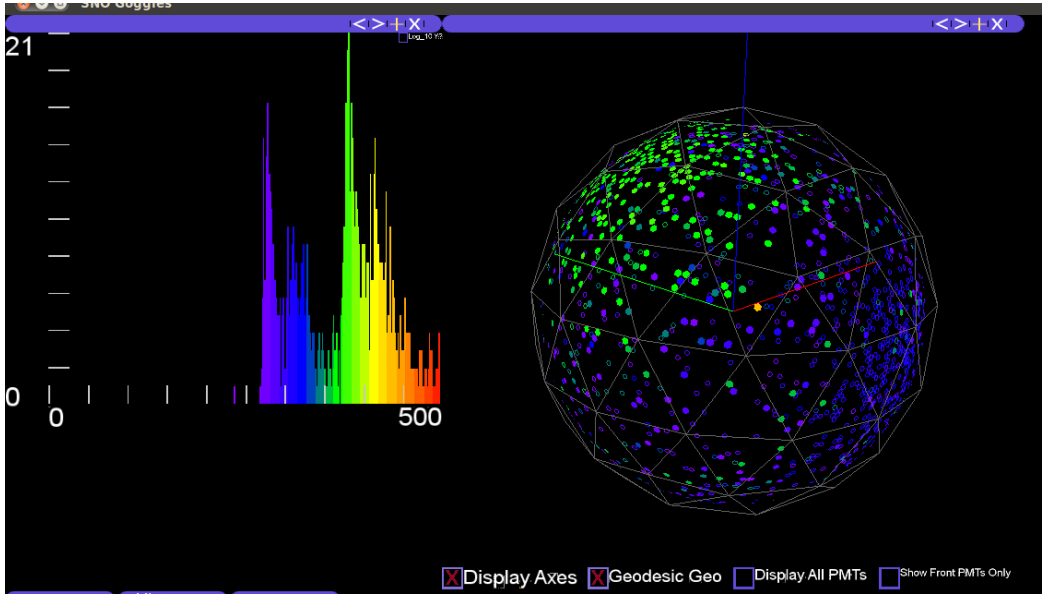
Queen Mary
University of London

SNO+



PILEUP BACKGROUND REJECTION FOR SNO+

3/28/2012

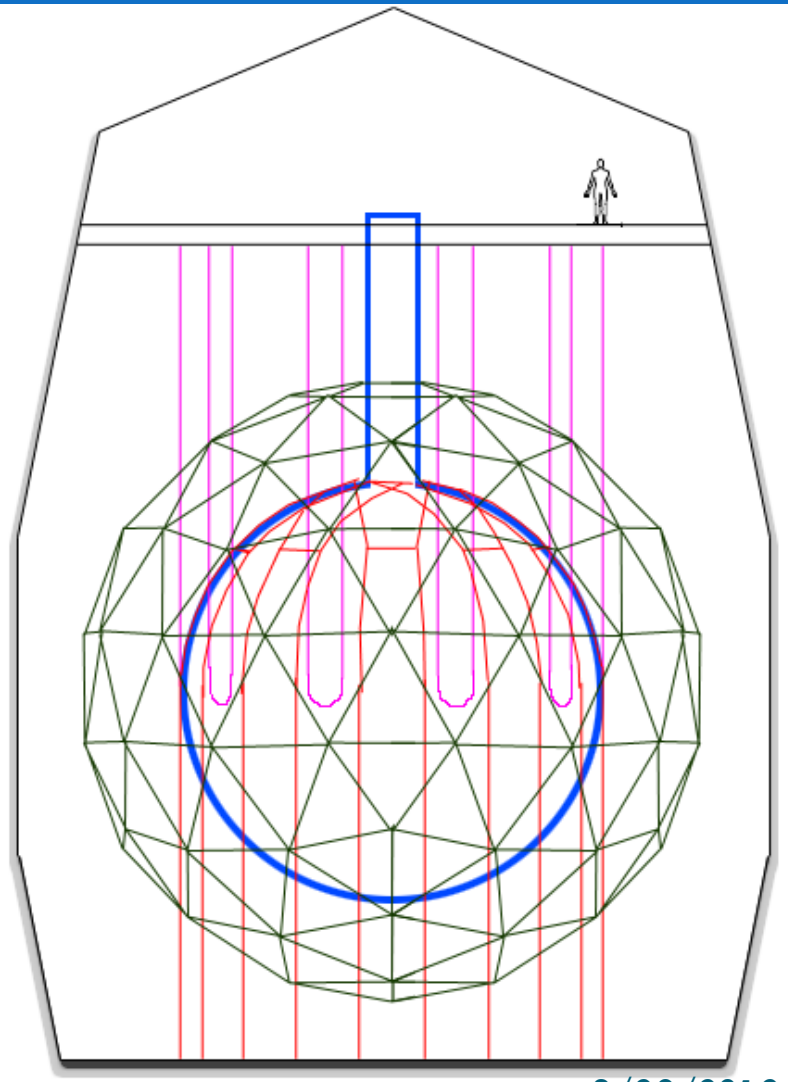
Double beta decay phase

SNO+ Aims

- Neutrinoless double beta decay
- Low energy solar neutrinos
- Geo neutrinos
- Reactor neutrinos
- Supernova neutrinos
- Nucleon decay

SNO+ Detector

- ~780 tonnes Liquid scintillator
- Inside a 6m radius acrylic vessel
- Instrumented by ~9,000 PMTs
- Shielded by ultra pure water
- Depth of 6000mwe

