SIMULATION OF NEUTRINO SIGNAL FROM DARK MATTER ANNIHILATION FOR JUNO EXPERIMENT

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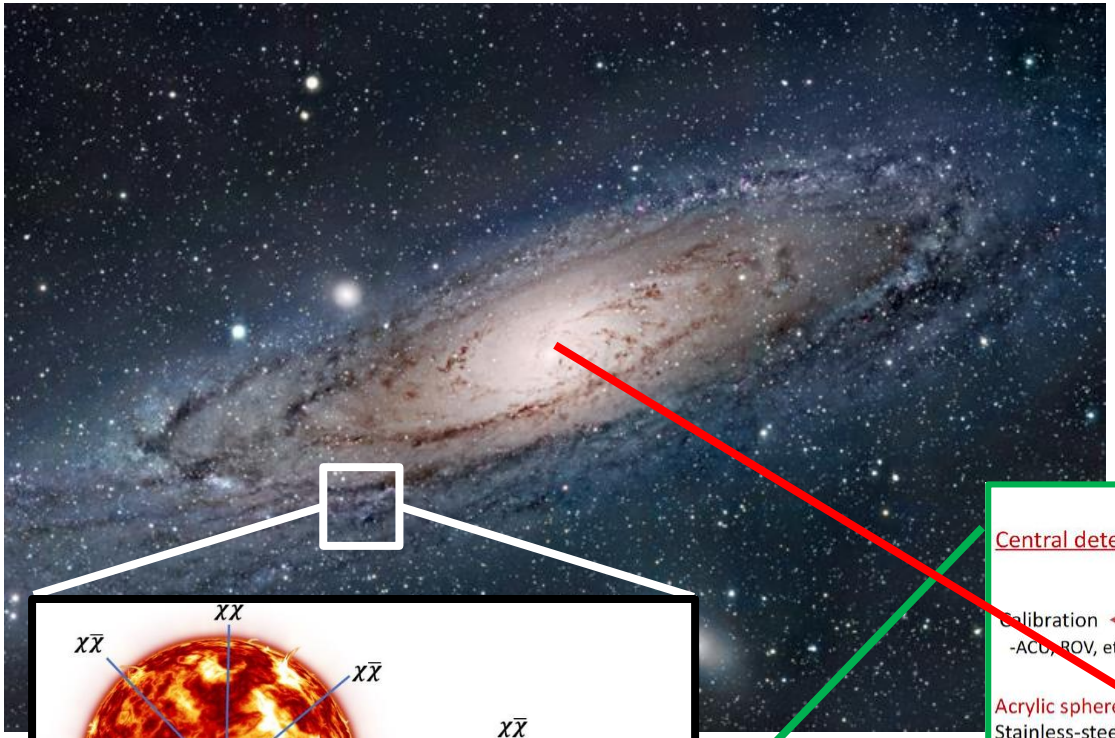
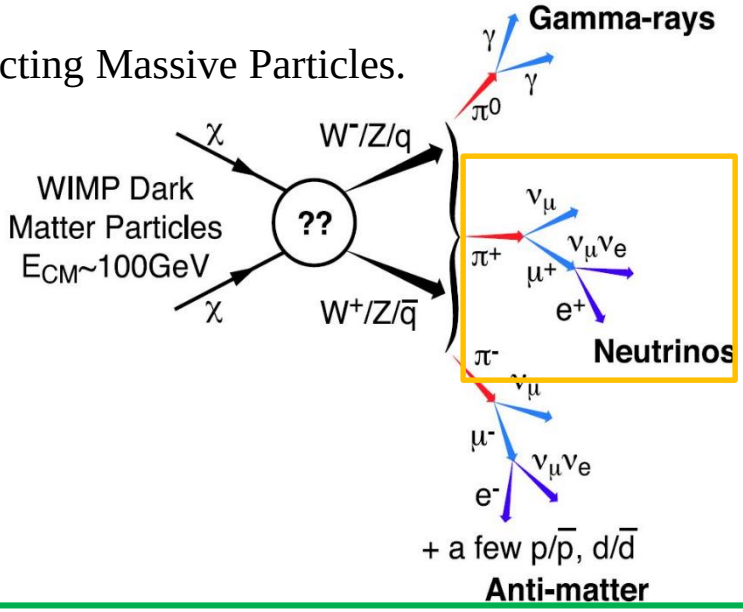
Objective

