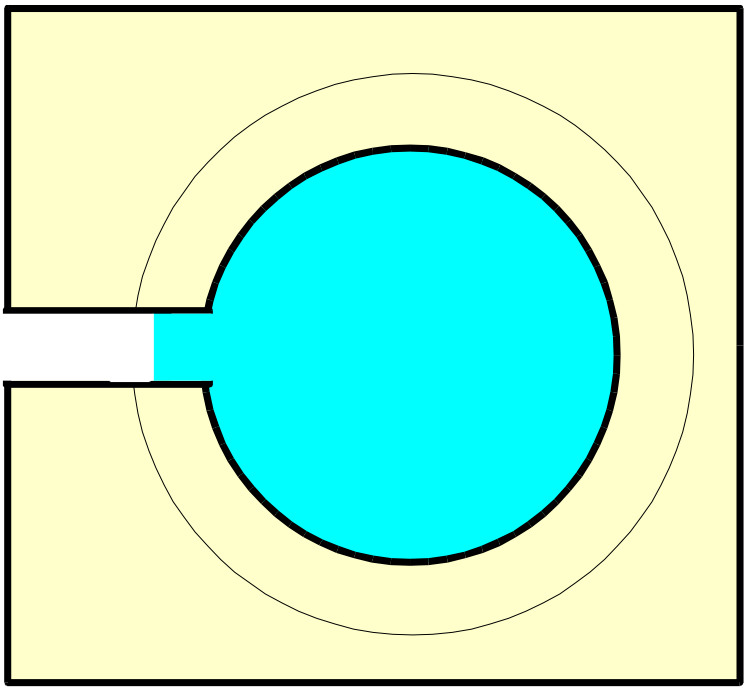
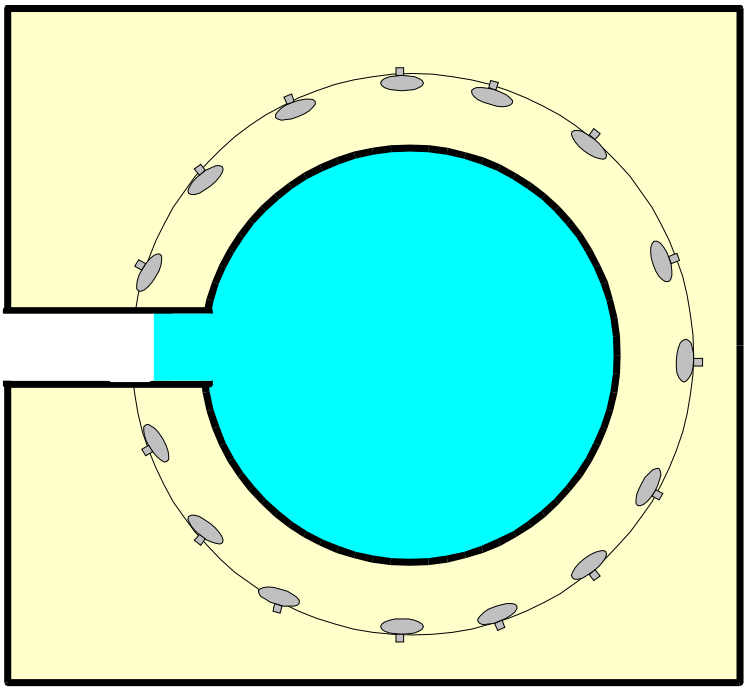
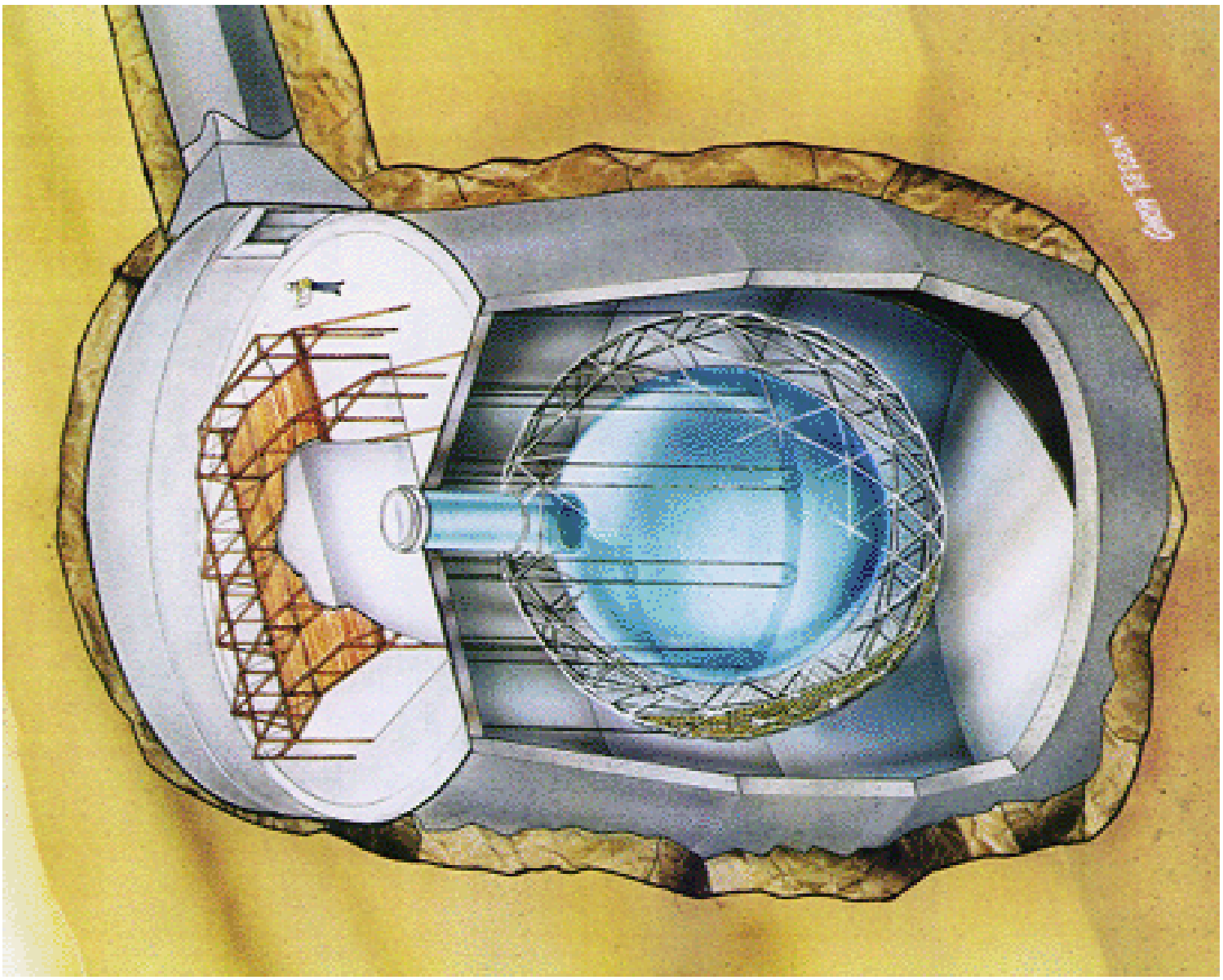
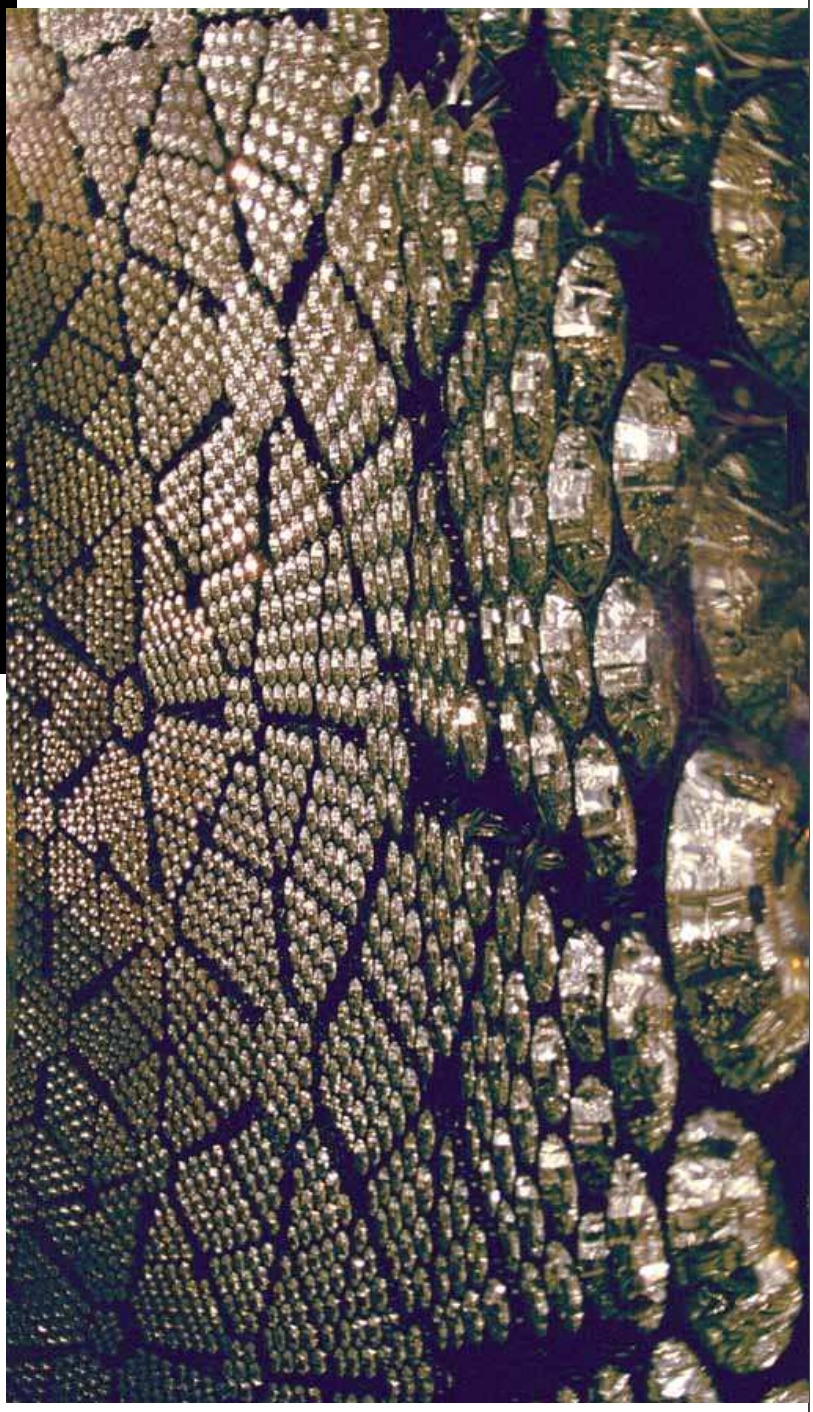
A Possible UK Niche

