

Sudbury Neutrino Observatory

- Design
- Physics Objectives
- Calibration
- Data
- Status and Plans

Canada:

Carleton

UBC

Guelph

Laurentian

Queen's

US:

Brookhaven NL

Lawrence Berkeley NL

Los Alamos NL

Pennsylvania

Washington

UK:

Oxford



SNO Physics Goals

- ***Search for ν flavor change***
 - Ratios of CC/ES, CC/NC***
- ***Spectral Distortions***
- ***^8B Total Flux (test of solar models)***
- ***Time dependences:***
 - Diurnal***
 - Annual***
 - Solar cycle***
- ***Measurement of hep flux***
- ***Supernova watch, relic SN neutrinos***
- ***Antineutrinos***
- ***Atmospheric neutrinos***
 - ν above the horizon***
 - ν /anti- ν ratio***



Detector Performance

February 2001

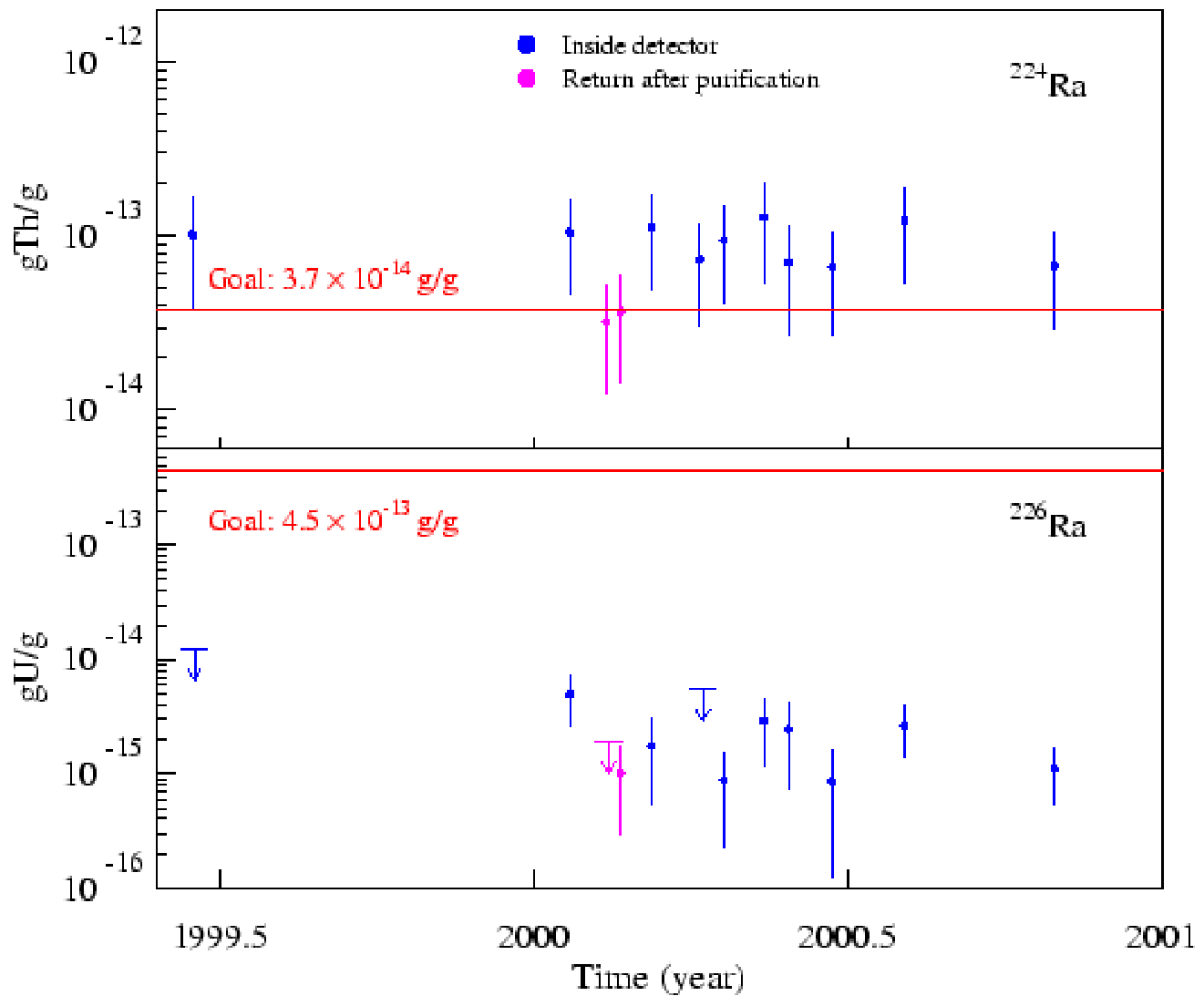
Trigger Rates and Thresholds

| <i>Trigger Type</i> | <i>Hardware Threshold</i> | <i>Rate (Hz)</i> |
|---------------------------|---------------------------|------------------|
| <i>Pulsed Trigger</i> | Zero Bias | 5 |
| <i>100 ns Coincidence</i> | 16 PMTs | 8 |
| <i>20 ns Coincidence</i> | 16 PMTs | 0.02 |
| <i>Energy sum</i> | ~150 p.e. | 4 |
| <i>Prescaled (1:1000)</i> | 11 PMTs | 0.1 |

