Newsletter Interview

THE NRRP ETIC PROJECT AND THE ITALIAN CANDIDACY TO HOST EINSTEIN TELESCOPE

Interview with Monique Bossi, infrastructure manager of ETIC, INFN Perugia Division

Last June 6, during an event that took place in Rome at the headquarters of the National Institute for Astrophysics (INAF), the Prime Minister Giorgia Meloni formalized Italy's candidacy to host the future detector of gravitational waves that will be built in Europe, the Einstein Telescope (ET), on the site of the former mine of Sos Enattos, in the Nuoro area, in Sardinia.

The event was attended by the Deputy Prime Minister and Minister of Foreign Affairs and International Cooperation Antonio Tajani, the Minister of Universities and Research Anna Maria Bernini, the Minister of Labor and Social Policies Elvira Calderone, the President of the Region of Sardinia Christian Solinas, the Nobel Prize in Physics, and President of the Scientific Technical Committee appointed by the MUR to support the Italian candidacy, Giorgio Parisi, the President of the INFN, who coordinates the scientific participation in ET, Antonio Zoccoli, and were also present, among others, the Undersecretary of State to the Presidency of the Council of Ministers, Alfredo Mantovano and the Italian Ambassador and Head of Delegation in the Board of Governmental Representatives of Einstein Telescope, Ettore Sequi. The meeting was opened by the President of INAF, Marco Tavani.

Currently, the Italian bid competes with the Meuse-Rhine Euroregion site proposed by the Netherlands: the final decision on the site that will host the infrastructure is expected to be taken internationally by 2025. The next few months will therefore be decisive for the preparation and promotion of the two candidate sites.

For the realization of the studies and activities necessary to enhance the Sos Enattos site, Italy has recently set aside an allocation of 50 million euros from the NRRP, as part of Mission 4 Education and Research coordinated by the MUR, to finance the project ETIC (Einstein Telescope Infrastructure Consortium), largely dedicated to enhancing the candidacy of the Sardinian site, and has also supported, again in the context of the NRRP, two other complementary projects, TeRABIT focused on the connection and high-performance network needs of the site and Sardinia, and MEET, led by INGV, which with the activities of its Work Package FABER deals with the geophysical characterization of the same site. Introducing ETIC to us is the Infrastructure manager Monique Bossi, from the INFN Division of Perugia.

What are the goals of ETIC and what activities will be developed over the next three years of the project to enhance the Italian bid to host Einstein Telescope?

ET is likely to be the largest research infrastructure to be built in Europe in the coming decades, an extremely ambitious and complex project that, neither nationally nor internationally, can be done alone. Within the various initiatives activated by our country, ETIC has a central role precisely with respect to the candidacy. Let me explain further. The candidacy of a country to host such an infrastructure is highly articulated and must be solid in all its components: political-institutional, scientific, economic-social, and also, of course, technical and technological. With regard to the first aspect, we recall in particular, among the various initiatives taken by political representatives at the national level, the press conference to make the candidacy official, the establishment by the Ministry of Universities and Research of the Scientific Technical Committee of which Ambassador Ettore Sequi is also a member, in charge of advancing the political discussion in Europe, as well as the visit to Sos Enattos by Minister Anna Maria Bernini, who also took part in the Einstein Telescope scientific community events. In addition to this, there is the support of local government, with the Autonomous Region of Sardinia having already funded SAR-GRAV, the first laboratory at the Sos Enattos site. From the scientific point of view, Italy's leadership in the field of physics, in general, and in gravitational astronomy and multimessenger astronomy, in particular, is recognized, as witnessed by the decades-long commitment of INFN, its researchers, and the experience of Virgo, as well as represented, to date, by the 535 (out of more than 1430) Italian female scientists participating in the international ET collaboration. Let us now come to the socioeconomic and technical/technological aspects, because it is precisely on these two components that the ETIC project financed under the NRRP notice (Mission 4, Component 2, investment 3.1.a) for Research Infrastructure focuses. On the one hand, the pre-feasibility study on the site in the area of Sos Enattos and on the other hand, the strengthening of the network of laboratories that contribute to the scientific and technological development necessary for ET: two ambitious objectives built around a complex structure of more than 140 activities carried out by 27 operational units (distributed among 3 research institutions and 11 universities) spread throughout Italy, which for the next 30 months can count on funding of almost 50 million euros. ETIC, concretely offers the conditions and resources to conduct the research necessary both for the characterization of the site in Sardinia and for the development of new enabling technologies for ET, two central elements in the bid (so-called bid-book) that Italy is preparing for the final choice in 2025.

What skills will be needed to conduct these activities?

The skills needed are multiple and multidisciplinary, and the ETIC partnership reflects these needs both in terms of laboratories and facilities and professional profiles. In this regard, I think it is also important to mention the 50 positions and 10 doctoral fellowships offered to female researchers who have chosen ETIC to begin or consolidate their studies and careers. Returning to the competencies, from a technological point of view, the challenges concern some well-identified macro-areas of development reflected both in the structure of the project itself and in the mixed research groups spread over the territory, for example: the groups in Padua, Bologna, Rome Tor Vergata, Florence and Cagliari focus on optics, electronics and photonics. The groups in Naples and Roma Sapienza on vacuum and cryogenics, the groups in Pisa, Perugia, and L'Aquila on suspensions, and the groups in Turin and Bologna on computing. Then of course there is all the civil engineering and sustainable design part that requires design and construction skills, including aspects of

sustainable and concerted inclusion in a well-defined environmental, social and economic context. In this the groups in Rome, Cagliari, Sassari and Catania are in the forefront. The continuity that has been chosen between the Research Units of ET and the Operational Units of ETIC ensures that what has been done so far will be enhanced by the resources of the project and put at the service of the bid. I would like to conclude by highlighting the important lead role of INFN. From the outset, the NRRP has been characterized by the need for very high managerial and managerial skills in order to achieve the ambitious goals within the set timeframe, a need derived from the European program from which it descends and the historical moment in which it was conceived. For this reason, the MUR itself has established the obligation to hire an Infrastructure manager for each individual project, capable of flanking top-level managerial skills with scientific expertise.

