Short-Baseline Experiments with Reactors and Sources

Jun Cao and Soo-Bong Kim (April 19. 2015) at Fermilab

■ Reactor: an intense source of electron antineutrinos with energies between a few and several MeV

.■ Radioactive source: neutrinos or antineutrinos produced by a strong (0.1~10 MCi) nuclear decays

- Precise measurements of oscillation parameters by reactor neutrinos
  - Determination of unknown neutrino properties or testing theoretical models
  - Sensitive test of the three-flavor framework or new physics beyond Standard Model

  - Expected precisions of θ_{13} and Δm_{ee}^2 by ~2017
    $\sin 2(2\theta_{13})$: 10% Double Chooz, 3~4% Daya Bay, 5% RENO
    Δm_{ee}^2 [10^{-3} eV^2] : 0.07 Daya Bay, 0.1 RENO

  - Expected precision of θ_{12}, Δm_{21}^2, and Δm_{ee}^2 by ~2025
    JUNO/RENO-50: better than1%

- Large liquid scintillator detector with a baseline of ~50 km from reactors [JUNO and RENO-50]
  - Determination of neutrino mass hierarchy with an energy resolution of 3% at 1 MeV
    [3~4σ significance: 6 yrs. of JUNO, 10 yrs. of RENO-50]
  - Precise measurements of oscillation parameters θ_{12}, Δm_{21}^2, and Δm_{ee}^2 by ~2025
  - Neutrinos from the Earth, the Sun, and Supernova
  - JUNO: fully approved, start of excavation in Jan 2015,
    data-taking in 2020
  - RENO-50: R&D funded

- Search for sterile neutrinos
  - Short baselines (5~20 m) of reactor neutrinos (2015~2016) : DANSS, Hanaro, Neutrino-4, Nucifer, NuLat, Poseidon, PROSPECT, SoLid, and Stereo [sensitivity of sin2($2\theta_{14}$) ~0.01, reactor anomaly proven or rejected with 5σ significance by 2020]
  - Strong (0.1~10 MCi) radioactive neutrino sources (^{51}Cr, ^{37}Ar, ^{144}Ce, ^{37}Sr, ^{8}Li) for Δm_{41}^2 ~1 eV^2 and $\sin^2(2\theta_{14})$ ~ (0.03 - 0.04):
    SOX with ^{144}Ce/^{51}Cr in 2016,