DCBA (**D**rift **C**hamber **B**eta-ray **A**nalyzer) inverted ABCD

DCBA collaboration
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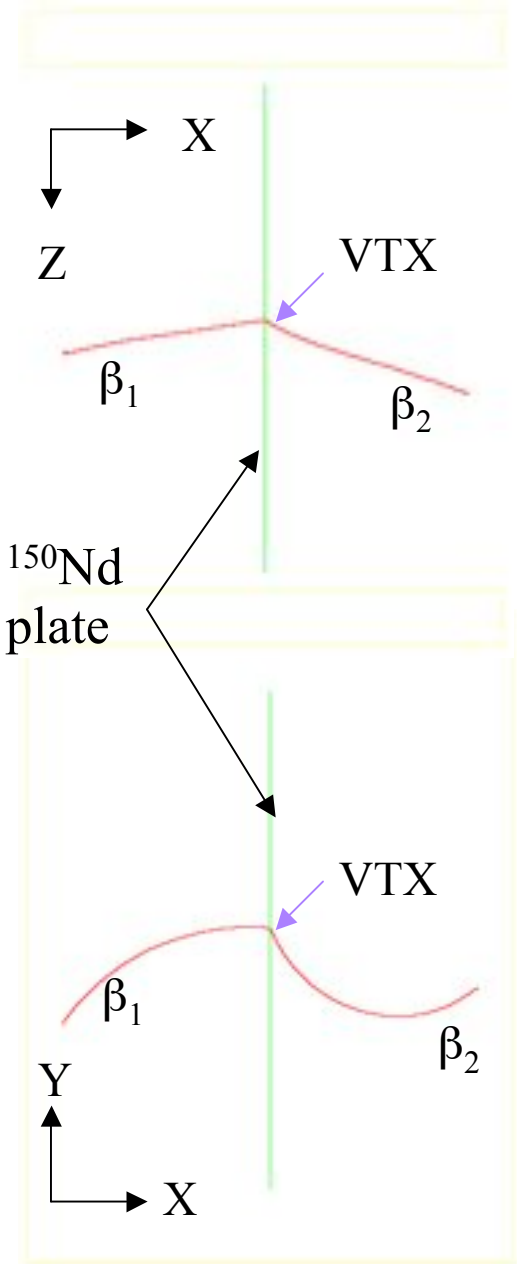
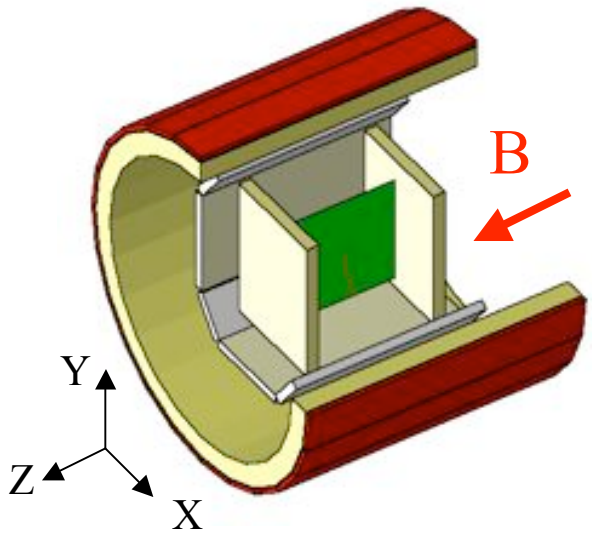
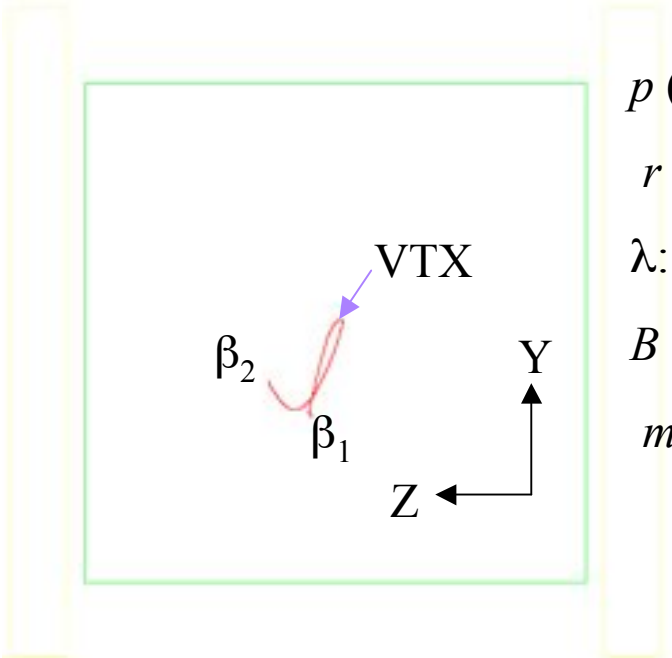
Contents

