Status of the DANSS

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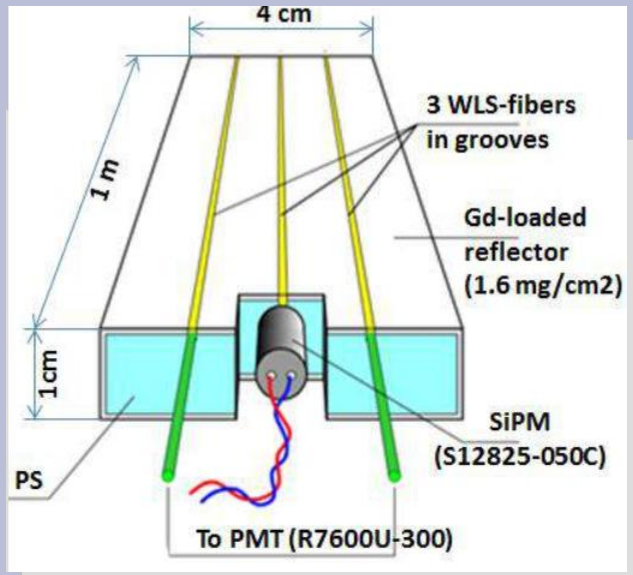
for the DANSS collaboration

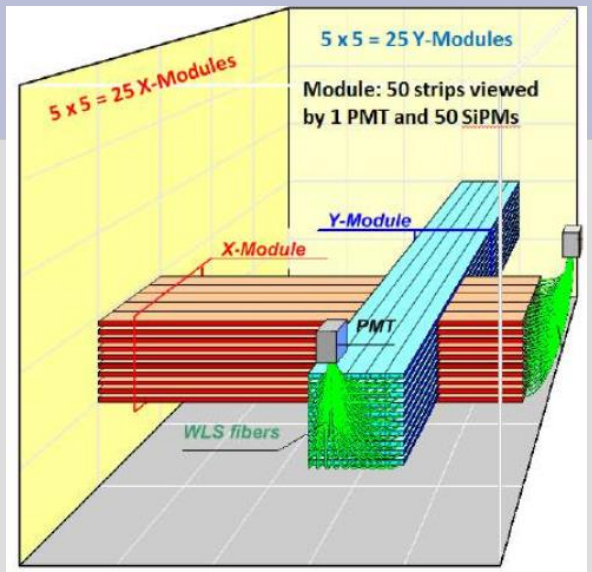
AAP 2018 @ Livermore

The DANSS design

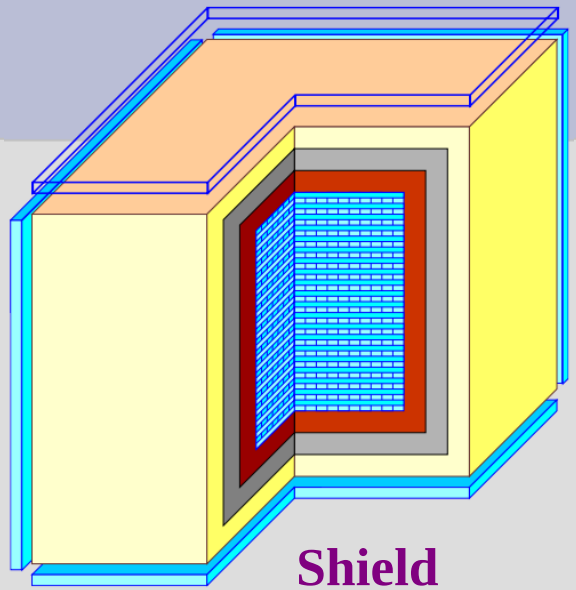
Strip



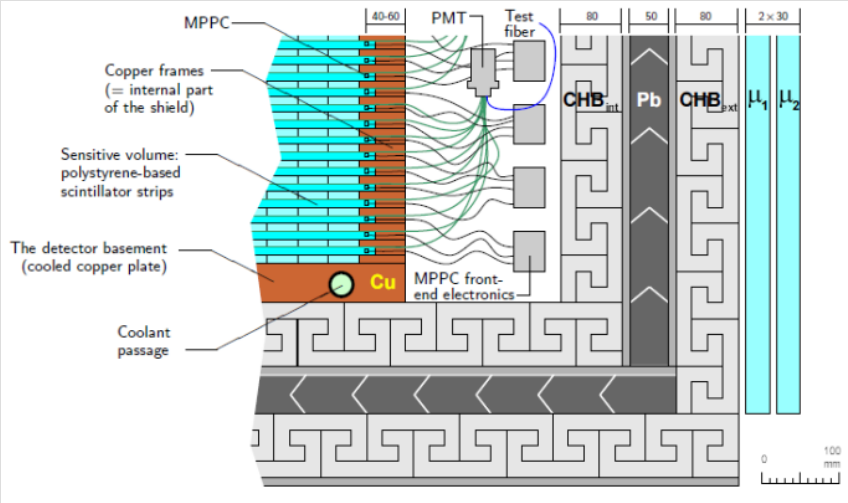
Module



Detector

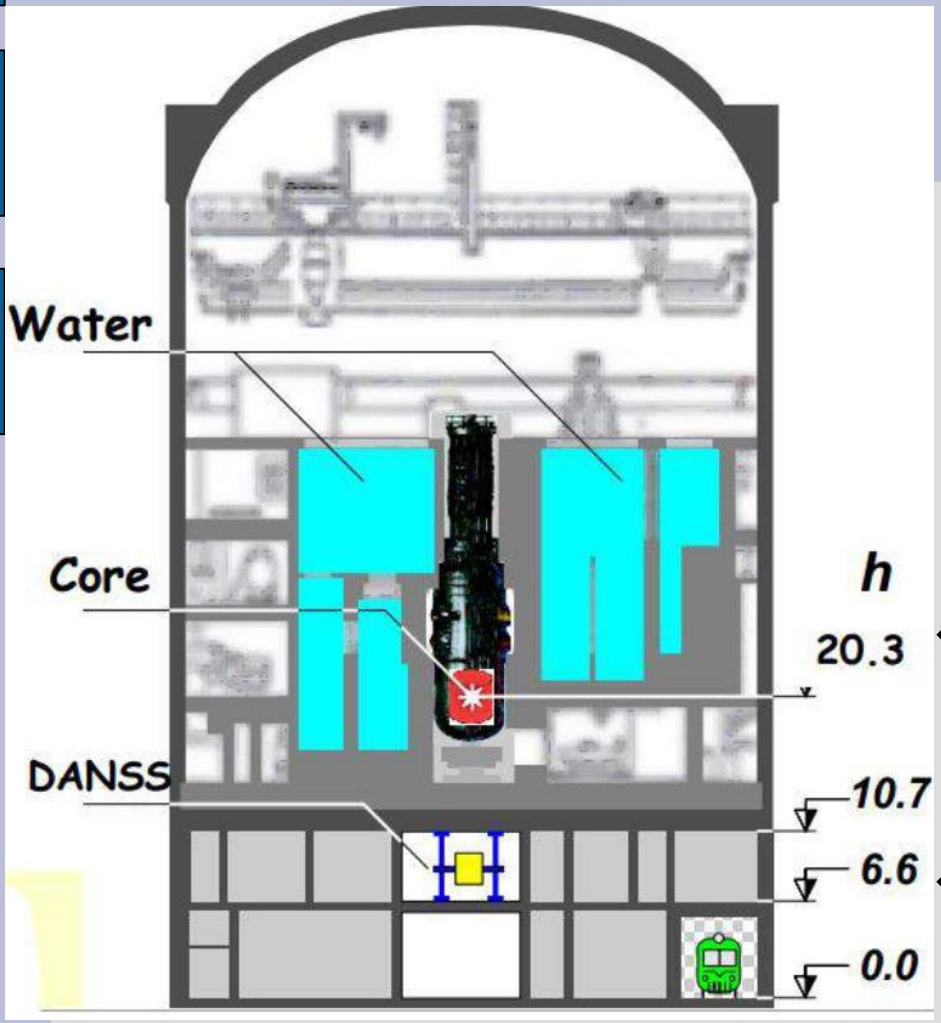


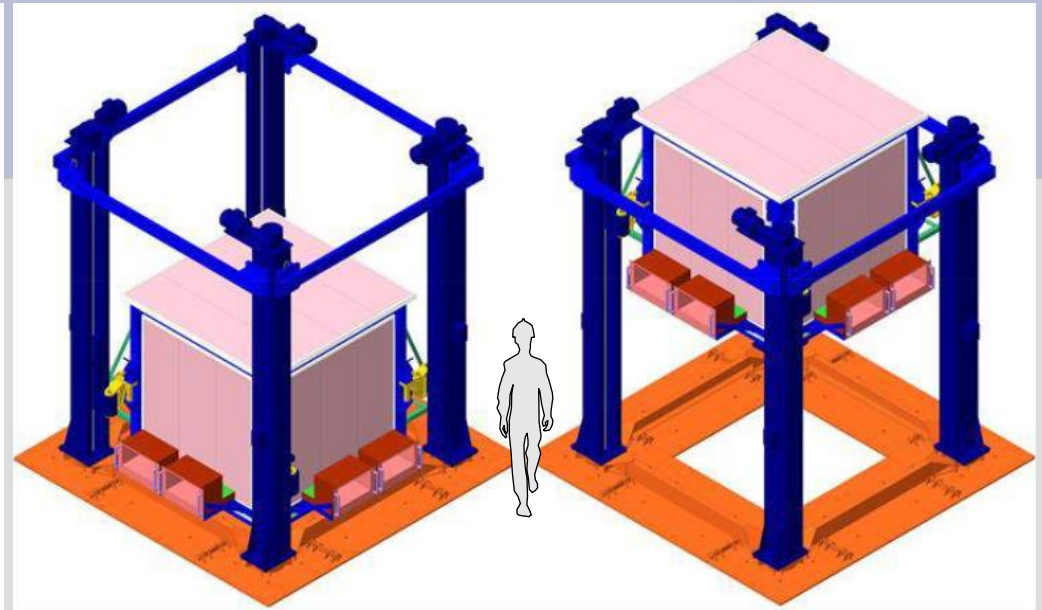
Shield



- **Cubic meter highly segmented neutrino spectrometer made of 2500 PS strips viewed by 2500 SiPMs & 50 PMTs.**
- **Multilayer passive shielding: Cu/CHB/Pb/CHB=5/8/5/8 cm**
- **Active muon veto made of 2 x 3 cm PS plates from all sides except bottom.**

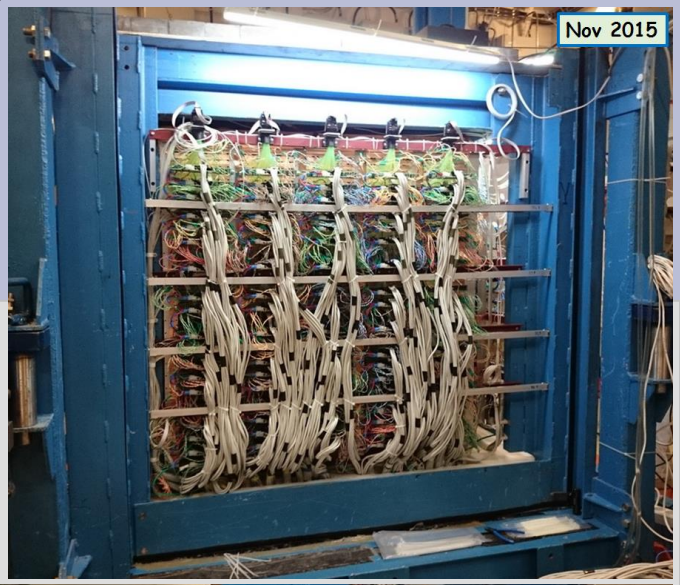
The location and movable platform





- The DANSS is located at Kalininskaya NPP (KNPP) under 3 GW WWER-1000 reactor (H=3.6 m, ∅ =3.1 m), which provides ~ 50 m.w.e. (6-fold μ reduction and no cosmic n).
