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DAEdALUS: using multiple accelerators to determine CP violation in the neutrino sector

Measurement of delta, the CP violating phase in the neutrino mixing matrix, is a crucial next step in our understanding of the universe. It appears as a +- sin(delta) term in the expression for the rate of oscillation from muon to electron neutrinos: CP violation makes the rate for nu_mu to nu_e transitions different from nu_mu bar to nu_e bar. However delta can be determined by measuring either of these rates: DAEdALUS proposes to use the second.
The oscillation depends on L/E, and we maintain strict control of E by using decay-at-rest pi+ mesons which provide a source of muon antineutrinos up to 53 MeV, with very low electron antineutrino contamination. For a good measurement one needs three values of L corresponding to 0, pi/4 and pi/2 of an oscillation. The near measurement establishes the total rate; the medium one the oscillation wavelength, and the far one, at the oscillation peak, the amplitude. Rather than building a source and three detectors, we propose a single detector, shared with LBNE, a large Gadolinium loaded water Cerenkov at the underground DUSEL facility, and, at different distances, three sources from different accelerators. These machines need to deliver protons with an energy of order 1 GeV, and to run at several Megawatts. The requirements are similar to those of proposed ADSR systems, and there are opportunities for synergies in their development. We outline the technical challenges of producing such high currents, with the proposed possible solutions. These include stacked cyclotrons, the MultiMegawatt cyclotron, the Compact Superconducting Cyclotron, and the FFAG. We discuss the timescale for possible results, and how they would complement those of LBNE.

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