Prospects for Proton Decay Searches in JUNO

Yuhang Guo, Livia Ludhova, Wanlei Guo, Qingmin Zhang

(On Behalf of JUNO Collaboration)

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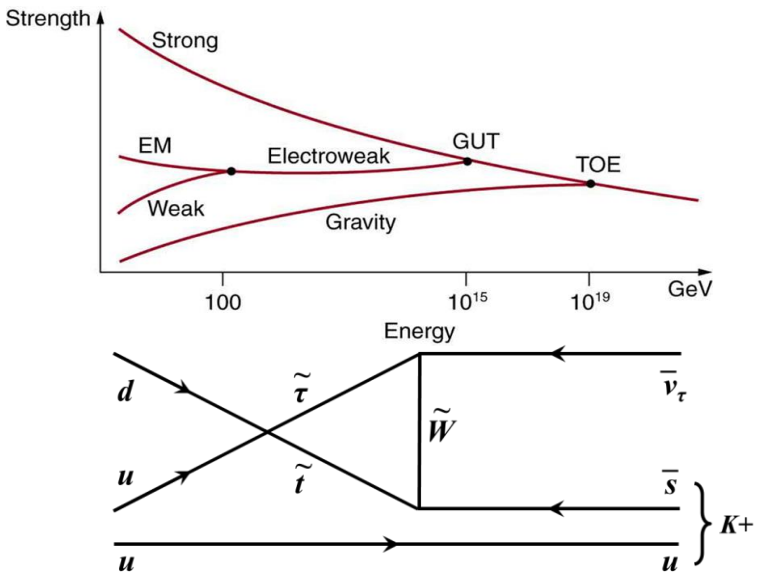
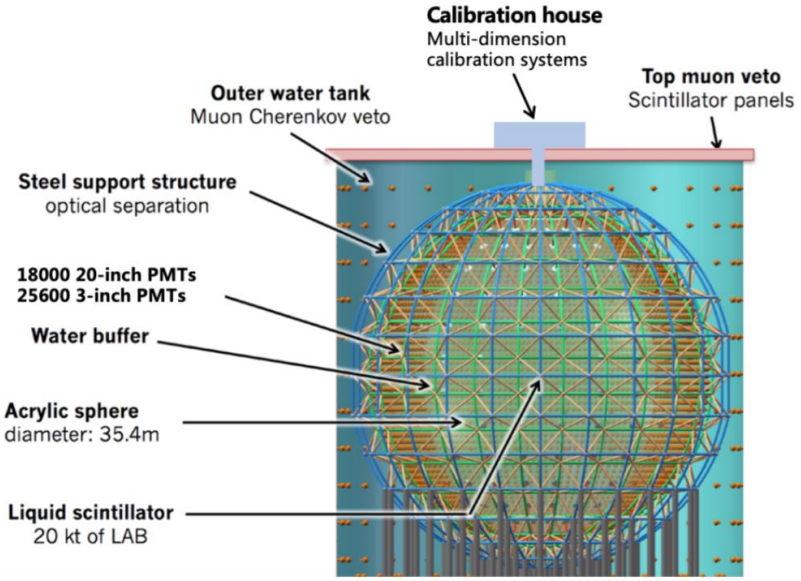
Introduction