- The detector is built on a movable platform. Data are taken at 3 distances 10.7 m (Up), 11.7 m (Middle), and 12.7 m (Down) from the reactor (center to center), changed sequentially 3 times per week.

Detector Assembly

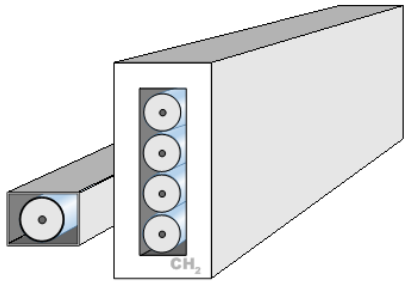


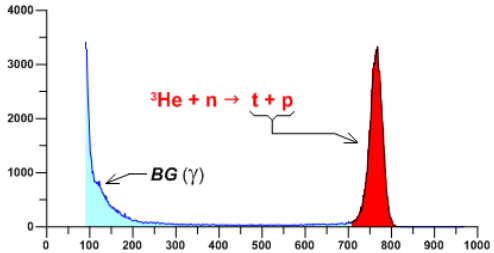
Background monitoring

- **Permanent monitoring of gamma-BG with four NaI (3'x3'): 1 inside + 3 outside the DANSS shield**

  no (ON – OFF) visible difference

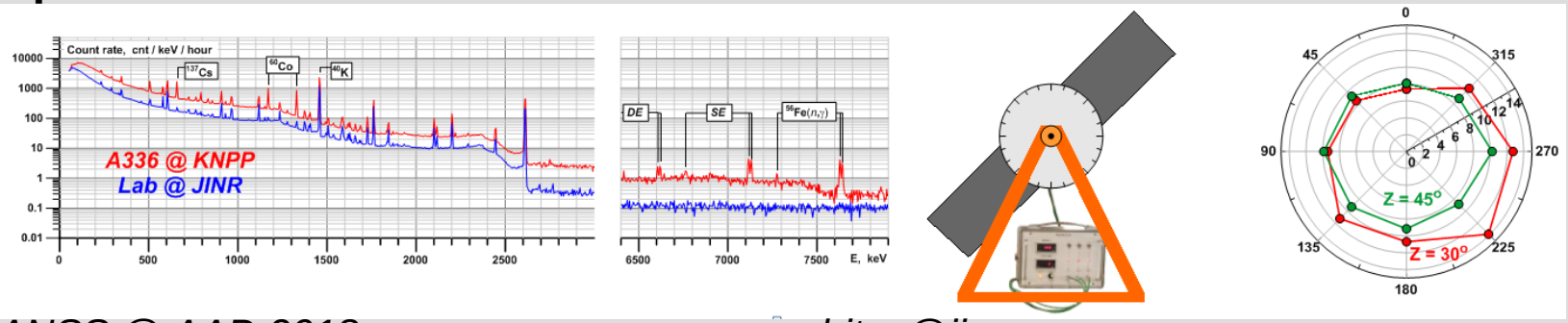
- **Permanent monitoring of neutron flux with three ^{3}He neutron counters: 1 inside + 2 outside the shield**





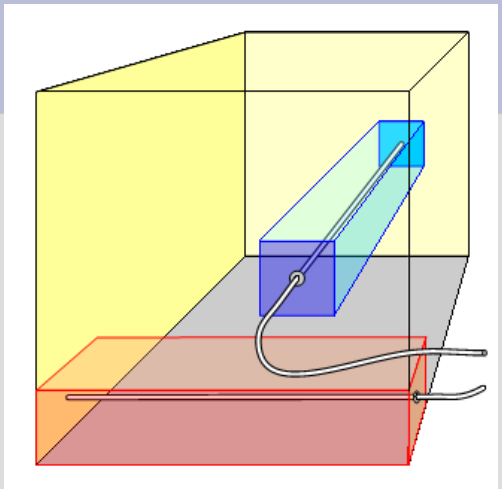
Φn =	0.57	outside (OFF)
Φn =	300.4	outside (ON)
Φn =	0.03	inside (OFF)
Φn =	0.04	inside (ON)
Φn =	6.0	en plein air

