

SCIENTIFIC PROPOSAL

At present the Standard Model of elementary particles and interactions is confirmed with a high precision. Nevertheless, it still contains conceptual problems like the hierarchy problem and requires a number of input parameters. From the theoretical point of view it is expected to be a low energy effective model of a more fundamental theory. However, until recently, no experimental evidence for physics beyond the Standard Model had been found, with one exception: The discovery of neutrino oscillations. The fact that neutrinos are massive particles has considerable impact on different domains of physics. In view of the importance of this discovery and its implications, a number of projects are running, planned in the near future, or under study in order to address many still open questions about neutrinos. Among them are those concerning their Majorana or Dirac nature, the mass hierarchy and absolute mass scale, the electromagnetic properties, the knowledge of the mixing angle θ_{13} , the possible existence of sterile neutrinos and of CP violation in the leptonic sector.

As far as CP violation is concerned, three options are at present under very active investigation : super-beams, neutrino factories and beta-beams. While superbeams are conventional neutrino beams pushed to their ultimate intensities, neutrino factories and beta-beams are novel concepts. Neutrino factories are based on the production, collection, acceleration and storage of muons to obtain muon and electron neutrino beams of opposite helicities. The energy of these beams would be of several tens of GeV and the needed baseline of the order of 3000 Km. These beams could address in one step the leptonic CP studies, the measure of the hierarchy of the neutrino masses and the precision measurement of the θ_{23} , δm_{23}^2 and θ_{13} parameters. Beta-beams consist in accelerating and storing radioactive ions decaying through beta decay. Very pure (anti)electron neutrino beams of energies up to 1 GeV can be produced. The production of beta-beams requires a very close synergy with the nuclear physics community working on the EURISOL project. In the beta-beam baseline studied so far, neutrinos from a beta-beam and a superbeam (produced by the same proton driver) are sent to a gigantic Cherenkov detector located in an upgraded underground Frejus laboratory. A large physics program can be performed, including CP (and CPT violation) in the leptonic sector, proton decay and the detection of supernova neutrinos.

Recently it has been proposed to use the beta-beam concept to have intense neutrino beams at low energies (typically a few tens of MeV up to about a hundred MeV). Very intense exotic beams will be available in the future at various facilities like at GANIL and GSI or the EURISOL project, offering different possible sites for a low-energy beta-beam facility. This could offer a unique opportunity to improve our knowledge on neutrino properties, like the neutrino magnetic moment, as well as to perform systematic studies on neutrino-nucleus interactions in an energy range of interest for nuclear, particle physics and astrophysics. In fact, these reactions are extremely important for the interpretation of some current neutrino experiments, like oscillation measurements, as well as for the study of the feasibility of new projects, such as new observatories to detect neutrinos emitted in a supernova explosion, a phenomenon not yet fully understood. Finally, the role of neutrino-nucleus interactions in nucleosynthesis is at present under active investigation.

The workshop aims at bringing together worldwide experts, experimentalists and theoreticians, working on the feasibility and physics potential of the above-mentioned facilities, as

well as on related topics in other fields like astrophysics and cosmology. Having this in mind, we plan to devote much time to informal discussions.

The central goals of the workshop are :

- to present status and future projects in neutrino physics and nuclear physics with exotic ion beams;
- to discuss the feasibility and physics potential of neutrino factories, super-beams, beta-beams and low-energy beta-beams;
- to address the impact in related fields, among which hadron physics, muon physics, baryogenesis and leptogenesis, nucleosynthesis.

More information on the facilities can be found on the web-sites :

<http://muonstoragerings.web.cern.ch/muonstoragerings>

<http://beta-beam.web.cern.ch/beta-beam/>