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THE IMPLEMENTATION OF CTAO, THE FUTURE GAMMA RAY OBSERVATORY, A WORLD LEADER IN THE COMING DECADES, WILL REPRESENT A EUROPEAN AND NATIONAL SUCCESS We talked about this with Federico Ferrini,

new director of CTAO

In March, Federico Ferrini took over as director of the Cherenkov Telescope Array Observatory (CTAO), which will be the largest gamma ray telescope in the world. After having spent more than 30 years in astrophysics research and teaching at the University of Pisa, Ferrini was director, from 2011 to 2017, of the European Gravitational Observatory (EGO), the consortium which hosts the Virgo interferometer, right in the crucial years of implementation of the Advanced Virgo project for the upgrade of the detector and the discovery of gravitational waves. Now Ferrini begins a new experience as head of CTAO, a cutting edge scientific and technological enterprise, in which Italy is taking part with the National Institute for Astrophysics (INAF) and INFN. The significance of the CTAO project, whose headquarters are in Italy, in Bologna, has also been recognised by ESFRI, which has included it in the roadmap that indicates the research infrastructures of primary interest for Europe.

After the recent experience as head of EGO that ended with the success of Virgo, now you are facing a new and significant challenge as director of CTAO. What are the most stimulating and challenging aspects of this project?

CTAO is a project that involves the construction of a research infrastructure that will allow us to study the universe through gamma rays, which are the most intense electromagnetic signals coming from the cosmos, in an absolutely extraordinary range of energy amplitudes.

CTAO will be an observatory devoted to run certain key projects, as priority mission, but also dedicated to the requests of scientists worldwide interested in using this unique infrastructure. This is a fundamental novelty with respect to previous gamma research systems. I would like to underline, in fact, that it consists of two large installations: one in the northern hemisphere, on the



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island of Las Palmas in the Canary Islands, and one in the southern hemisphere, in Chile, about 20 kilometres from the large optical telescopes of the European Southern Observatory (ESO). In total, around 120 telescopes of three types will be installed, each one aiming at optimising sensitivity in different and complementary energy bands. CTAO will keep us busy with many challenges, big numbers and complexity of choices (from the R&D phase to production). Different problems to be faced, such as ensuring the quality of the mirrors for decades, fast tracking of transient phenomena by very heavy metal; and innovative detection chambers with technological solutions, which for now are competing with each other.

What is the roadmap of the CTAO project and what are the next steps?

There are numerous milestones in the CTAO roadmap, starting with the transformation from a German non-profit organisation into a European Research Infrastructure Consortium (ERIC), as decided by the Council of Member States. This objective, for the achievement of which we are in close collaboration with the Ministry of Education, University and Research (MIUR), will lead to an ERIC in Italy, hopefully by the end of 2019. By the same date, I have planned the complete definition of the design and engineering of both the infrastructures as well as the installation of the scientific equipment. During 2020, the construction process will start. It must be designed in an industrial manner, once the construction and integration contracts have been well planned and awarded. At the same time, preparation of all the data control, acquisition, distribution and analysis software will be completed, having built the data management centre in Zeuthen, near Berlin, in 2019. The construction, integration, acceptance and commissioning of the 120 telescopes and the overall systems of the North and South sites must be completed by the end of 2023, in order to start scientific observations at the beginning of 2024.

Large fundamental physics projects often require the development of new technologies. What are the most advanced aspects of this project, both from the scientific as well as technological point of view?

The scientific groups involved, the best worldwide in this field, have developed extremely refined solutions with impressive performance. An emerging problem is that there is a surplus of solutions for the same experimental request: the management task, therefore, will be to identify a single solution that has the characteristics to satisfy the scientific requests and, at the same time, is "simple", solid and sustainable, but the management will also have the task of having the choice accepted and obtaining the consent of all participants.



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Like all big projects, CTAO is also the result of significant international collaboration. What is Italy's role in this area?

Italy, thanks to INAF and INFN, has for years been one of the leading countries in gamma astronomy, both for its significant participation in the more specifically scientific aspects, as well as for the technological contributions in the history of high energy astrophysics instrumentation, with participation in satellite enterprises and the development of terrestrial systems. Having the management of CTAO, the world's leading project in the sector for the coming decades, in Italy is certainly a great opportunity, as well as a sign of international distinction and importance.

CTAO is an ESFRI project, an infrastructure considered of significance at the European level. What does this mean? What are the characteristics that allowed CTAO to become part of the ESFRI roadmap?

Being part of the ESFRI European roadmap for large research infrastructures, as well as being a clear recognition of the global excellence of the project, provides significant opportunities for ad hoc funding from the European Commission in the various research funding framework programmes. At the same time, being an ESFRI project puts CTAO in a prominent position within the now customary planning of investments in large research infrastructures of national interest by the main countries. CTAO is included in the national roadmaps of the major European countries and its implementation will be seen as both a European and national success.

What does it mean to be the head of large scientific infrastructures that have very ambitious goals, like EGO and CTAO?

After many years of scientific research in theoretical astrophysics, often aimed at the study of complex systems, I have put myself at disposal of the community with the aim of collaborating in the implementation of "difficult" projects, trying with my experience and my mental attitude to build that bridge that unites the conceptual and technological development of an experiment with its implementation, subject to finances, timing and many other kinds of constraints. At the same time, I try to maintain intellectual affinity with the scientific component and the ability to flexibly and diplomatically interface with the customer component, in order to develop the project to the satisfaction of both, as it should be. In other words, I have fun with my fellow scientists and engineers, and openly dialogue with the funding agencies. If all this makes it possible to facilitate the implementation of these ambitious projects, I am happy as a small cog in the machine of knowledge.