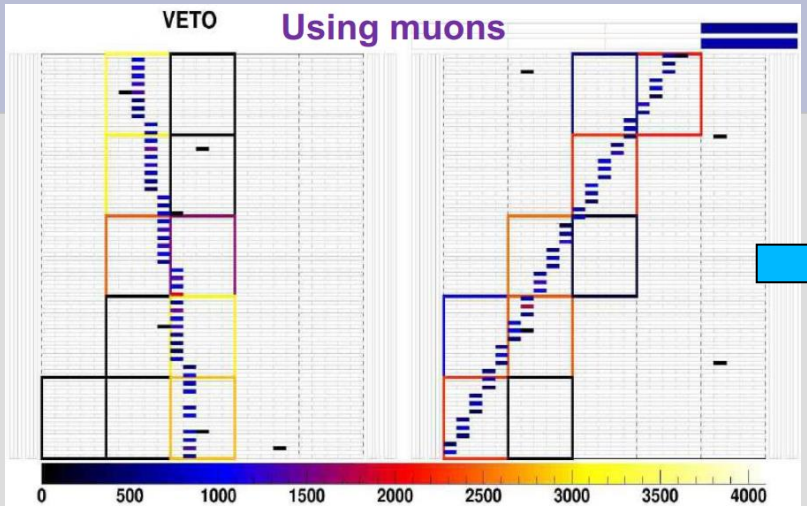
- **Episodic measurements with HPGe and "MuMeter"**

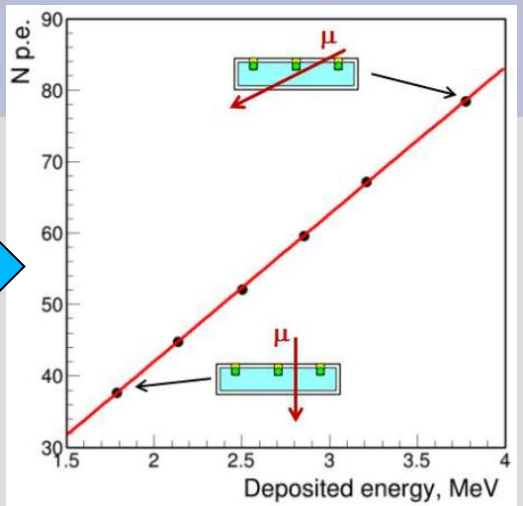


Calibrations (energy & time)