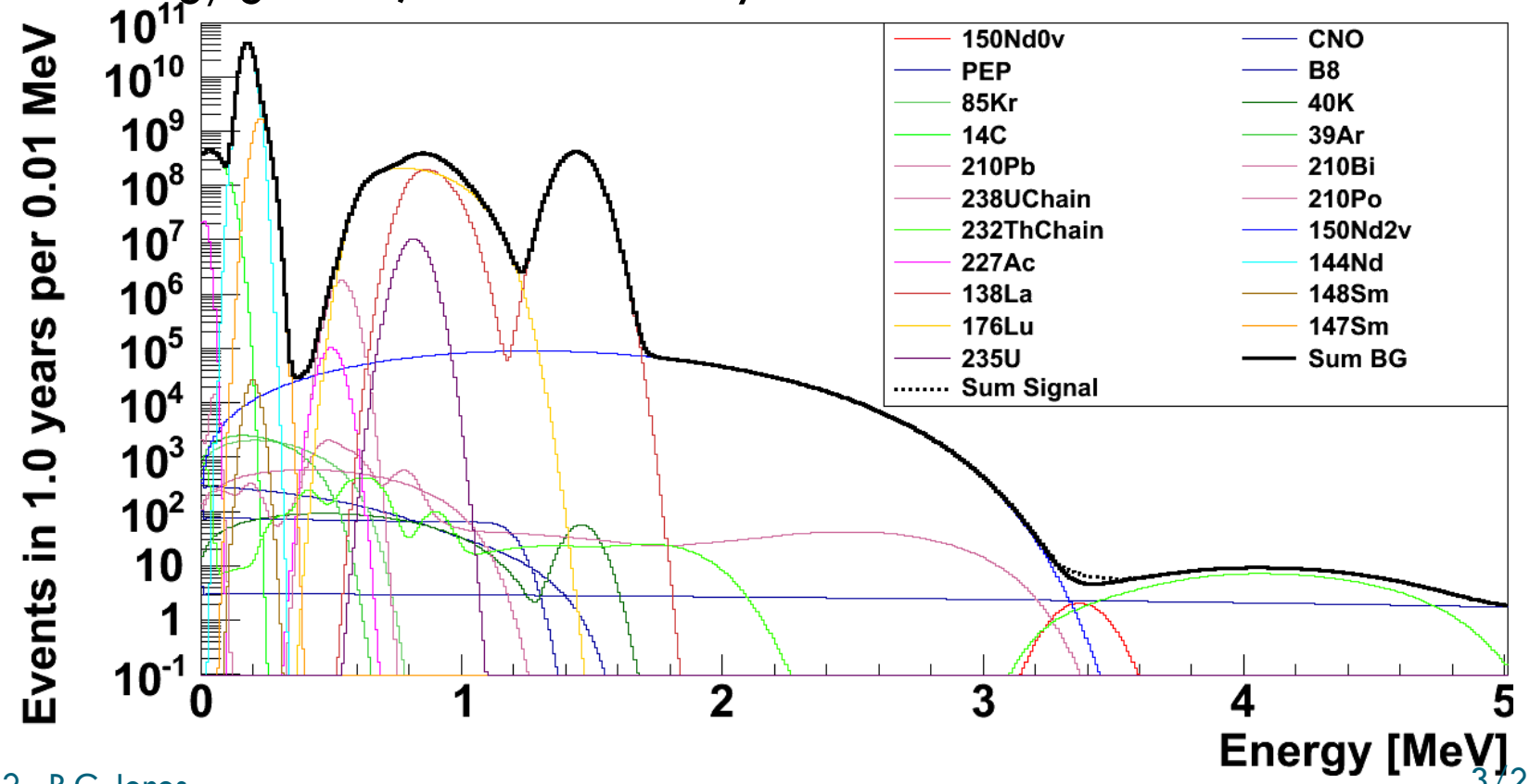


Double Beta Phase

- Initial 0.1% ^{nat}Nd loading into the liquid scintillator
- Increase to 0.3% loading
- $Q_{\beta\beta}$ = 3.37MeV, above most natural backgrounds
- 5.6% natural abundance of ^{150}Nd