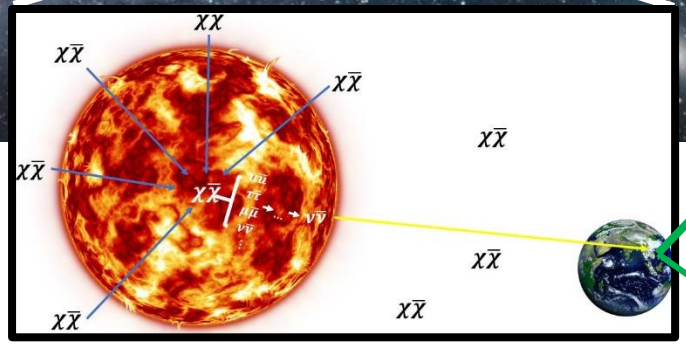
- Create Dark Matter generator in JUNO software framework
- Study neutrino signal from dark matter and background signal.

Indirect dark matter detection for JUNO experiment

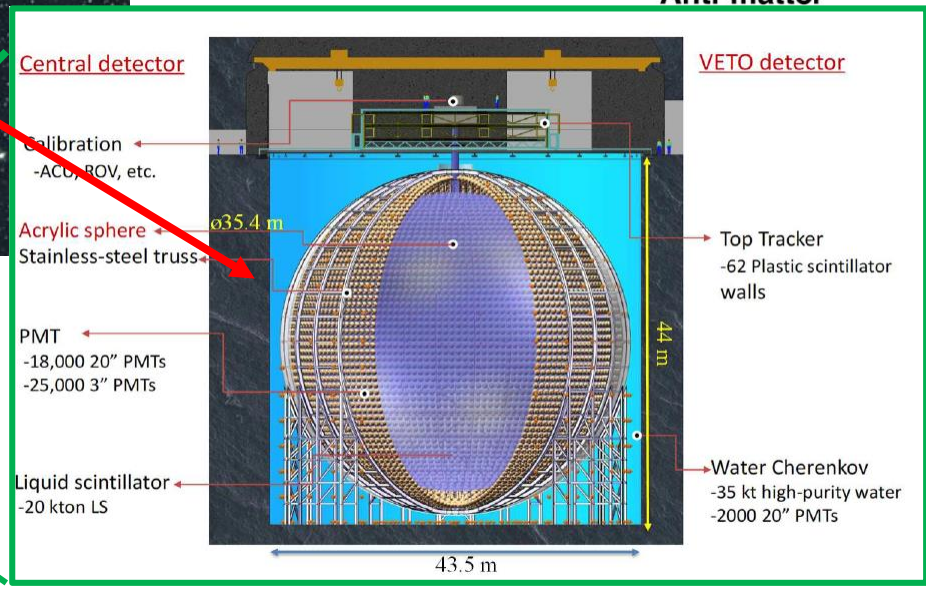
- The leading dark matter candidate is WIMPs or Weakly Interacting Massive Particles.







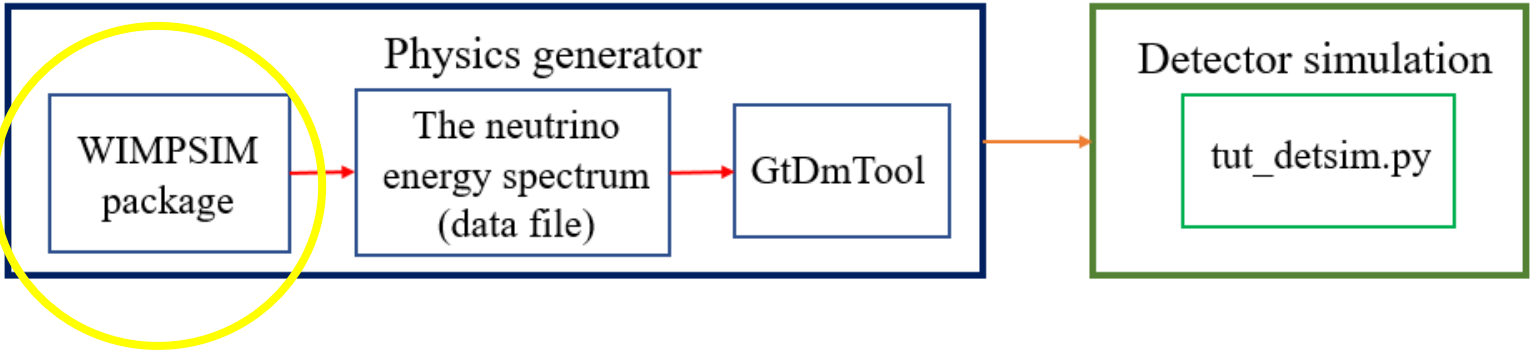
- The neutrino interaction with nucleon atoms inside the sun are considered by the element densities and opacity as the function of sun's radius.