DCBA-T2

Drift Chamber Beta-ray Analyzer







$^{150}Nd \rightarrow {}^{150}Sm + 2e^-$

$$p\cos\lambda = 0.3rB,$$

$$T = (p^2 + m_e^2)^{1/2} - m_e$$

p (MeV/c): momentum,

r (cm): radius,

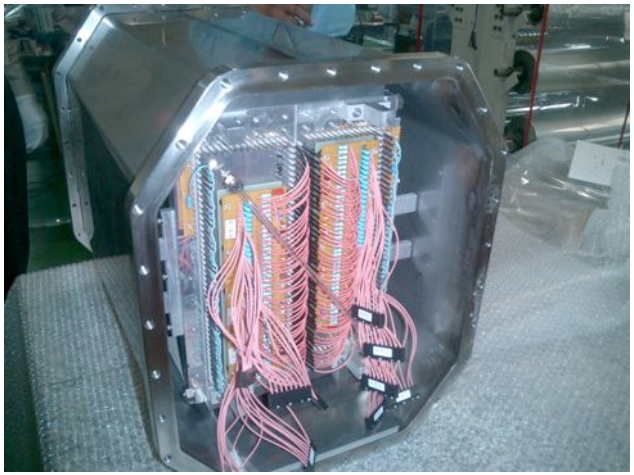
λ: pitch angle

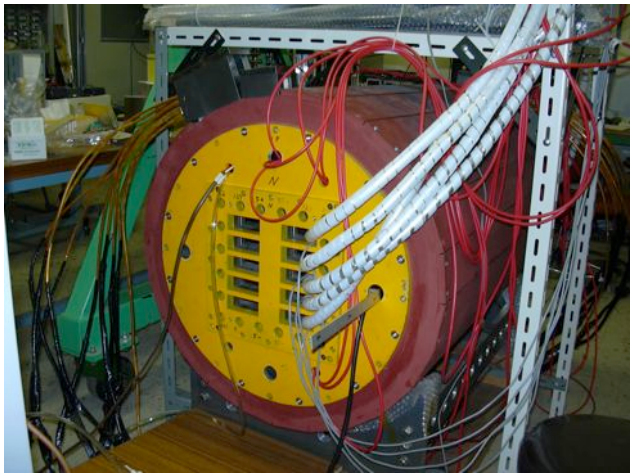
B (kG): magnetic field,

m_e (MeV/c^2): electron mass

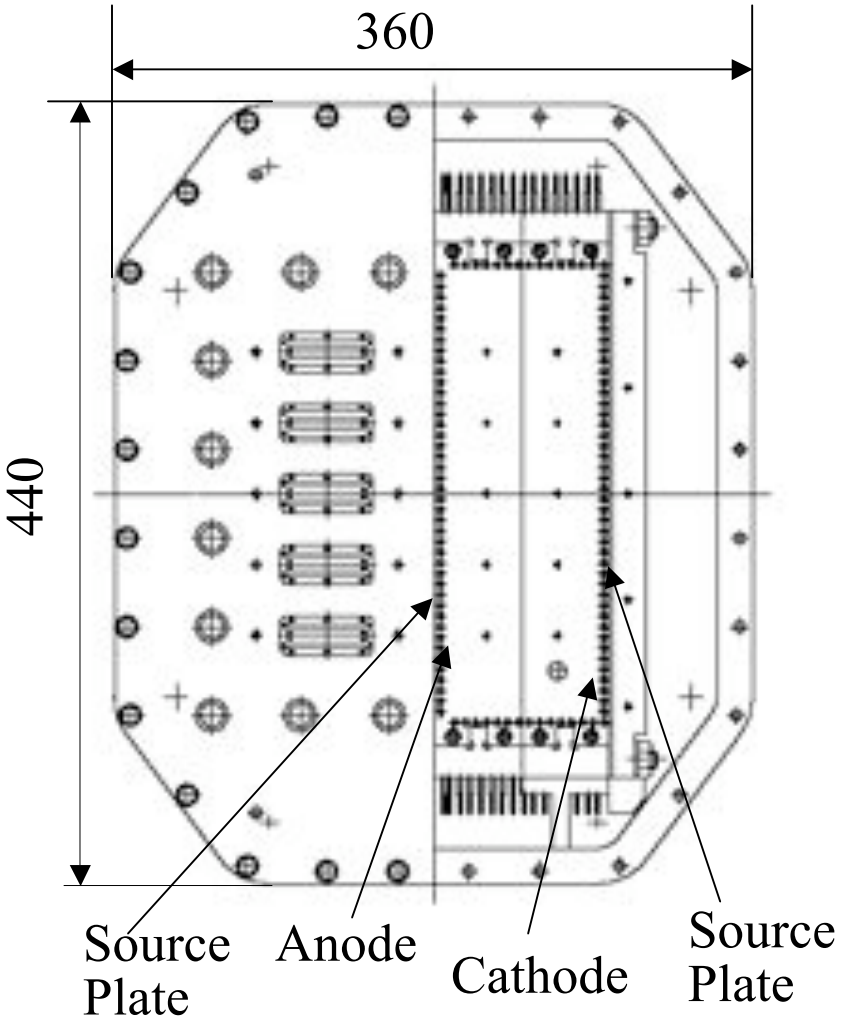
DCBA-T2 (under construction)

• Drift chamber	Multi-track capability
Source	Nd_2O_3 (40 mg/cm^2)
	(^{150}Nd =0.008 mol)
Sensitive vol.	18(X) × 26(Y) × 26(Z) cm^3
Signal readout	Flash ADC
X-position	Drift velocity × Drift time
	(σ_X ~ 0.5 mm)
Y-position	Anode wire position
	(σ_Y ~ 0.5 mm)
Z-position	Pickup wire position
	(σ_Z ~ 0.5 mm)
• Magnet	Solenoid coil +
	Flux return yoke
Magnetic field	0.8 kG (Max.)
Uniform Vol.	40 dia. x 70 cm^3 ($\delta B/B_0 < 1\%$)
• Veto-counters	Scintillation counters

