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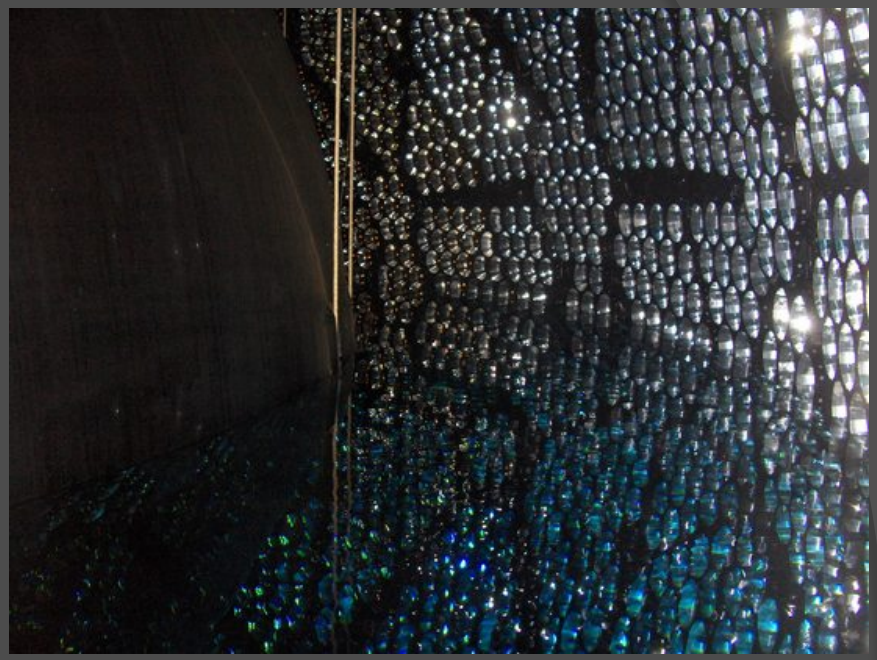
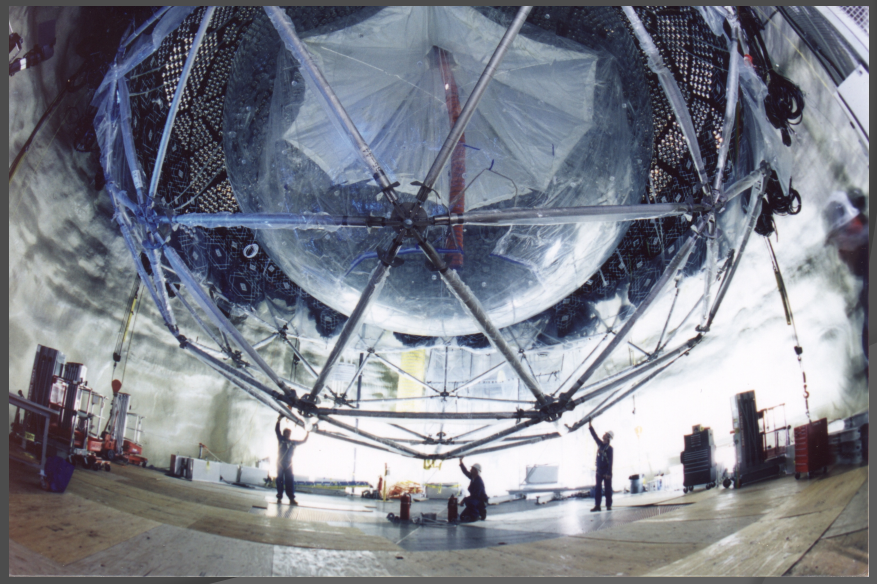
SNO+

Overview

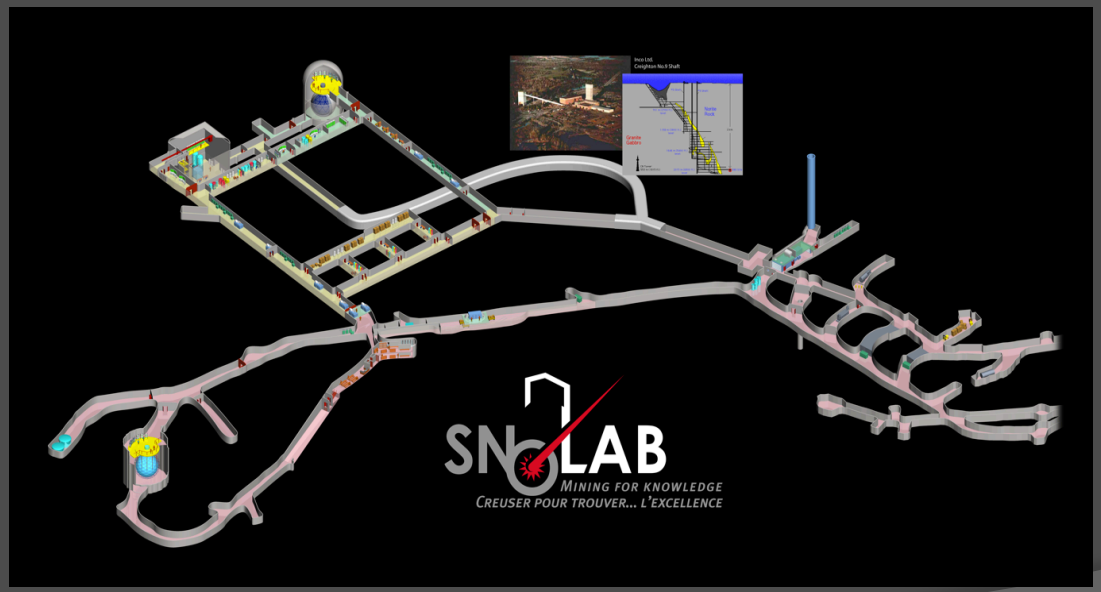
- Project Introduction
- Physics Goals
- UK Involvement

