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Sudbury Neutrino Observatory
Anticipated Rates

Experiment	Detection Rates (not SSM)
Chlorine	~25/year
Kamiokande	~45/year
SAGE/GALLEX	~50/year each
SuperK	~5000/year (>6.5 MeV)

SNO 1000 tons of D_2O

$\nu_e + d \rightarrow p + p + e^- - 1.44$ MeV (CC)
$\nu_x + d \rightarrow p + n + \nu_x - 2.22$ MeV (NC)
$\nu_e + e^- \rightarrow \nu_e + e^-$ (ES)

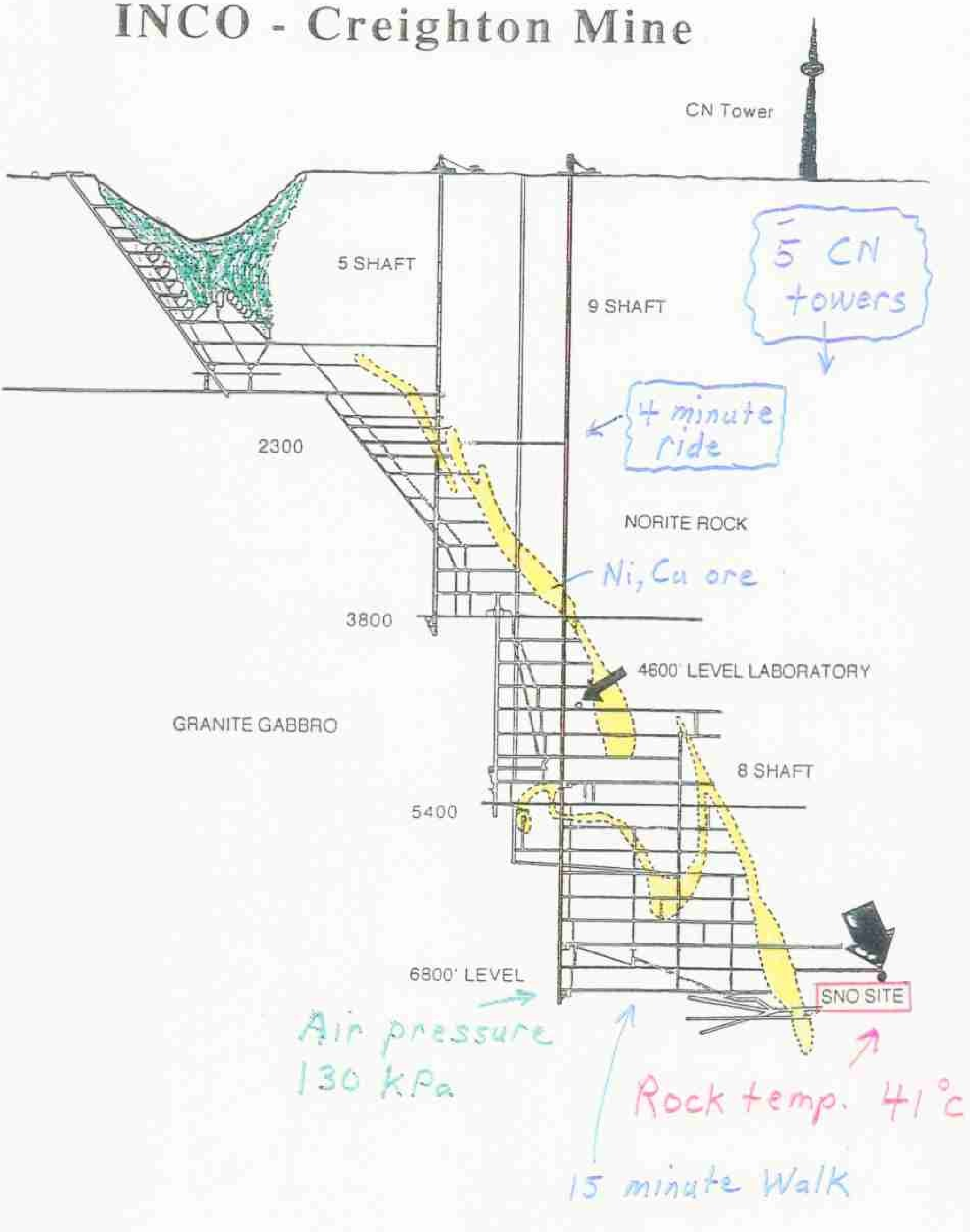
(Bahcall 95) BP98

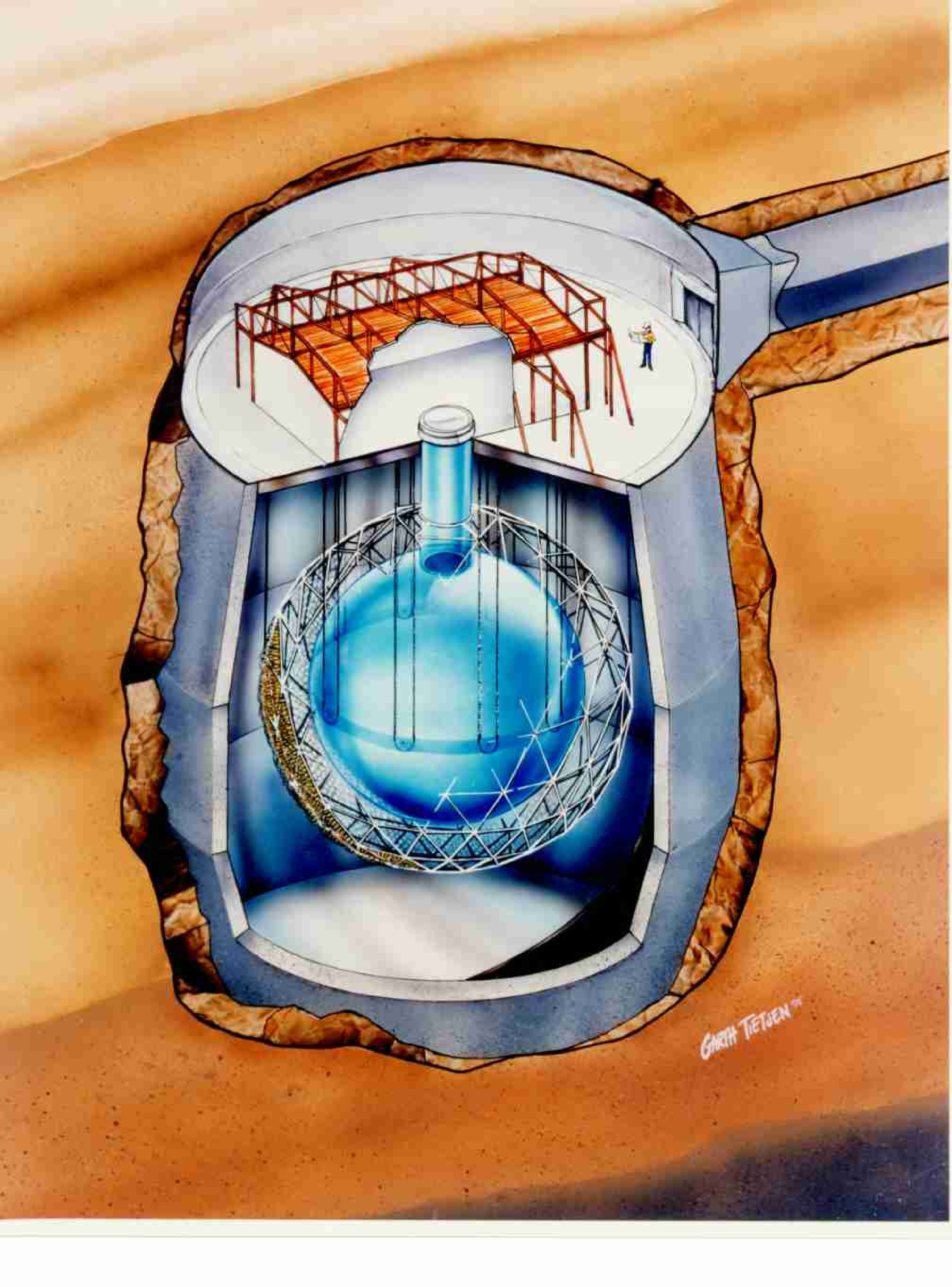
CC: 15000 events/year SSM 11000
NC: 6000 events/year SSM 4700
ES: 1000 events/year SSM

(With Threshold)

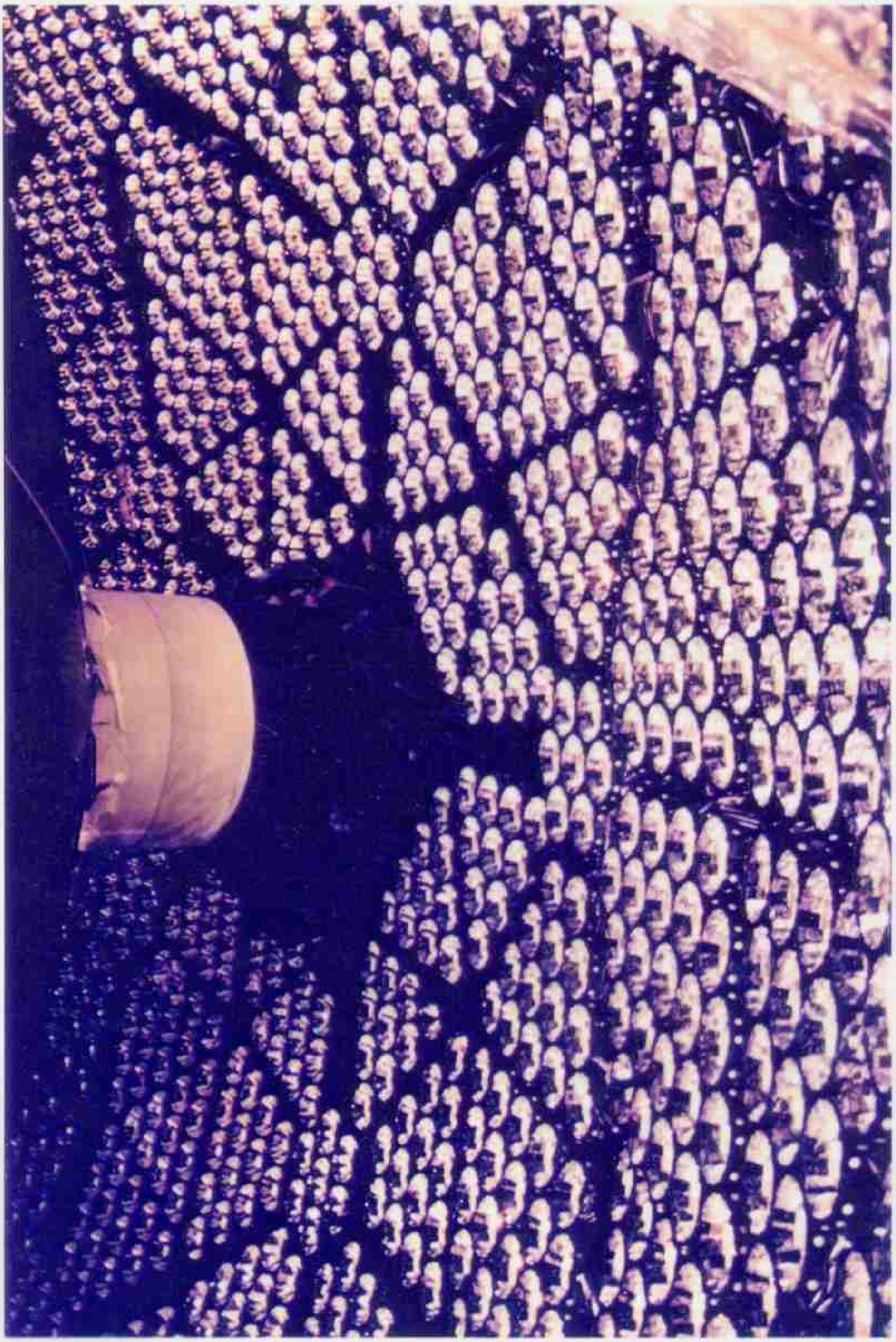
CC above 6 MeV and at SK meas.
Rate ~3300 events/year