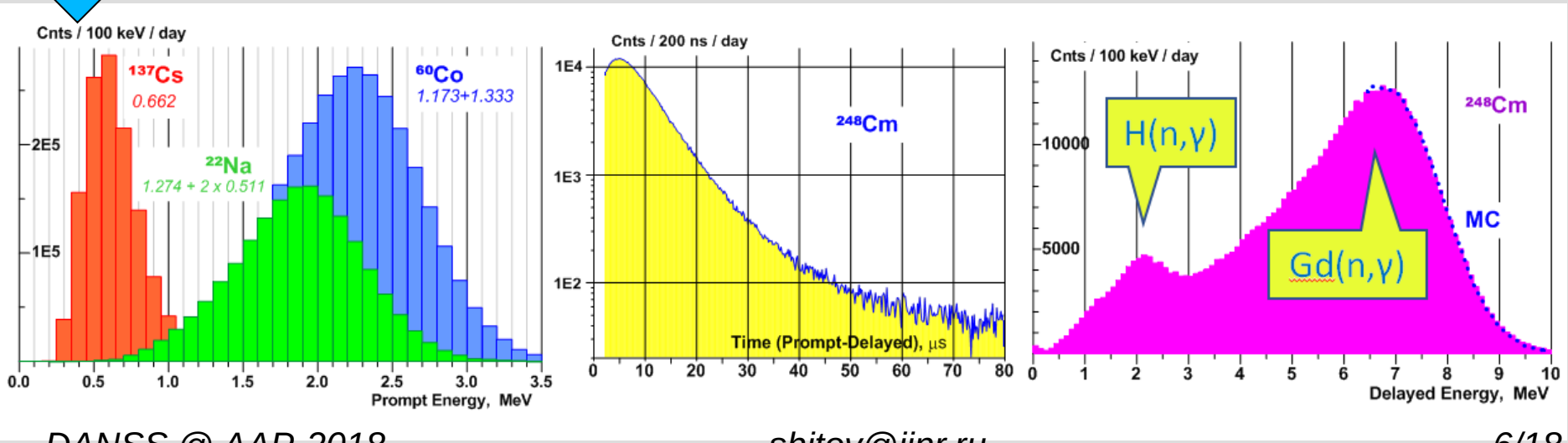
See arXiv:1804.04046 for details



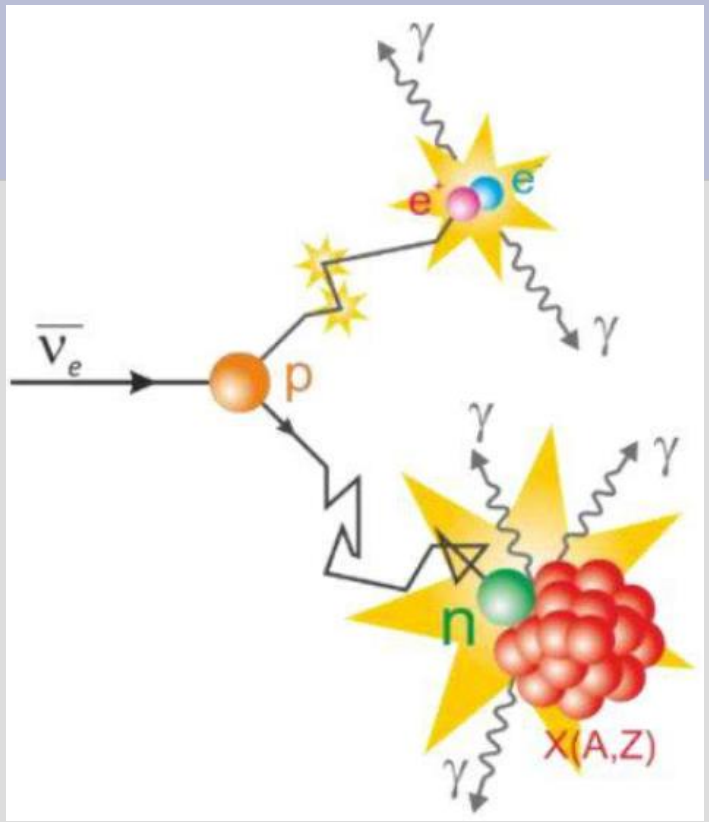


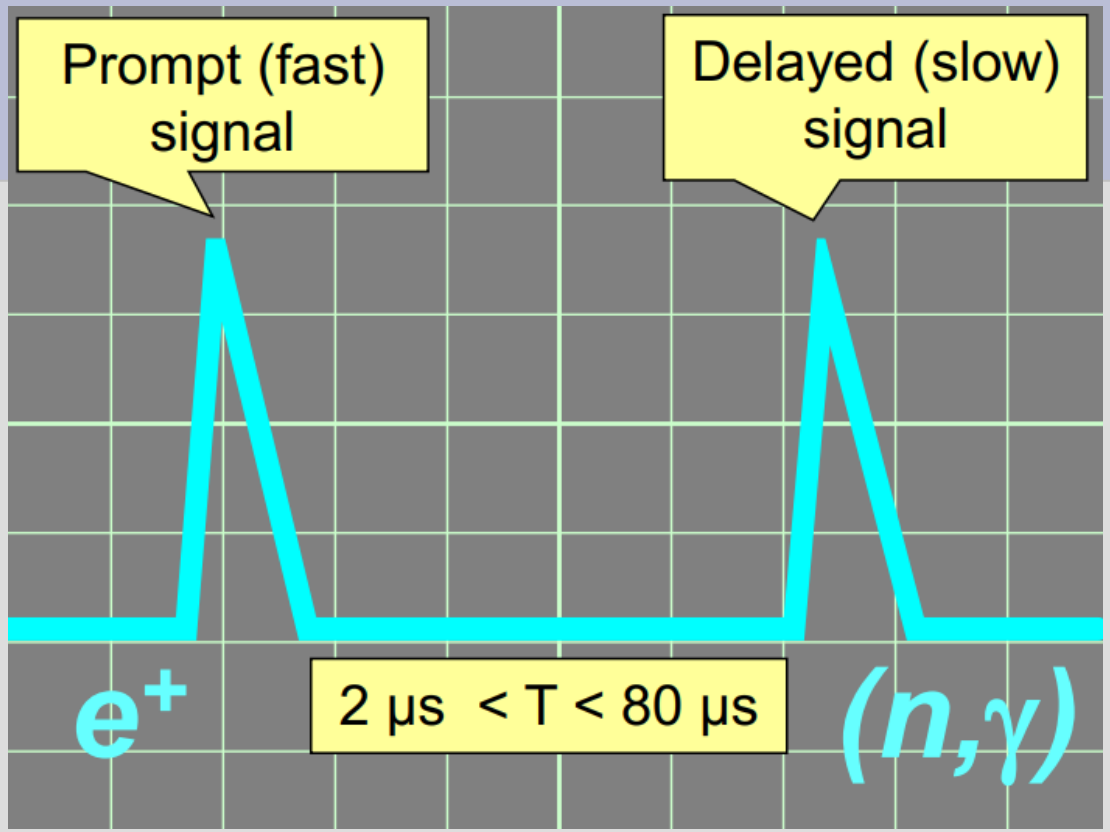


Using sources ^{22}Na, ^{60}Co, ^{137}Cs, ^{248}Cm *(few Bq)*



IBD signal pattern & basic cuts





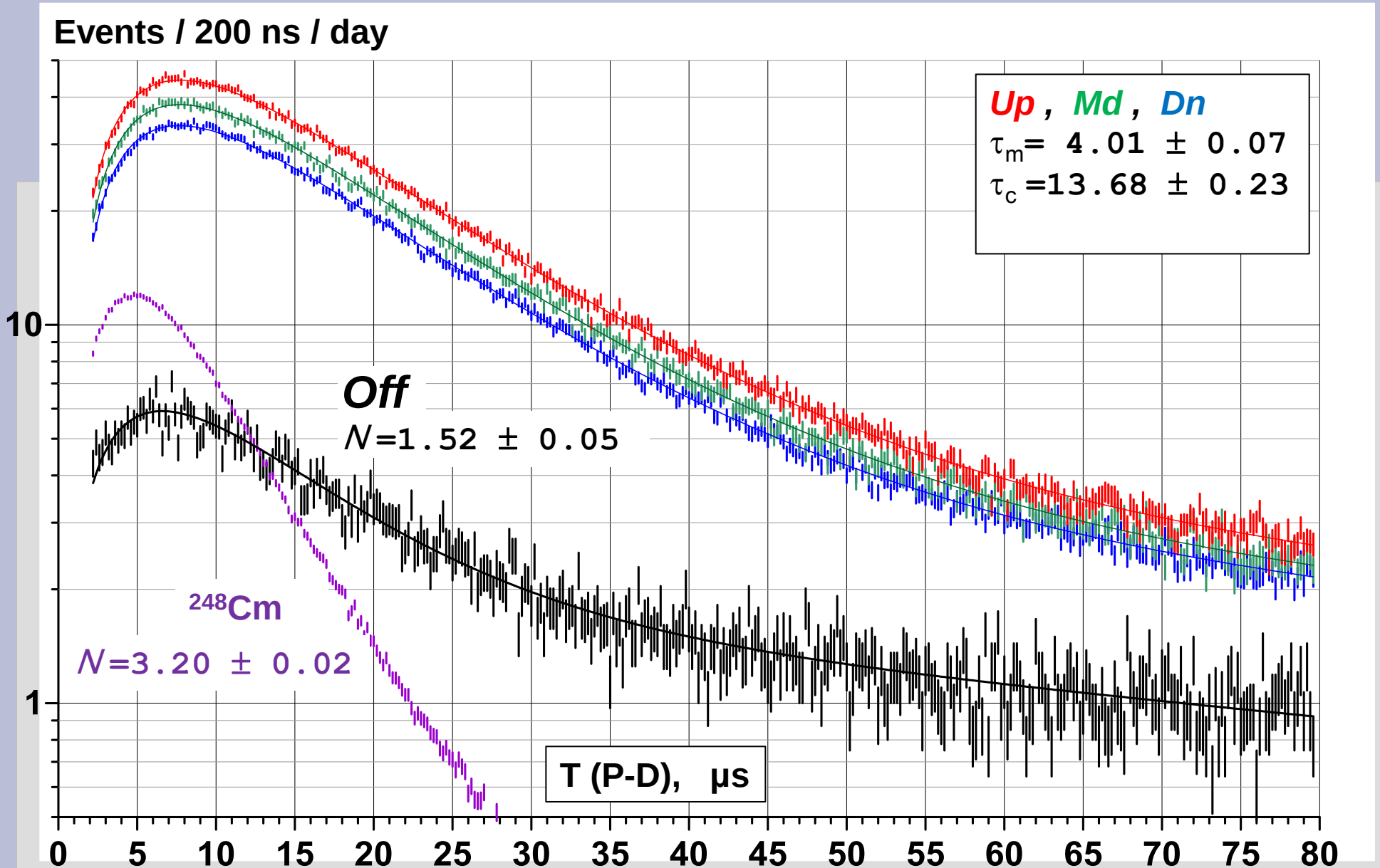
Main cuts (maximally relaxed):

- **Prompt signal (E > 0.7 MeV)**
- **Delayed signal (E>3 MeV)**
- **Time between signals is in [2, 80] μs**
- **No muons before prompt signal in 60 μs**

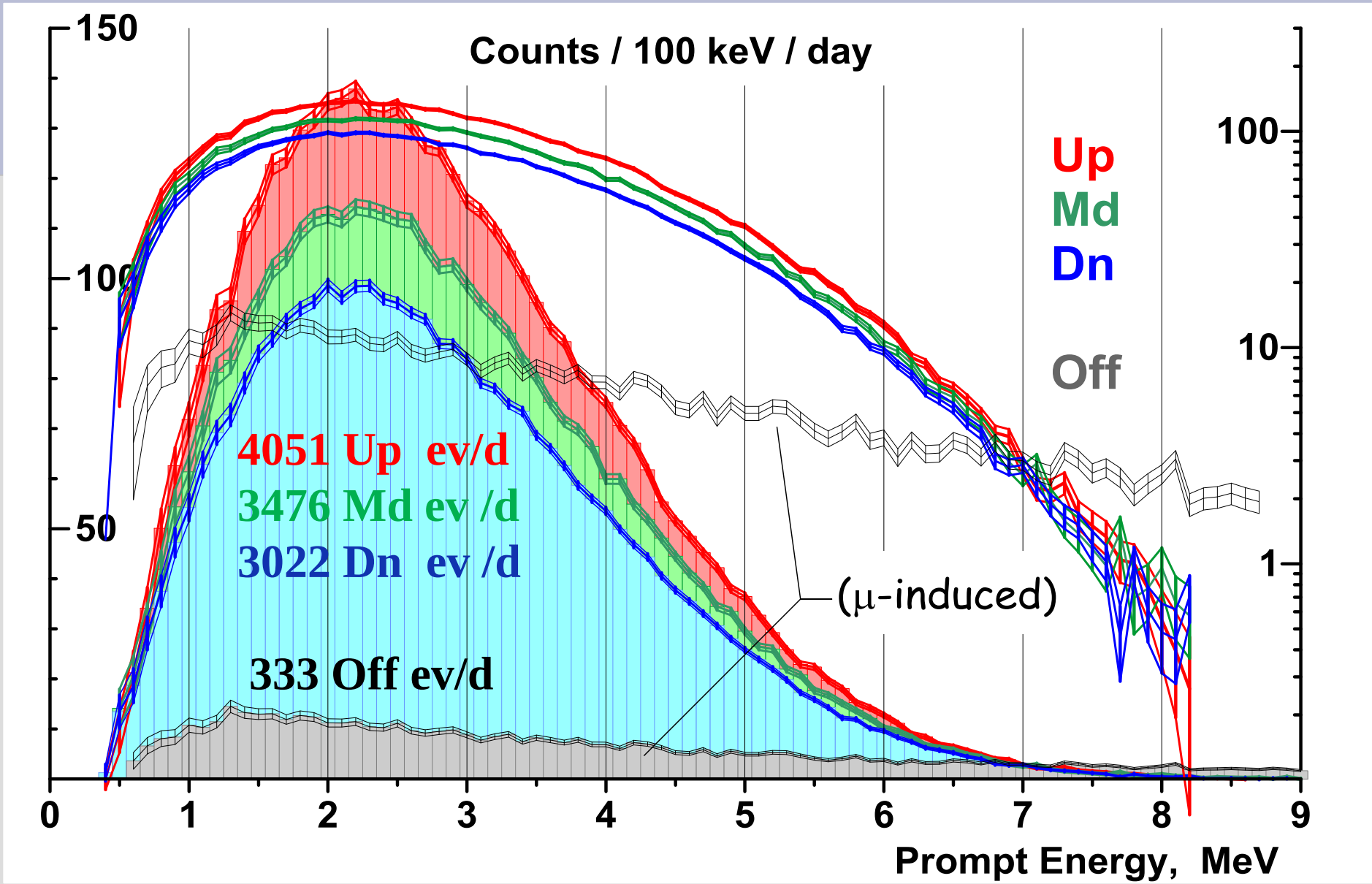
Additional cuts:

- **Hit multiplicities for both signals**
- **Positron clustering pattern cuts**
- **Spatial cut on distance between fast and slow signal vertexes**

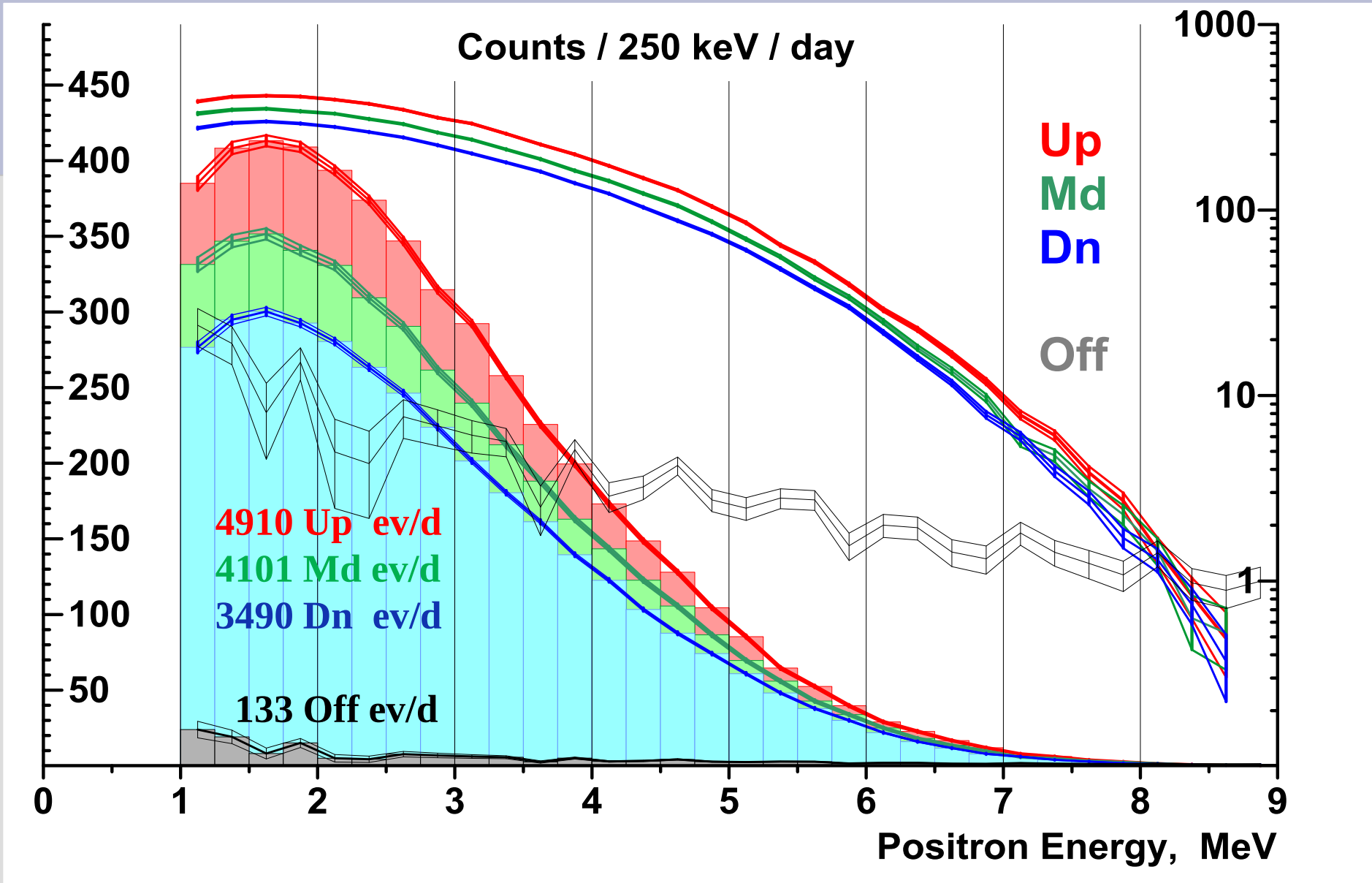
Time distribution spectra (PMT only)



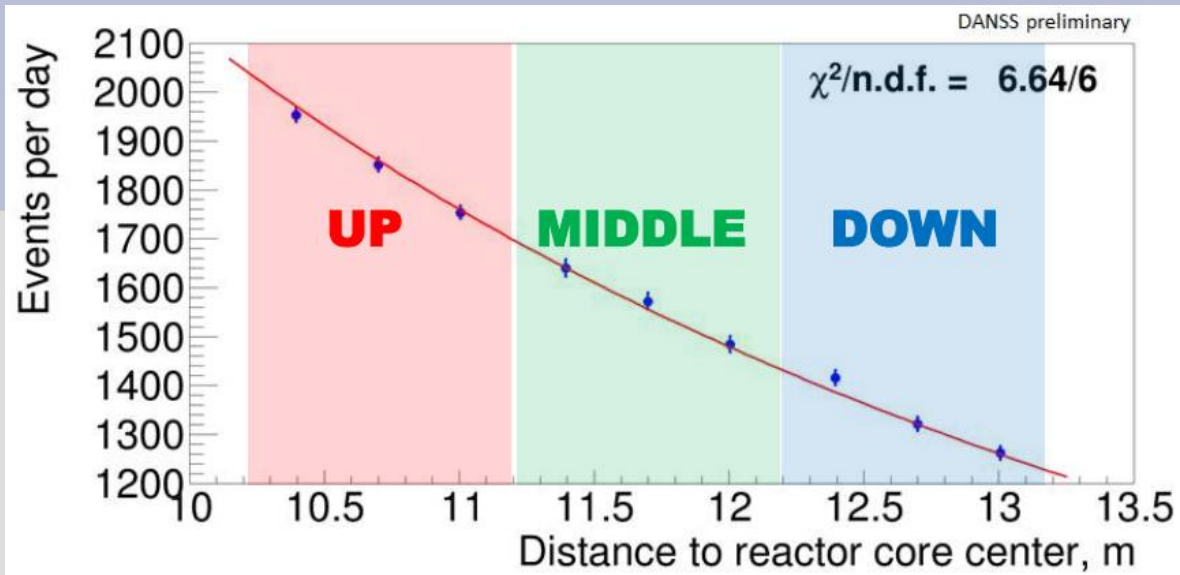
Prompt energy spectra (PMT only)