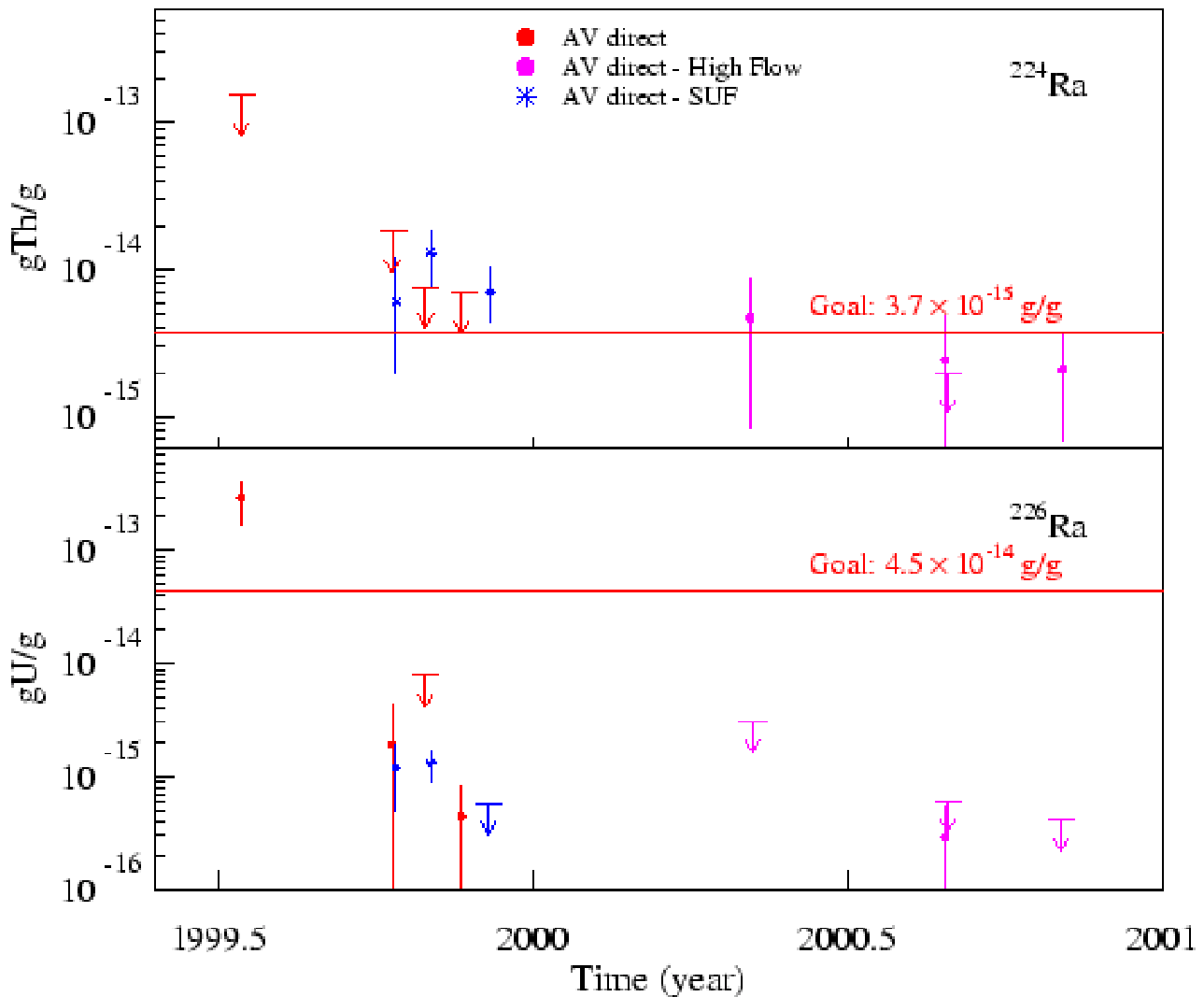
- **Trigger rate ~ 17 Hz**
- **Hardware threshold ~ 2 MeV**