From a SNO-man's Perspective









Nuclear Instruments and Methods in Physics Research A 432 (1999) 364–373

Measurements of photomultiplier single photon counting efficiency for the Sudbury Neutrino Observatory

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Received 11 February 1999

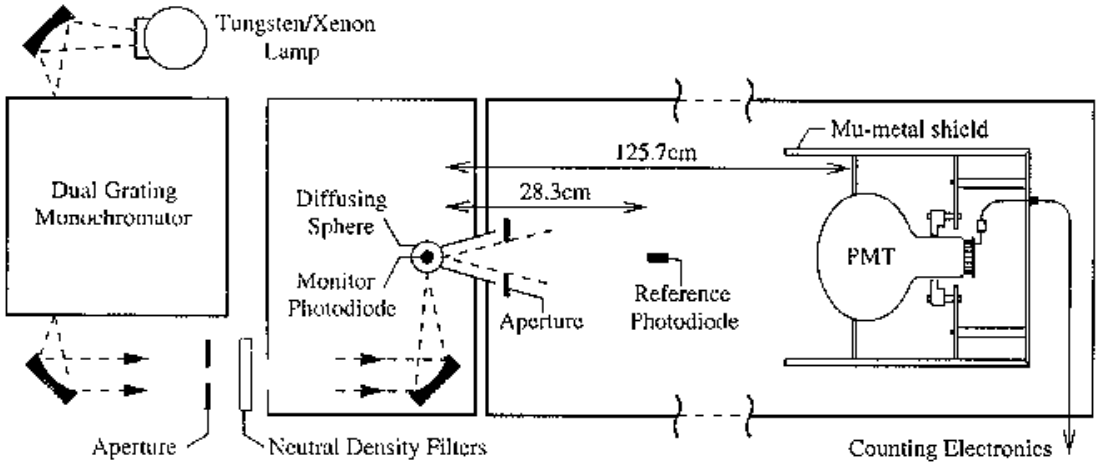
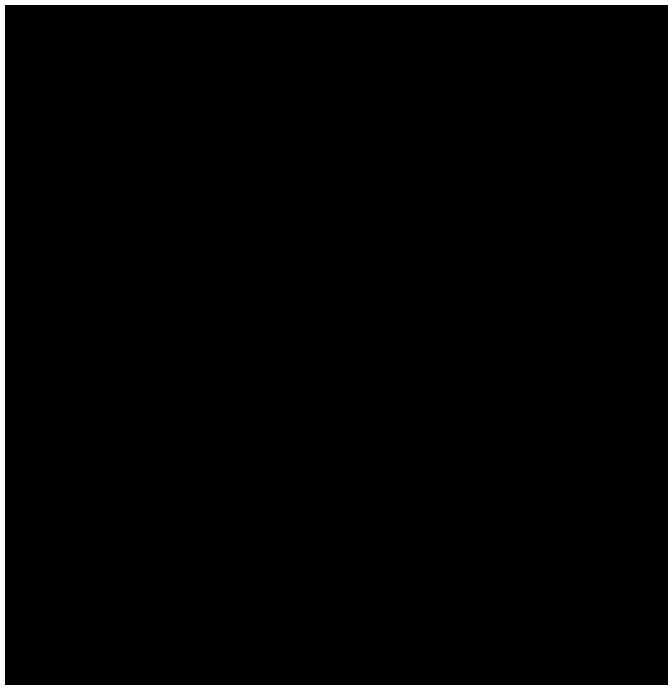
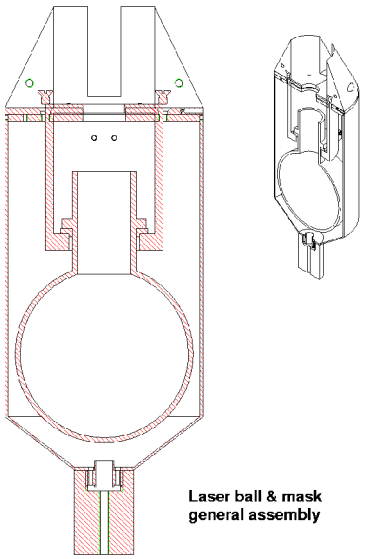
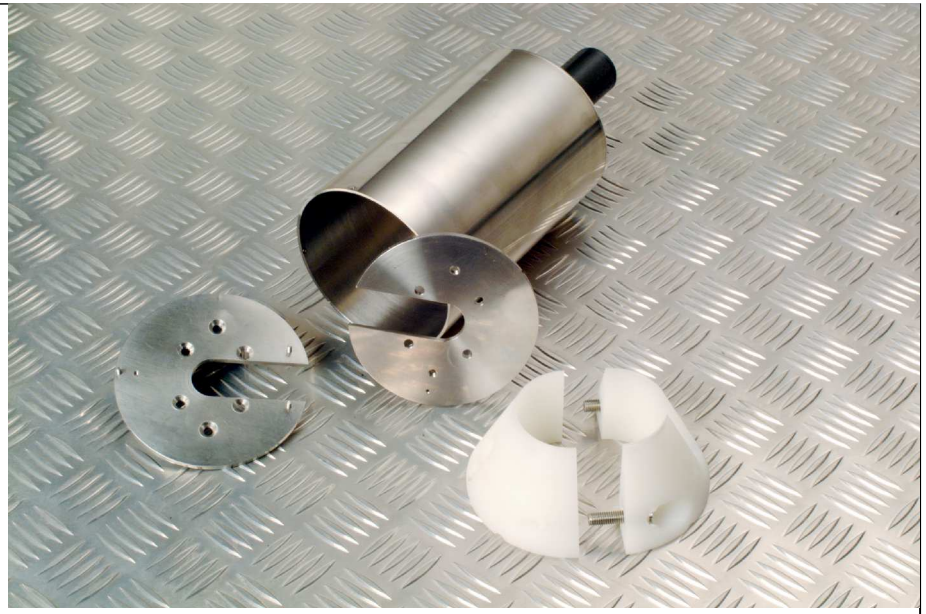