Jiangmen Underground Neutrino Observatory (JUNO)

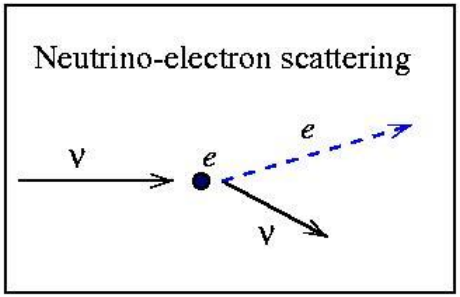
Dark Matter generator (1)

- The JUNO software framework is Monte-Carlo simulation to predict detector simulation of neutrino by experiment



Input parameter
- DM mass
- Number of event
- Channel
- Neutrino oscillation parameters

Considering
- Neutrino interaction with LS



Including effect
- PMT
- Geometry

Expected Neutrino Spectrum

- The differential neutrino flux of favor β (for $\beta = e, \mu, \tau$) from the dark matter annihilation ($\chi\chi \longrightarrow f\bar{f}$) is

$$\frac{d\Phi_{\nu_\beta}^{DM}}{dE_\nu} = P_{\nu_\alpha \to \nu_\beta}(E_\nu, D)\frac{\Gamma_A}{4\pi D^2}\sum_f B_\chi^f \frac{dN_{\nu_\alpha}^f}{dE_\nu}$$

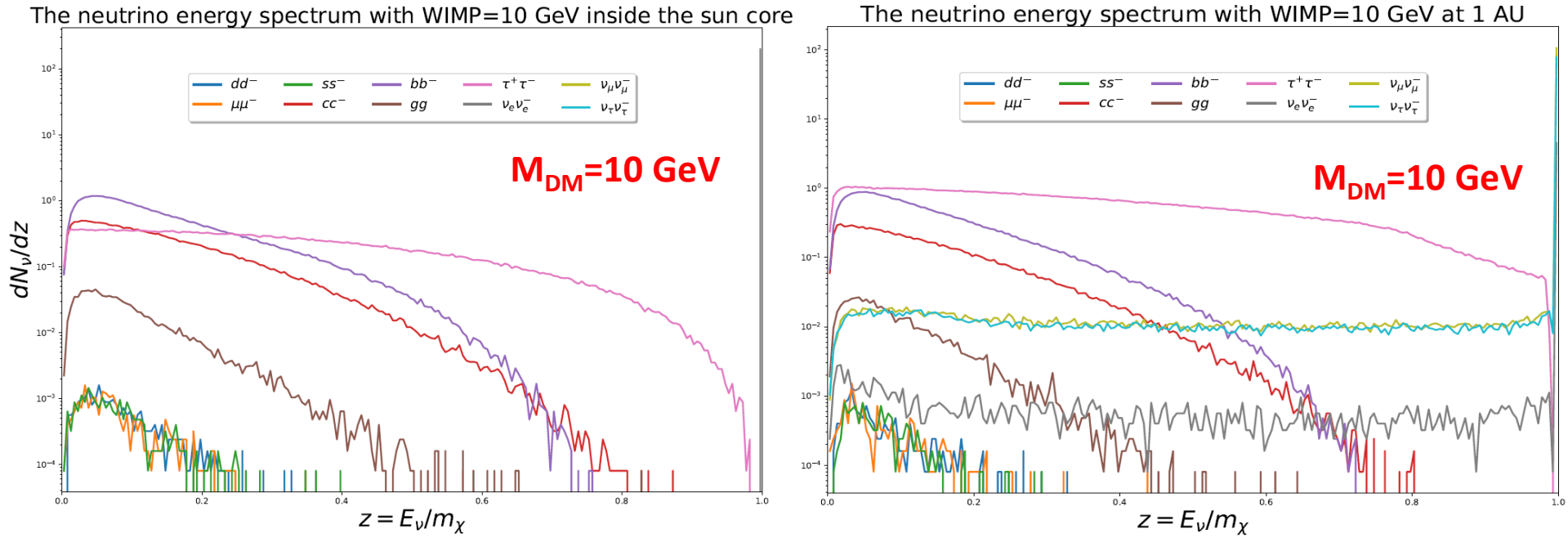


Figure 1. The electron neutrino spectrum with the ratio of neutrino energy and mass of WIMPs in the sun's core and 1 AU by using 10 GeV respectively. Each of color lines are different particle channels from DM annihilation.