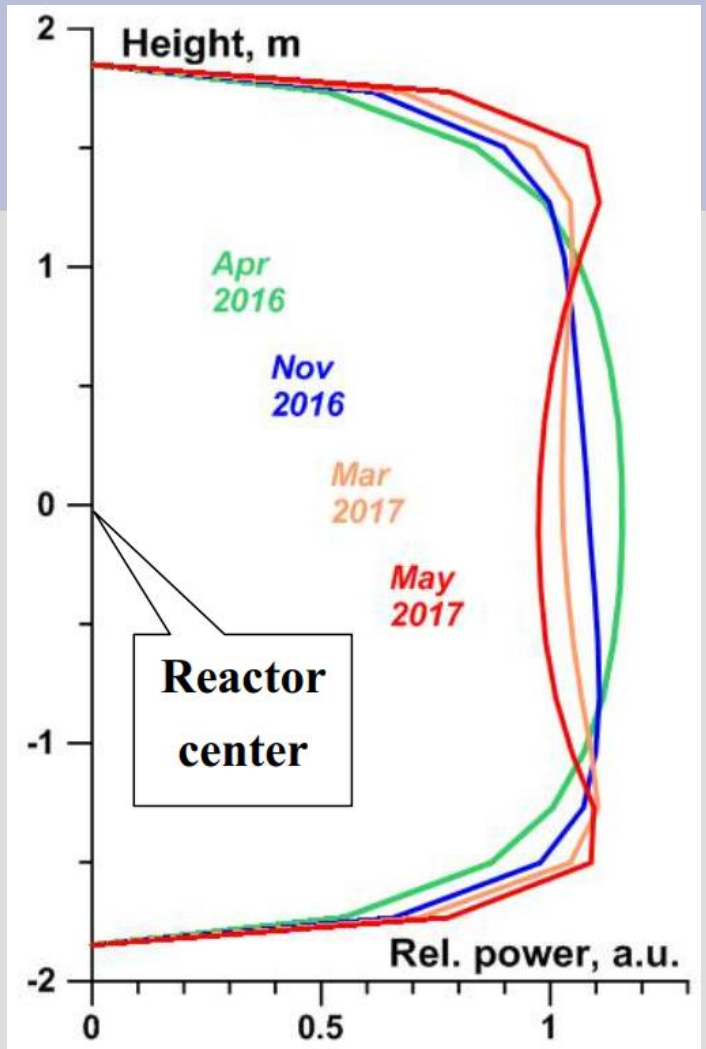
Positron energy spectra (PMT+SiPM)



IBD total rate vs. effective distance

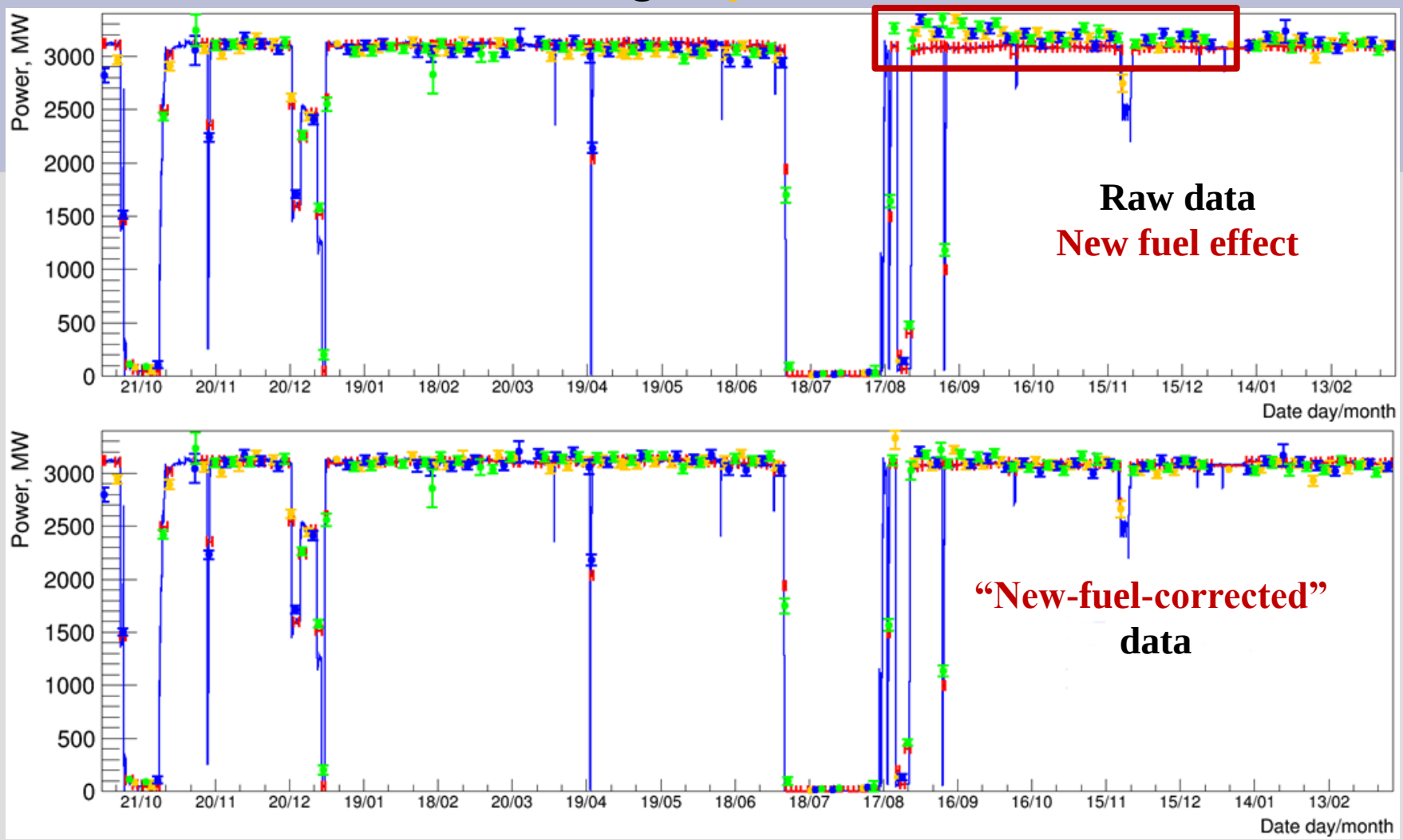


- **IBD intensity follows reasonably the 1 / L^2 dependence.**
- **Effective distance L takes into account real spatial distribution of the detection efficiency and the reactor core burning profile (monitored permanently by the KNPP staff) .**
- **The time variation of reactor core burning profile is taken into account with a precision of 30 min and ~10 cm.**



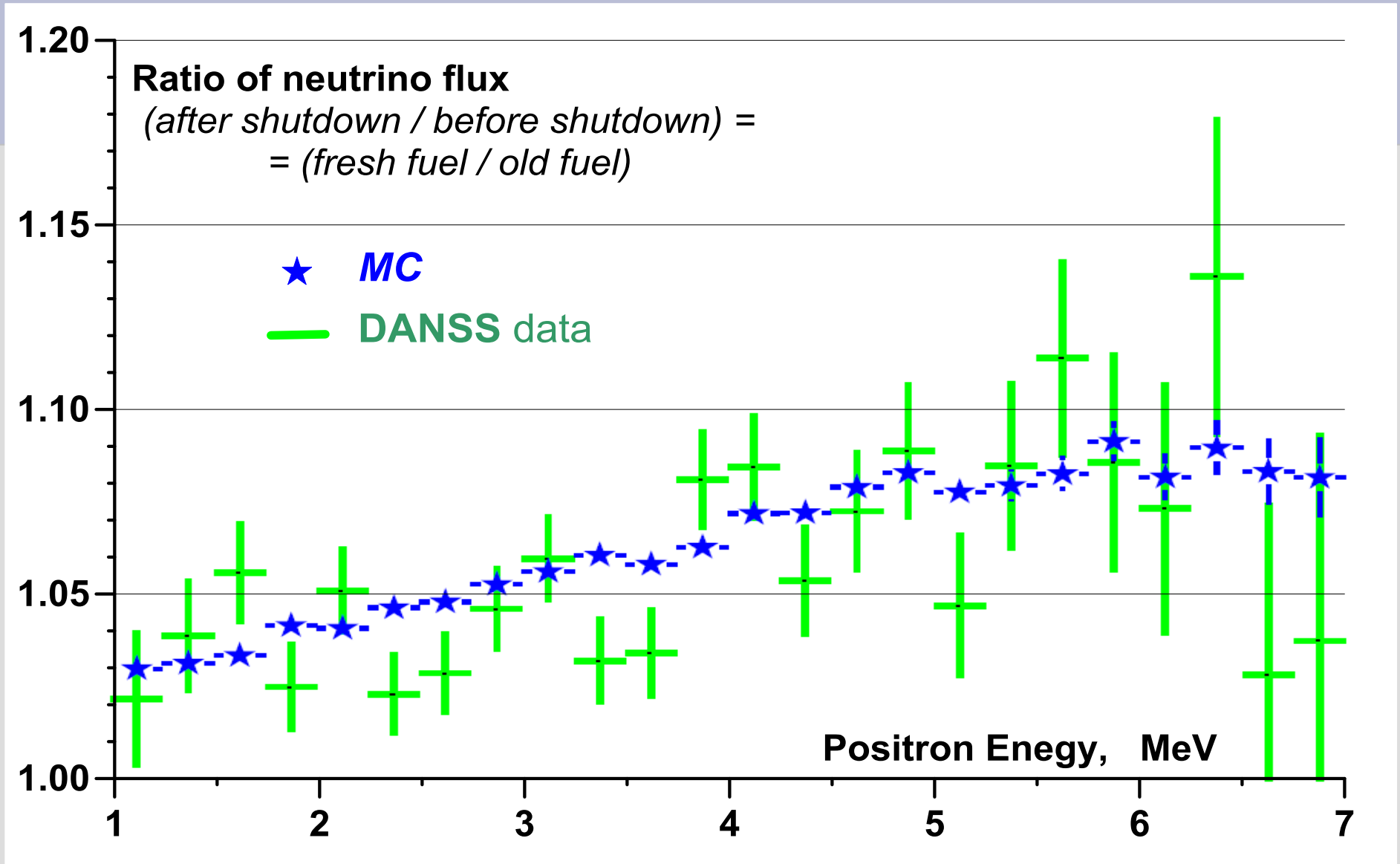
Time evolution of the core burning profile