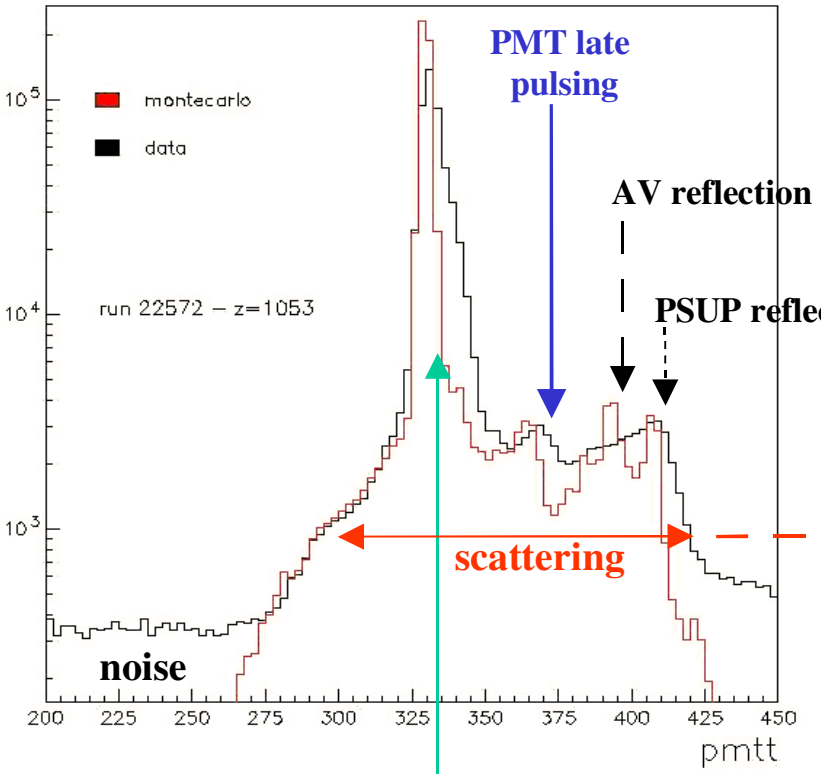
Fig. 1. A schematic diagram of the system used for measuring PMT photon-counting efficiency.

