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A EUROPEAN ERC GRANT FOR THE NEW ENUBET NEUTRINO SOURCE

Andrea Longhin, a researcher at the Frascati National Laboratories (LNF) INFN has been awarded one of the 302 2015 Consolidator Grants of the ERC (*European Research Council*) addressed, on a competitive basis, to high-impact research programmes. The grant, amounting to 2 million euros, will support the *Enhanced NeUtrino BEams from kaon Tagging* (ENUBET) neutrino physics project for a period of five years, which will officially start on 1 June.

The objective of the ENUBET project, which promises to open a new frontier in neutrino physics, is to provide physicists with an innovative technology for the production of intense sources of electron neutrinos (ν_e), with an accuracy ten times greater than standard: a novel investigation instrument in the field of neutrino physics.

Traditional beams, conceived back in the 60s of the last century, are characterised by severe limitations, which have heavily influenced the precision study of the oscillation phenomenon. The phenomenon is characterised by gradual transitions between the three neutrino families, which take place during propagation and which are due to the fact that neutrinos have a mass, even if small. Being able to measure, in particular, small differences in the oscillation from a muon neutrino into an electron neutrino ($\nu_\mu \rightarrow \nu_e$) and that involving their antiparticles - a phenomenon known as leptonic CP violation - would have important consequences. The predominance of matter over antimatter, which is observed in all that surrounds us, could in fact be a consequence of the behaviour of primordial neutrinos present shortly after the Big Bang.

For this reason, ENUBET will particularly focus on producing a well-controlled beam of electron neutrinos. This will allow, as never before, analysis of all the details of their interactions with ordinary matter: an almost obligatory step for a solid measurement of CP violation in neutrinos. The measurement will help the physicist community engaged on this front, which is preparing to build huge underground tests planned in Japan (*Hyper-Kamiokande*) and in the USA (DUNE).

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Thanks to the ERC funding and a team of physicists from INFN and other European institutions, ENUBET will address its challenge by measuring the positrons that accompany the production of electron neutrinos in the decay tunnels of traditional beams. In the tunnels, the particles flows are very high, reaching one million particles per second per square centimetre, which makes them unfavourable for the installation of detectors. The "intelligent" decay tunnel which ENUBET proposes is the basis for a large detector (approx. 50 metres long) based on innovative photo-silicon sensors, potentially able to overcome the difficulties - radiation resistance, response speed, competition of disturbance processes, high costs - that would have made such a programme totally unrealistic until a few years ago.
The idea of this positron detector (tagger) will be tested on a prototype subjected to testing with particle beams in specific areas at CERN in Geneva and at INFN in Frascati. The project, moreover, also potentially has the possibility to implement the first time-tagged neutrino beam: in this configuration, not only is the number of electron neutrinos accurately determined by counting the positrons, but it is also possible to individually associate each neutrino with its mother particle. The result is a priori knowledge of the characteristics of each neutrino in terms of energy and lepton family. This is among the most ambitious and complex objectives of the project, which would implement one of the pioneering ideas that Bruno Pontecorvo speculatively formulated in an article in the 1980s. ■