Radioactivity in Light Water



Radioactivity in Heavy Water

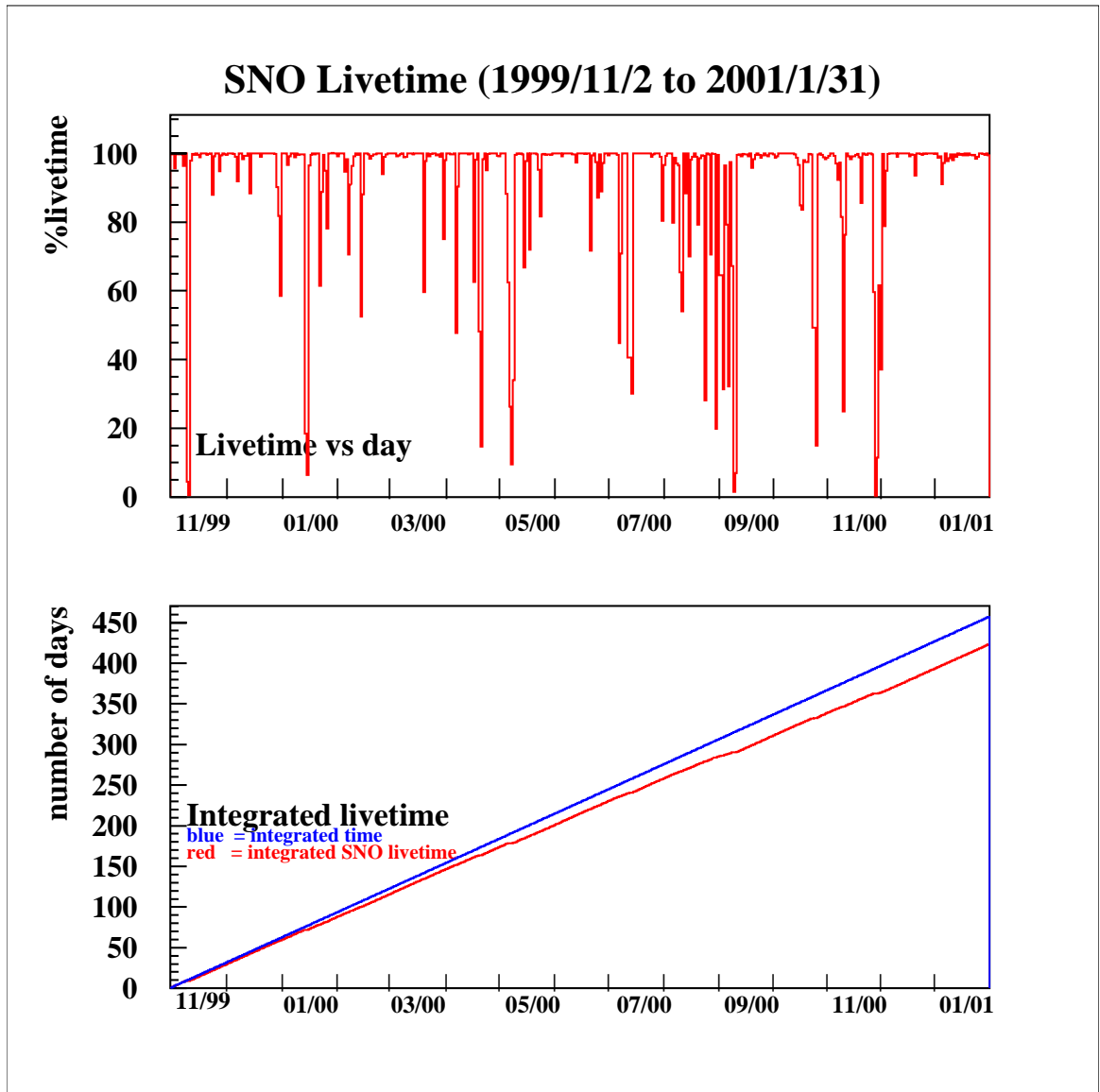


Goal: $d(\gamma,n)p < 5\%$ of SSM NC signal

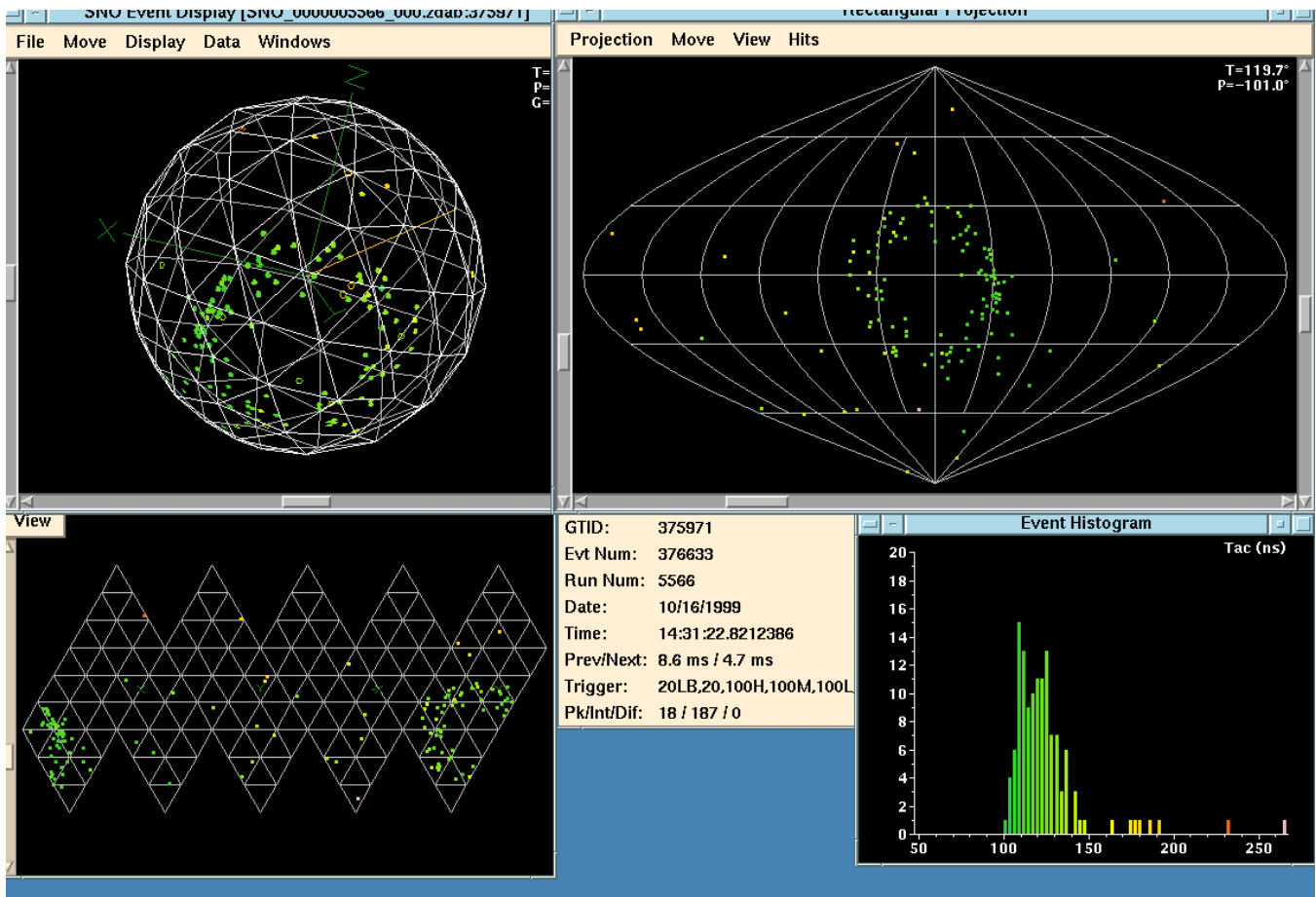
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Venice 3/01



Livetime



A Neutrino Event



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Venice 3/01



CC Analysis for Solar Neutrinos

- *CC cross section uncertainty
~3% (also CC/ES)*
- *CC/NC < 1%*

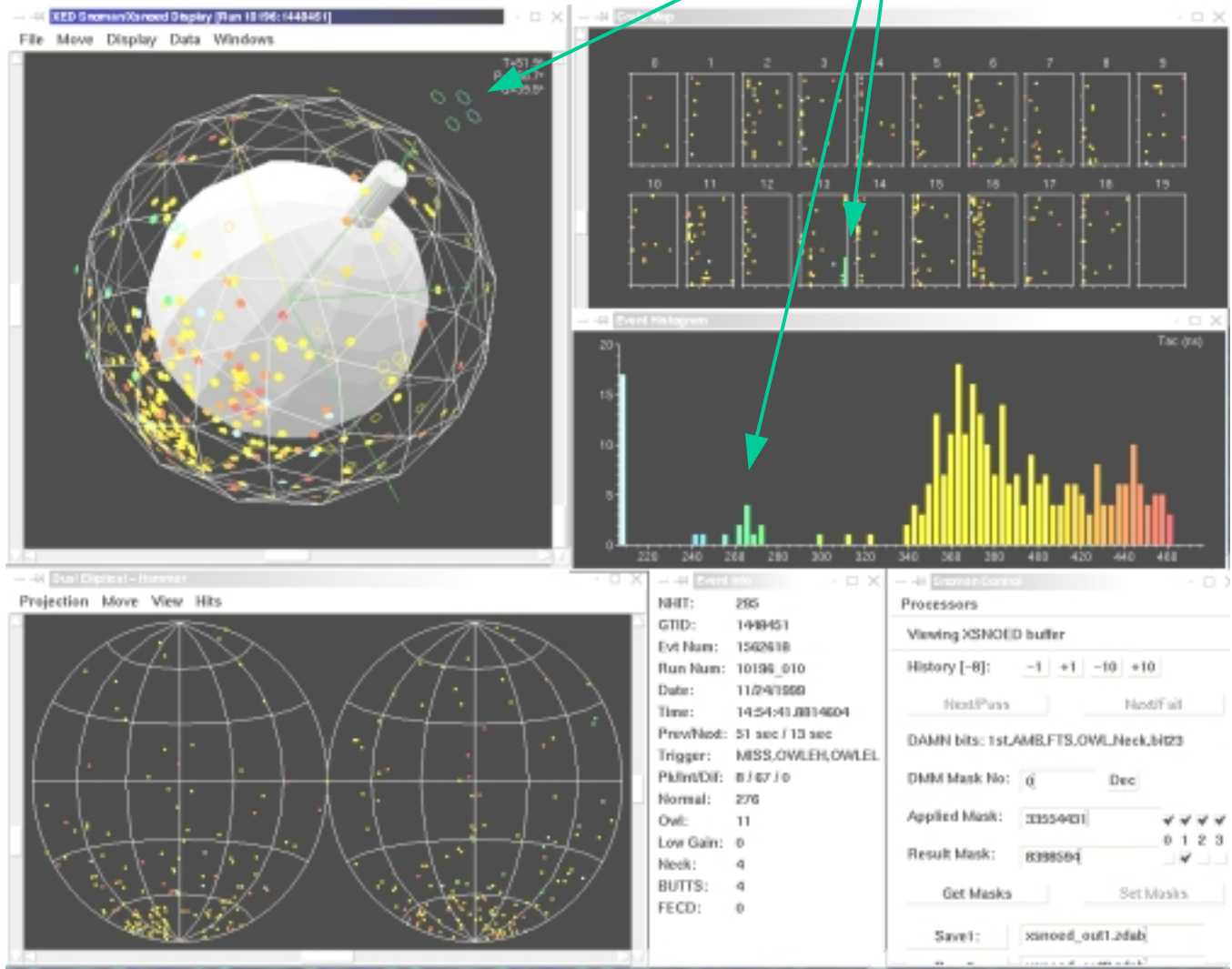
Systematic uncertainty goals:

- *Energy calibration 1%*
- *Fiducial volume 1%*
- *Background from instrumental light << 1%*