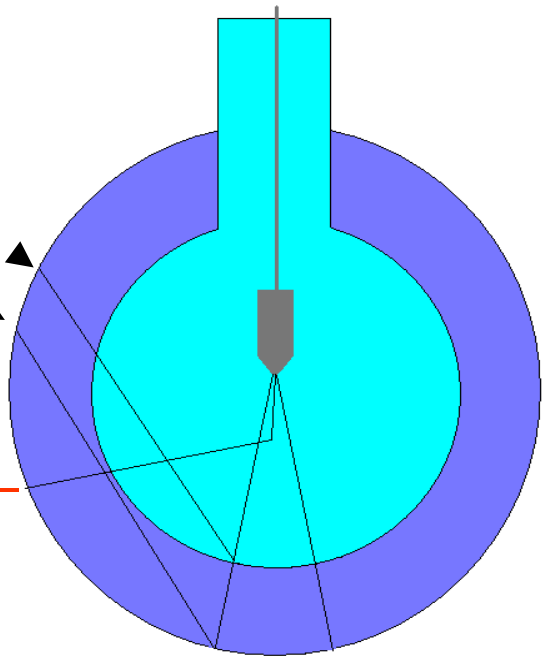


Masked Laserball



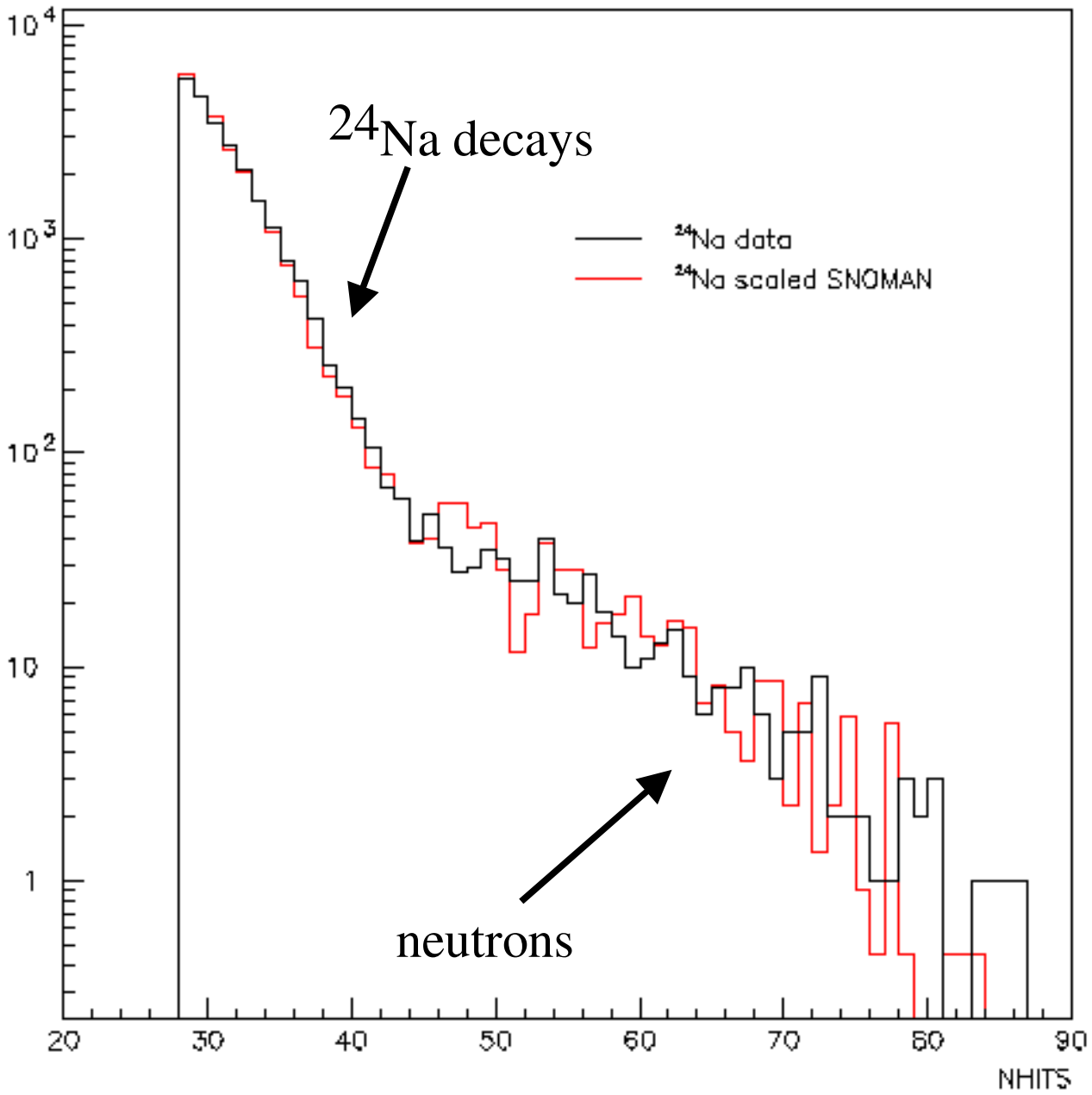


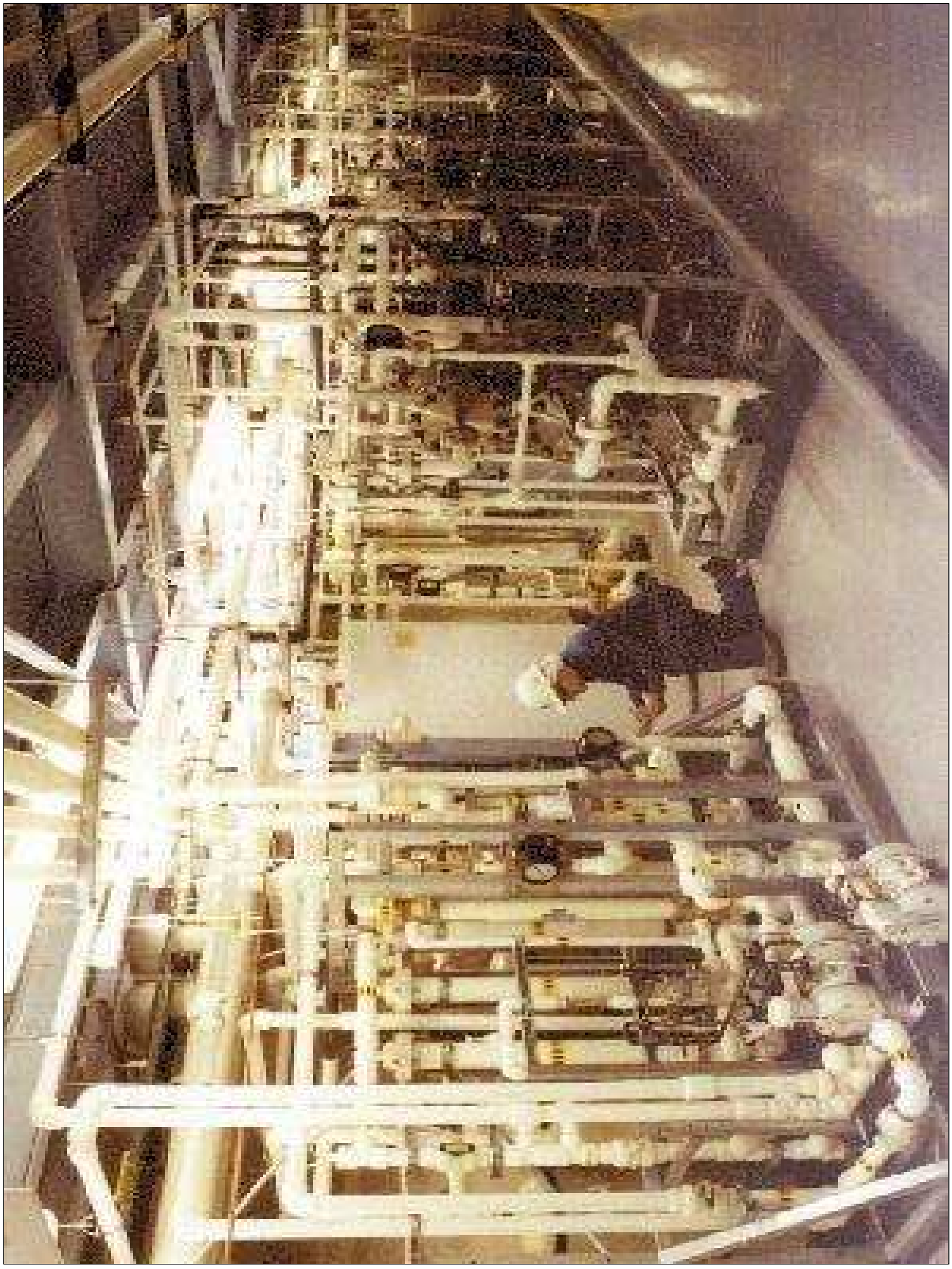




prompt

- Electronics Calibrations (charge,time)
  - **Charge Pulsar.** >600000 constants. Very stable.
- Optical Calibrations (absorption, scattering, timing...)
  - **Laser Source.** Photons 337-700nm, 0-45Hz.
- Energy Calibrations
  - **^{16}N source:** [$^{16}O(n,p)^{16}N^*$] β-tagged 6.1 MeV γ source
  - **^{8}Li source:** electron energy spectrum similar to ^{8}B
  - **pT source:** [$^{3}H(p,\gamma)^{4}He$] 19.8 MeV γ source
- Neutron Capture Calibration
  - **^{252}Cf source.** fission neutron source.
- Background
  - **U and Th sources.** Low energy γ rays (2.4, 2.6 MeV)


10^4
10^3
10^2
10
1
20
30
40
50
60
70
80
90
NHITS
^{24}Na decays
neutrons
^{24}Na data
^{24}Na scaled SNOMAN



A radium assay technique for the Sudbury Neutrino Observatory

T.C. Andersen,[a] R.A. Black,[e] I. Blevis,[b] J. Boger,[c] E. Bonvin,[d] M. Chen,[b] B.T. Cleveland,[e] X. Dai,[e] F. Dalnoki-Veress,[b] G. Doucas,[e] J. Farine,[b] H. Fergani,[e] A.P. Ferraris,[e] M.M. Fowler,[f] R.L. Hahn,[c] E.D. Hallman,[g] C. K. Hargrove,[b] H. Heron,[e] E. Hooper,[e] K.H. Howard,[e] P. Jagam,[a] N.A. Jelley,[e] A.B. Knox,[e] H.W. Lee,[d] I. Levine,[b] W. Locke,[e] S. Majerus,[e] G. McGregor,[e] G.G. Miller,[f] M. Moorhead,[e] A.J. Noble,[b] M. Omori,[e] J.K. Rowley,[c] M. Shatkay,[b] C. Shewchuk,[b] J.J. Simpson,[a] D. Sinclair,[b] N.W. Tanner,[e] R.K. Taplin,[e] P.T. Trent,[e] J.-X. Wang,[a] J.B. Wilhelmy,[f] and M. Yeh[c]

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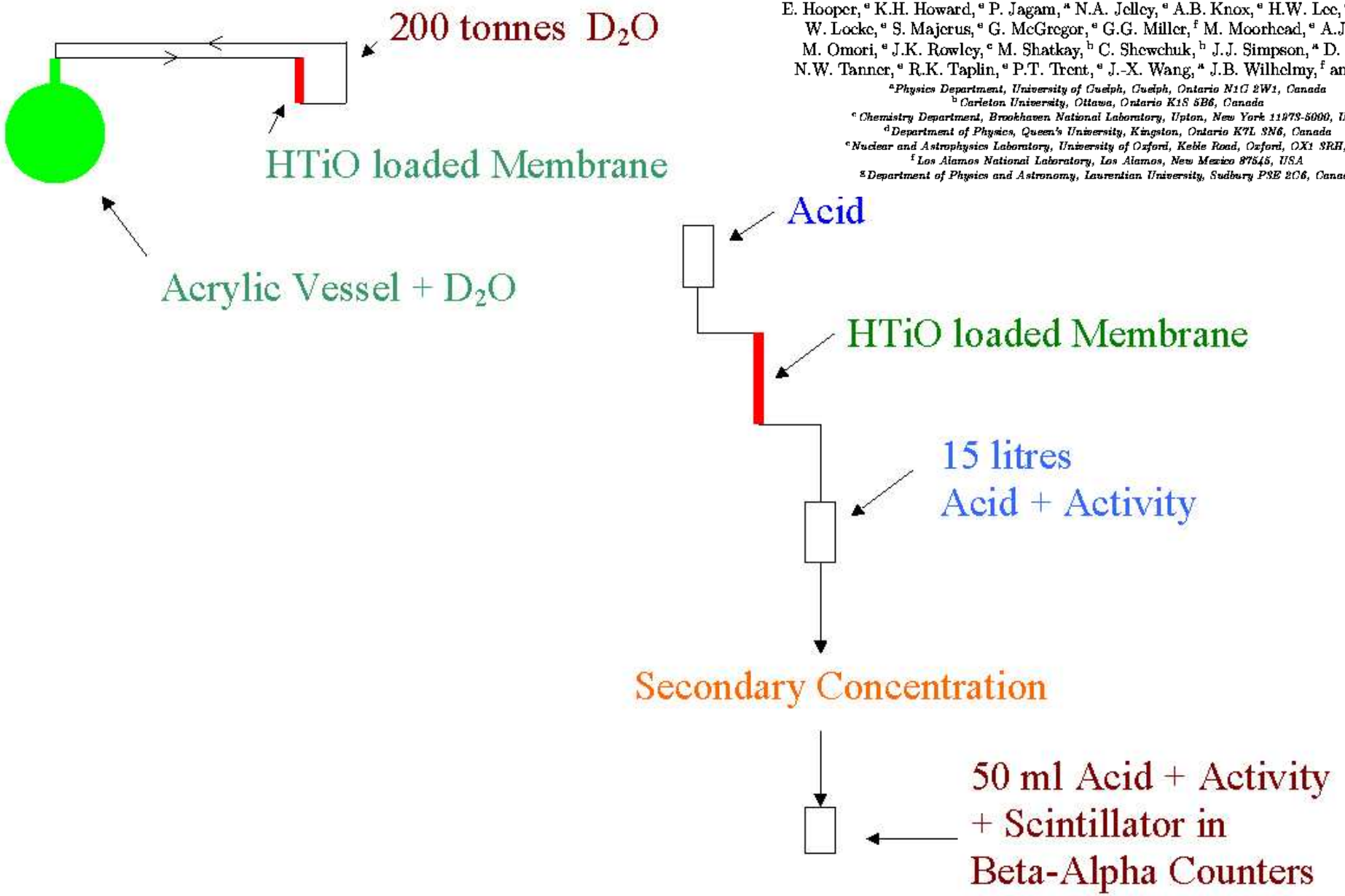
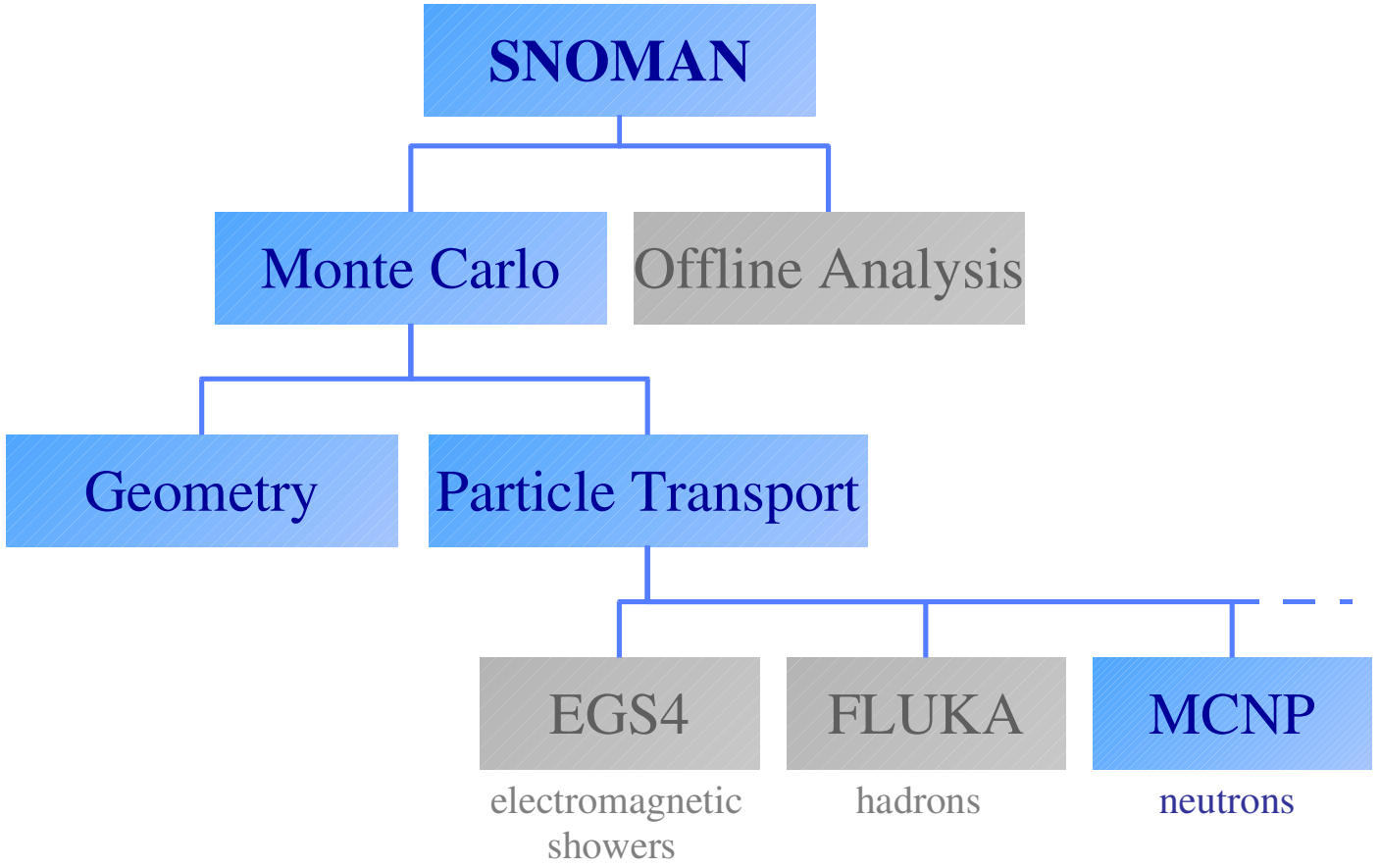
[g] *Department of Physics and Astronomy, Laurentian University, Sudbury P3E 2C6, Canada*