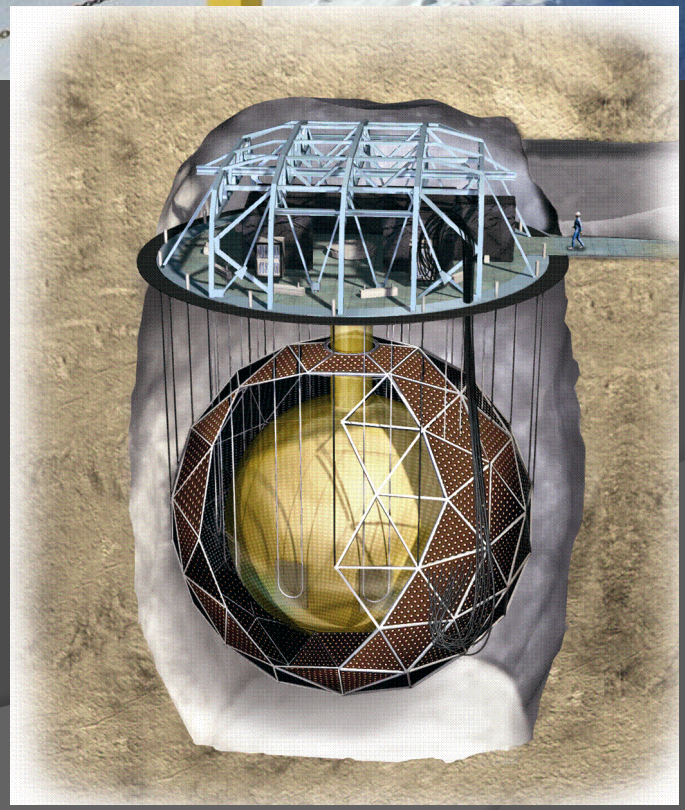




SNO

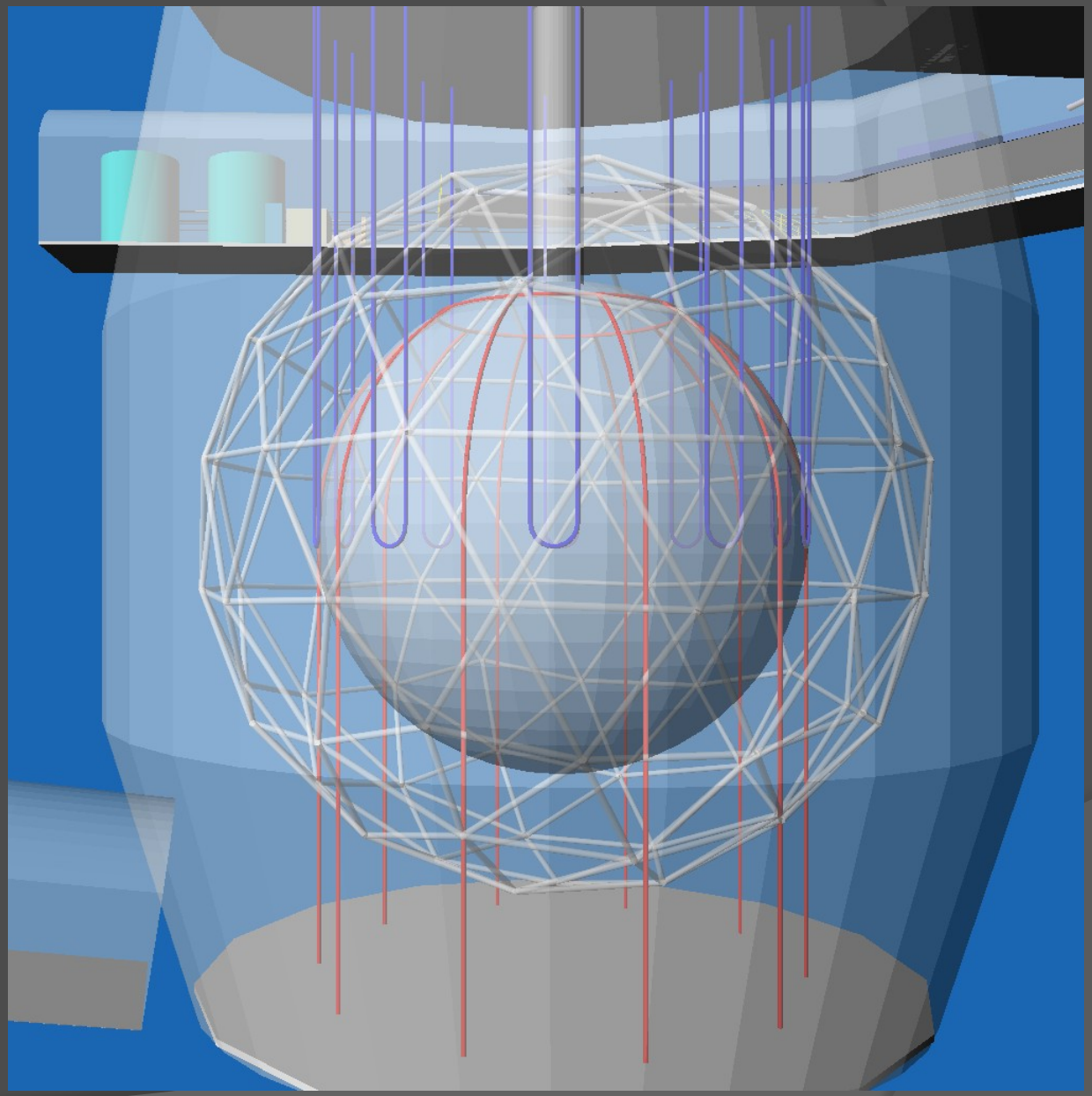
- Successful neutrino detector
- 2 km below Sudbury, Ontario
- Part of the rapidly growing SNOLab





SNO+

- Replace 1000t D_2O with scintillator
- Retain ~9000 PMTs, electronics
- Some hardware changes (hold down ropes, purification systems)



SNO+ Physics

- A diverse instrument for studying neutrinos
- Allows study of
  - Low energy solar neutrinos
  - Neutrinoless double beta decay (with an addition)
  - Geo-neutrinos
  - Reactor neutrinos
  - Supernovae
  - Nucleon decay