Expected Neutrino Spectrum (contd.)

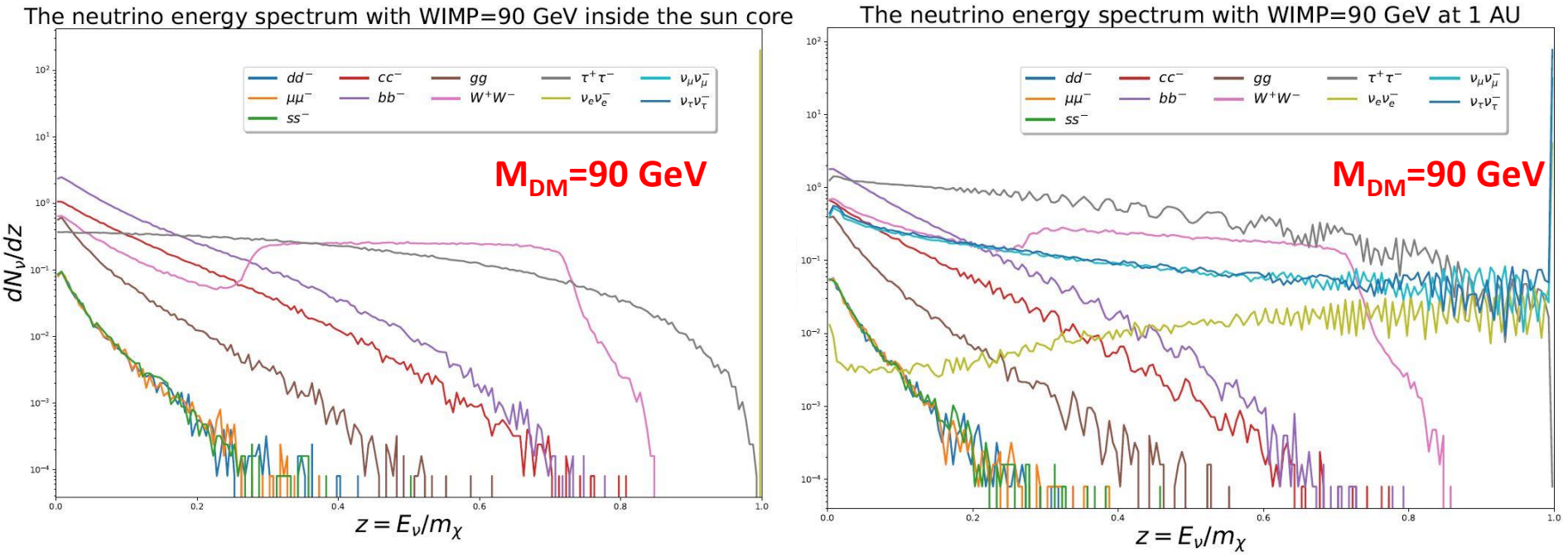


Figure 2. The electron neutrino spectrum with the ratio of neutrino energy and mass of WIMPs in the sun's core and 1 AU by using 90 GeV respectively. Each of color lines are different particle channels from DM annihilation.

Expected Neutrino Spectrum (contd.)