The SNO Monte Carlo



Current Index of SNOMAN User's Manual

(see also Programmer's Manual and Companion)

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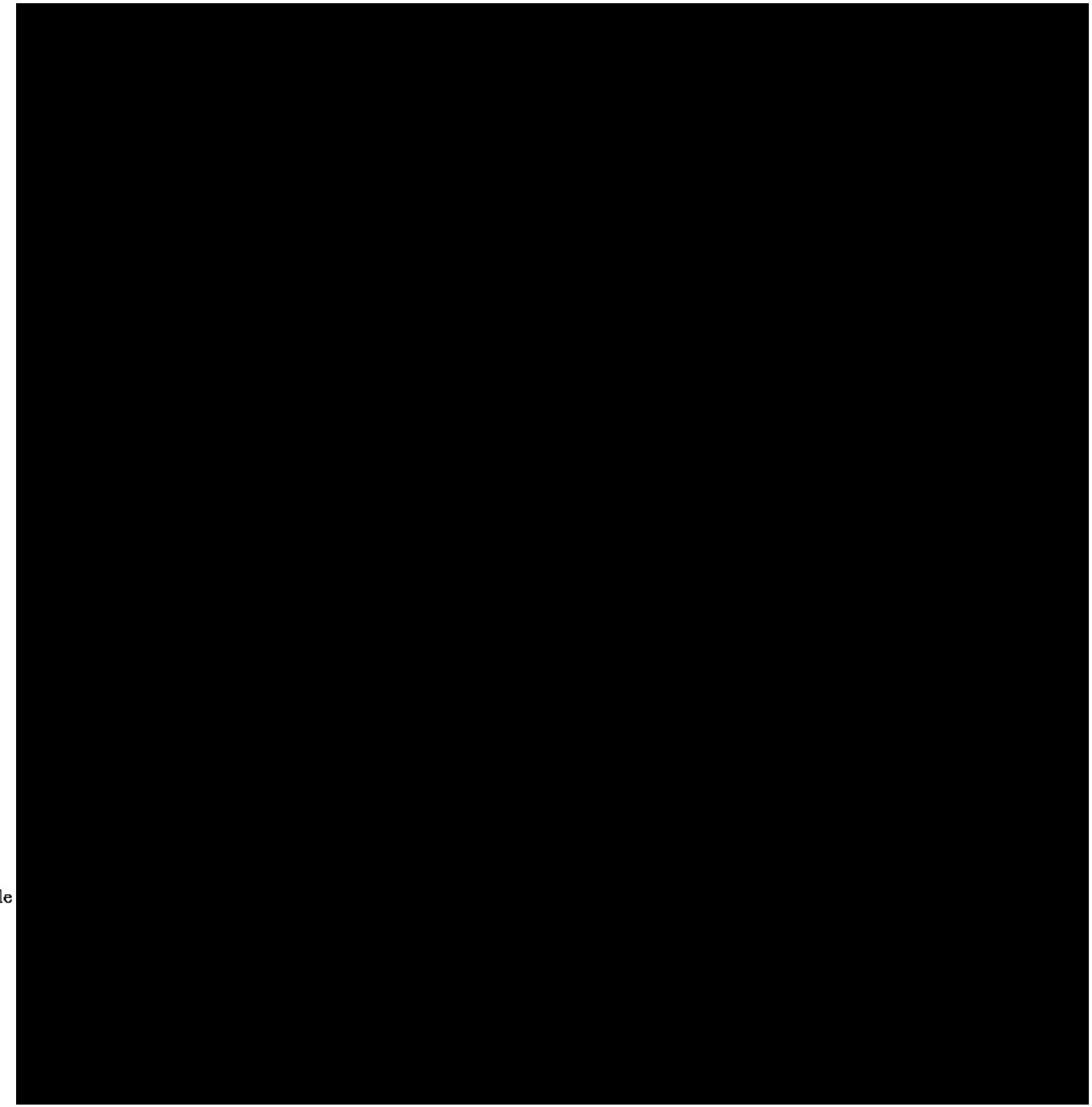