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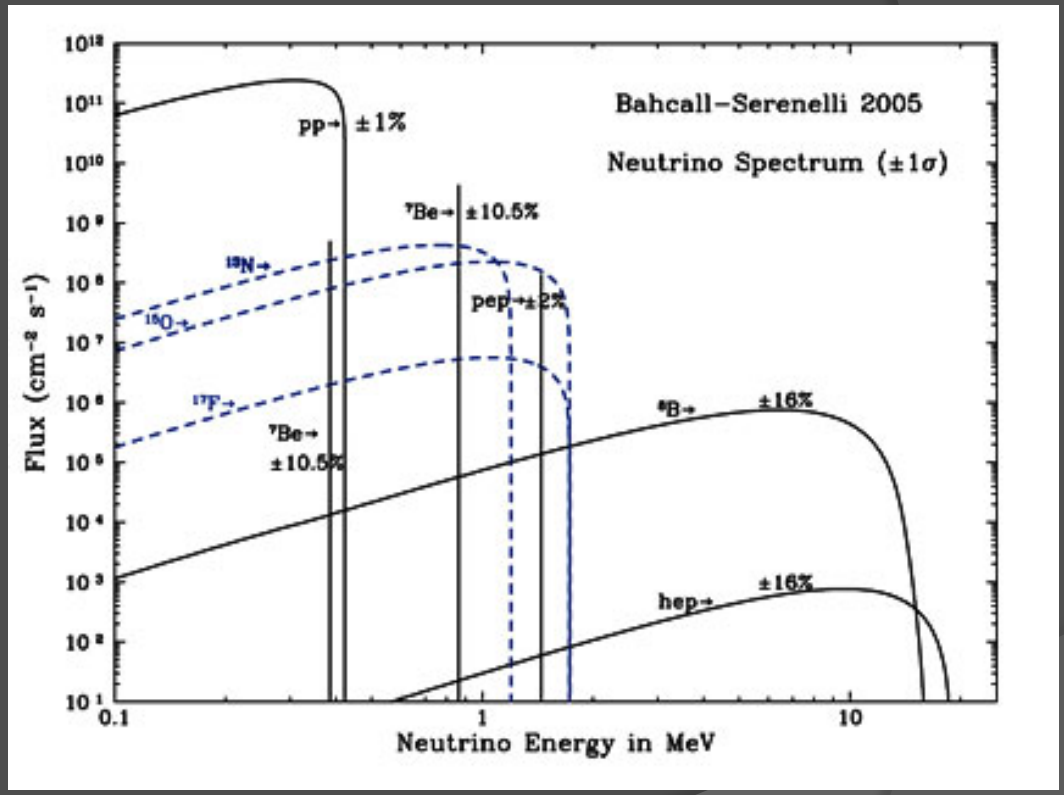
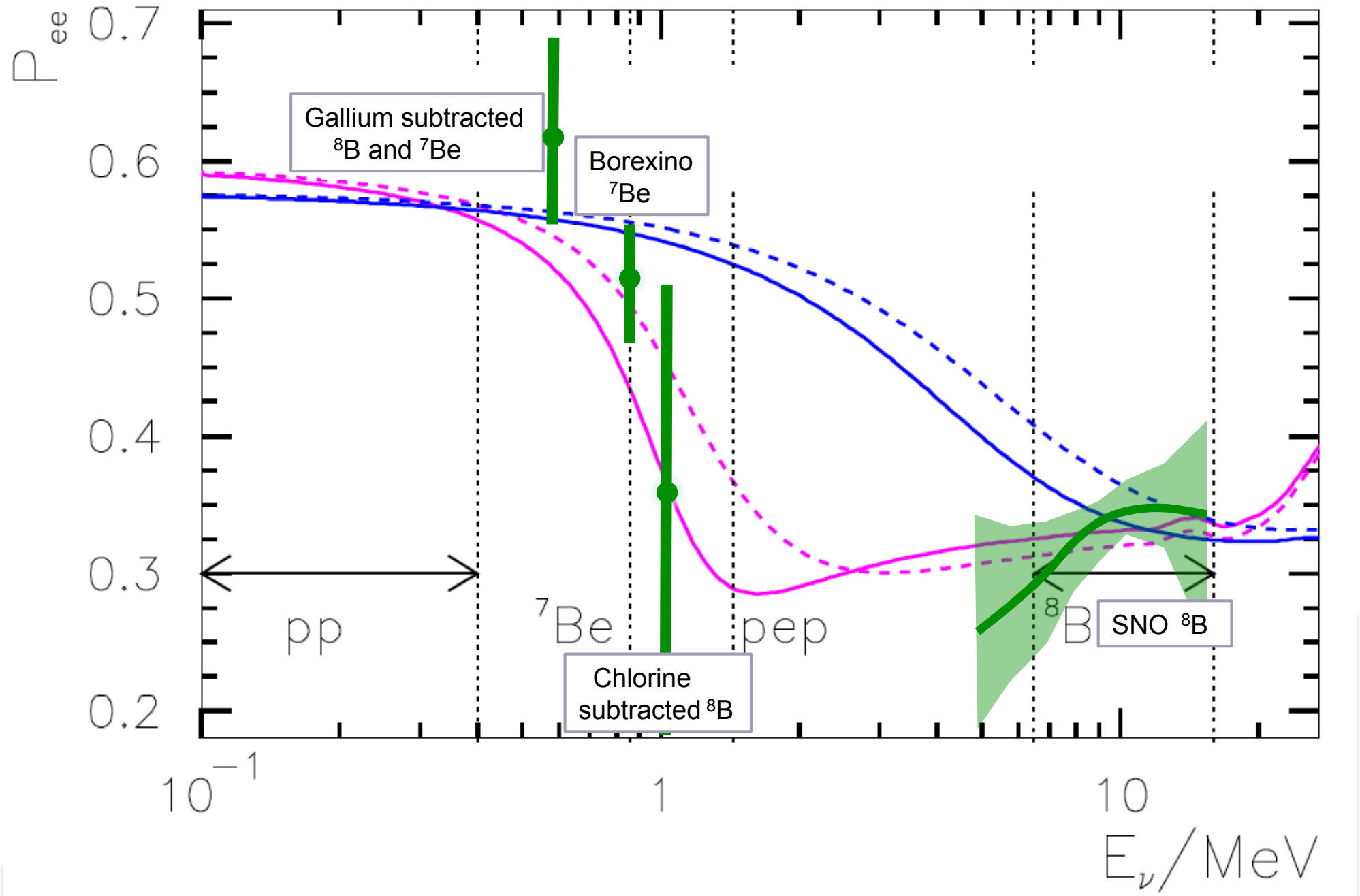
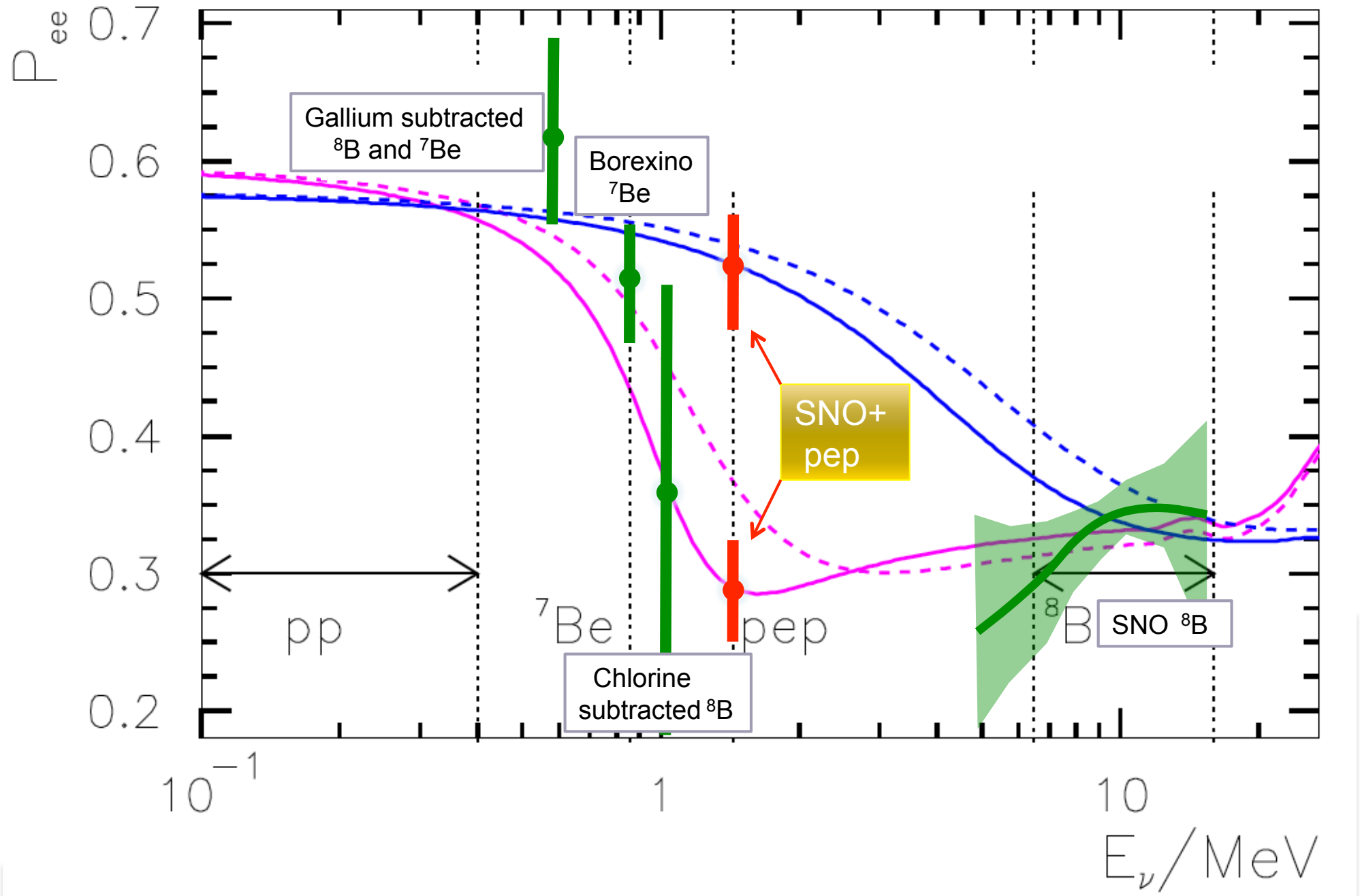
Physics – Solar Neutrinos