As part of ETIC, a day was already organized for companies interested in participating in the ET project, which received great interest. What is your assessment of this first confrontation between research and industry? What is the contribution that the industry world in Italy, and also abroad, will be able to bring to ET and how do you plan to promote their involvement?

This was a two-day meeting with Italian companies held last February at the European Gravitational Observatory, where the Virgo experiment is located, in Cascina, Pisa. We believe that an early direct confrontation with companies, as potential suppliers or partners in research and development activities, was very useful and necessary. The advanced design and frontier technologies that will be needed to achieve the sensitivity envisioned by ET cannot be developed without collaboration and co-design between the research and industrial worlds. ETIC, in this sense, fully assumes one of the cross-cutting axes of the NRRP, which is, precisely, public-private collaboration. In this sort of brokerage, the heads of ETIC's various activities were able to explain their technological needs to the 50 or so business delegates attending the event. We are seeing the positive balance on a daily basis: the various purchasing procedures and supply tenders published by ETIC are of great interest to Italian companies and beyond. ET and its international visibility make ETIC's activities interesting also for foreign companies, certainly European, but not only. Once again emphasizing that ET is a European project and that Italy has all the cards, including from an industrial point of view, to build the infrastructure. It is quite clear that the economic spin-offs of such an initiative will be very important: in the short and medium term for the direct involvement of partner or supplier companies, in the medium term, hoping that the final choice will reward the Sardinian candidacy, for the construction of ET and the necessary civil infrastructure, including roads, utilities, etc., and in the long term for the maintenance of both ET and the ecosystem that its presence will generate. The example of CERN in Meyrin (Geneva) and what it has achieved, and now represents, for its territory can clearly give us an idea of the economic impact, on very different scales,.

ETIC has already published its most relevant tender for the preparatory study for the development of the technical and economic feasibility project of ET in Sardinia. This is a European call for tenders with an investment of €14 million: can you explain what work will have to be done, what the most challenging tasks will be, and why it is so important for the Sos Enattos area bid?

I believe that from the very title of the call for bids "Preliminary study for the development of the technical and economic feasibility project of the Einstein Telescope gravitational wave observatory in the Region of Sardinia, in different configurations, including the execution of surveys and investigations and the preliminary

environmental impact assessment, for infrastructural works, underground and above ground, construction and plant engineering" one can understand the extent of the investment. This is a pre-feasibility study that will have to provide all the spatial and constructive elements to support Sardinia's candidacy. So this task shows an obvious degree of complexity and uniqueness, requiring extremely high levels of expertise. In fact, functional surveys and investigations are included in the site study for the optimization of the location, on the surface and underground, of ET infrastructure; a preliminary environmental impact study is also planned, again for both surface and underground works. All conducted taking into account the different geometric configurations being evaluated by the Einstein Telescope International Scientific Collaboration. These studies will form the backbone of the technical component of the bid-book. Regarding ETIC, within the work package dedicated specifically to sustainable design coordinated by the University Sapienza in Rome in close collaboration with INFN Southern National Laboratories, a multidisciplinary working group has been established to verify the compatibility between proposed solutions and scientific requirements.

Einstein Telescope will be a major research infrastructure involving both surface and underground facilities, which will fit into a natural setting to be protected and enhanced. How will ETIC be involved in taking care of both environmental and energy aspects?

Here, too, there are several lines of action that concur to make ET an environmentally and energy sustainable infrastructure. On the one hand, there is the ETIC project, which, like all NRRP-funded initiatives, is required to meet very stringent parameters. Think, for example, of the principle called Do Not Significant Harm (DNSH) whereby interventions under the NRRP must not cause significant harm to the environment and contribute with a specific allocation of activities and resources to the ecological transition. This is what we are already applying extensively in the selection of suppliers, materials and services: all must meet certain requirements in order to participate in procurement procedures or tenders promoted by ETIC. But Einstein Telescope, in addition to being a major scientific, technological, economic and social investment, is also a major civil engineering project that will be built both above and below ground and, as such, it requires careful planning of environmental aspects in the construction phase and energy aspects in the operation phase. ETIC holds these aspects in very high regard, one example for all: the management of soil and rock from mechanized tunnel excavation. This waste material will be partly waste that will have to be transported and disposed of properly, but partially it can be reused, think of granite, in a local circular economy, such as manufacturing activities. It is obvious that for this type of work, all the activities conducted on site are accompanied by in-depth investigations and studies: geotechnical and geophysical analyses, map of quarries and springs and watercourses, etc., using the most advanced design techniques (3D models and Artificial Intelligence models) to ensure an intervention with the lowest possible environmental impact and respect for existing constraints. Regarding energy aspects, the entire scientific and non-scientific community dreams of an infrastructure powered by clean energy, which is why ETIC also includes the study of renewable energy systems. In conclusion, I would, however, like to emphasize that the attention given to the "gentle" insertion of ET into the natural and geographic context of the Sos Enattos area would be sterile if the community active in supporting the Italian candidacy did not give the same attention to the involvement of the local communities affected by the project. This is an economically fragile area, and its silence and limited anthropization have become the strength of the candidacy. A research center such as ET can determine the economic and social development of the region that hosts it, provided that its

realization is the result of shared, concerted decision-making processes that are well represented to the citizens who are so enthusiastically accompanying the Sardinian and Italian candidacy to host ET, the future great gravitational wave detector.