Pseudo-Dirac Solar neutrinos at JUNO

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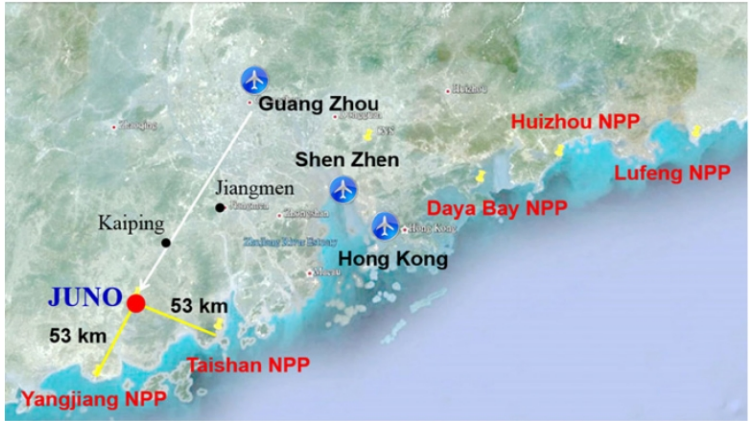
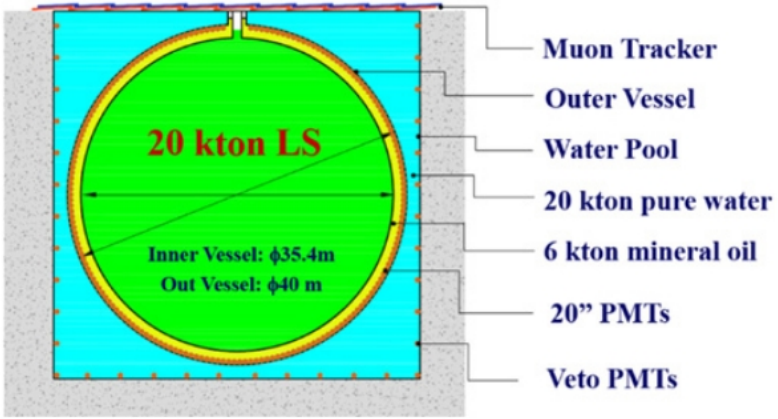
The JUNO Experiment

- Jiangmen Underground Neutrino Observatory (JUNO)
- Liquid scintillator technology
- 20 ktonne fiducial volume
- Primary goal is to determine the neutrino mass hierarchy





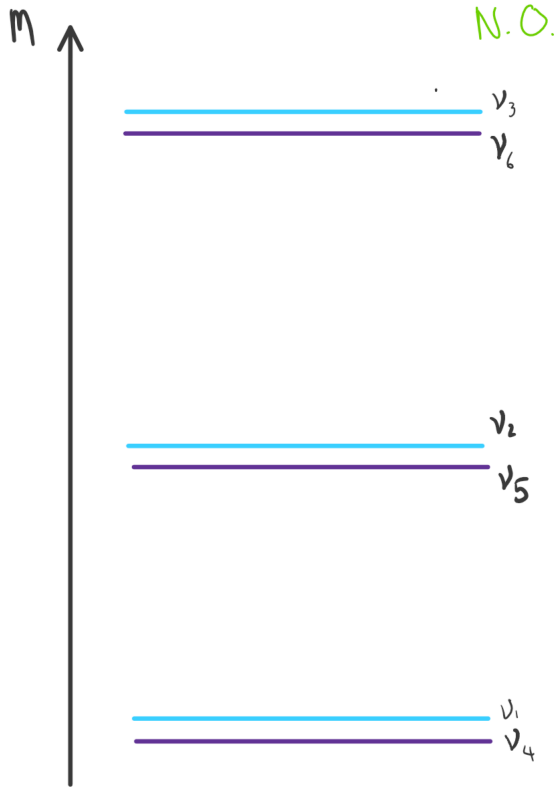
Fengpeng An et al 2016 J. Phys. G: Nucl. Part. Phys. 43 030401