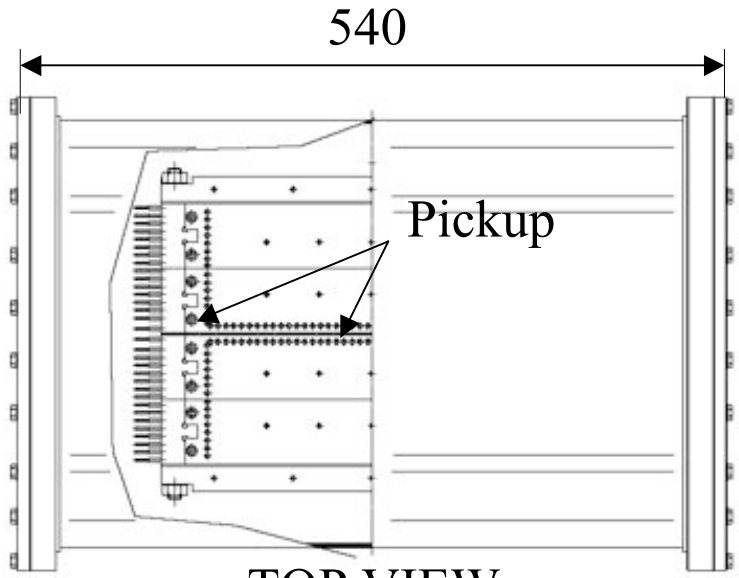




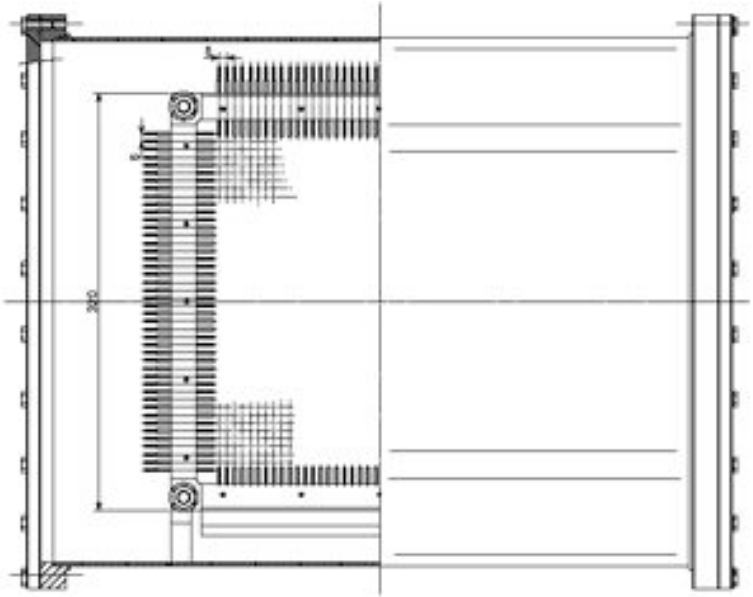
DCBA-T2



FRONT VIEW

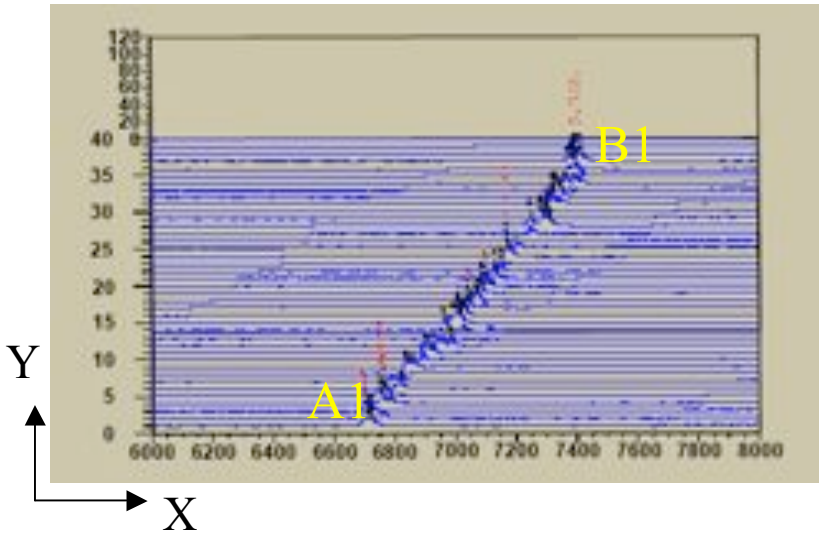


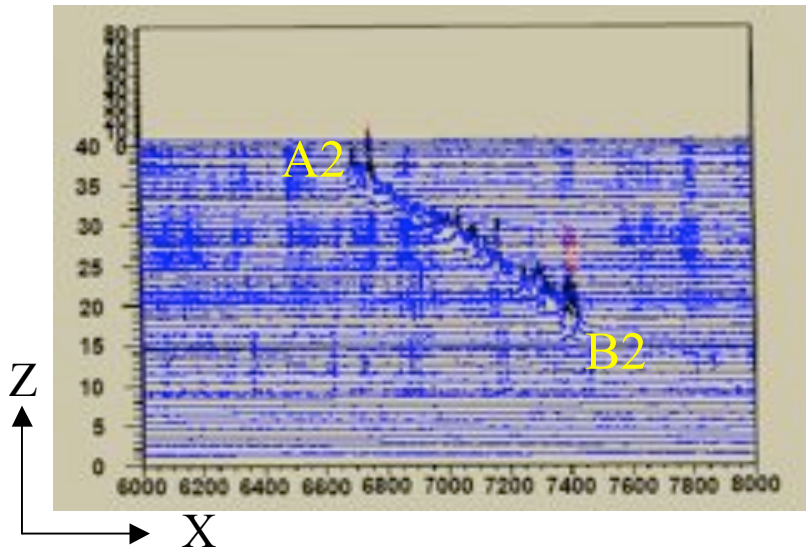