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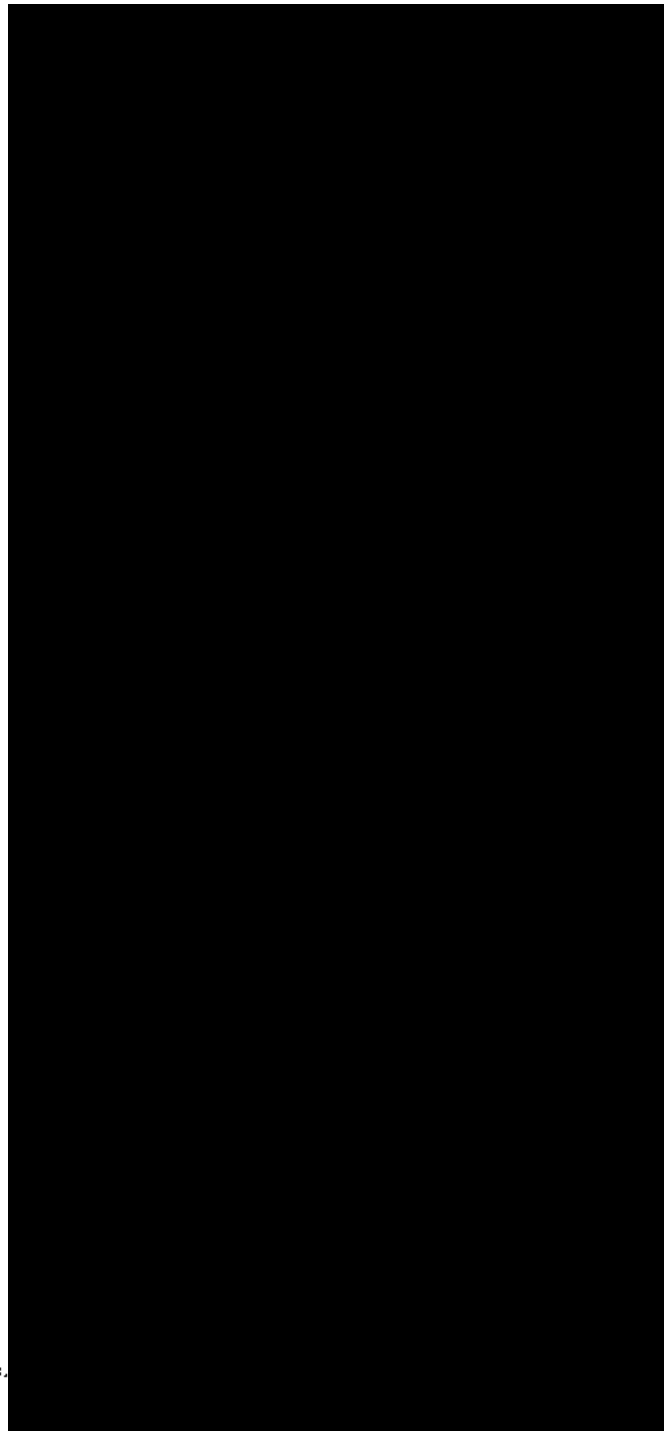
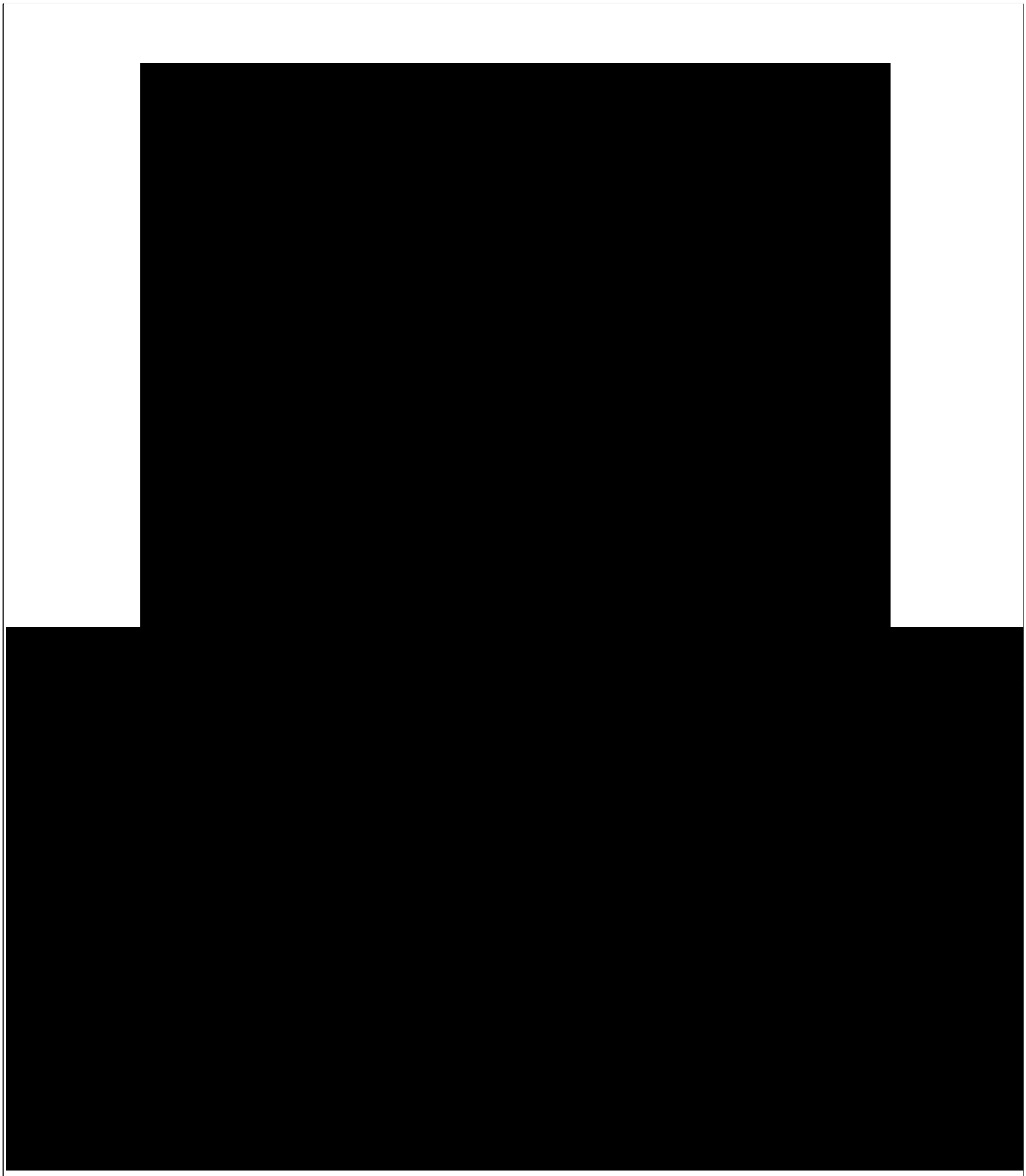
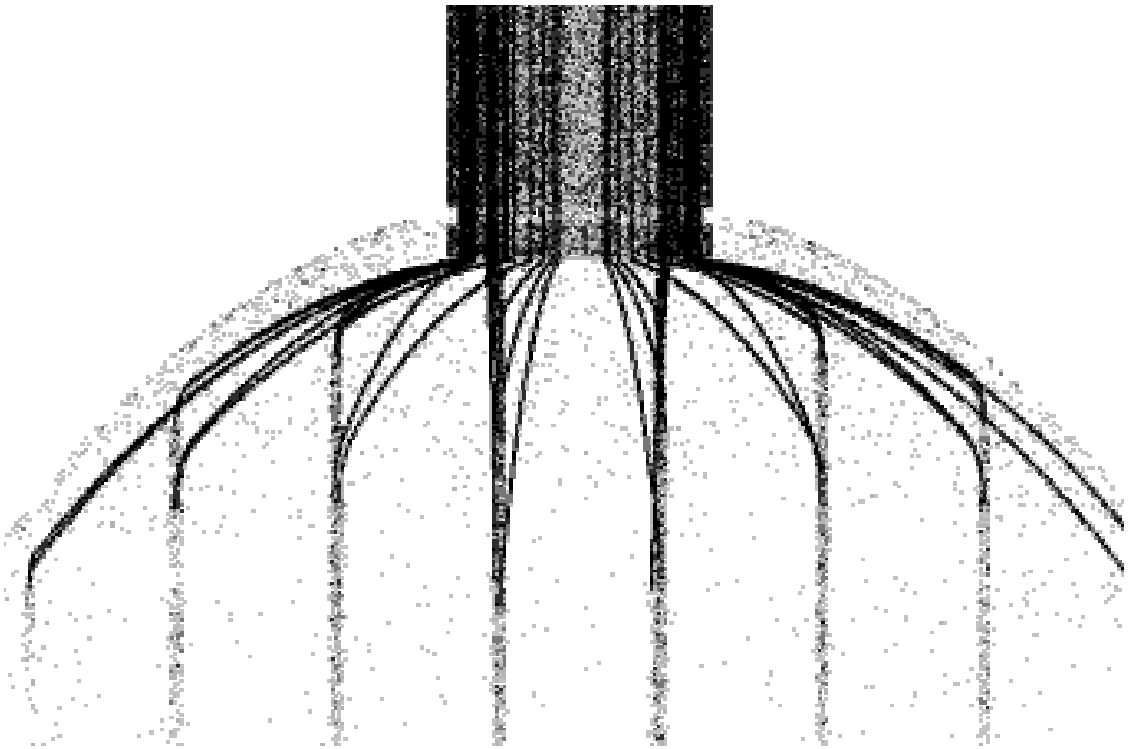
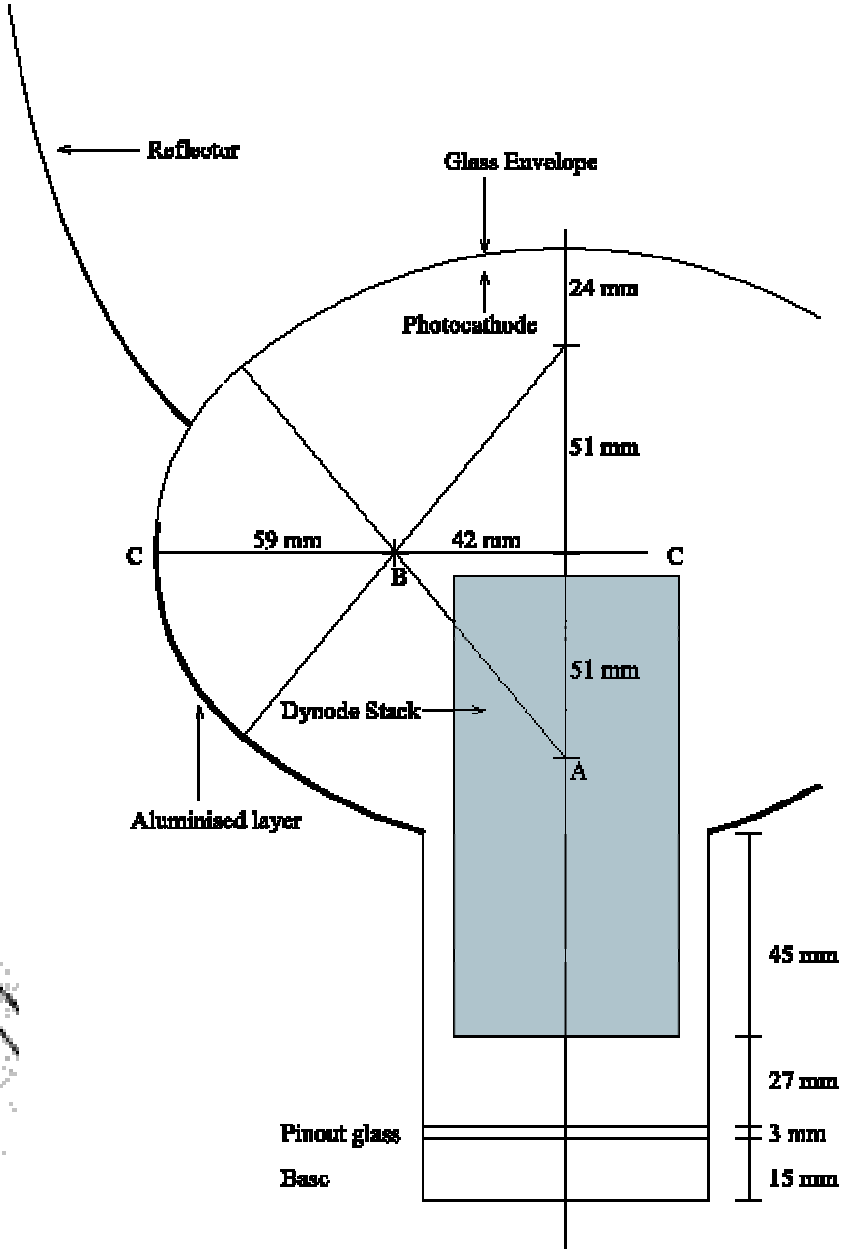
      - EGS4_AUSGAB.