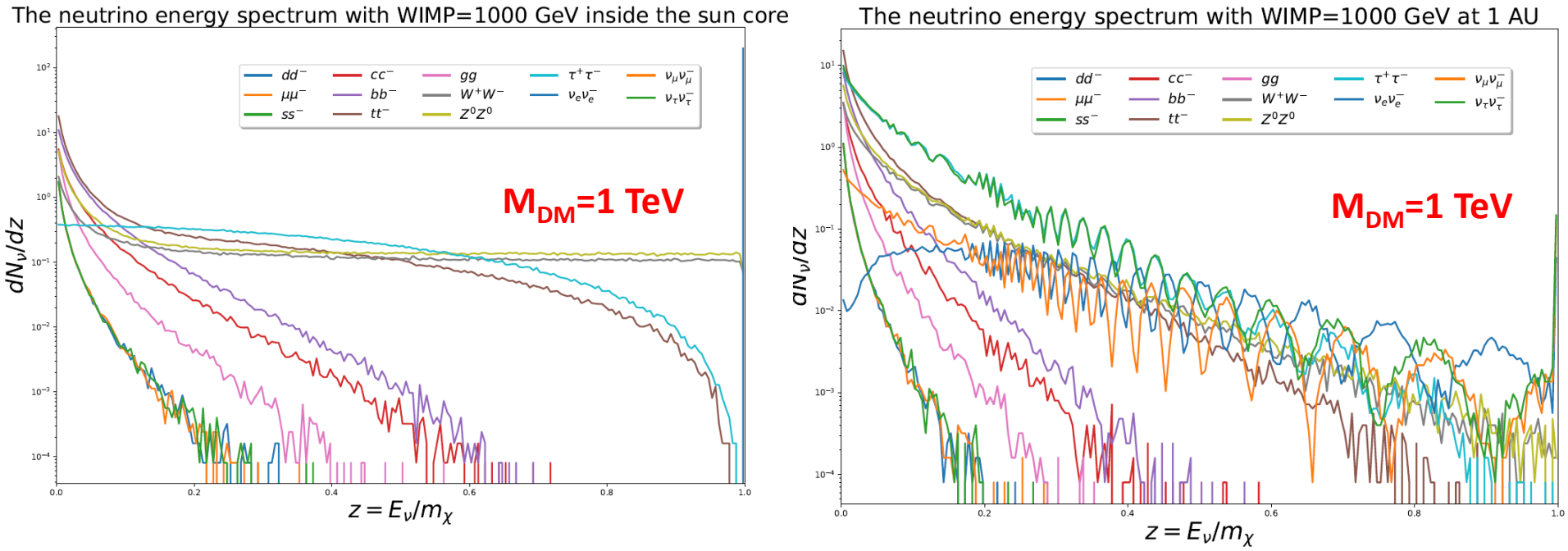
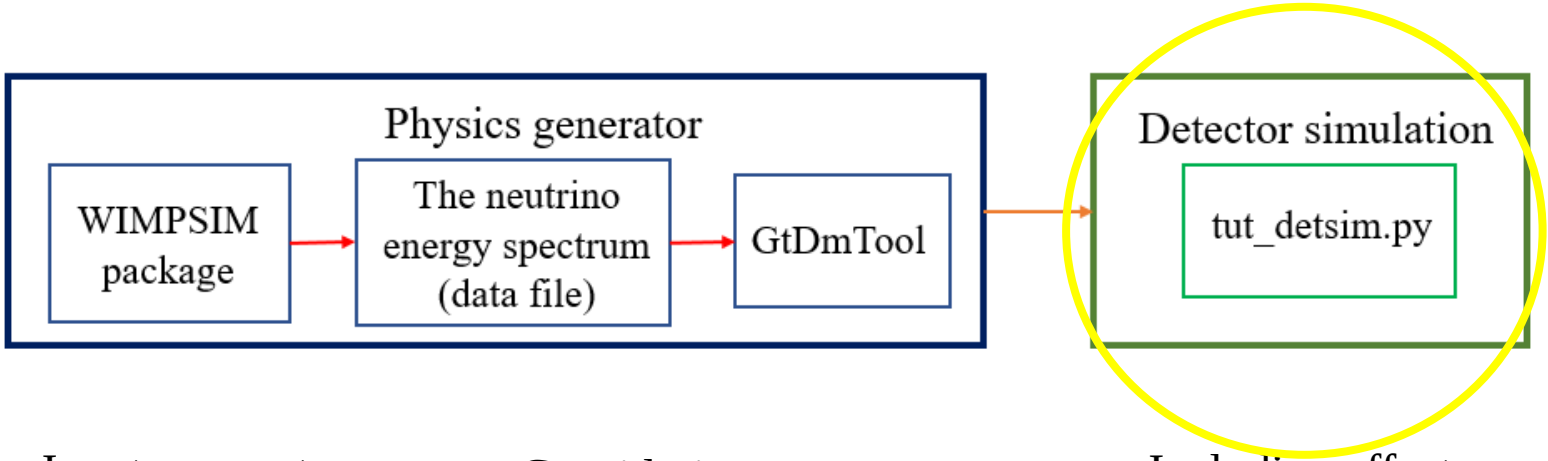


Figure 3. The electron neutrino spectrum with the ratio of neutrino energy and mass of WIMPs in the sun's core and 1 AU by using 1 TeV respectively. Each of color lines are different particle channels from DM annihilation.