Neck Event

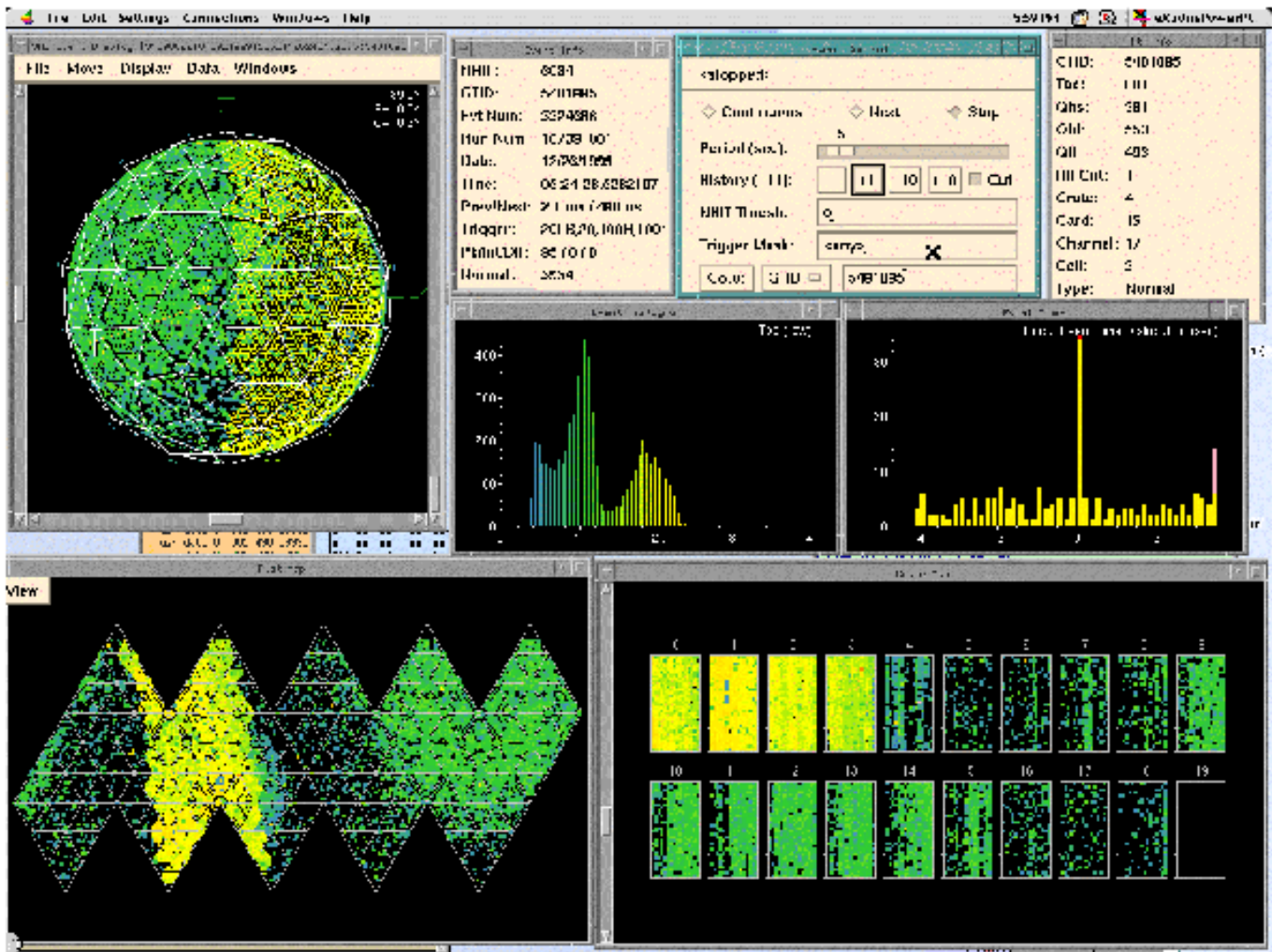
Note Neck Tubes Fired



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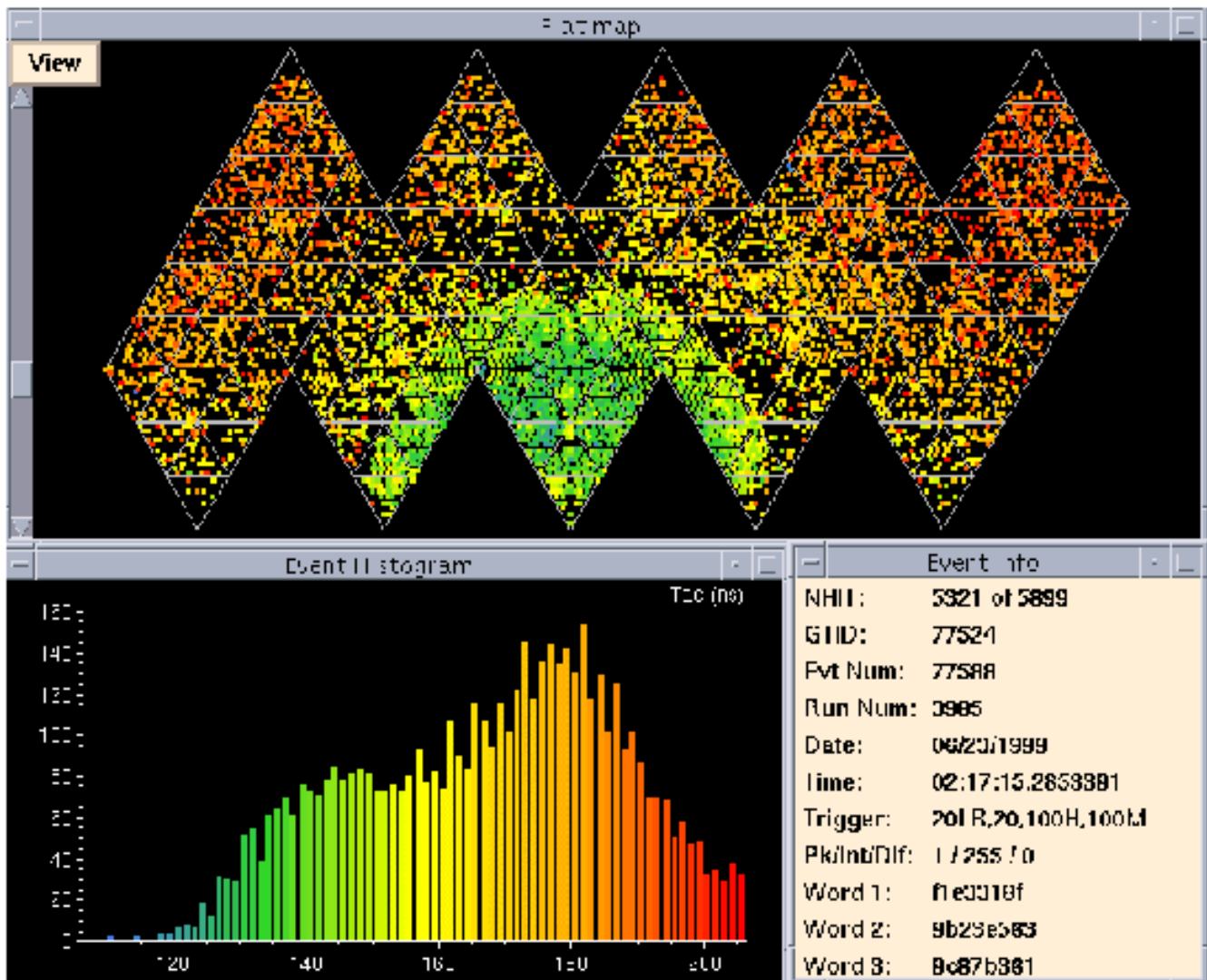
HV Breakdown at underwater end