Pseudo Dirac neutrinos

$$\bar{\Psi} m \Psi + \bar{\Psi}^c \mu \Psi, \mu \ll m$$

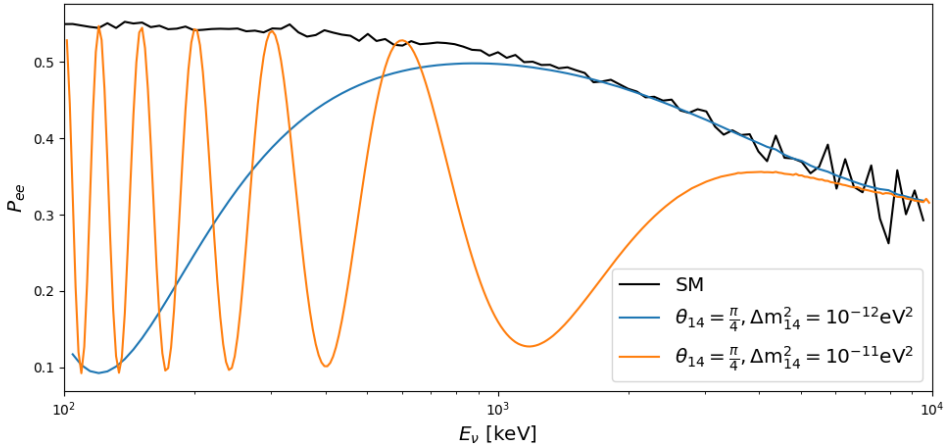
See e.g.: 2211.09105

- Dirac neutrinos split into 2 Majorana neutrinos
- Maximal mixing angle with very small mass difference between pairs
- Results in 3 active and 3 sterile neutrinos
- We look at Δm^2_{14} neutrino splitting only for simplicity and allow θ_{14} to vary

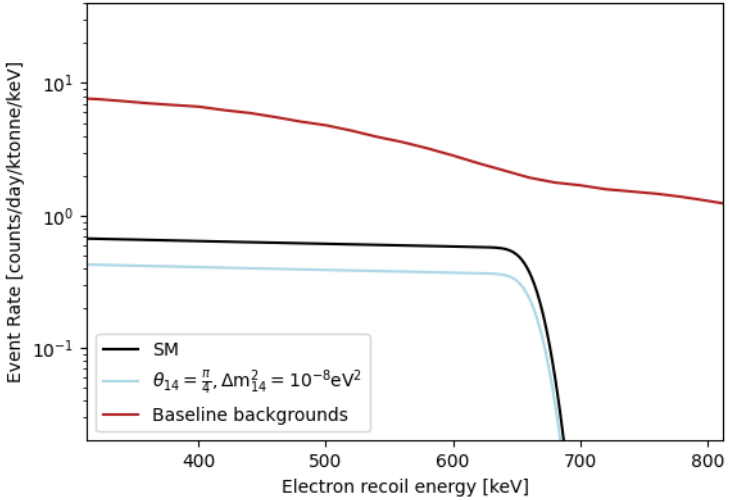


Solar neutrinos

- Be7 neutrinos most prominent **signal** at JUNO
- Most prominent **backgrounds** are Bi210 and Kr85
- Measure recoil energy of scattered electron



$$\frac{dR_{\mathrm{Be}^7}}{dE_{\mathrm{recoil}}} = N_e \phi_{\mathrm{Be}^7} P_{e\alpha} \left(\frac{d\sigma}{dE_{\mathrm{recoil}}} \right)_\alpha$$