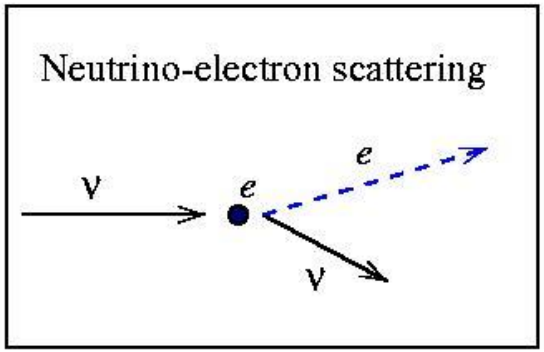
➢These spectra are different according to the WIMPs mass, the channel, and the location that have an effect from the neutrino oscillation, neutrino-nucleon cross section and tau decay.

Dark Matter generator (2)



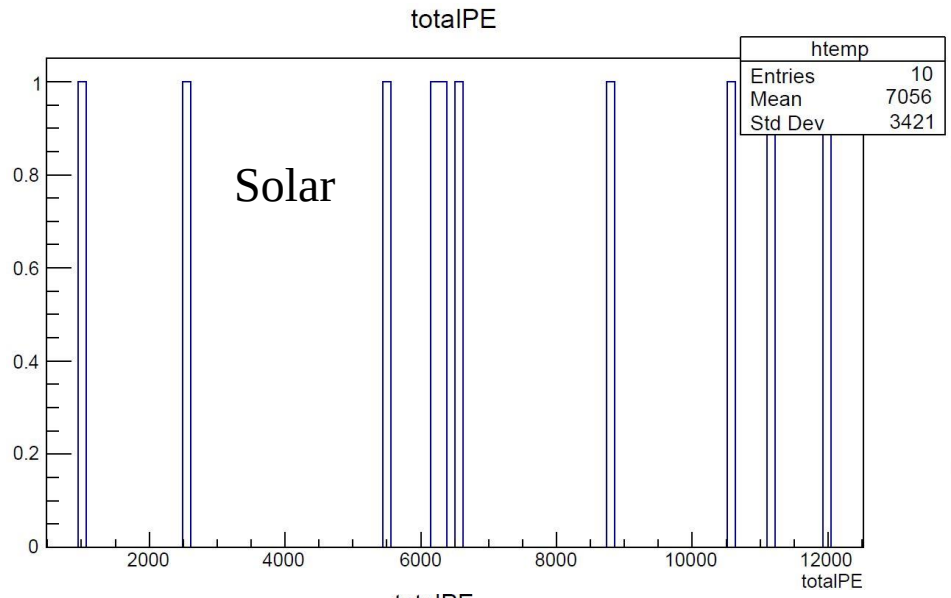
Input parameter
- DM mass
- Number of event
- Channel
- Neutrino oscillation parameters

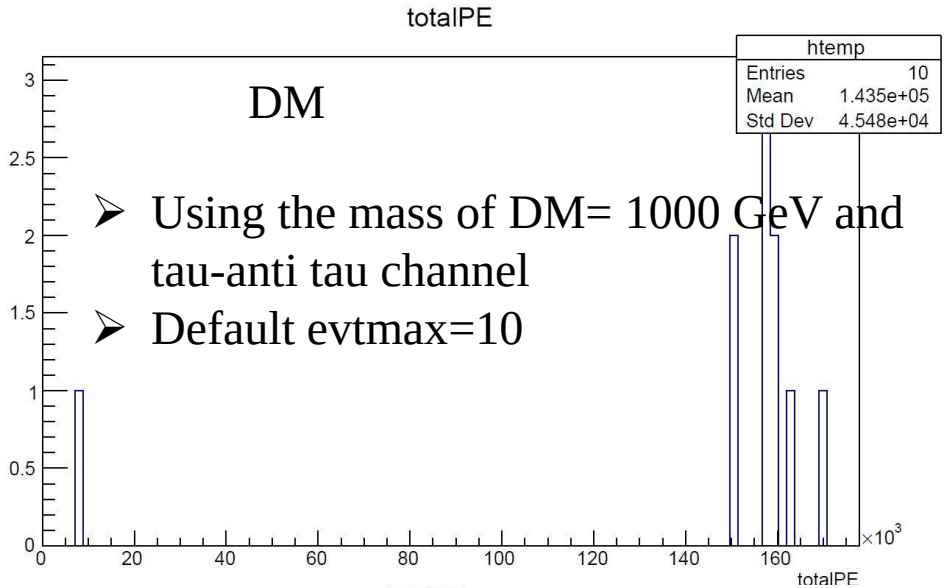
Considering
- Neutrino interaction with LS (Can't detect neutrino directly)