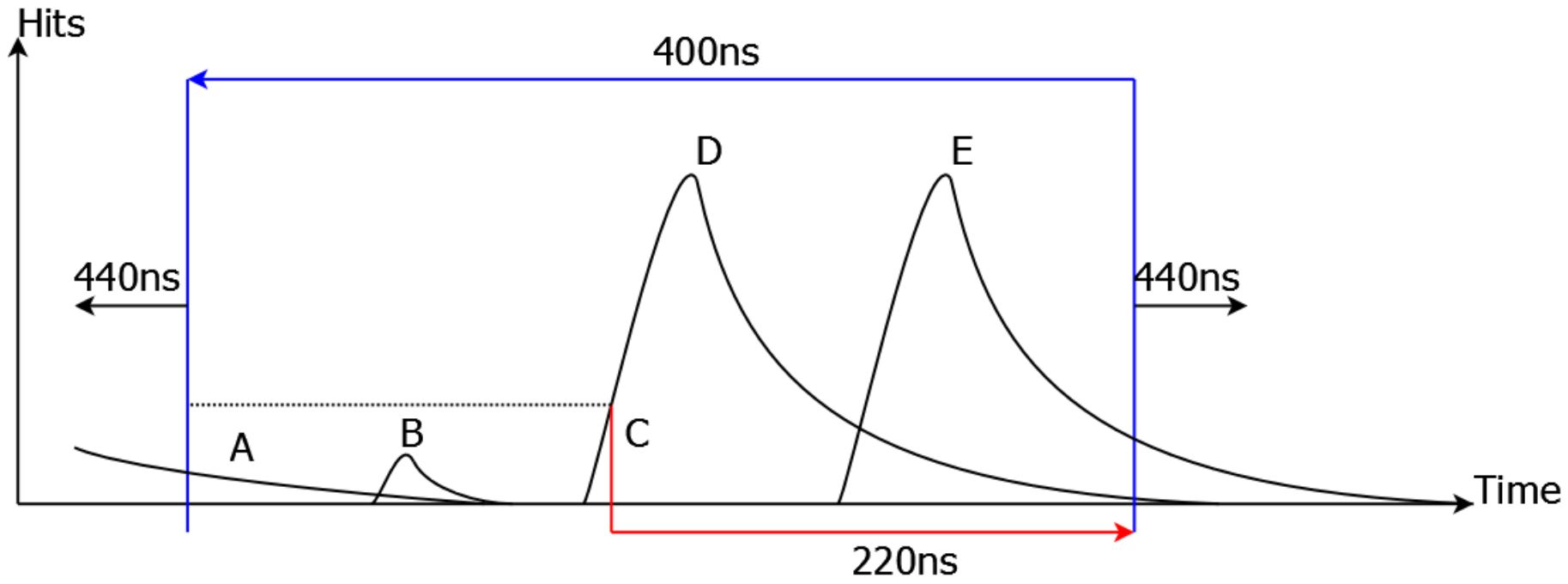
Predicted Spectra

- Monte Carlo predicted plots
  - Signal (red): 320meV, NME=2.32, G=19.2x10^{-19} yr^{-1}
  - 10^{-7} g/g ^{138}La, ^{176}Lu in Neodymium