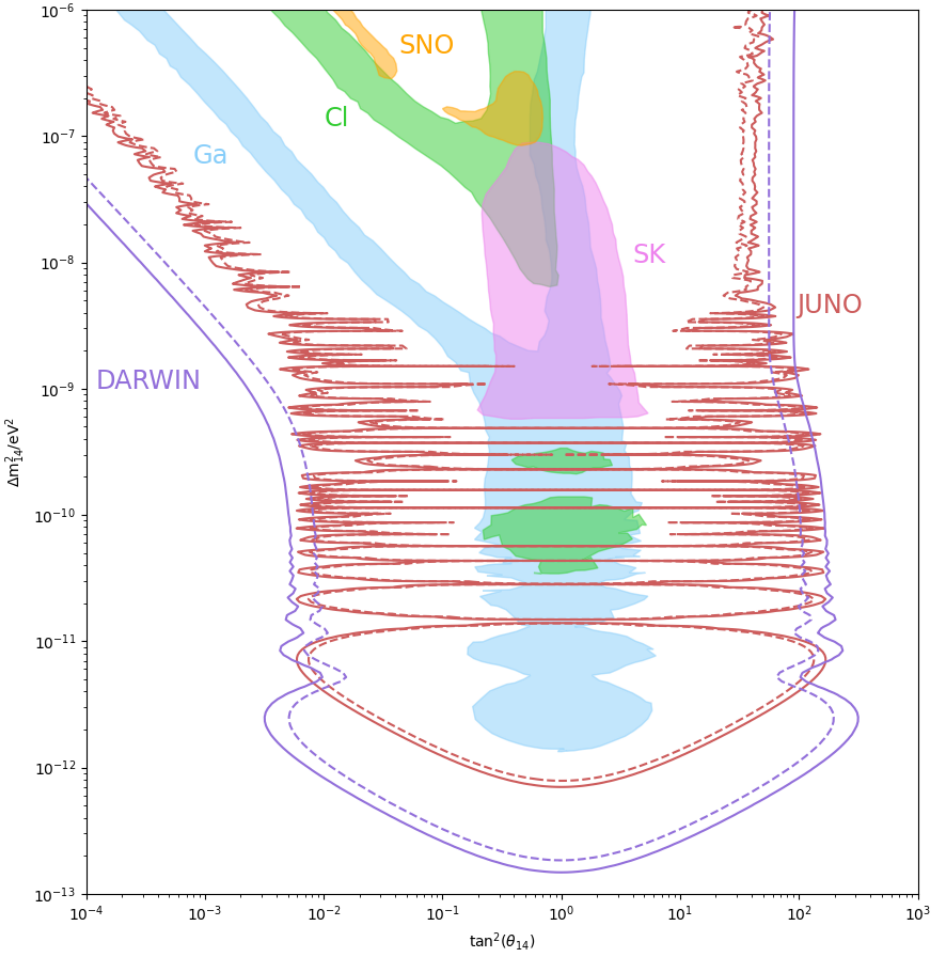


Results

- Assuming **6 years** and **20kt** fiducial mass
- Sensitivity far exceeds current/past neutrino experiments
- Competitive with the future DARWIN experiment (2111.02421, Y. Perez-Gonzalez et. al.)