- ^{8}B, ^{7}Be, pp previously studied
- Next targets are pep, CNO
- SNO+ predicted ~3600 pep events/ (kton year) above 0.8 MeV




P_{ee}
0.7
0.6
0.5
0.4
0.3
0.2
Gallium subtracted
^{8}B and ^{7}Be
Borexino
^{7}Be
pp
^{7}Be
pep
^{8}B
SNO ^{8}B
Chlorine
subtracted ^{8}B
10^{-1}
1
10
E_ν/MeV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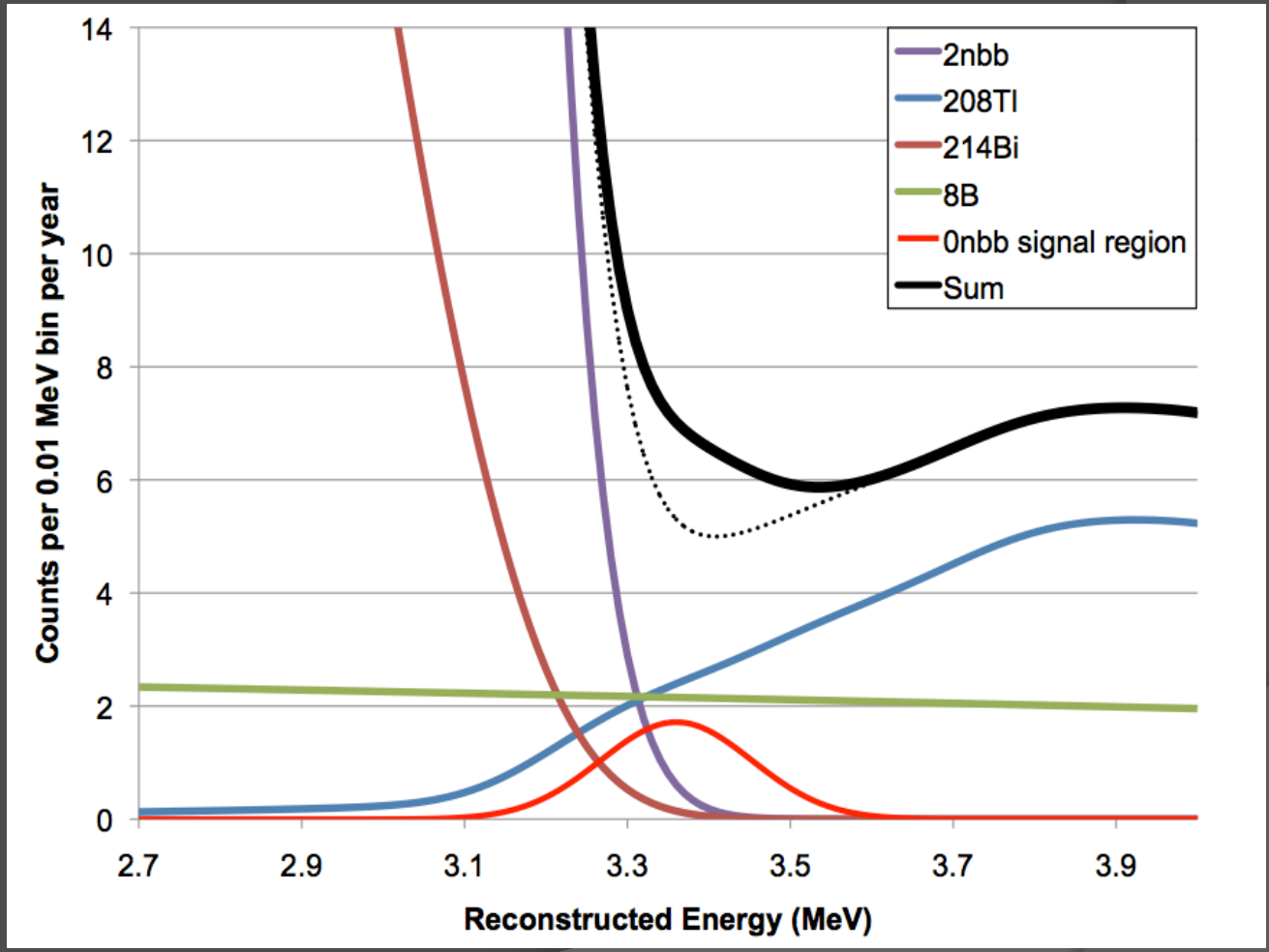
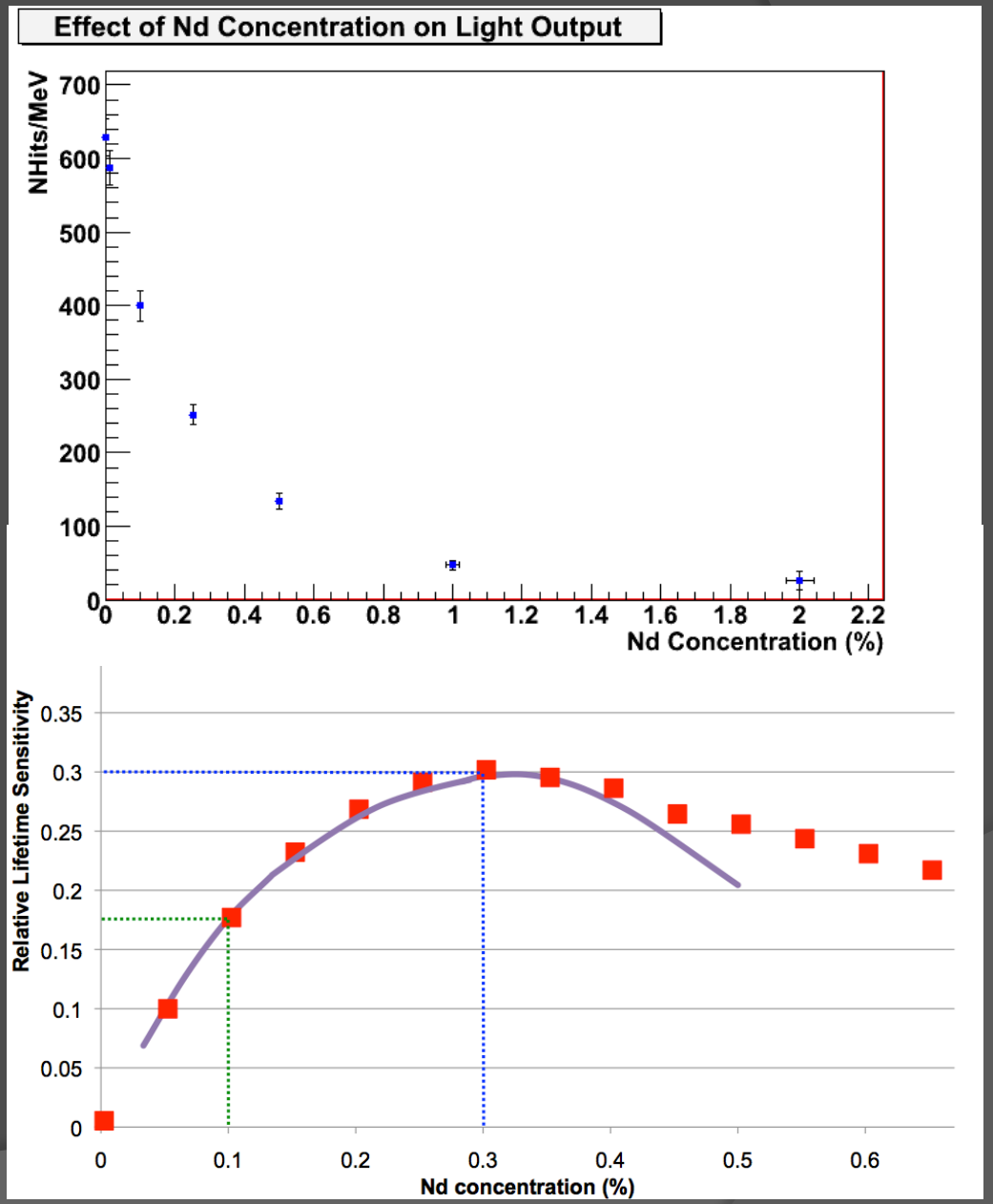
Phyiscs – Neutrinoless Double Beta Decay