TOP VIEW

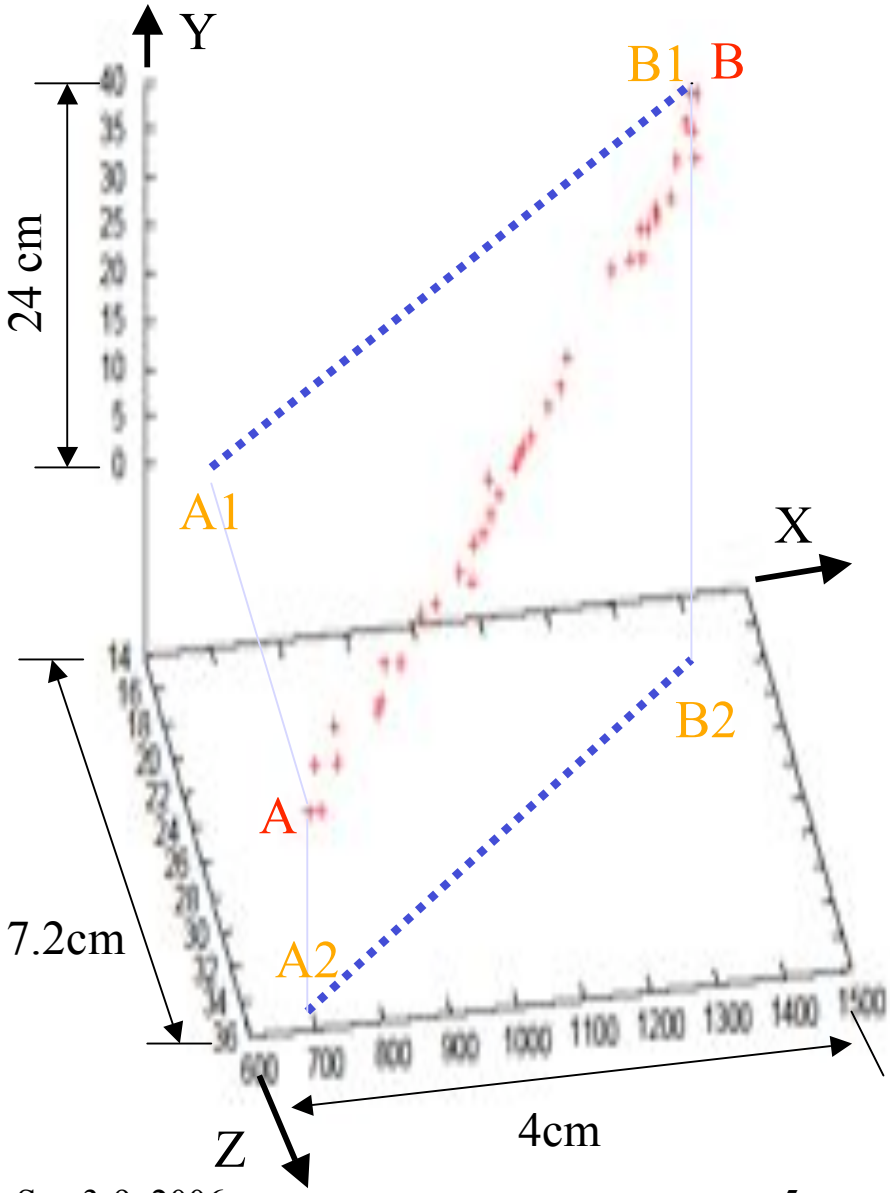


SIDE VIEW

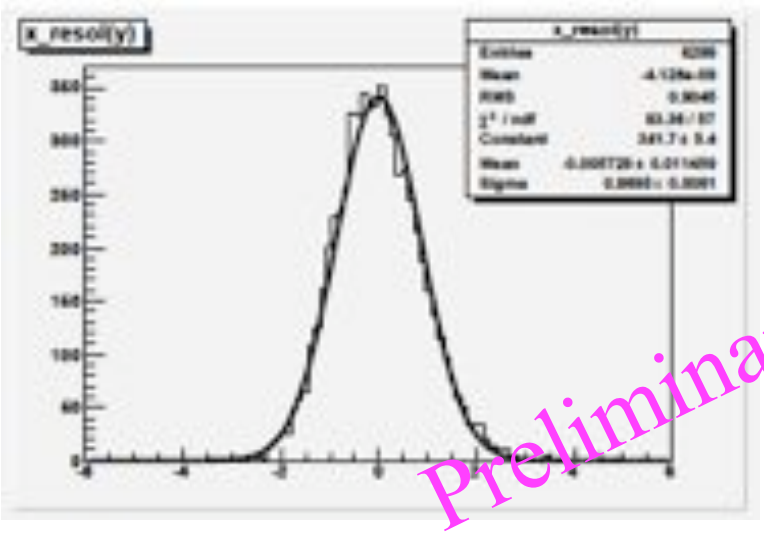
3-D raw data plot of cosmic ray