Reactor monitoring: Up – Middle – Down data

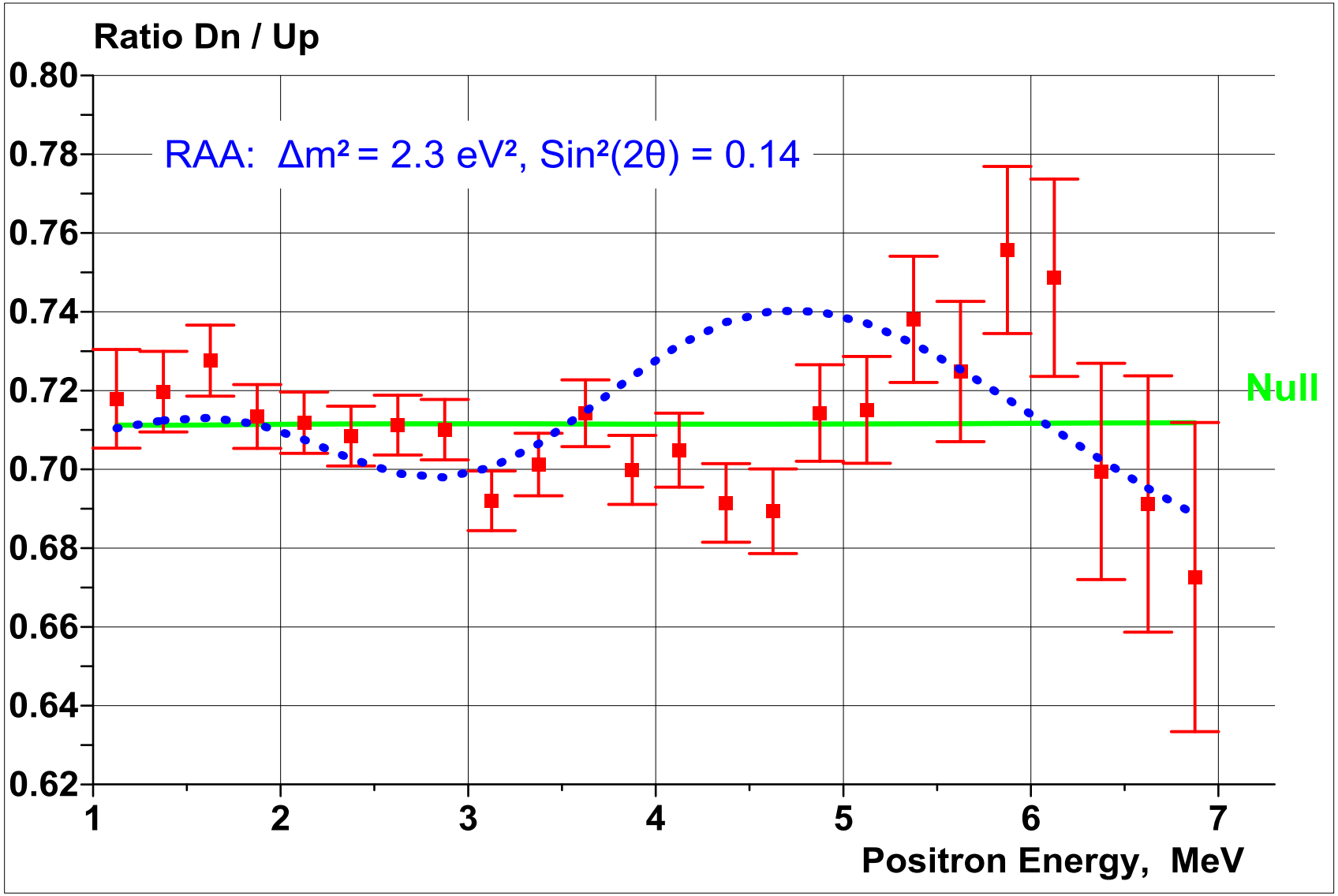


- The DANSS is constantly monitoring reactor since October 2016.
- We are sensitive to the fuel composition (U-Pu content in fuel)

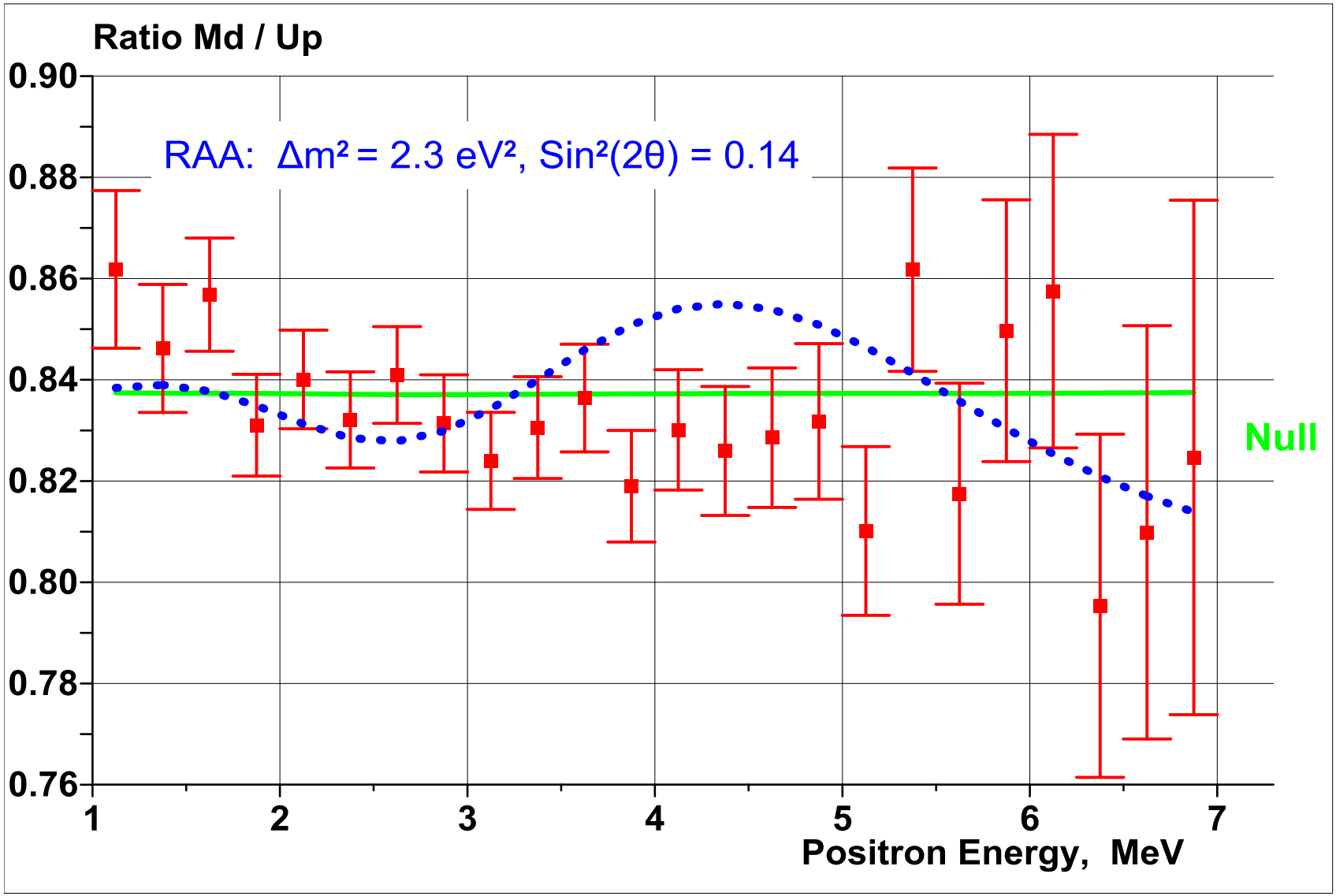
Reactor antineutrino flux: start vs. stop of fuel cycle