- Double beta decay candidate chosen to be ^{150}Nd
- Can be added to (and removed from) scintillator



Phyiscs – Neutrinoless Double Beta Decay

- Currently studying Nd loading and effect on light transmission
- Increasing amount of Nd improves sensitivity
- Start with 0.1% to verify model, increase from that



UK Involvement

Queen's University
Laurentian University
University of Alberta
TRIUMF
SNOLAB

University of Pennsylvania
University of Washington
Black Hills State University
Armstrong Atlantic University
University of North Carolina
Brookhaven National Lab

Oxford University
Sussex University
Leeds University
Liverpool University
Sheffield University
QMUL

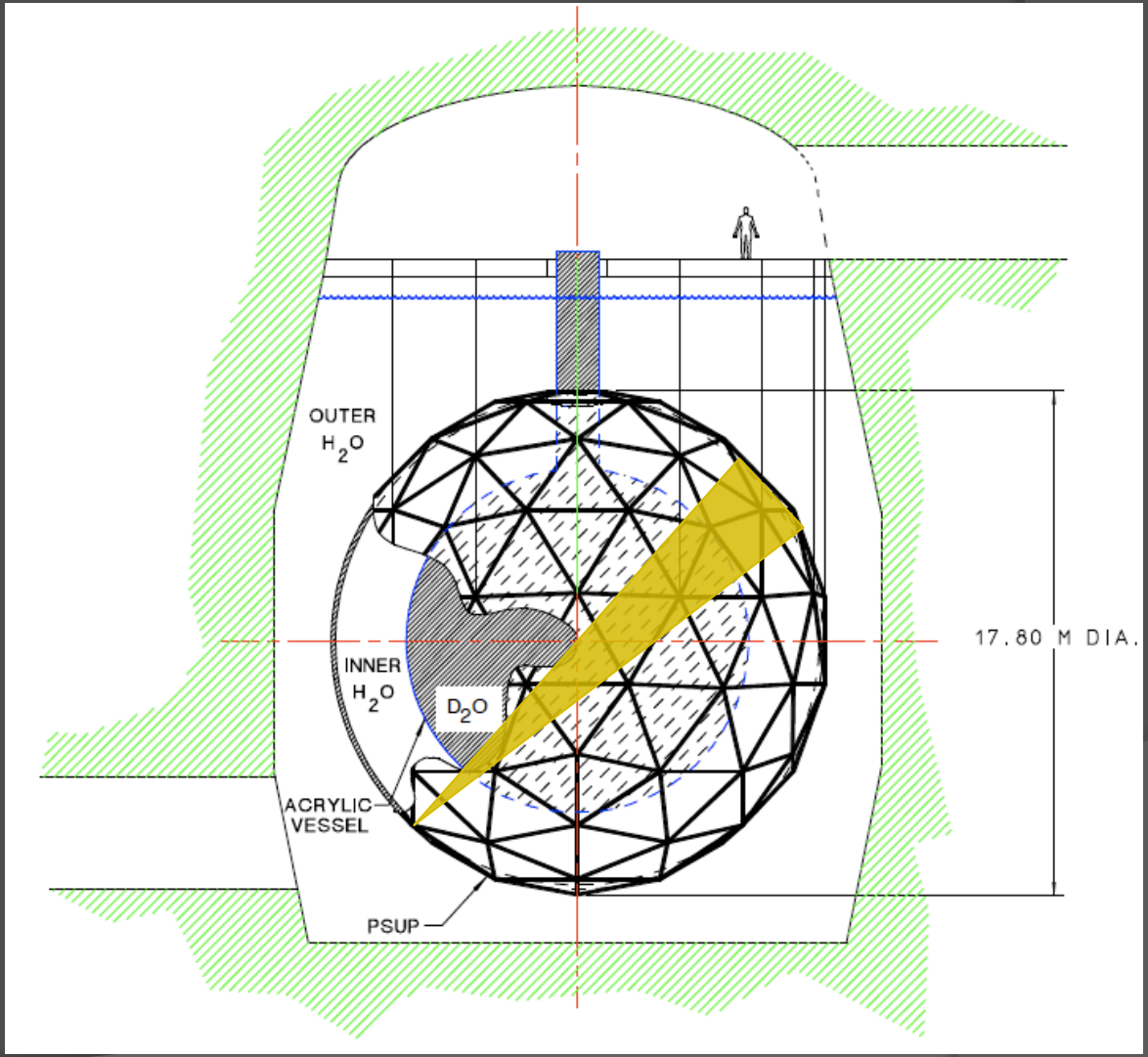
LIP Lisbon

TU Dresden

- UK personnel include heads of: event reconstruction, calibration, analysis and data flow
- Make up ¼ of academics in collaboration