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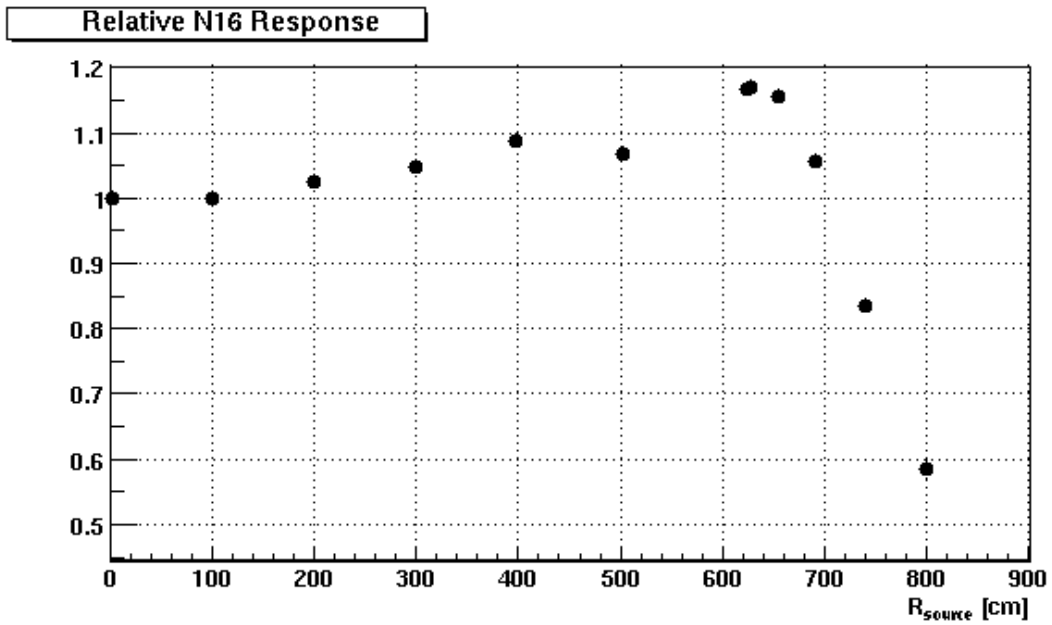
"Bubbler"



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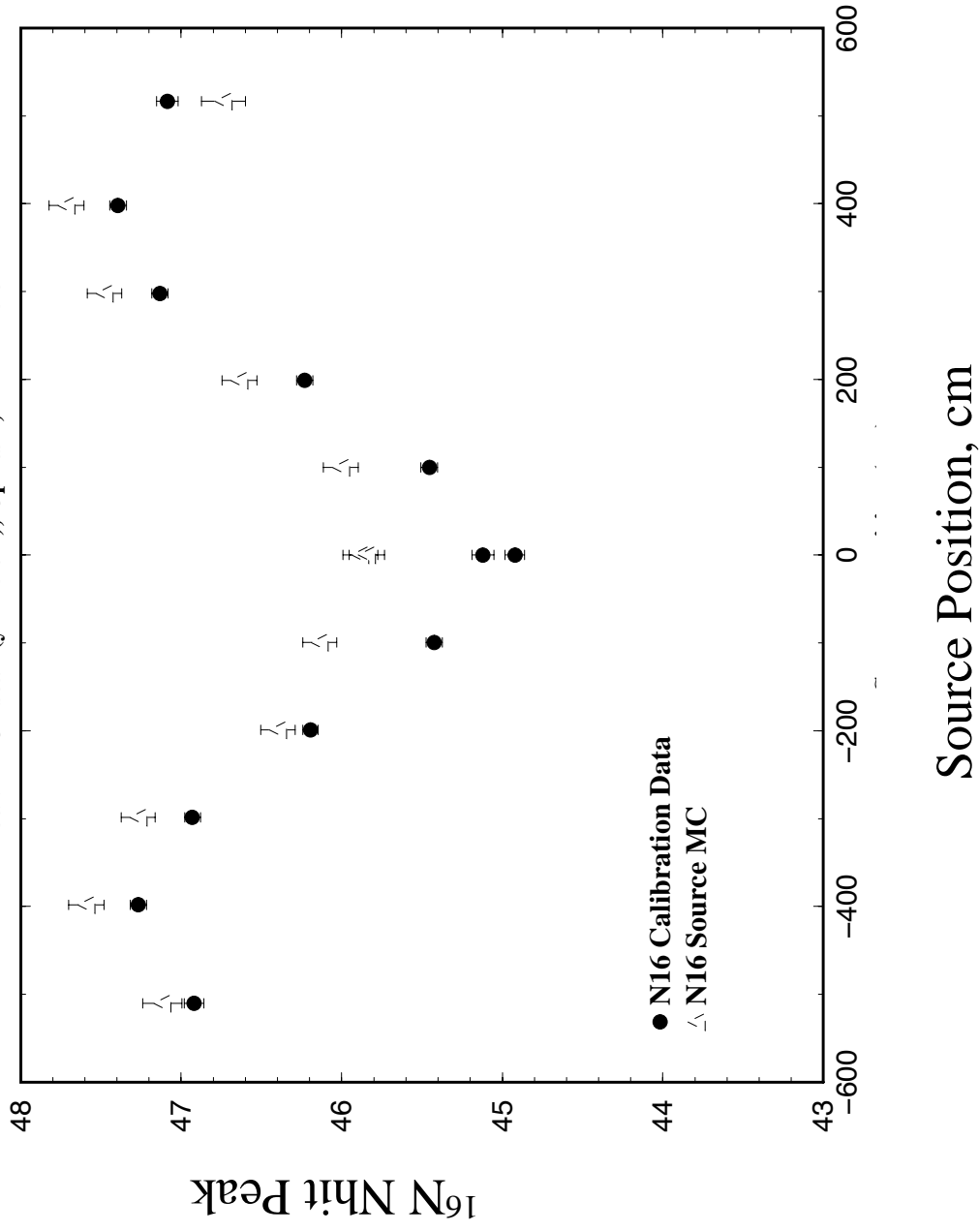