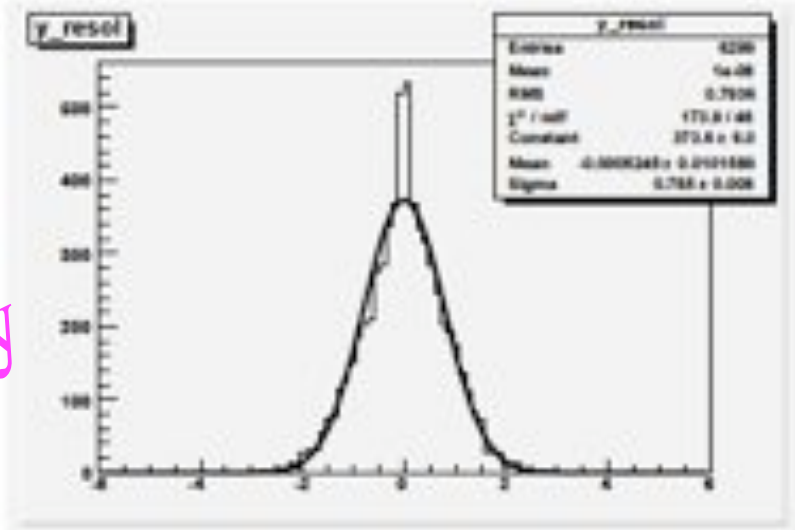




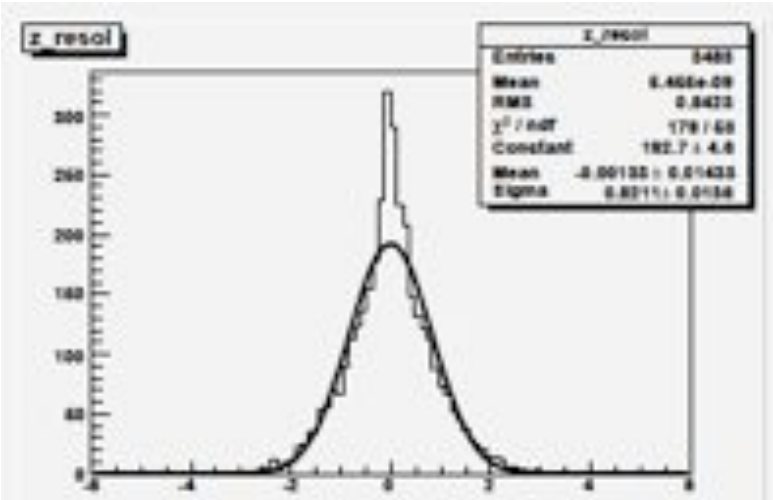


Position resolution of DCBA-T2





Preliminary

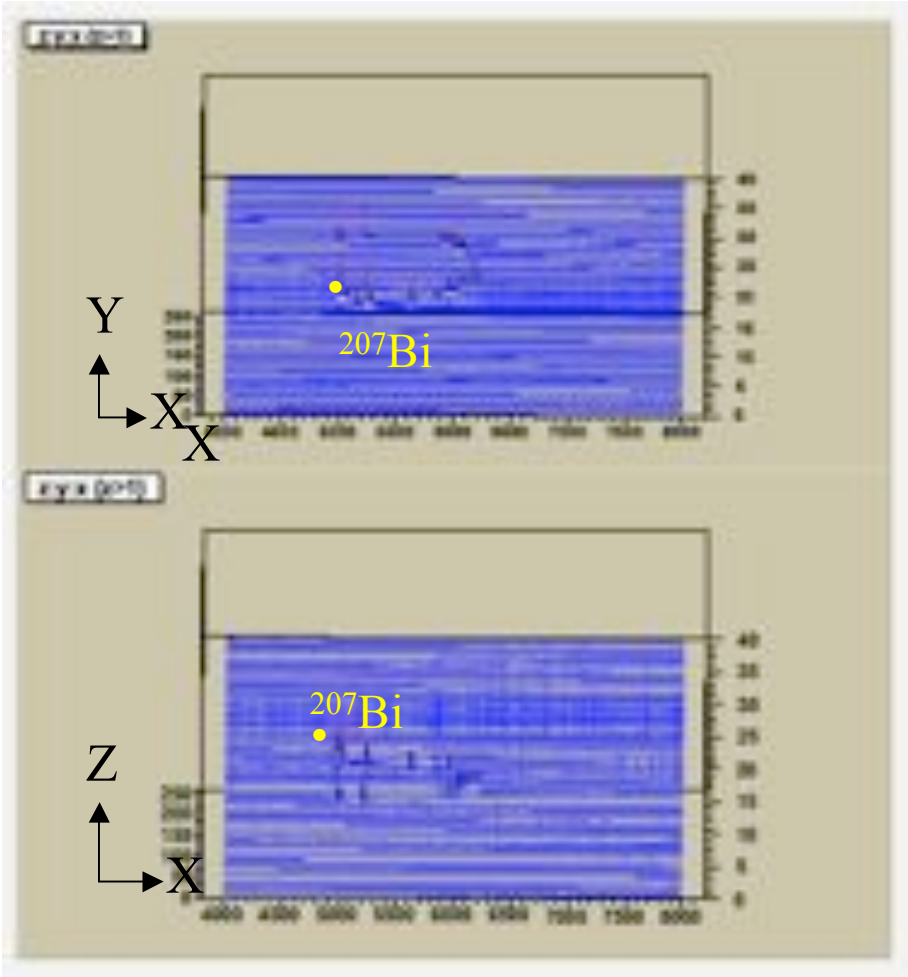


$\sigma_X = 0.87$ mm