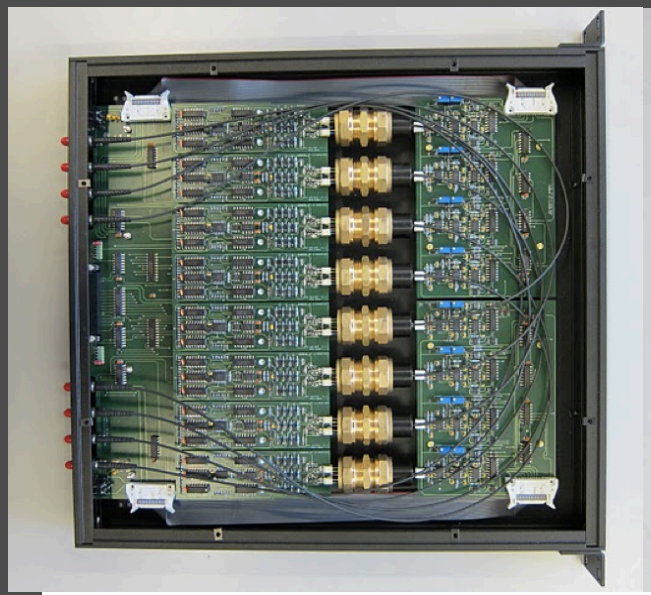
UK Involvement

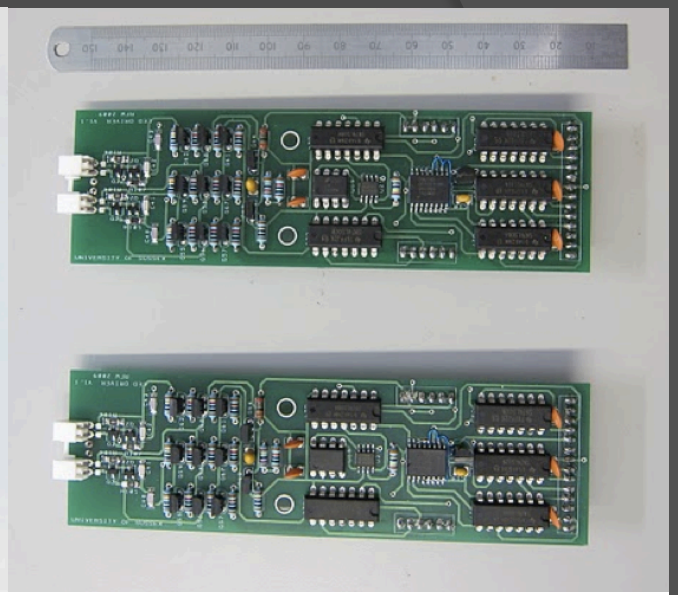
- UK largest project is LED calibration system
- Divided into two separate entities
  - Timing
  - Scattering Modulus

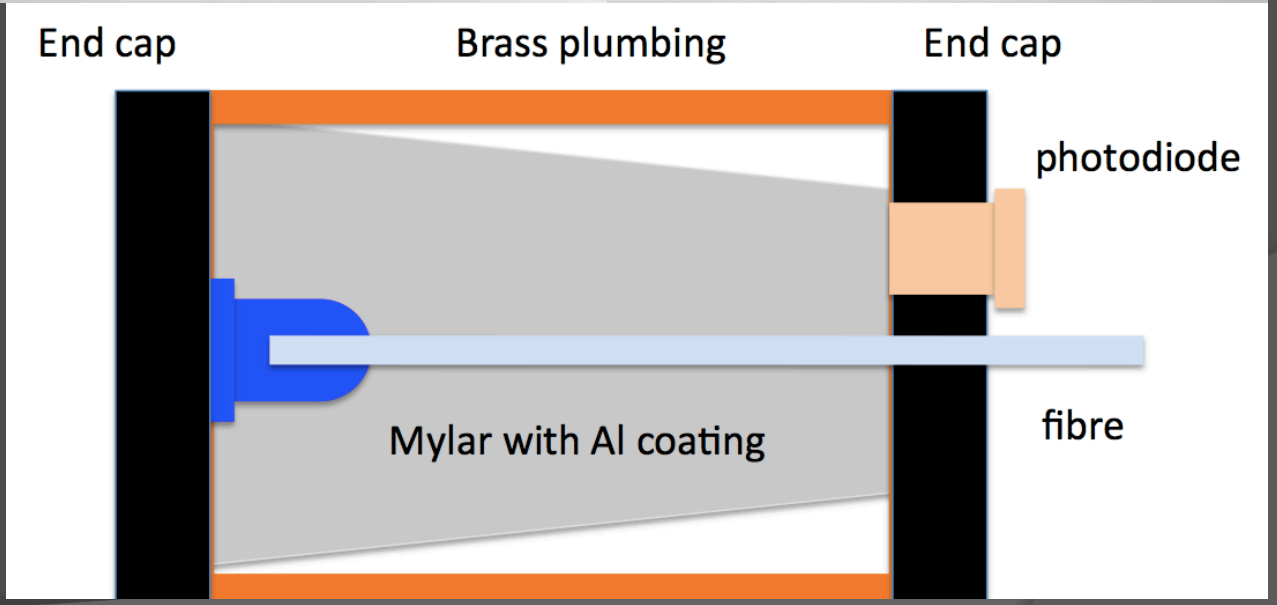


UK Involvement

- Require fast rise time pulses (Leeds)
- Collimators will inject light and allow for monitoring (Sussex)