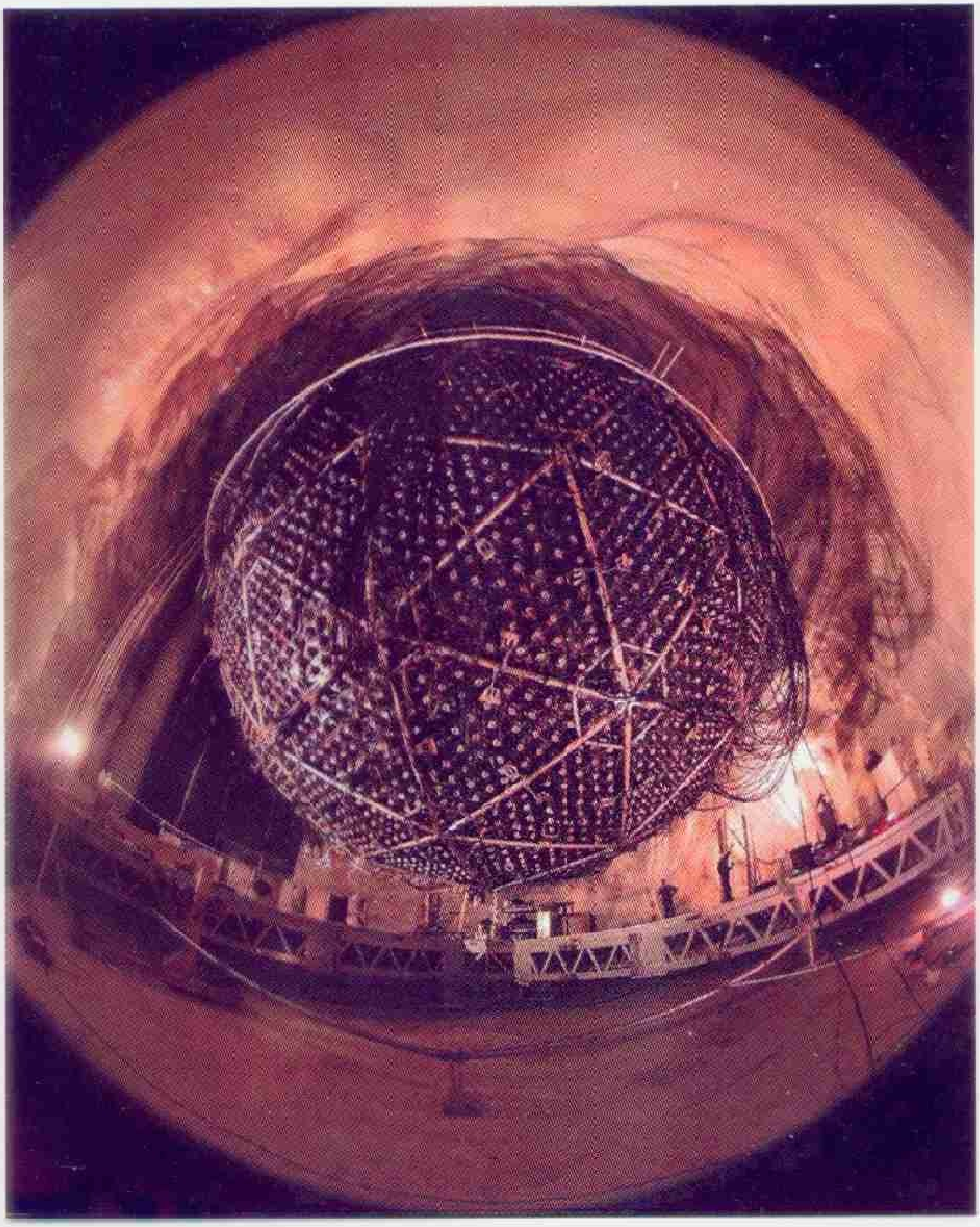
INCO - Creighton Mine

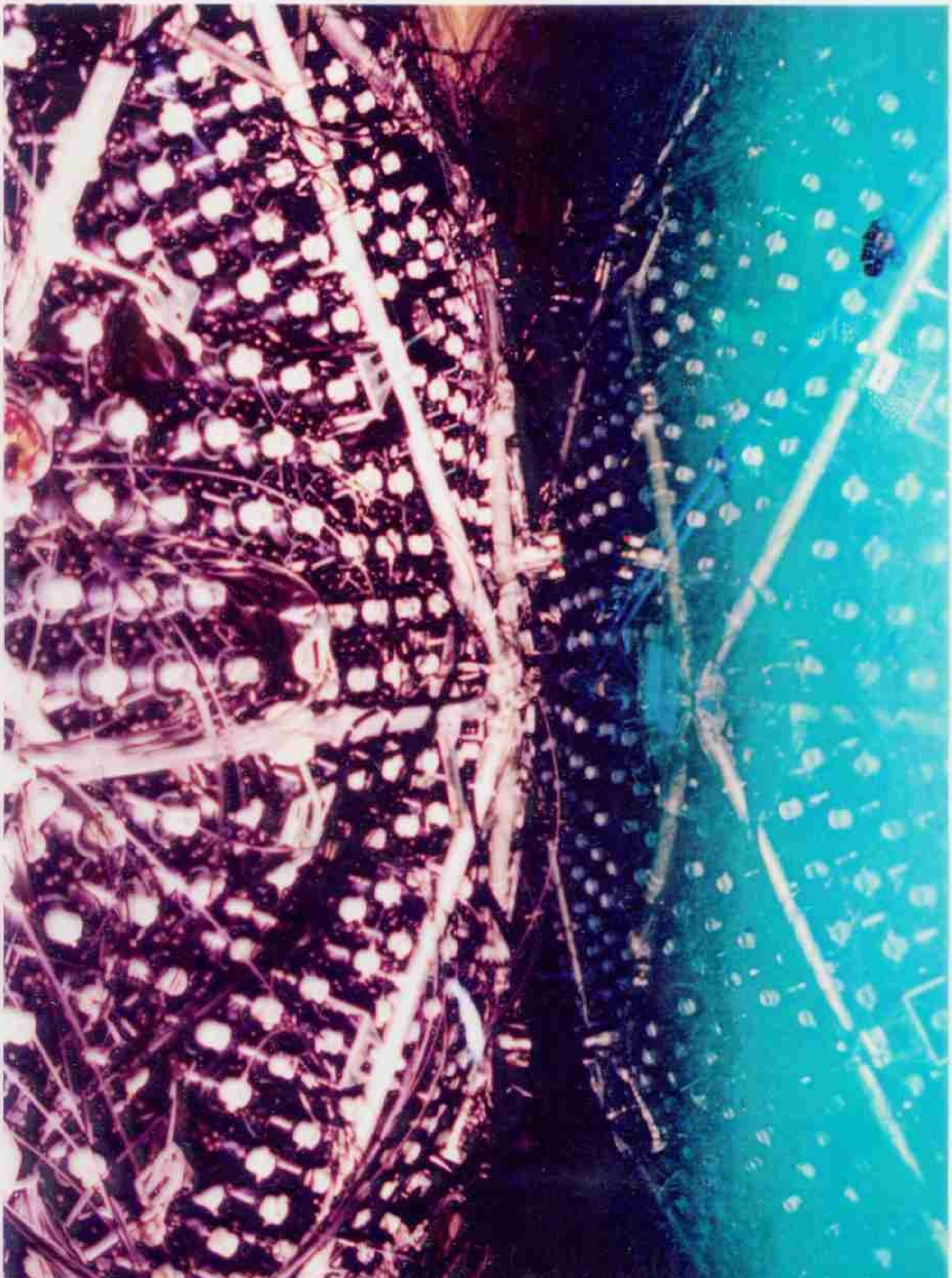



GARTH TIETJEN


PARTNERS
IN PROGRESS

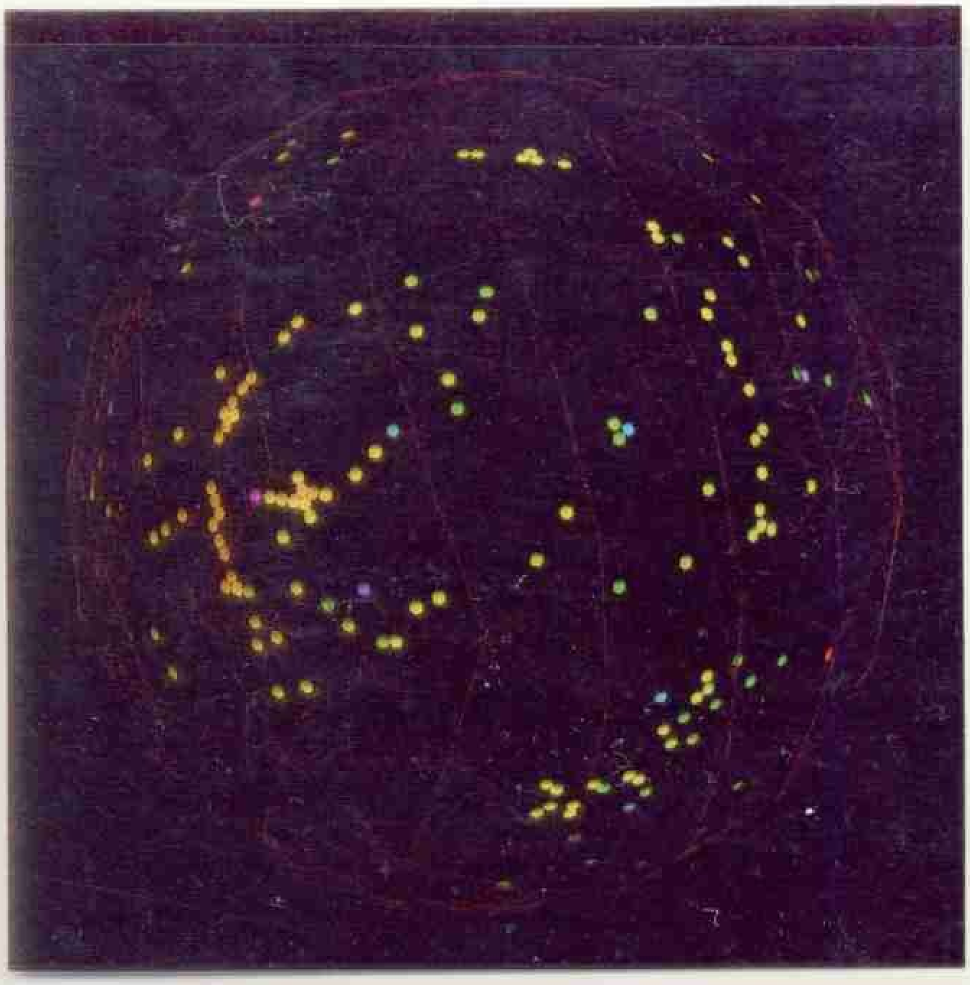


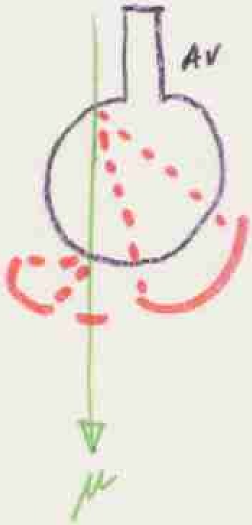




NS

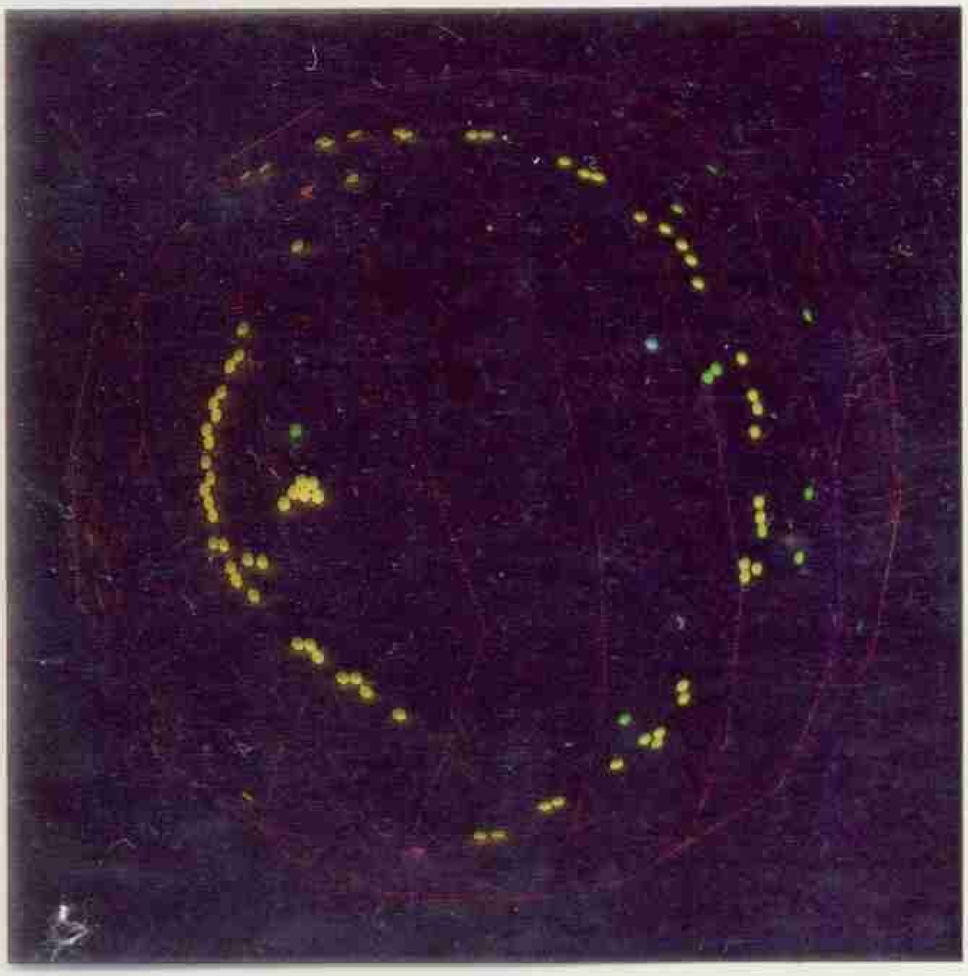
ht





REAL

PARTIAL CERENKOV CONES: CUT OFF BY TOTAL INTERNAL REFLECTION IN ACRYLIC



SIMULATED

Neutral Current Detection at SNO

Use two techniques with different systematic uncertainties

❄ $MgCl_2$

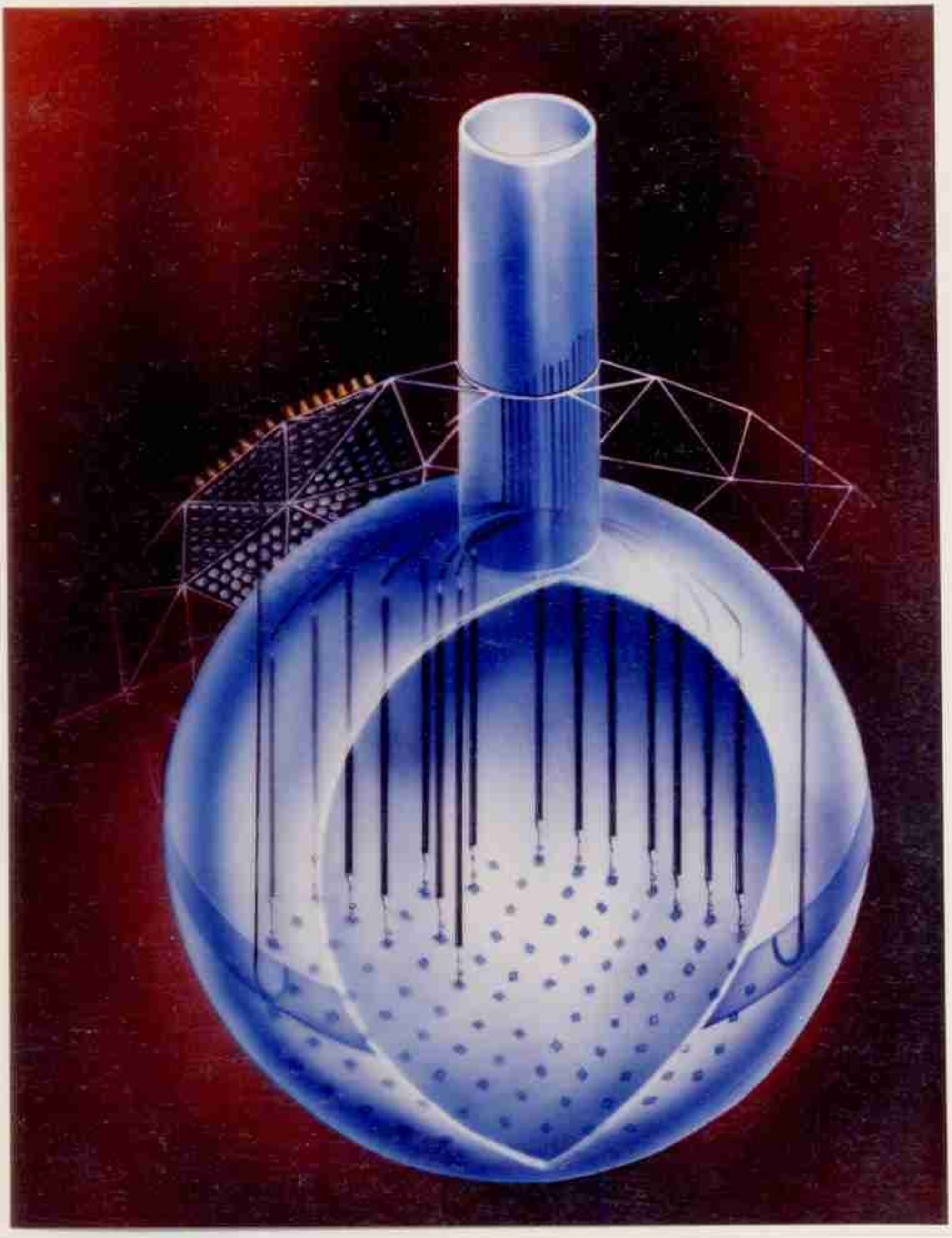