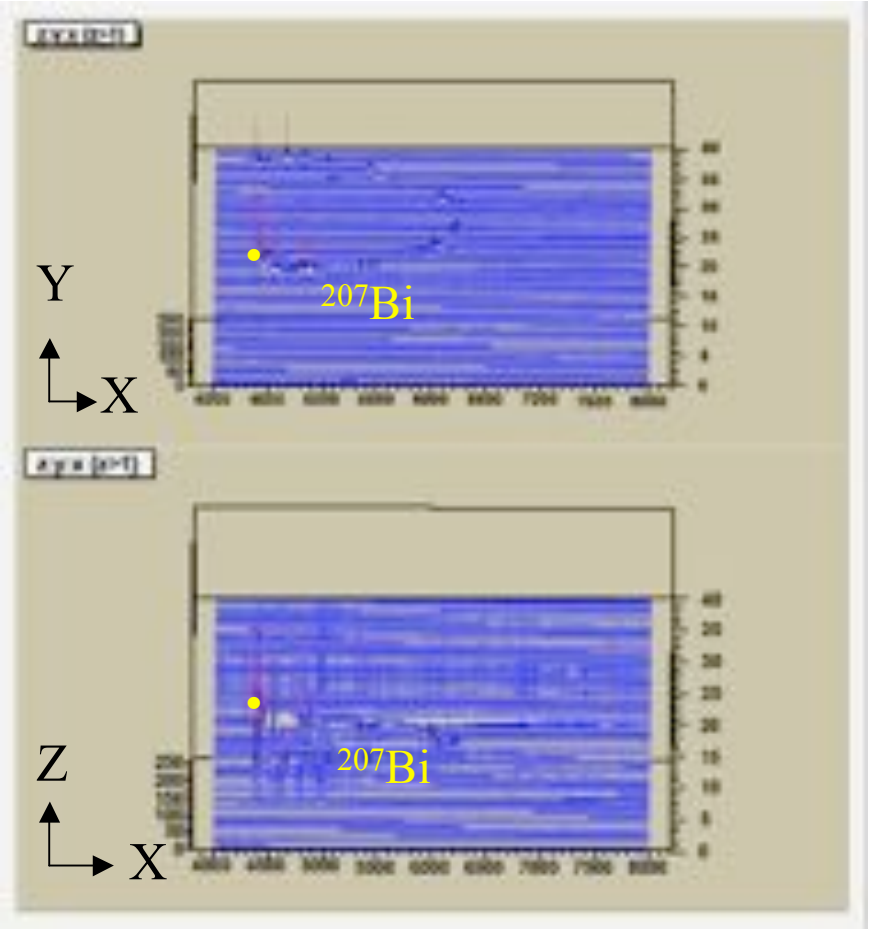
$\sigma_Y = 0.79$ mm

$\sigma_Z = 0.82$mm

Electrons from ^{207}Bi

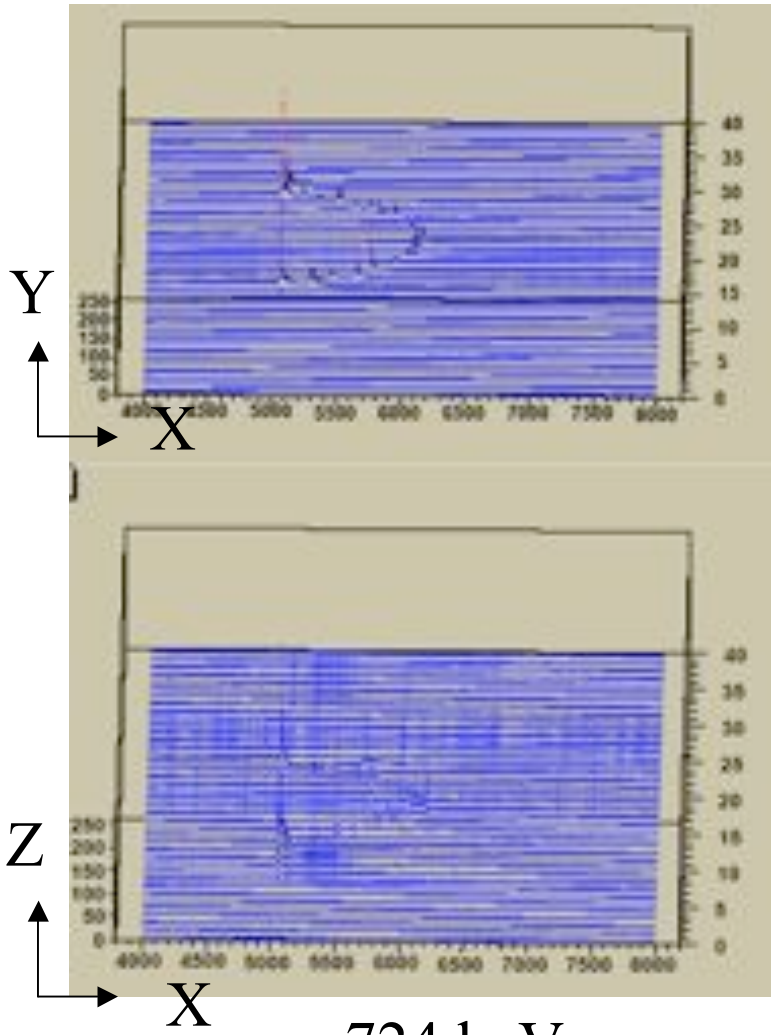


T = 458 keV

