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Towards a future high-intensity neutrino programme

The ISS Programme Committee

High-precision measurements of neutrino oscillations are required

It is widely recognised that a precise and detailed knowledge of the properties of the neutrino is of the highest scientific importance. High-precision accelerator-based measurements of neutrino oscillations are an essential part of the programme required to determine these properties.

Three classes of facility have been proposed to serve the high-precision era: second-generation super-beam experiments; beta-beam facilities; and the neutrino factory. The cost of each of these options is significant making it likely that the particle-physics community will eventually have to make choices. The criteria upon which these choices will be made include: the measured values of the oscillation parameters, in particular the value of θ_{13}; the physics reach and the cost of each of the proposed facilities; and the schedule on which each facility can be implemented. It is important that the best possible information be available at the time the decisions are needed. For each option, significant investment in hardware R&D and engineering design is required for a Conceptual Design Report (CDR) to be produced.

The International Scoping Study of a future Neutrino Factory and super-beam facility (the ISS), which presented its conclusions at NuFact06 (24 – 30 August, 2006, Irvine, California) studied the physics case for high-precision measurements of the properties of the neutrino, compared the performance of the different options on an equal footing, and outlined a number of accelerator and detector baseline scenarios for a neutrino factory that now need to be carried forward in a design study.

Timescale

The decision on the precision accelerator-based neutrino-oscillation programme should be possible soon after the reactor and long-baseline neutrino oscillation experiments which are presently being implemented, have provided information on the key parameter θ_{13}. Meeting this timescale requires that CDRs for the considered facilities be available by ~2012. In addition, it is important that interim design reports (IDRs) containing reliable estimates of performance and cost are available by ~2010. It is anticipated that at this time, LHC results being available, decisions on the infrastructure needed for the high-energy-frontier exploration will be made. For substantial neutrino infrastructures to be included in plans for the future of the field appropriate IDRs will need to be available.

The International Design Study initiative

In order to provide the information required, full design studies of the super-beam, beta-beam, and neutrino factory options are needed. To support the instigation of the various studies, and to provide a degree of oversight during the design-study period, it is proposed that an organisation such as that shown in figure 1 be put in place. The three separate design studies would each be initiated by those seeking to propose a particular option, and would be carried out in parallel.

The teams carrying out the studies would be strongly encouraged to work together on areas of common interest. The detector requirements for beta-beams and super-beams are very similar as are the multi-Megawatt proton driver and target for the neutrino factory and super-beam. The over-arching synergy, the neutrino-oscillation science driver, is recognised in the form of the Neutrino Oscillation Physics Working Group, which is envisioned to continue the work of performance evaluation and comparison that was initiated through the ISS. The regional oversight bodies could provide a degree of coordination.

To facilitate the initiation of the various design studies, the ISS Programme Committee seeks to produce a short document, to be published alongside the ISS report, that will summarise the R&D roadmap to the decision point in ~2012.

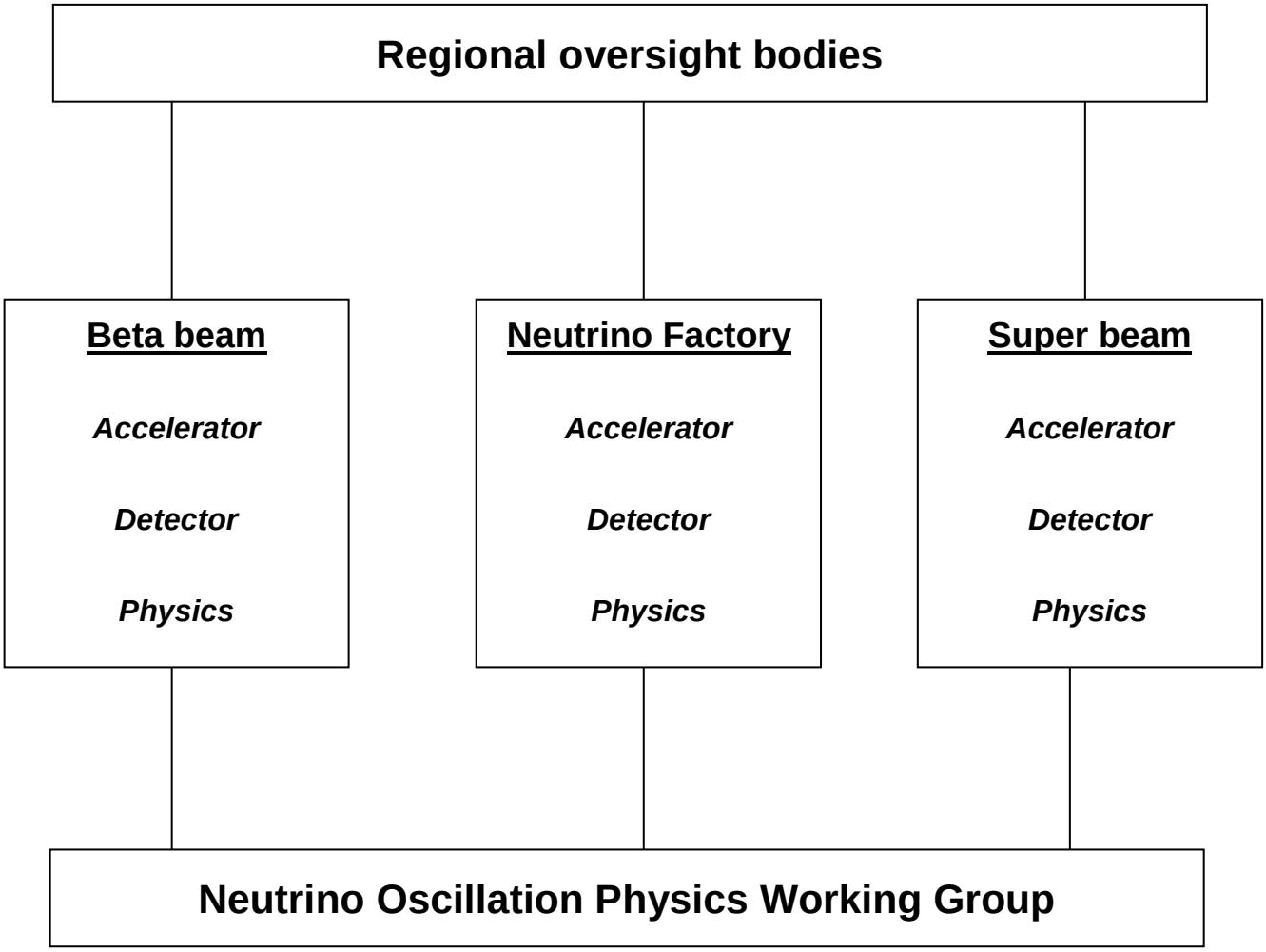

Figure 1: Organisation for the design-study programme.