Variation of response across the detector



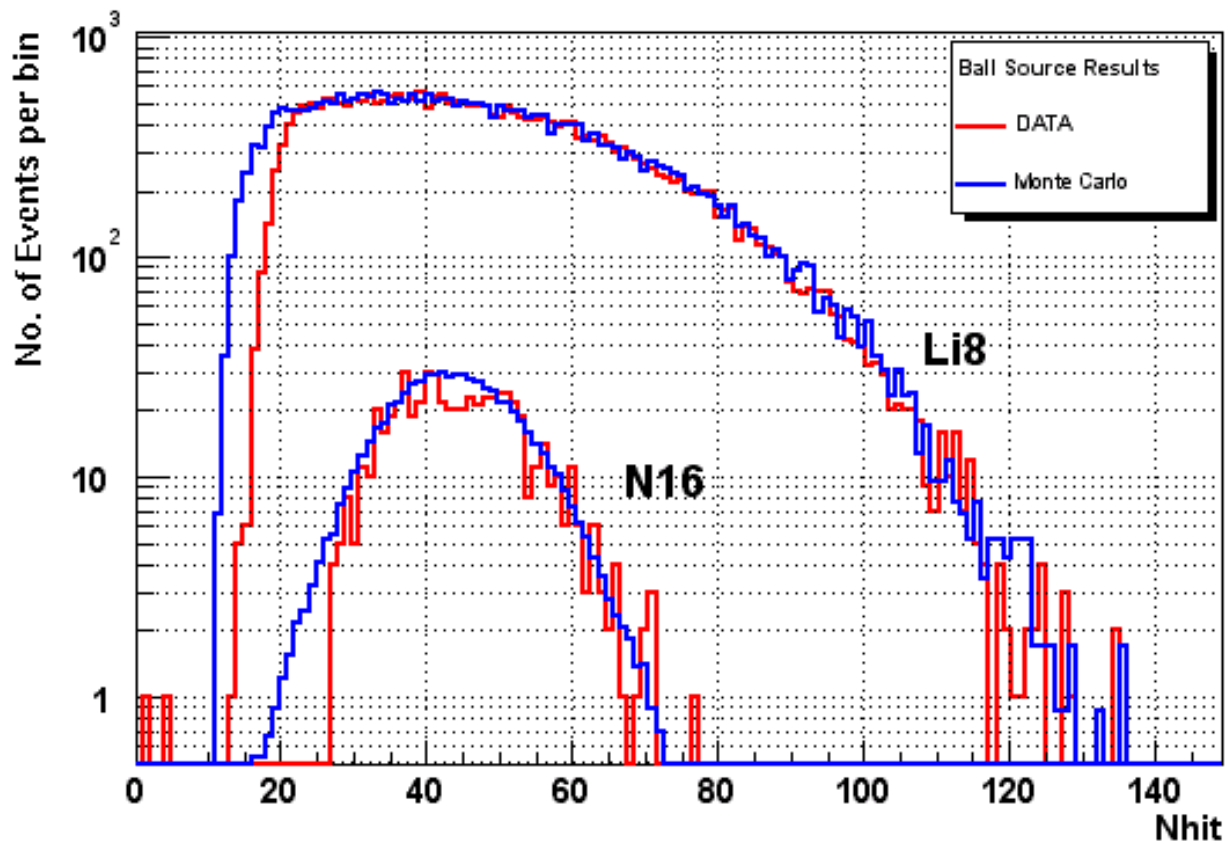
Comparison of N16 MC and Actual Energy Scale

Dec99 D2O xscan (y=z=0 cm), Optics 1, Rfit < 550 cm



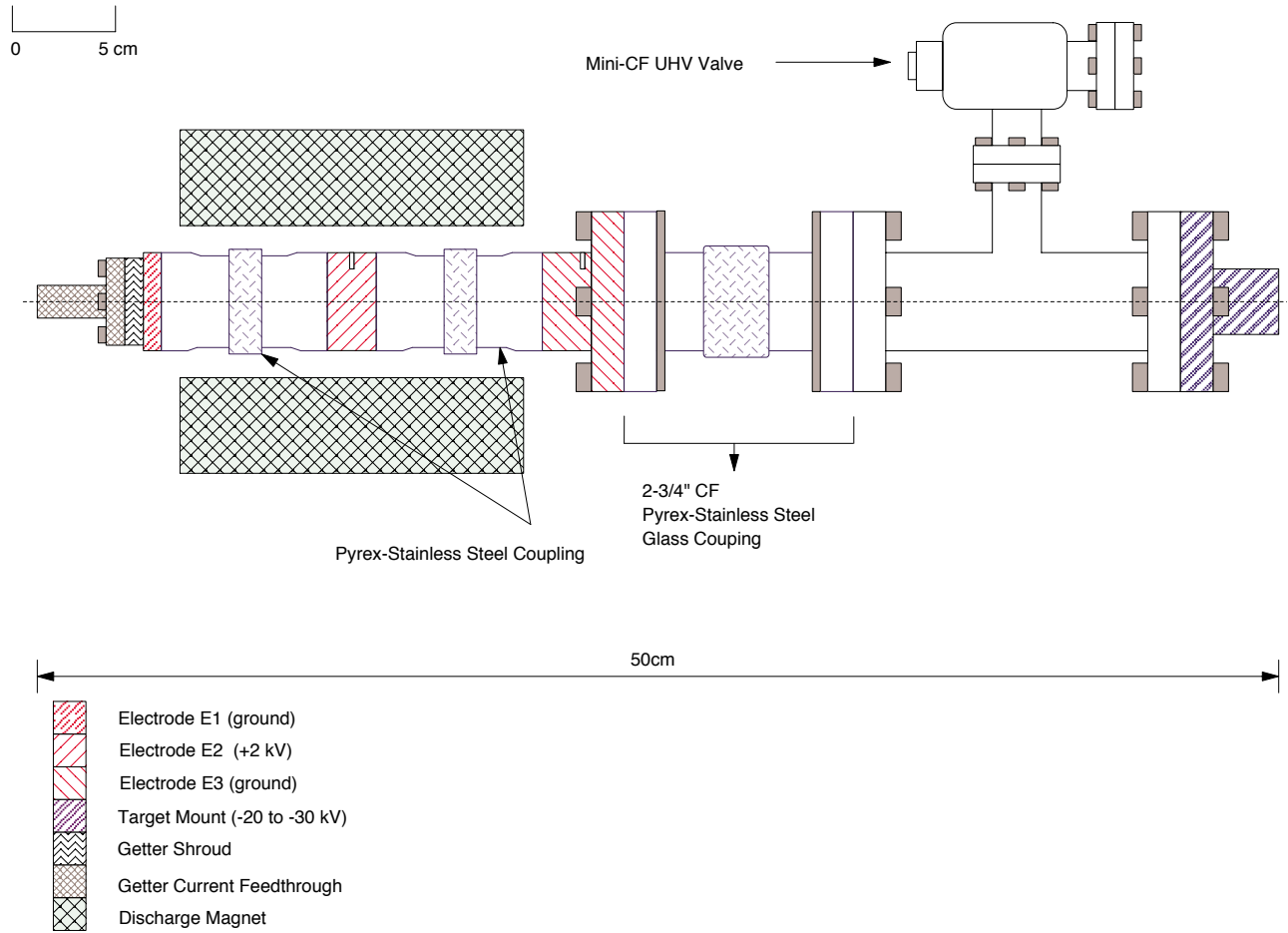
^8Li Calibration

Produced by (n,α) on ^{11}B .
13 MeV endpoint, $\tau_{1/2} = 0.84$ s
 β are tagged by α detection