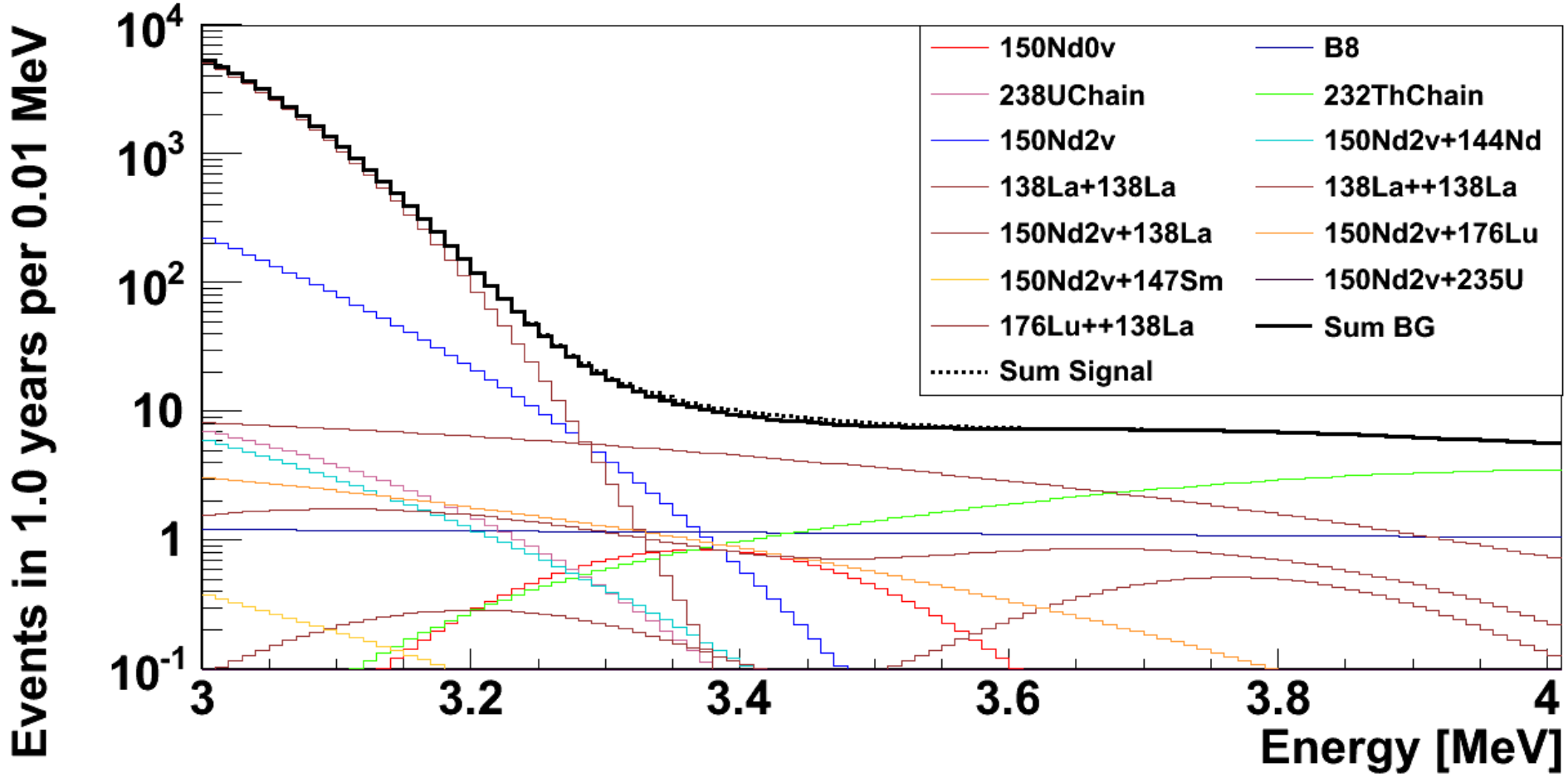


Pileup Definition

- Trigger window is 400ns
  - => Multiple interactions within 400ns



Pileup Backgrounds



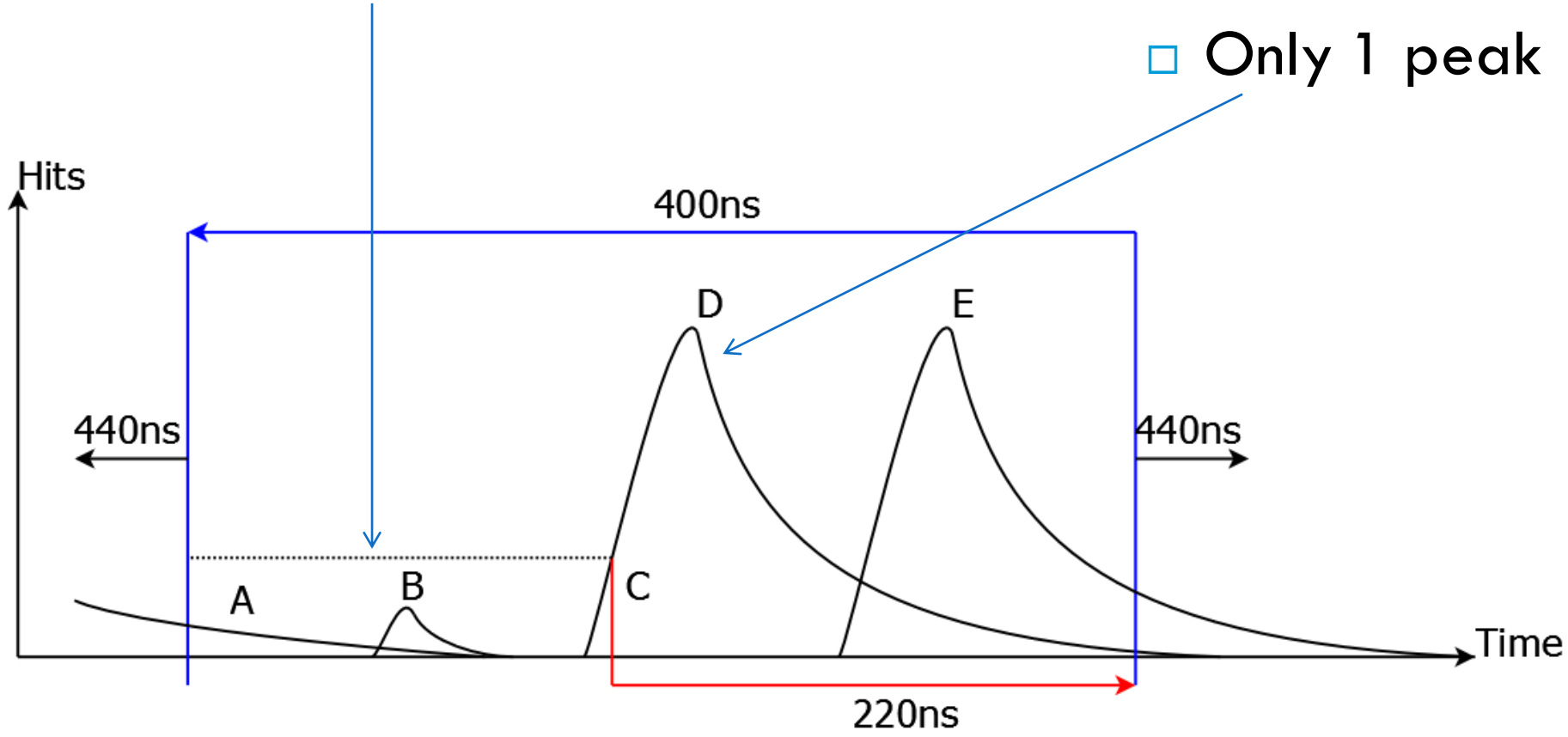