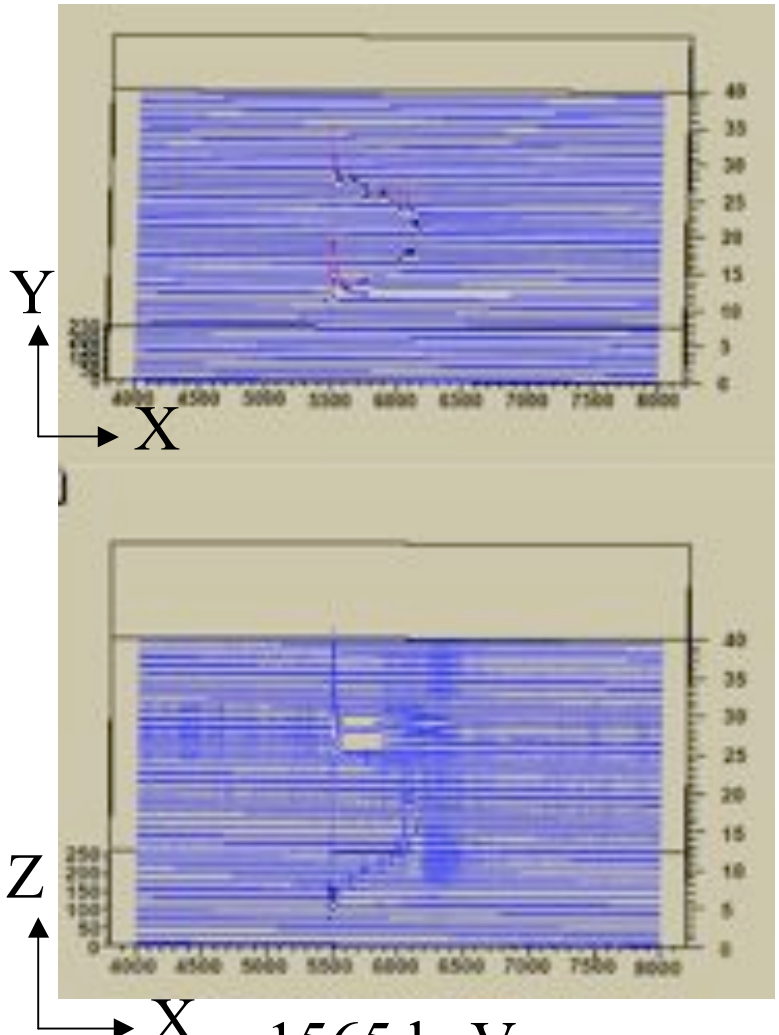


T = 971 keV

Background electron events

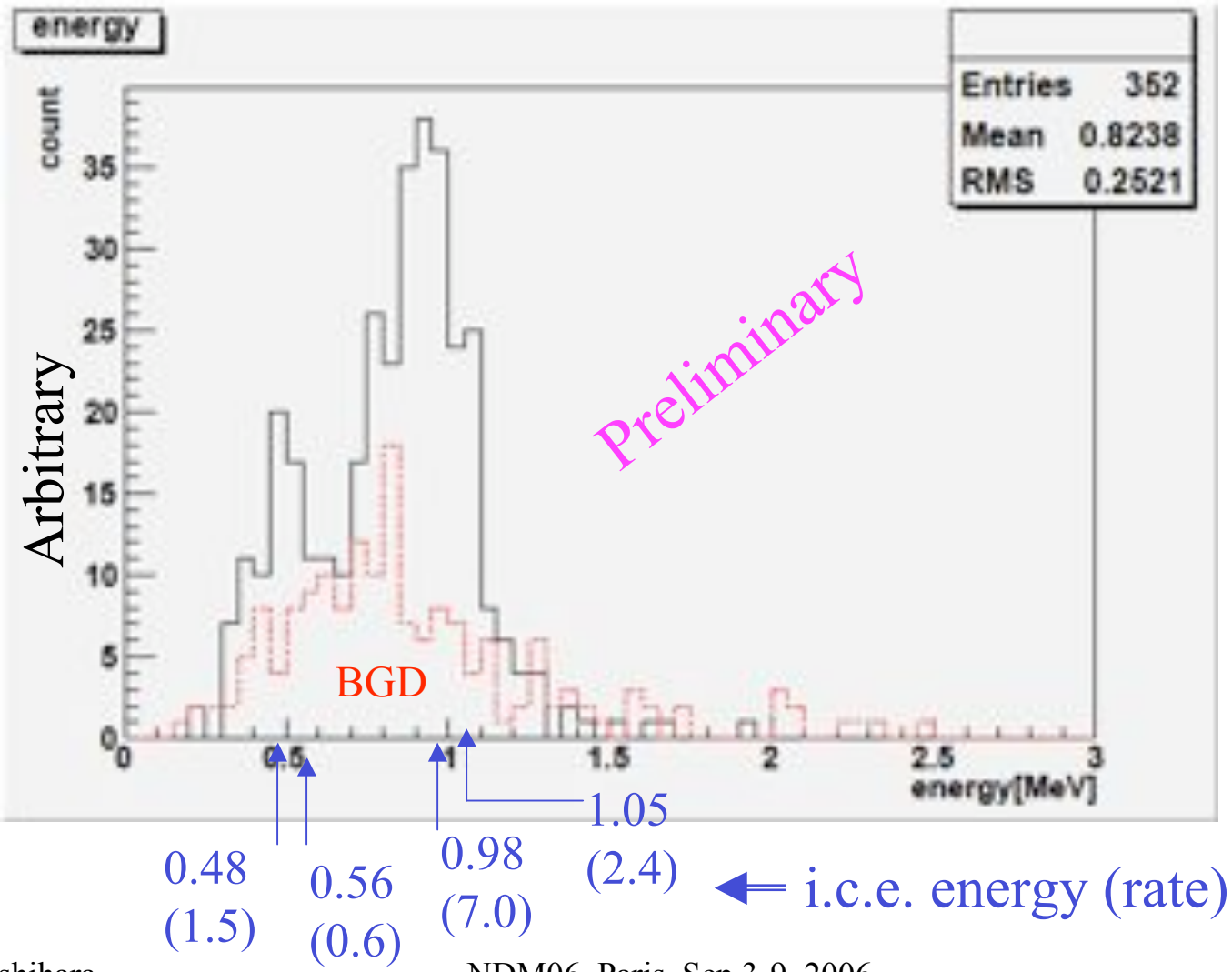


724 keV

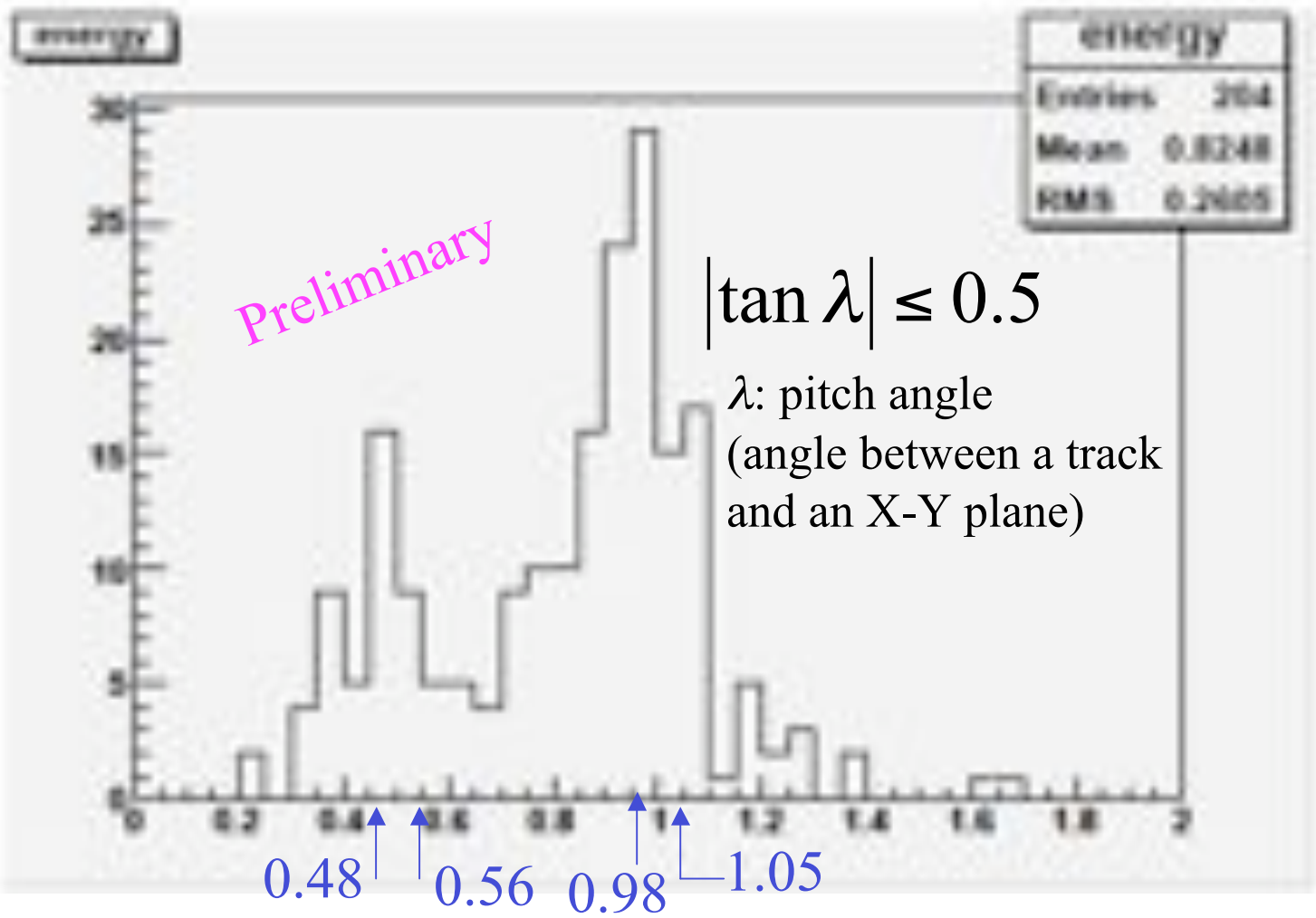