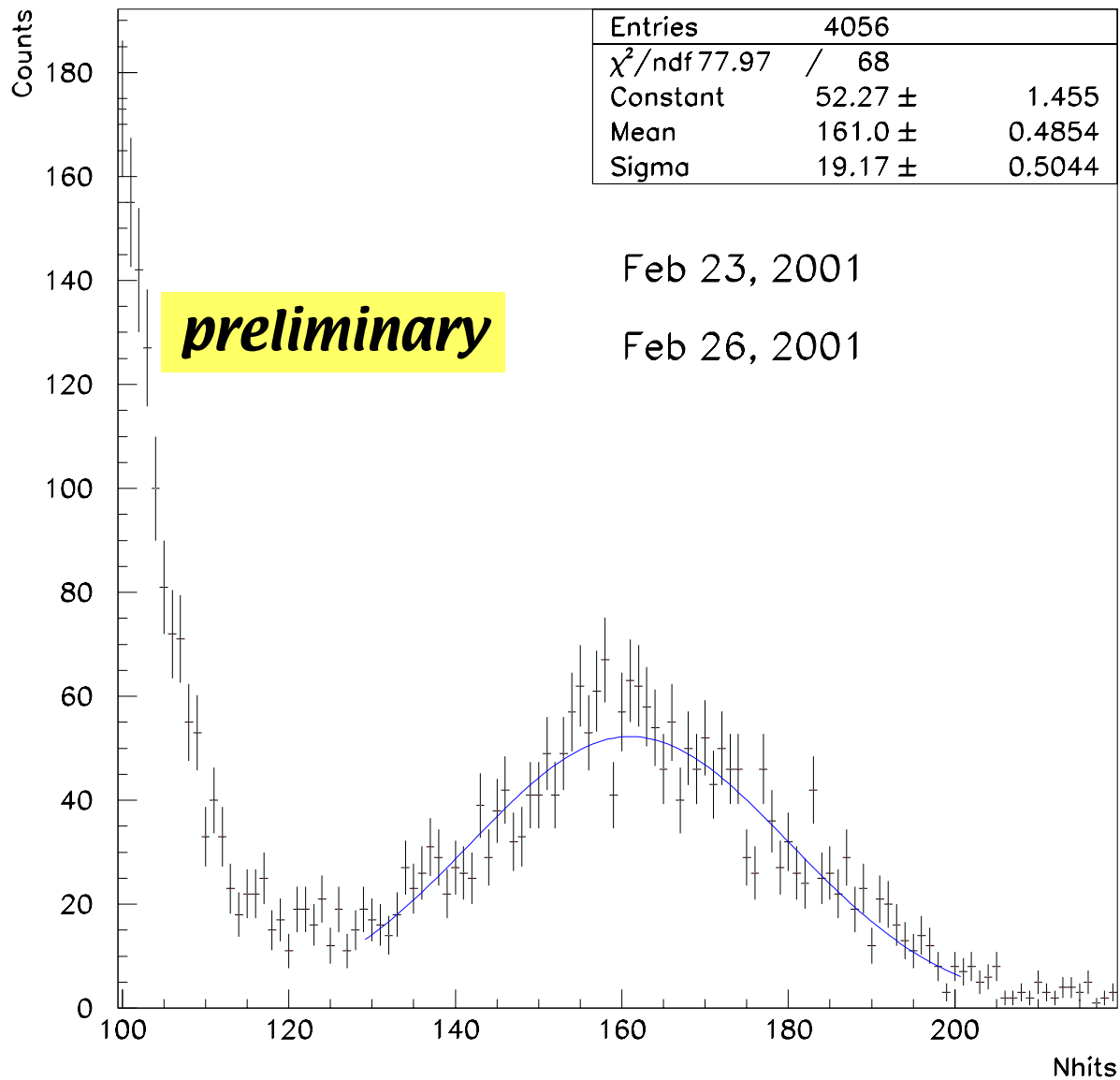
High Energy calibration point.
Energy dependence of sacrifice.

${}^3\text{H}(p,\gamma){}^4\text{He}$ Accelerator Source: 19.8-MeV Gammas



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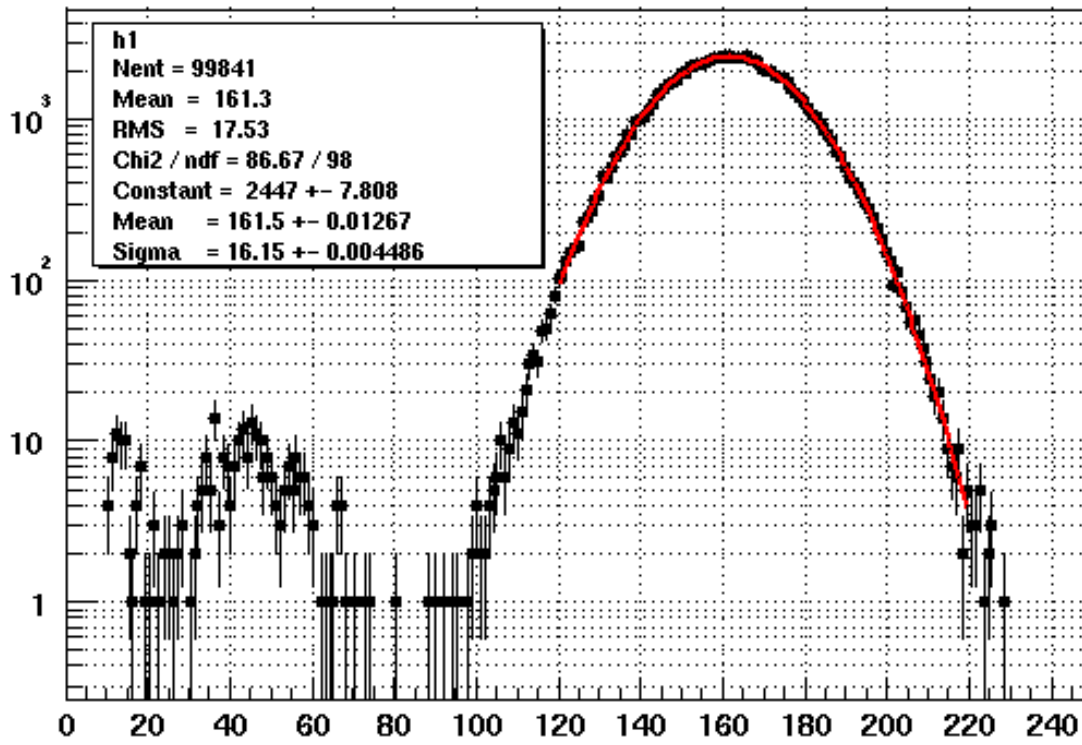