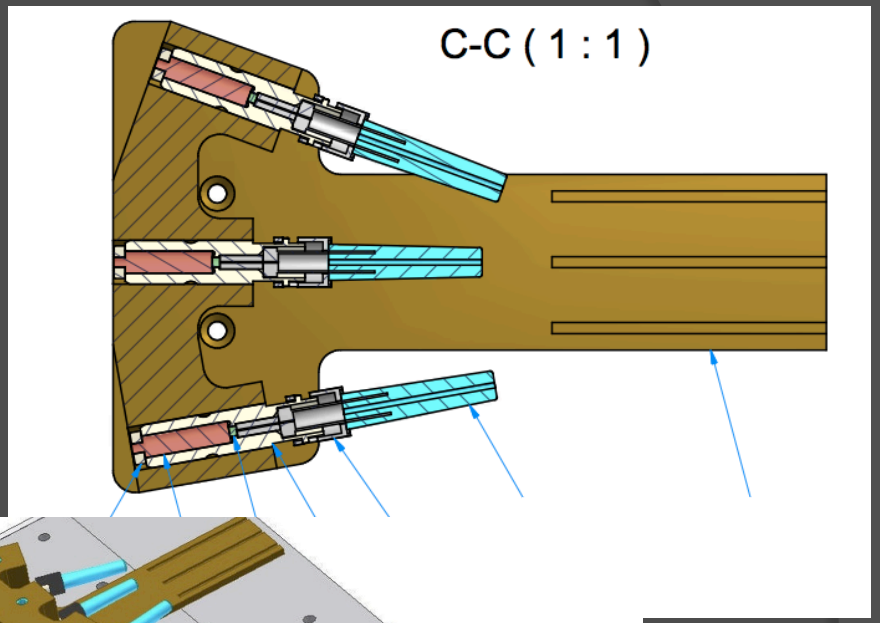


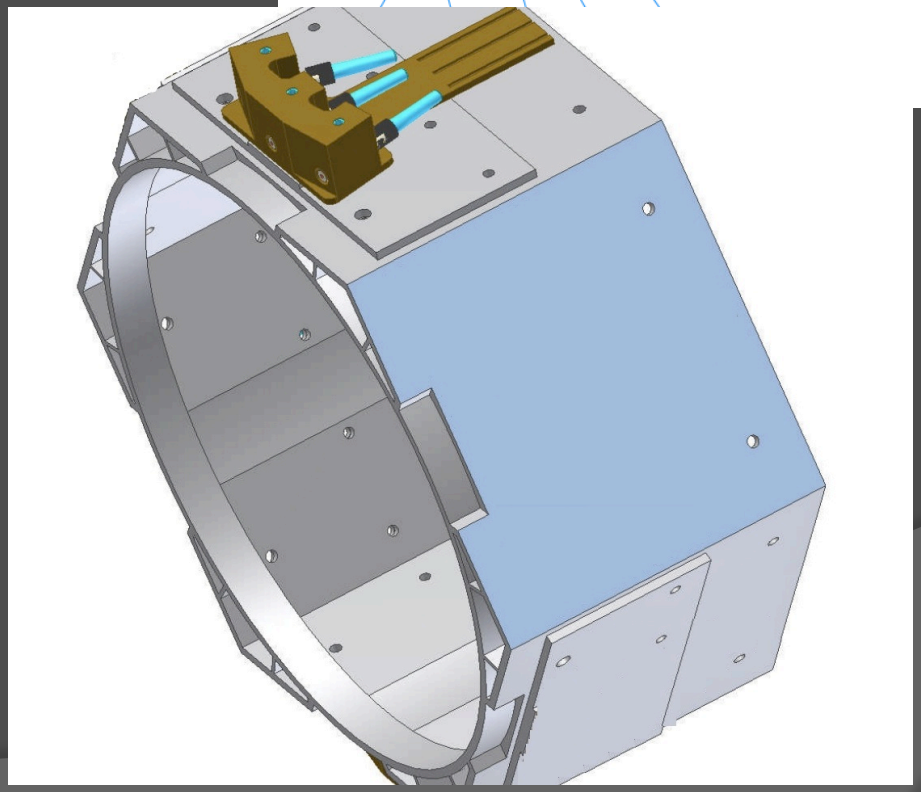




LED Calibrations – Scattering Modulus

- Want to monitor scattering properties of scintillator
- Three beams (0°,10°,20°)
- Four injection points
- Five wavelengths



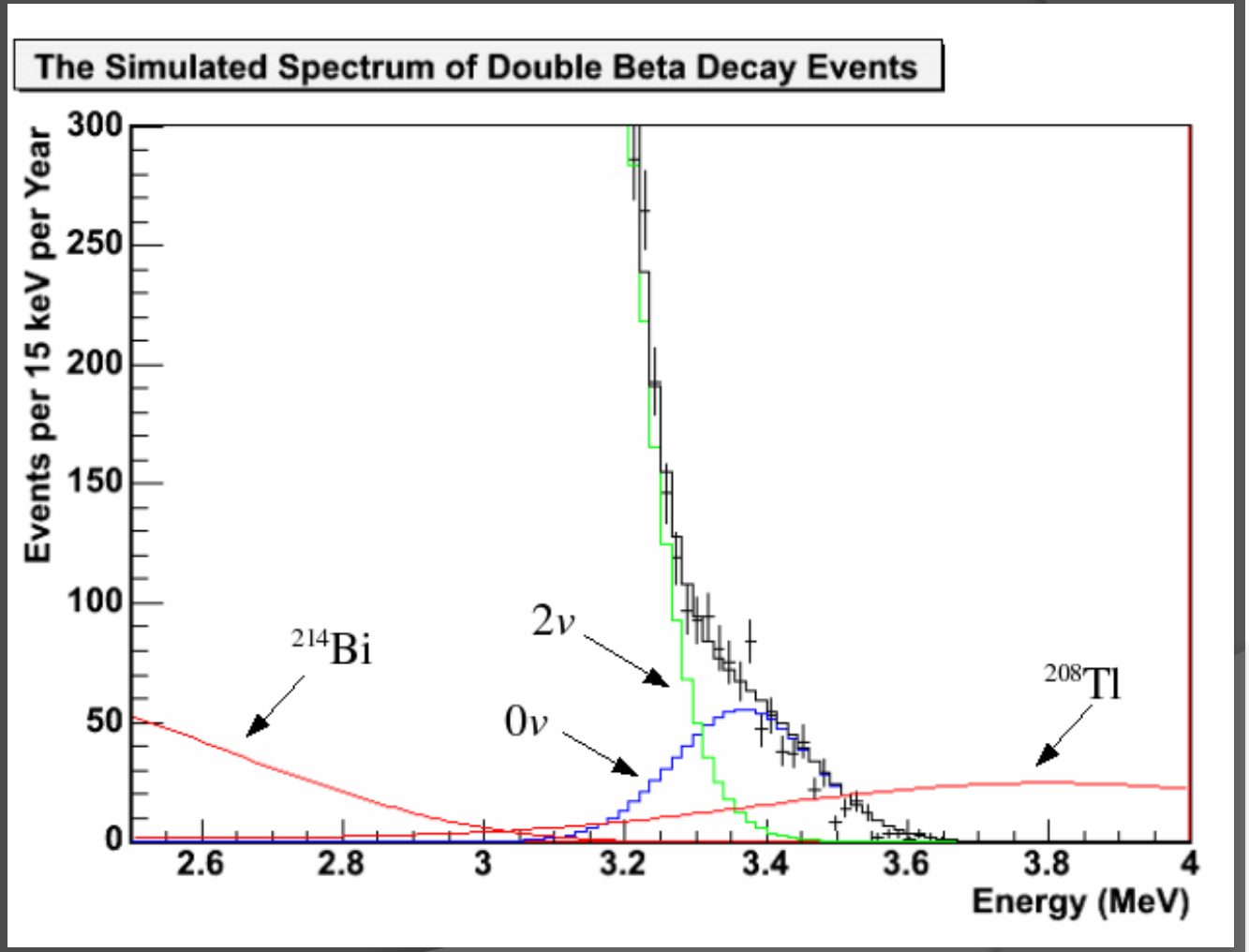


Conclusion

- UK's large contribution to SNO+ continues from SNO
- SNO+ building towards taking data soon
- See Phil Jones talk following this one