Pileup Rejection

- Single interaction events have:
  - Well formed raw hits in the trigger window
  - A well defined photon emission timing spectrum
  - Isotropic photon emission

- These are the things to test

Pileup Rejection Techniques

- No pre trigger hits
- Only 1 peak



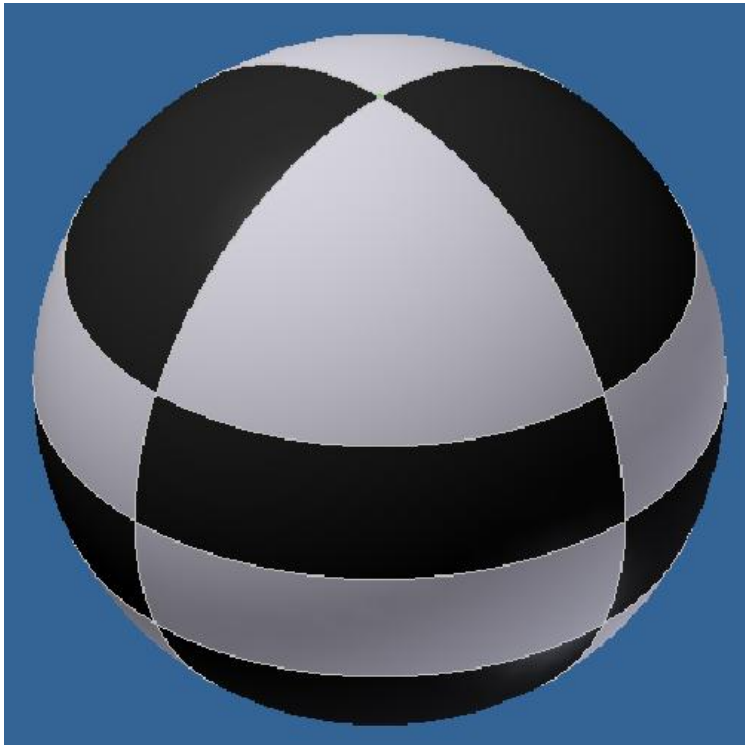
Pileup Rejection Techniques (2)

- Event reconstruction – does it reconstruct?