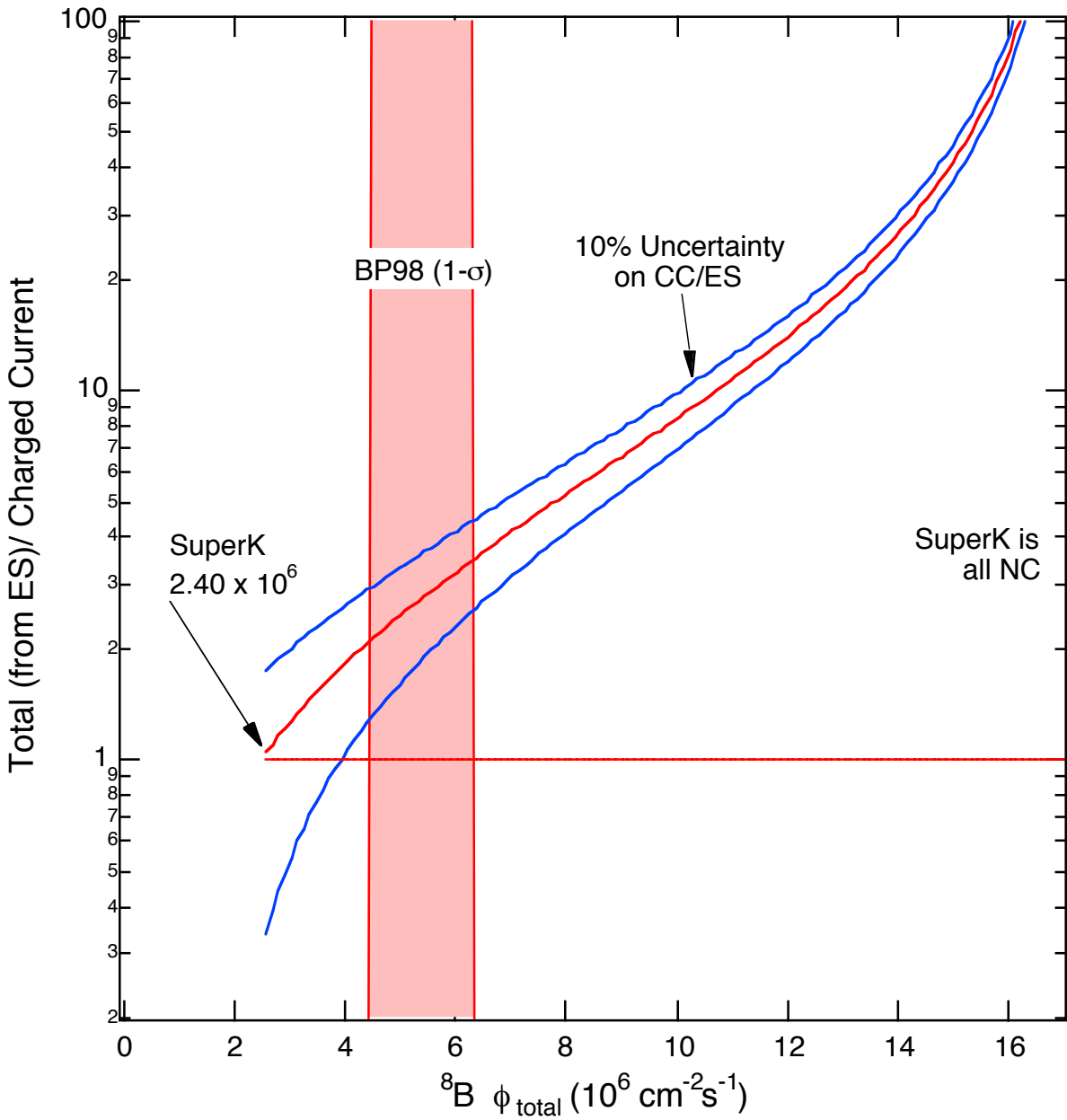


Spectrum of 19.8-MeV γ s from $^3\text{H}(p, \gamma)^4\text{He}$ gun (2 runs), and Gaussian fit (line) .



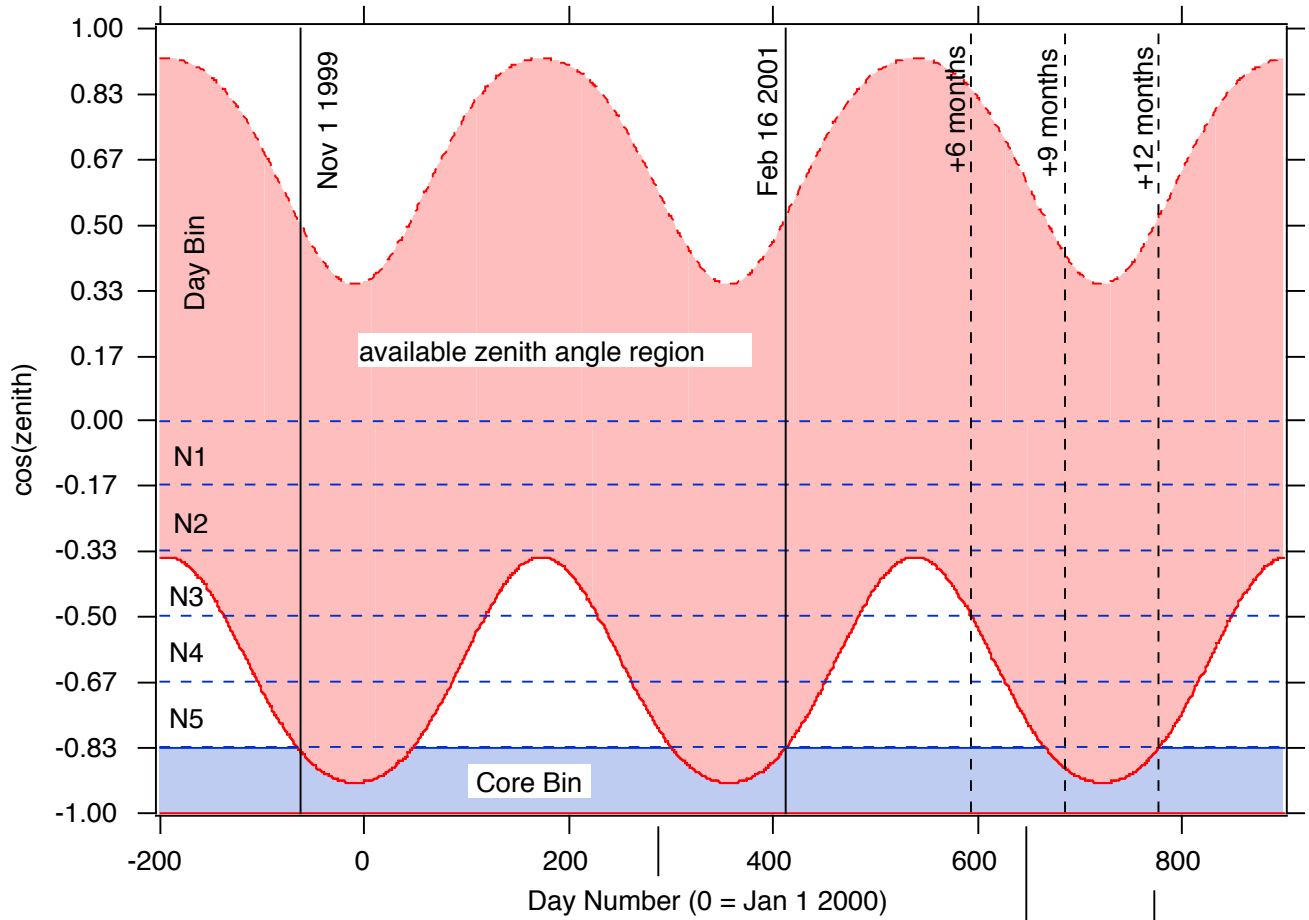
Monte Carlo of 19.8 MeV gammas





CC/ES ratio can yield NC rate





D_2O

$NaCl$

3He



SNO

- *SNO has started its physics program*
- *SNO will soon give us:*
 - *Measure of the solar ν_e flux*
 - *Ratio **CC/ES***
 - *First high-resolution solar ν_e spectrum*
 - *First high-resolution hep spectrum*
 - *First measure of total flux of ν_e, ν_μ, ν_τ*

