circulation of scientists coming from every part of the world and the possibility of developing important scientific collaborations.

### **The mission of TIFPA combines the two souls of scientific research: fundamental research and technological research connected to it, including the development of applications in other sectors and for society. What are TIFPA's main activities in the latter area?**

At TIFPA we work in three technology sectors related to space physics, medical physics, and the physics of sensors alongside conventional research groups in the INFN divisions. The former have the task of encouraging exchange and the technology development and transfer activities linked to fundamental research undertaken at the centre. We are currently considering how to make this facility more effective, and how to encourage greater exchange with the entrepreneurial and production world. Accordingly, a fourth sector will soon be set up: the new sector will deal with quantum sciences and technologies for connecting TIFPA activities that are conducted in collaboration with the University of Trento and FBK, in part overlapping those of the Quantum at Trento (Q@Tn) consortium that INFN is part of.

### **The TIFPA had a significant role in creating the Province's new proton therapy centre, what was its contribution to one of the few Italian centres specifically dedicated to this important oncological therapy technique?**

INFN was closely involved in the undertaking to build a proton therapy centre in Trento right from the start, following the intuition of the late Prof. Renzo Leonardi. The founding of TIFPA, with the direct involvement of APSS, gave a clear operating framework to this contribution. This is realised through an extended research group in medical physics connected to National Scientific Committee 5 (CSN5), as far as regards the more strictly applied aspects, but also to CSN3, for the part linked to nuclear physics. Through TIFPA, INFN manages the experimental room as a facility that involves a Program Advisory Committee for selecting measurement campaigns both on behalf of internal and external parties. It also provides for the technical assistance and monitoring as far as regards radiation protection. Recently, INFN has also launched a close dialogue with APSS to move towards an operational model that is more and more advantageous for both partners.

### **How does TIFPA participate in and communicate with local organisations and its region?**

Beyond natural collaborations with partner entities, TIFPA has contributed to science communication at the provincial school institutes. Recently, we became promoters of the Asimov Prize, still absent in the province. An important path, launched with some meetings that also involved hospital clinics, led to a much more extensive dialogue with APSS. TIFPA moved from being a somewhat obscure acronym to now having an important role in the future of research activities in the medical field, also supported by the recently established Degree in Medicine at the University of Trento. In the future, we would like to have more substantial relationships with MUSE, the Science Museum of Trento, as far as regards communications and finding more robust channels for engaging with the Trentino manufacturing and entrepreneurial sector, as well as organisations like Trentino Sviluppo and HIT (Hub Innovazione Trentino) for fully realising the purpose of TIFPA regarding technology transfer locally.

### **After ten years from its foundation, how do you now see the Centre that you direct?**

TIFPA is still a young institution, but it has already moved beyond its first phase of growth. Our perspective is now one of consolidation in provincial and national research organisations, and of becoming a visible reference point within INFN as far as regards the facilities that we can offer in collaboration with partners. But, above all, we want to imagine TIFPA as a place where new ideas can be experimented, thanks to the possibilities of interdisciplinary collaboration and cross-fertilization that find a fertile environment here. And thanks to these new ideas, we can welcome applied and technological developments that make the most of the surrounding favourable conditions that the province of Trento offers. To do this, we'll need to become more attractive and encourage the inclusion of new technologies, researchers, and staff members who wish to share this adventure with us.