advantage:
just add material to D_2O

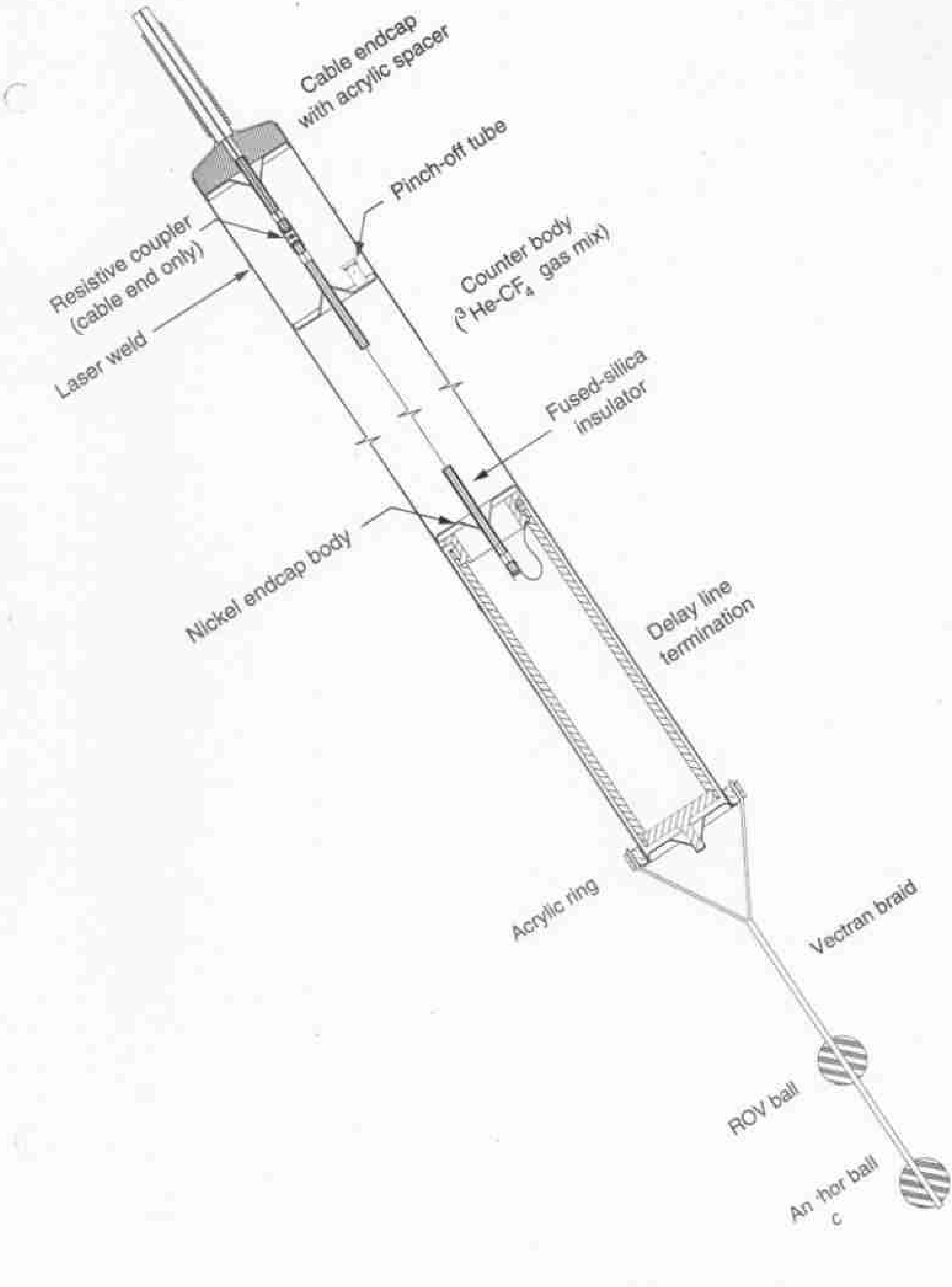
disadvantage:
CC and NC signals are intermingled within PMT response

❄ ^{3}He-filled proportional counters:

advantage:
CC and NC signals detected with separate systems. Hence they are distinguished on an event-by-event basis.

disadvantage:
complicated hardware




Cable endcap
with acrylic spacer
Pinch-off tube
Resistive coupler
(cable end only)
Laser weld
Counter body
(^{3}He-CF$_4$ gas mix)
Fused-silica
insulator
Nickel endcap body
Delay line
termination
Acrylic ring
Vectran braid
ROV ball
An hor ball
c

Background Issues at SNO

Any photon greater than 2.2 MeV can breakup the deuteron. This is a background for the NC detection.

For Example: 0.53 micrograms of Th distributed evenly through the heavy water would produce 1% SSM equivalent in neutrons: ~50/year

Th is usually present in most materials at some level:

Material	Mass for 1%	
CVD Ni	450 kg	Very Clean
Nylon	600 g	Rather Dirty
Polishing Compound	~10 Sand Grains	Filthy

Background Issues at SNO

Any photon greater than 2.2 MeV can breakup the deuteron. This is a background for the NC detection.

For Example: 1.3 micrograms of Th distributed evenly through the heavy water would produce 1% SSM equivalent in neutrons: ~50/year.

Th is usually present in most materials at some level. Some examples:

Material	mass for 1%	
CVD Ni	450 kg	it is clean
Nylon	600 g	not so clean
Polishing compound	~10 sand size grains	Filthy

- double purification of CVD Ni.