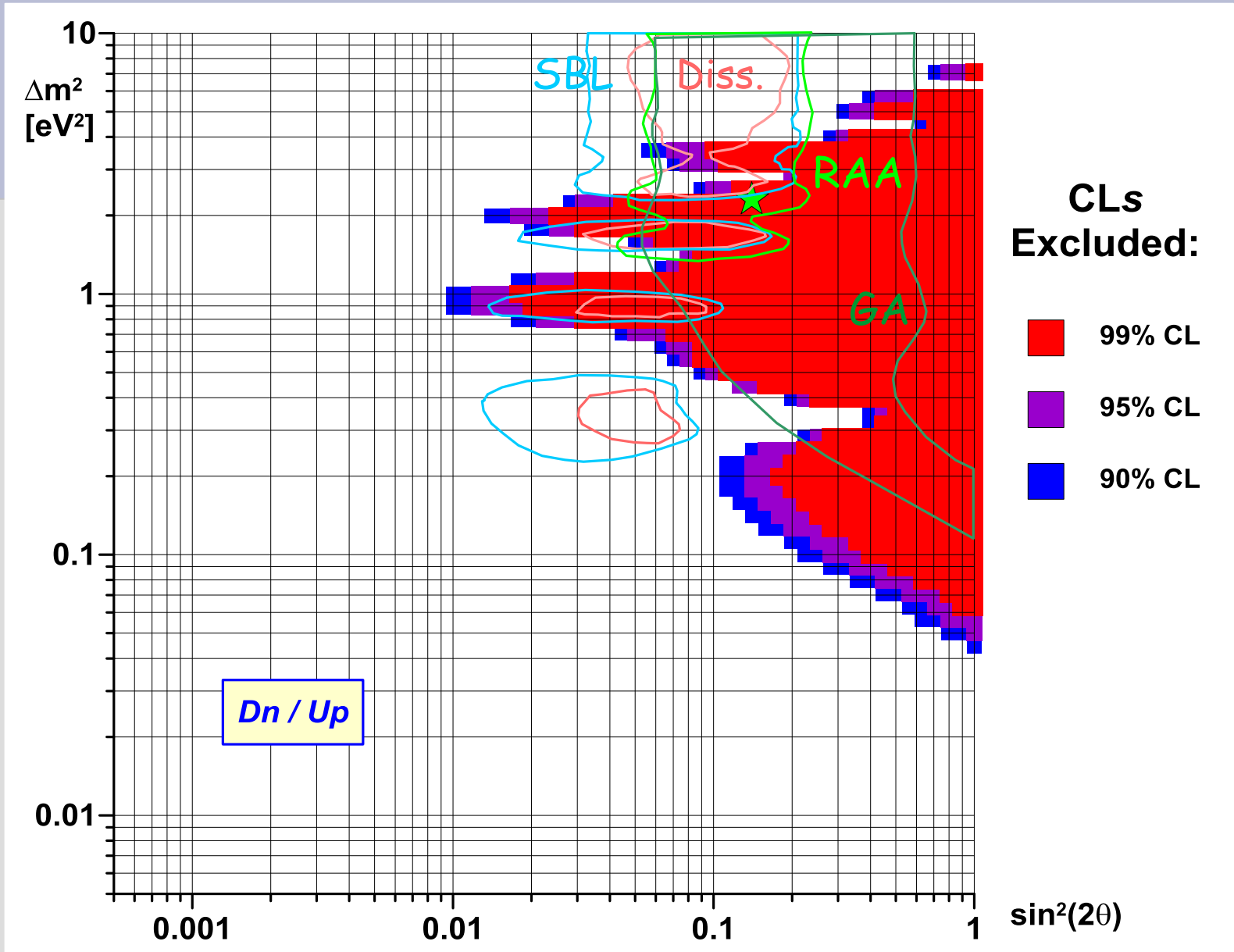
Oscillation probes: Down/Up



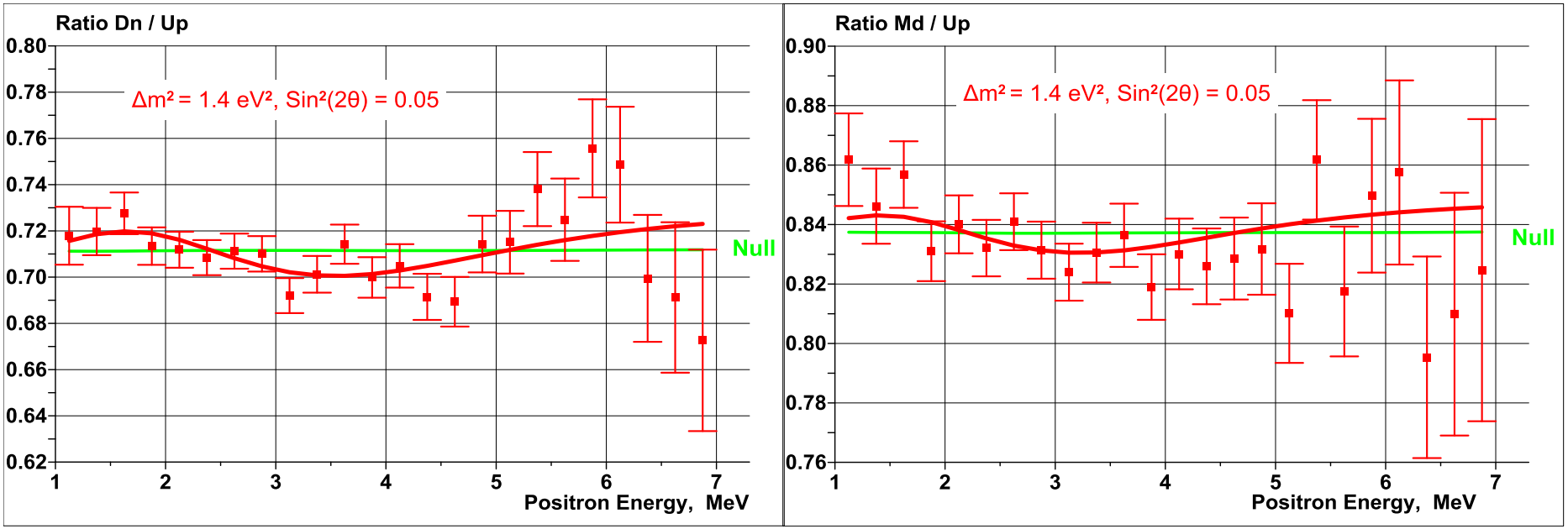
Oscillation probes: Middle/Up



Exclusion plot



Best fit point



- We have best fit point but significance is not high enough.
- Analysis of new data and studies of systematics are still in progress.

Summary

- **DANSS is in operation since April 2016 with regular (physics) data taking since October 2016 at a rate of ~5000 events per day.**
- **Basic energy and time calibrations have been done, detector performance match the expectations.**
- **Reactor monitoring is constantly demonstrating since October 2016, including sensitivity to U-Pu fuel composition. Spectrum changes are highly visible and meet calculated expectations.**
- **A large fraction of allowed sterile oscillation parameters region is excluded in a model-independent way, including the RAA best fit point ($\Delta m2=2.3$ eV^2, $\sin2(2\theta)=0.14$) excluded at 5σ level**
- **DANSS data taking and analyses is still in progress, updated results are coming soon.**