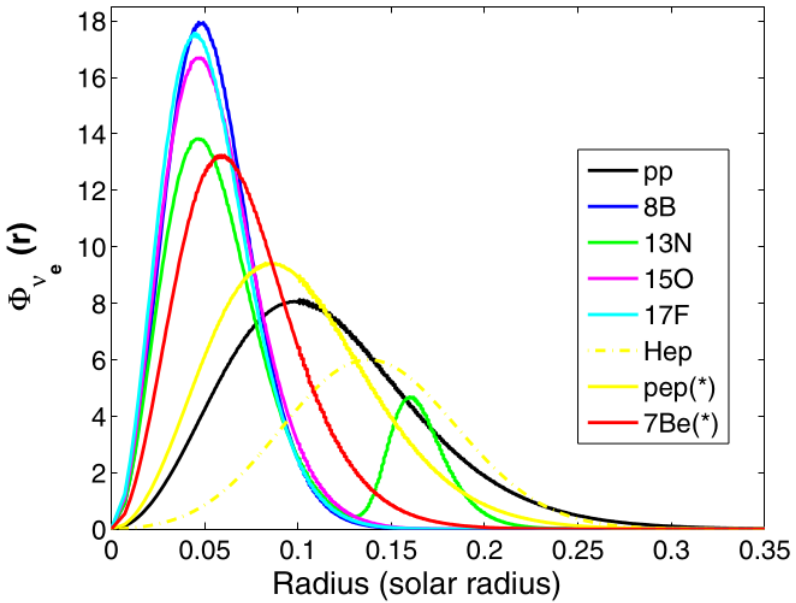
<u>Outlook:</u>

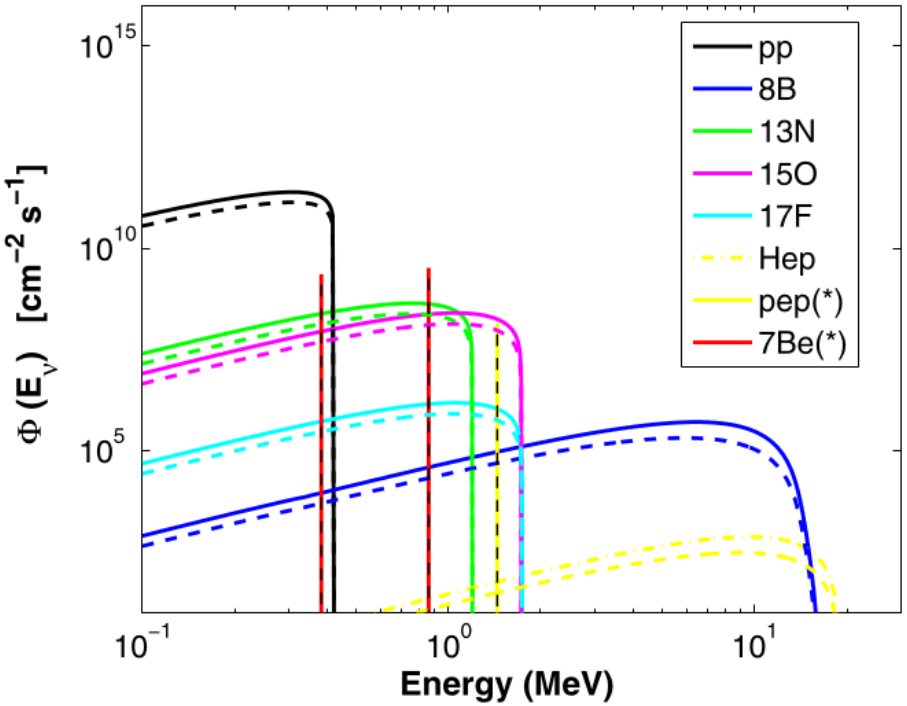
- Sensitivity for Δm^2_{25} and Δm^2_{36} splitting
- Analysis of full Pseudo-Dirac scenario



Thank you

Solar neutrino fluxes





Source: Ilídio Lopes and Sylvaine Turck-Chièze 2013 ApJ 765 14

Chi-squared

$$\chi^2 = \frac{\left((1+f_{\mathrm{Be7}})E^{\mathrm{Be7}} + \sum_{\mathrm{bkgs}}(N_{\mathrm{bkg}}-1)R_{\mathrm{bkg}} - E^{\mathrm{Be7}}_{\mathrm{SM}}\right)^2}{R^{\mathrm{Be7}}_{\mathrm{SM}} + \sum_{\mathrm{bkgs}} R_{\mathrm{bkg}}}$$

$$+\left(\frac{f_{\mathrm{Be7}}}{\sigma_{\mathrm{Be7}}}\right)^2 + \sum_{\mathrm{bkgs}}\left(\frac{N_{\mathrm{bkg}}-1}{\sigma_{\mathrm{bkg}}}\right)^2$$