Photodisintegration Neutrons from Cosmogenic ^{56}Co

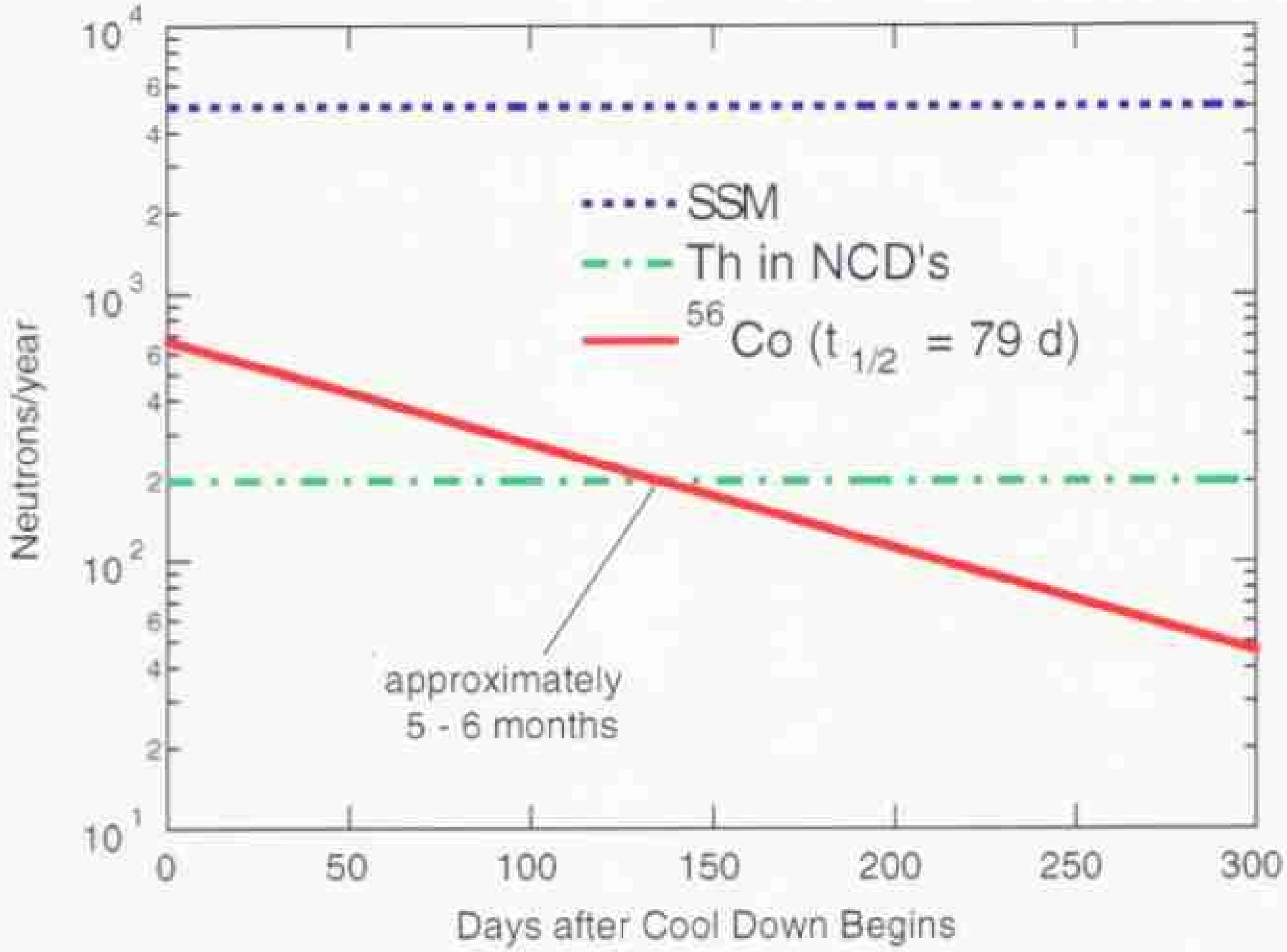
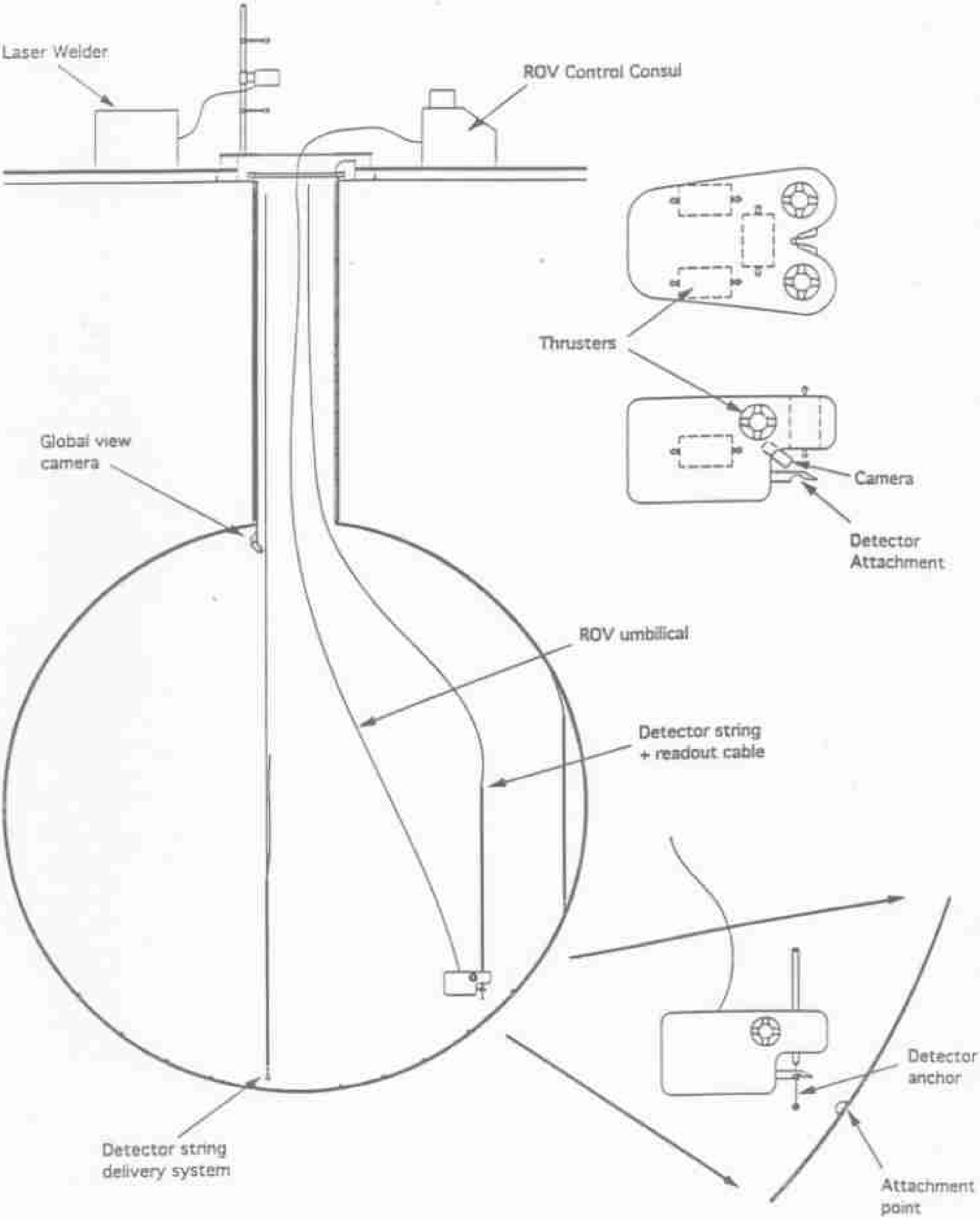
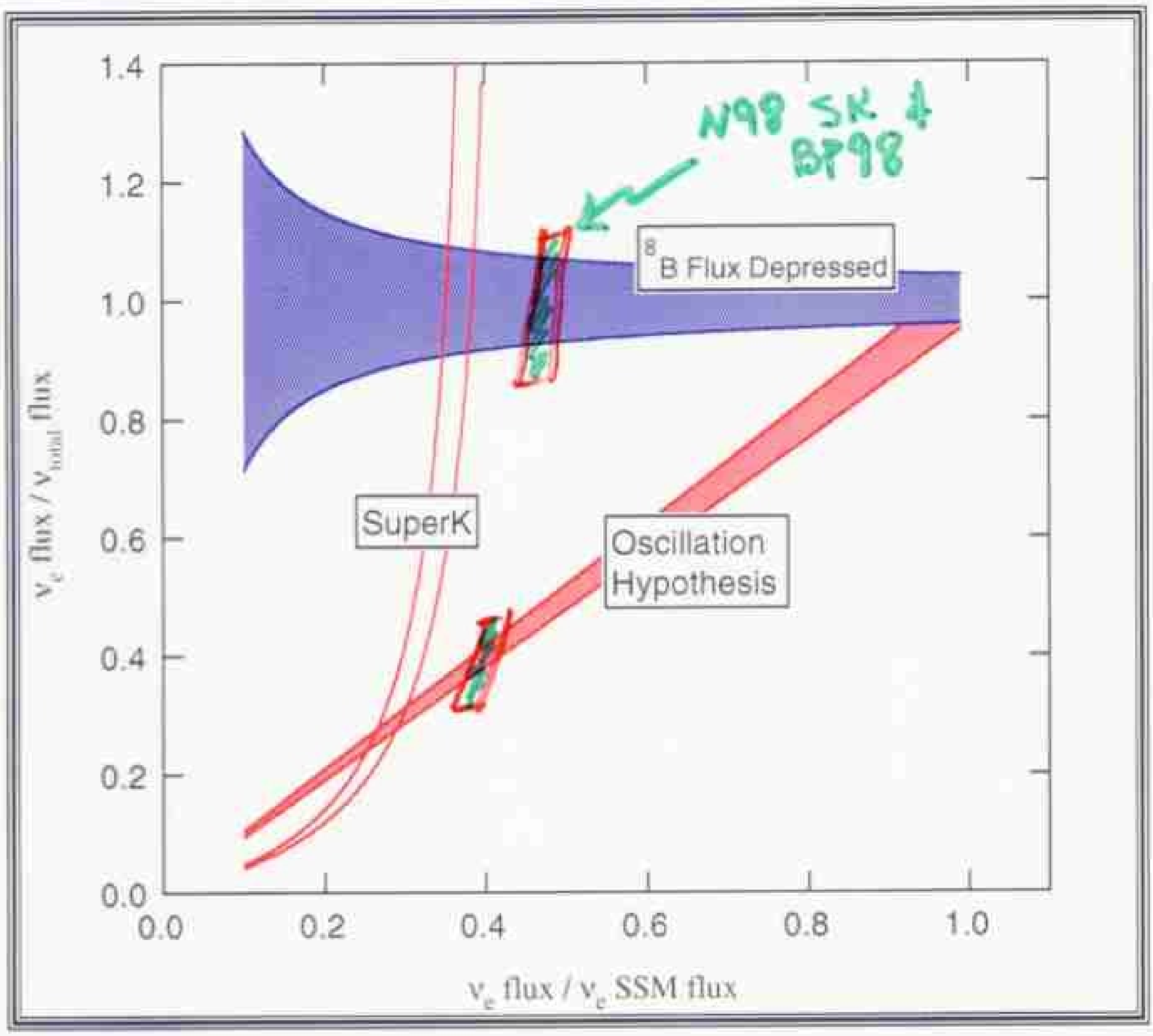


FIGURE 5. SCHEMATIC OF ROV DEPLOYMENT HARDWARE




CC/NC Ratio
1 Year



photodisintegration neutrons: 900/year
CC efficiency: 0.61
NC efficiency: 0.22

SuperKamiokande result from
Preprint Dated April 14, 1998