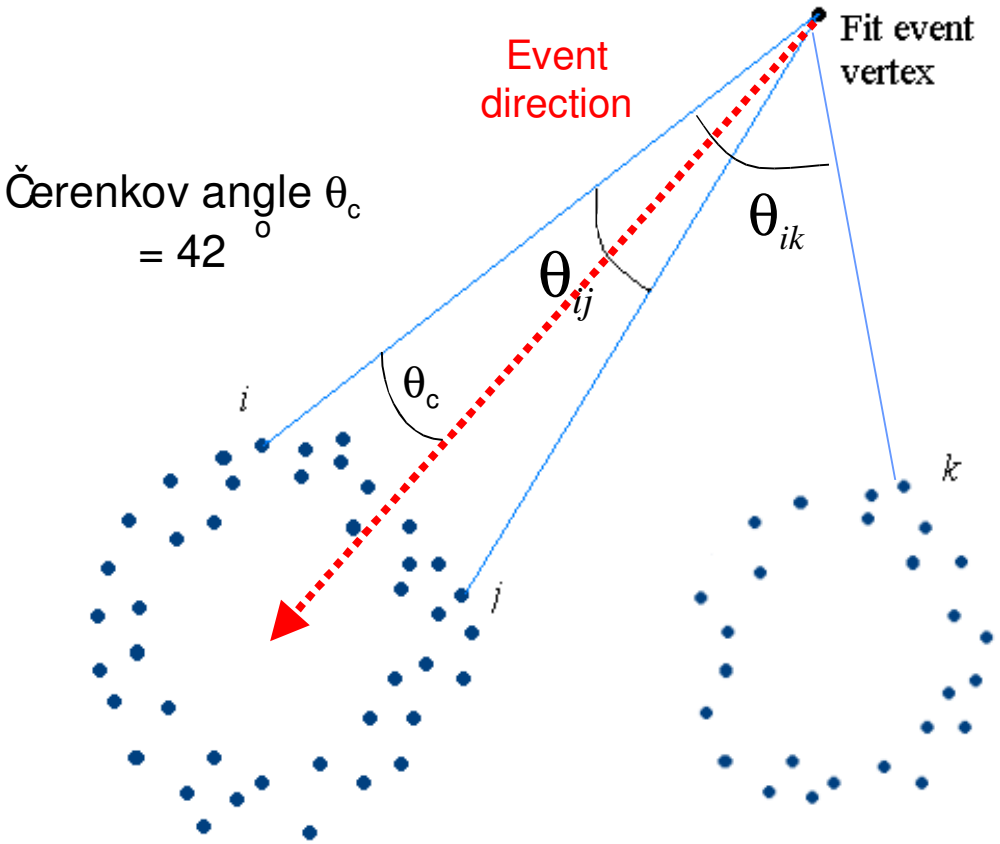




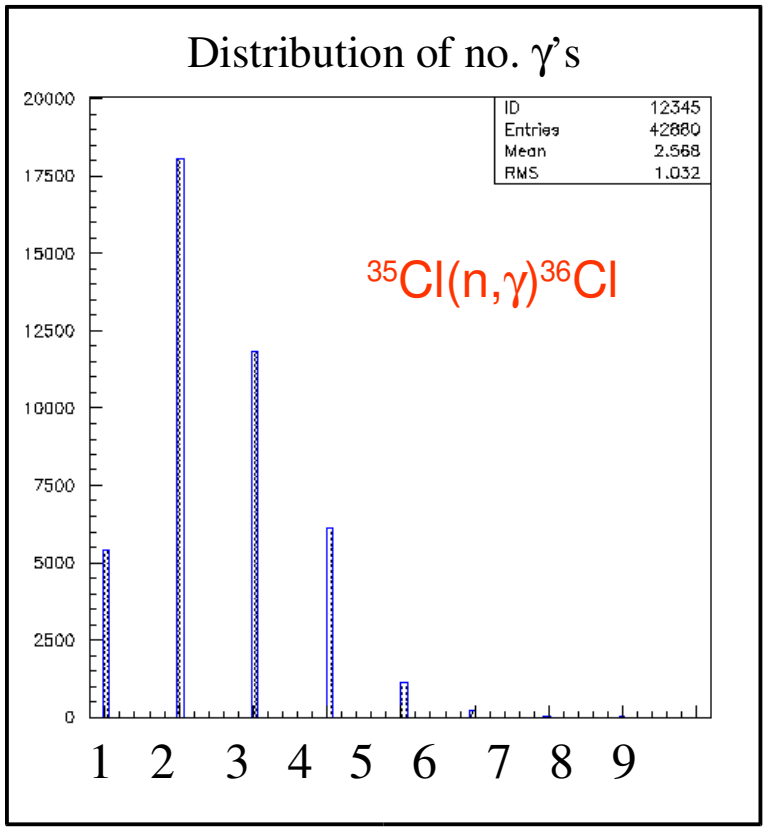



Reflector
Glass Envelope
24 mm
Photocathode
51 mm
C
59 mm
42 mm
C
B
51 mm
Dynode Stack
A
Aluminised layer
45 mm
27 mm
Pinout glass
3 mm
Base
15 mm