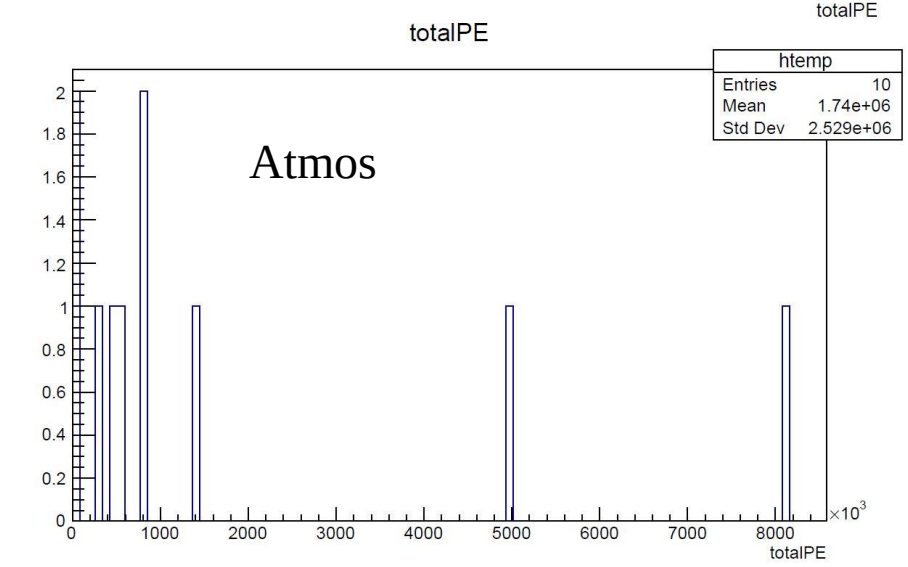
Including effect
- PMT
- Geometry

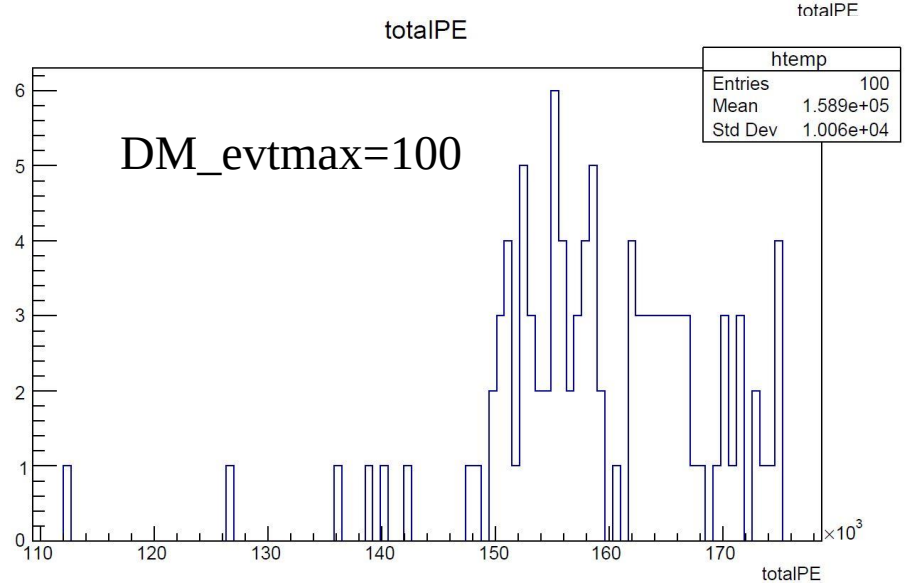
The preliminary result from JUNO detector simulation





- Using the mass of DM= 1000 GeV and tau-anti tau channel
- Default evtmax=10





Problem and future work

- The JUNO software is complex to create the another generator thus we add more mode in solar neutrino generator for DM mode and use neutrino-electron scattering according solar neutrino generator.
- Moreover, we would like to more argument for inputting file of neutrino event from WIMPSIM.