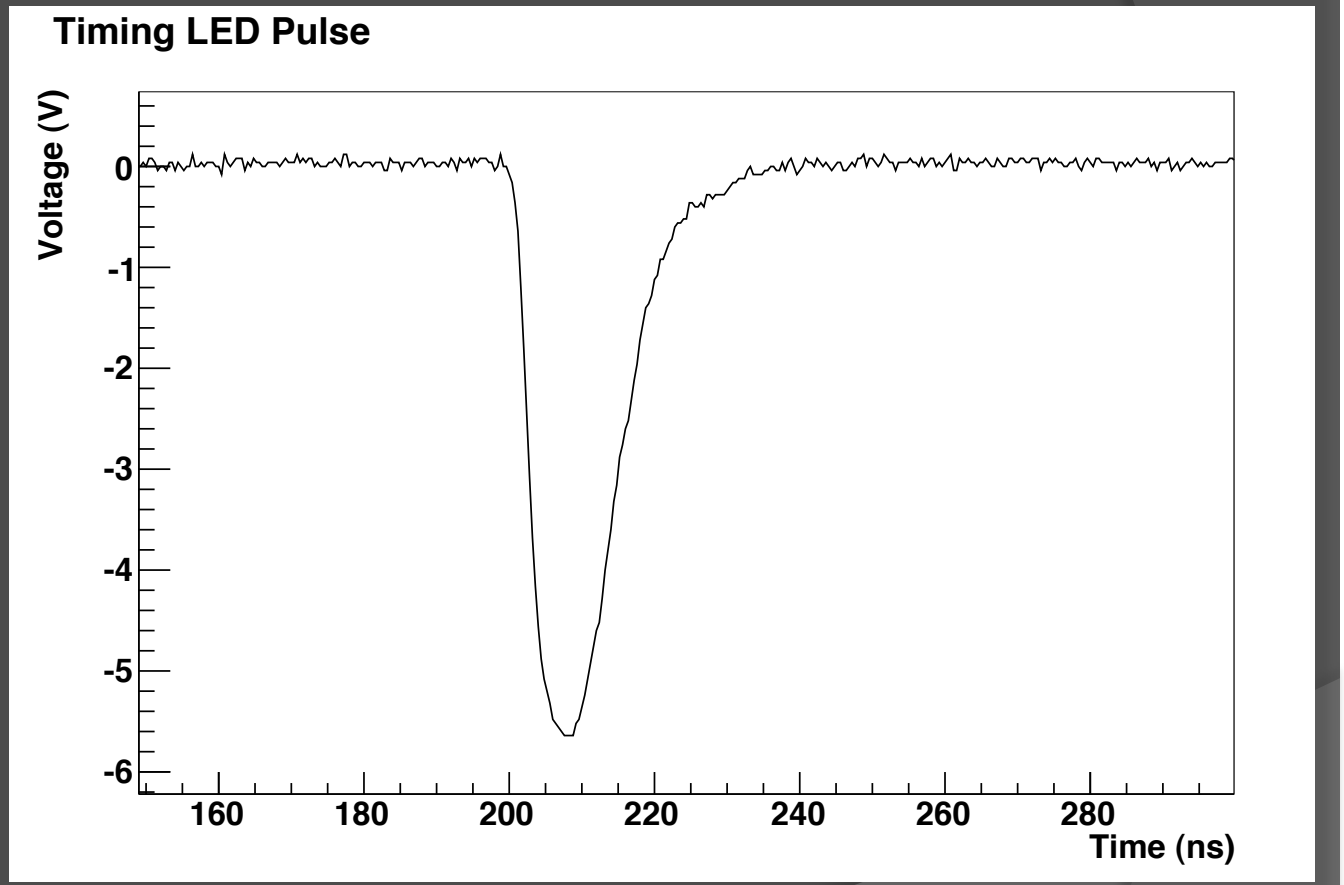
Phyiscs – Neutrinoless Double Beta Decay

- Large mass, low background leads to good separation
- Energy resolution?
- Include isotope with high end point energy, good phase space factor
- Chosen to be ^{150}Nd



LED Calibrations - Timing

- Important to know time response of PMTs
- Use LED light with “fast” rise time to define response



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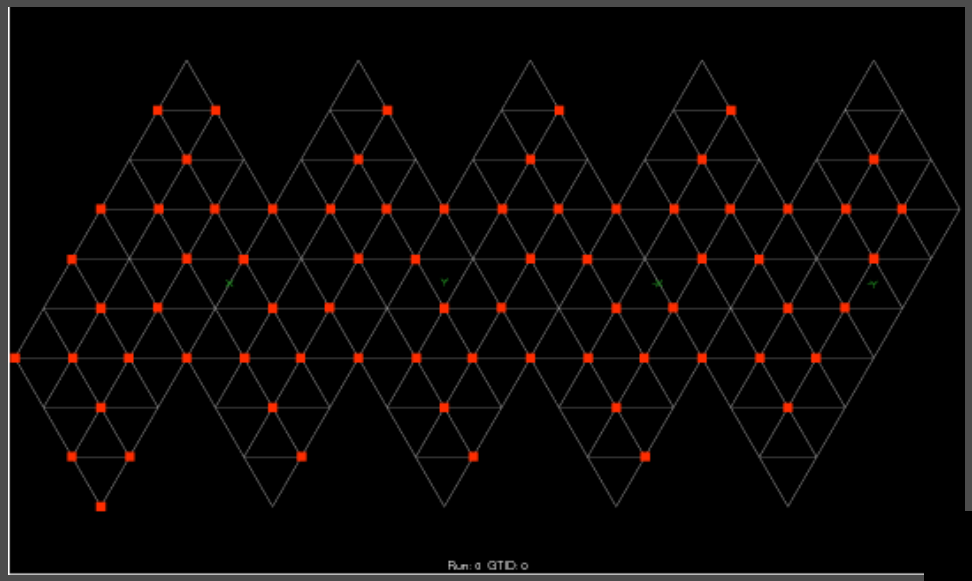

- Choose nodes from which to shine LED light
- 91 in total
- Allows for coverage of the entire detector with overlap

- Shining light from one LED produces hits on many PMTs
- Actual simulation with noise produces hits as shown at right