Event Isotropy



Ring of PMT hits



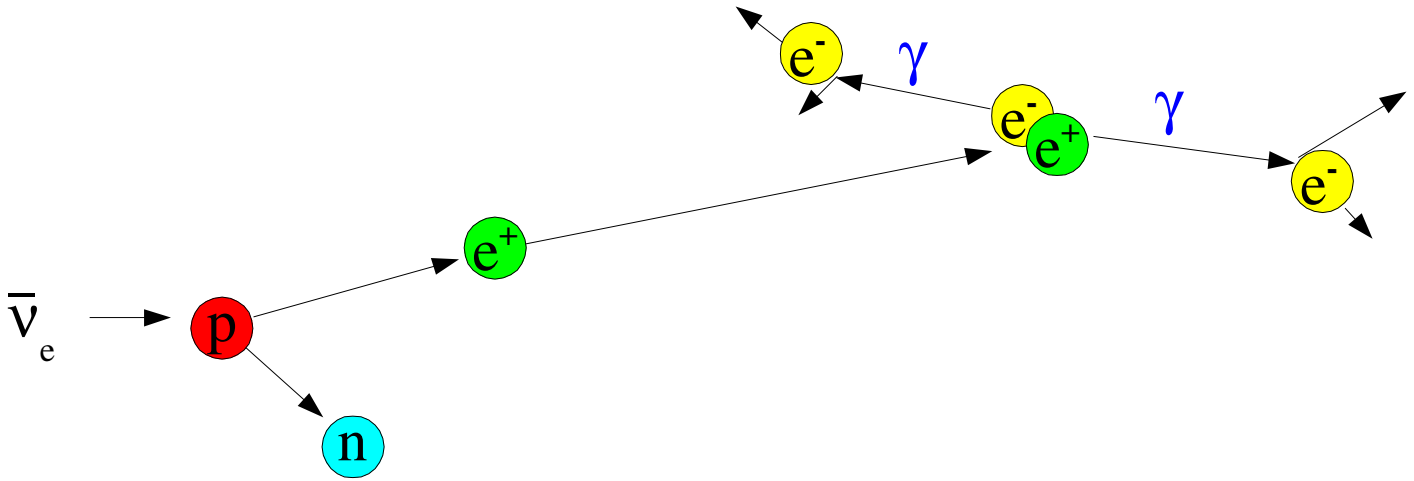
Define the parameters β_l as

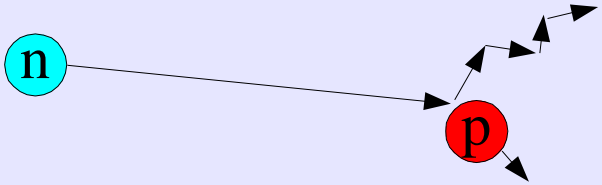
$$\beta_l = \left\langle P_l\left(\cos\theta_{ij}\right)\right\rangle_{i\neq j}$$

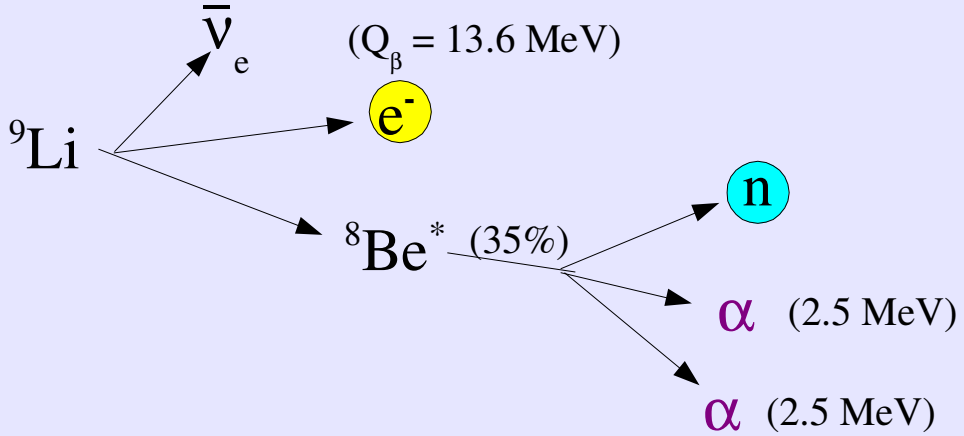
where P_l is the l^{th} order Legendre Polynomial.

$$\beta_{14} = \beta_1 + 4\beta_4$$

An Interesting Application...







Accidentals from e- and/or γ (Various Decays)

Cherenkov Light:

~50% Photocathode Coverage (reflectors)

\+ Wavelength Shifter (~3ns rise time) → ~25 hits/MeV (scaling from SNO)

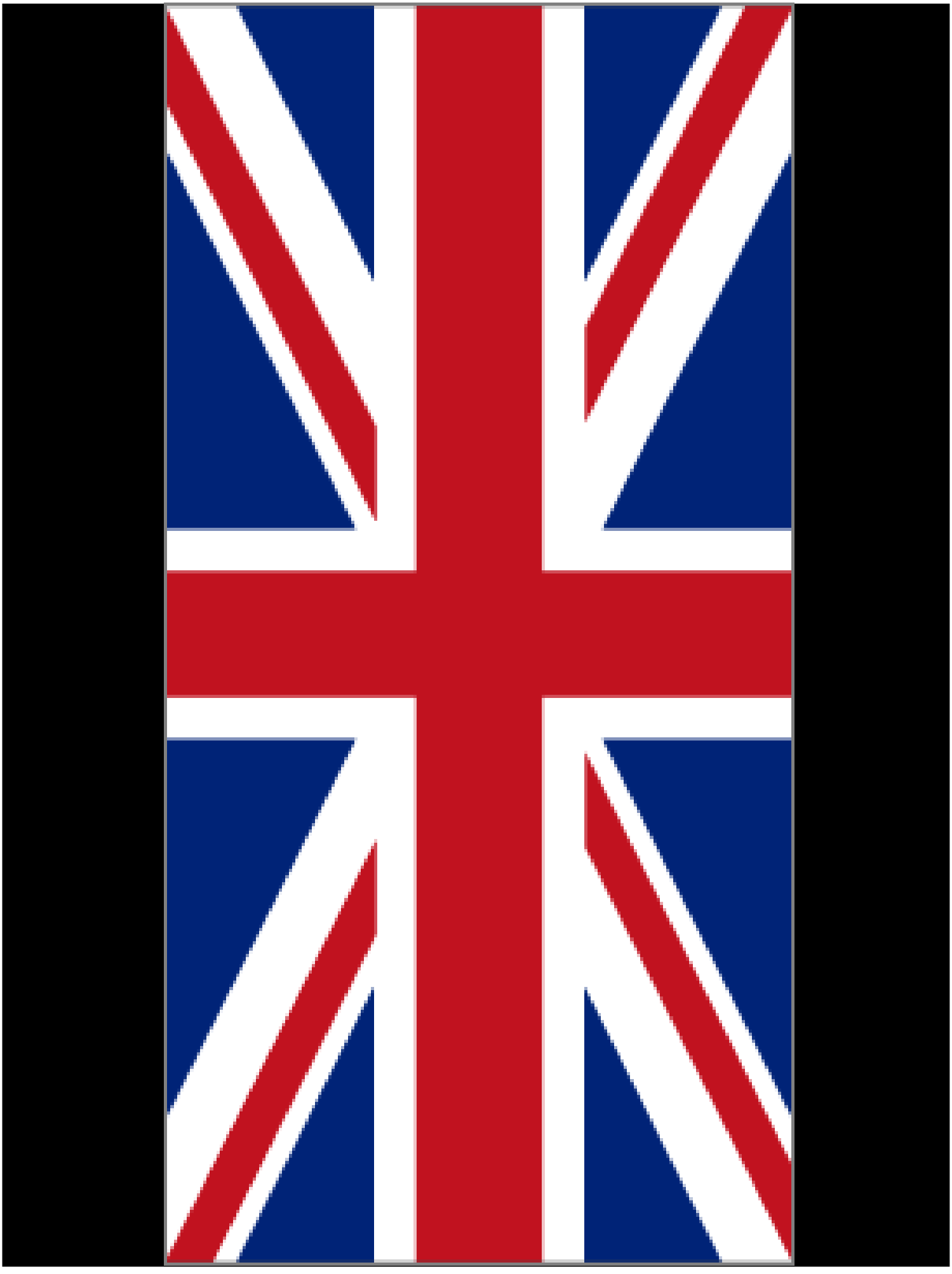
Scintillation Light:

Slooooooooooow Scintillator (pure pseudocumine: $\tau \sim 27$ns)

Use same wavelength shifter as above

Tune amount to also yield ~25 hits/MeV

(Energy resolution based on total of 50 hits/MeV)



"SATURDAY NIGHT LIVE'S"

DANA CARVEY

Eddie Farrell is a con man.

He's out of luck,
out of time and out
of money.

But he'll be
ready when...

OPPORTUNITY KNOCKS

In the world of cons...
Eddie's a pro.

IMAGINE ENTERTAINMENT Presents
A BRAD GREY/MELEDANDRI-GORDON COMPANY Production
A DONALD PETRIE Film DANA CARVEY
"OPPORTUNITY KNOCKS"
TODD GRAFF JULIA CAMPBELL and
ROBERT LOGGIA Music Supervised By BECKY MANCUSO and
TIM SEXTON Edited By MARION ROTHMAN
Production Designer DAVID CHAPMAN Director of Photography STEVEN POSTER, A.S.C.
Co-Producer RAY HARTWICK Executive Producer BRAD GREY
Written By MITCHEL KATLIN & NAT BERNSTEIN Produced By MARK R. GORDON
and CHRISTOPHER MELEDANDRI Directed By DONALD PETRIE

IMAGINE PG-13 PARENTS STRONGLY CAUTIONED
Some Material May Be Inappropriate for Children Under 13
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