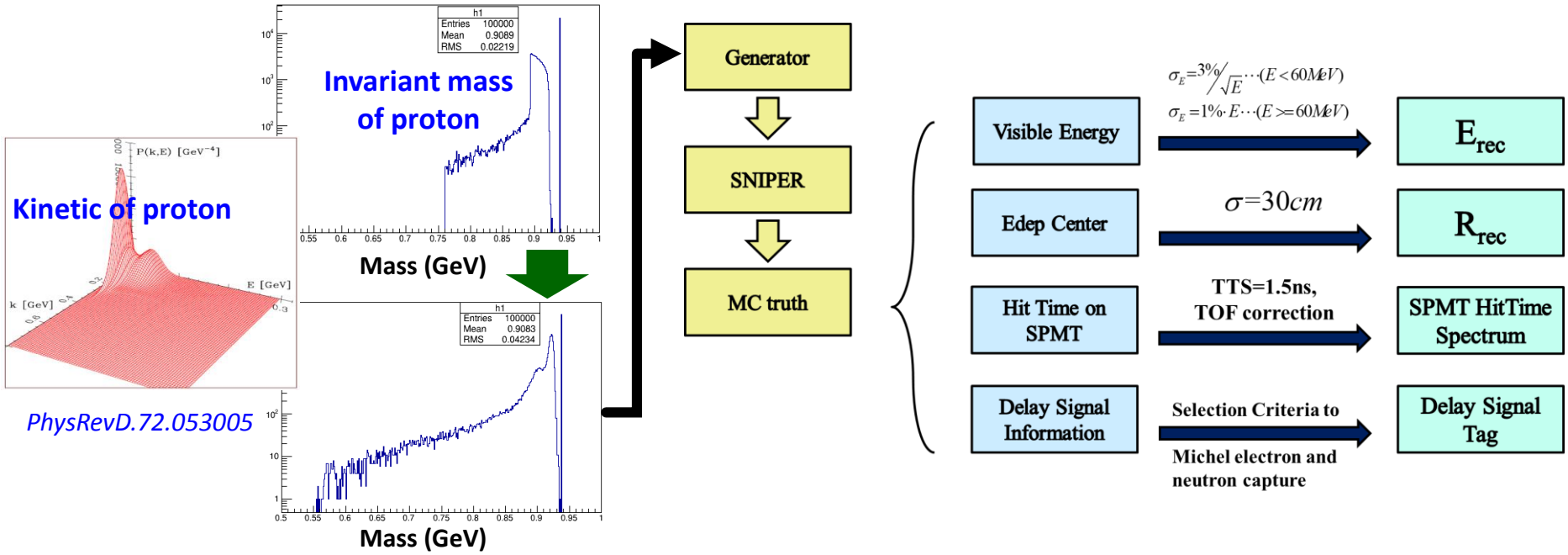




- Proton Decay is an apparent prediction of Grand Unification Theories (GUTs). The baryon number violation is one of three basic ingredients for an explanation to the asymmetry of Matter and Anti-matter in Universe.
- So many predicted decay modes, among which $p \rightarrow \nu K^+$ has large branching ratio in Super Symmetry (SUSY) GUTs.
- Many experiments have been contributed on this mode to explore new physics, including Super-K and KamLAND.
- The Jiangmen Underground Neutrino Observatory (JUNO), is a 20 kton Liquid Scintillator (LS) detector. It is expected to make great contribution on proton life time lower limit exploration.

Simulation

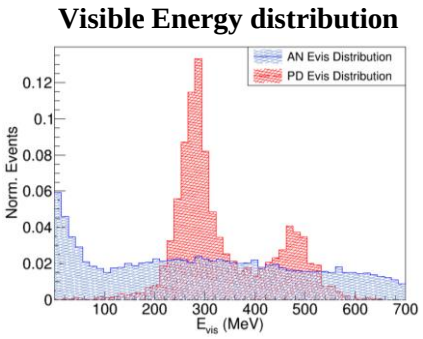
- We use GENIE as the generator of PD. In order to descript correctly the initial proton and K+ FSI, we have modified the codes based on the Spectral Function.
- The interaction between K+ and LS is simulated in SNIPER, developed by JUNO collaboration.
- The dominant backgrounds are the Atmospheric neutrinos and Cosmic Muons. But the CM can be rejected with VETO detector.

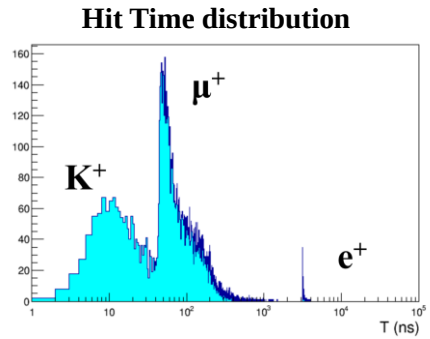


- Totally 10 k PD and 40 k AN have been simulated as the candidate database. In ten yeas, there will ~33 k AN discovered in JUNO. So the data volume of AN is equivalent to 36 years data taking.

Analysis and Conclusion

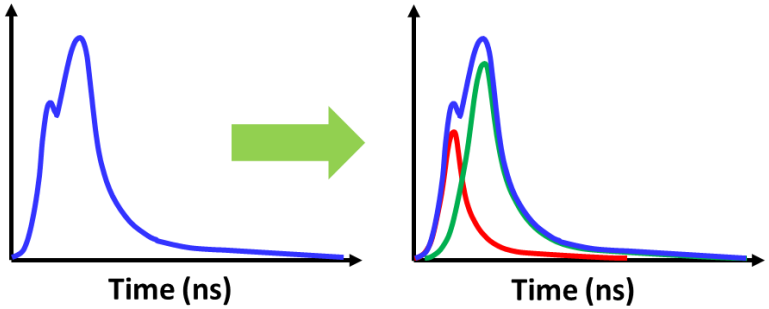
	PD	AN
E_{vis}	(200,600) MeV	Widely distributed
Delay Signal	Michel electron	Neutron capture
T_{hit}	Double pulse pile-up	Single pulse





A double pulse pile-up pattern usually means:

1. Larger uprising time (10%-90% of max.)
2. smaller χ^2 of double pulse fitting than single pulse fitting.



After the fitting, one can get the reconstructed correlated time difference and sub-pulse deposition, which can help to select further.

Conclusion:

- With 36 years data volume, the p2vK detection efficiency is estimated as 32.48% with 3 Atmos.ν remained in 36 years.
- This is a preliminary result and expecting further detailed study and improvement.