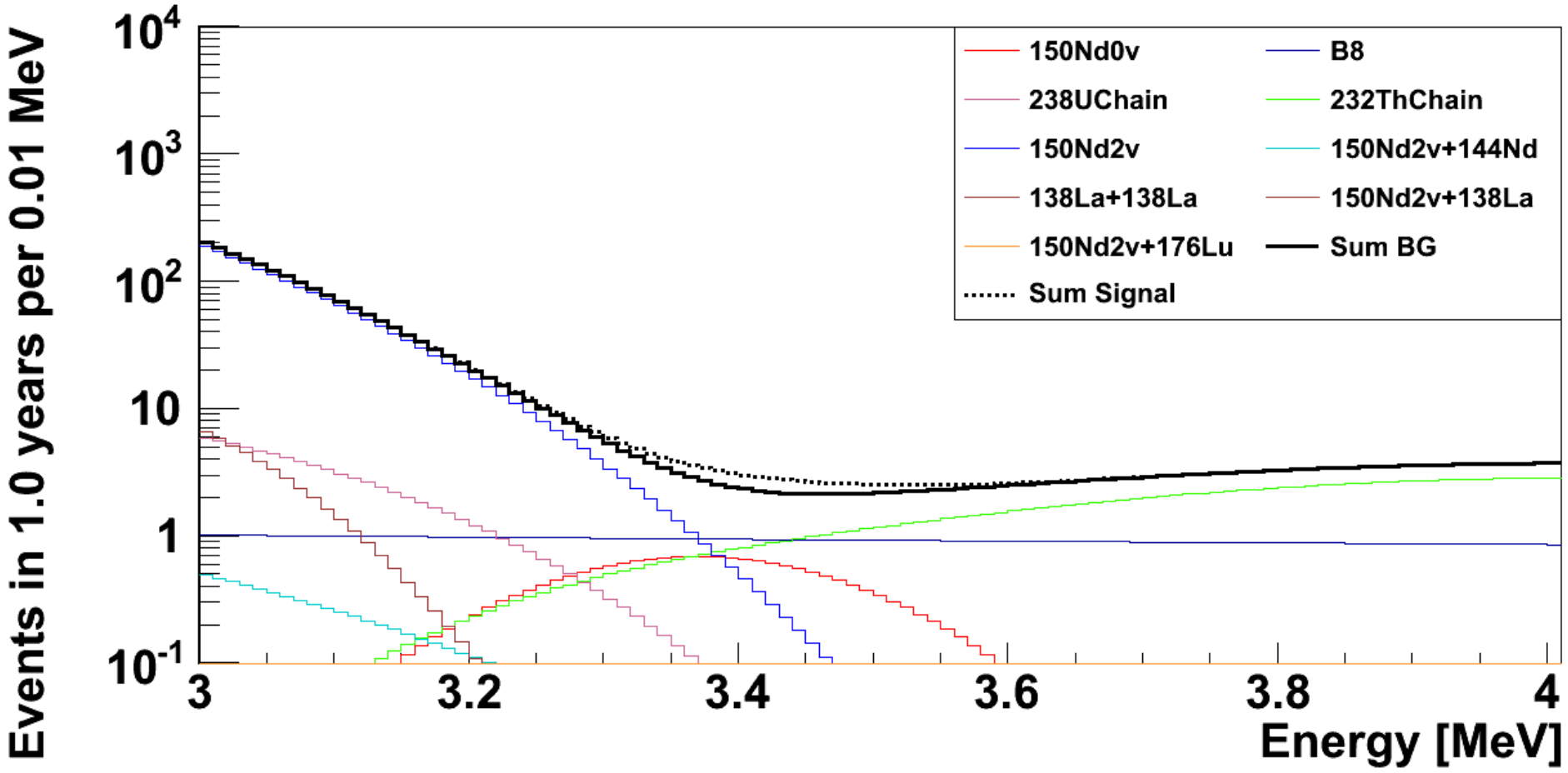
- Post reconstruction – does it make sense?
  - Causal hit times
  - Expected timing spectrum

Pileup Rejection Techniques (3)

- Sphere centred on event position
- Split into equal solid angle regions
- Count hits in each region
- Compare regions, should be equal



Post Rejection Backgrounds



Summary

- Pileup rejection is necessary for SNO+
- Techniques are predicted to perform well
- Data taking starts next year

Predicted sensitivity

- 80% livetime NME=2.5 (IBM-2) g0=2.69E-13yr
  0.3% loading