1565 keV

Energy spectra of electrons from ^{207}Bi and background in DCBA-T2



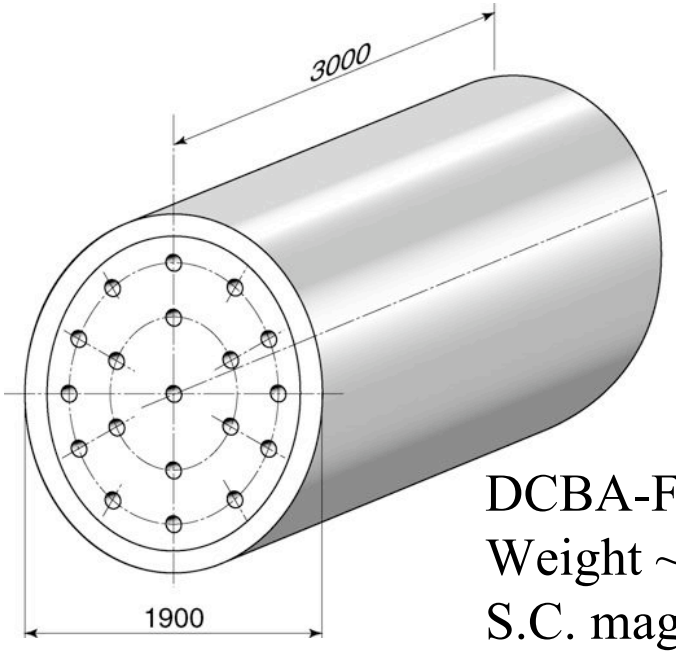
Energy spectrum in the forward region of source point



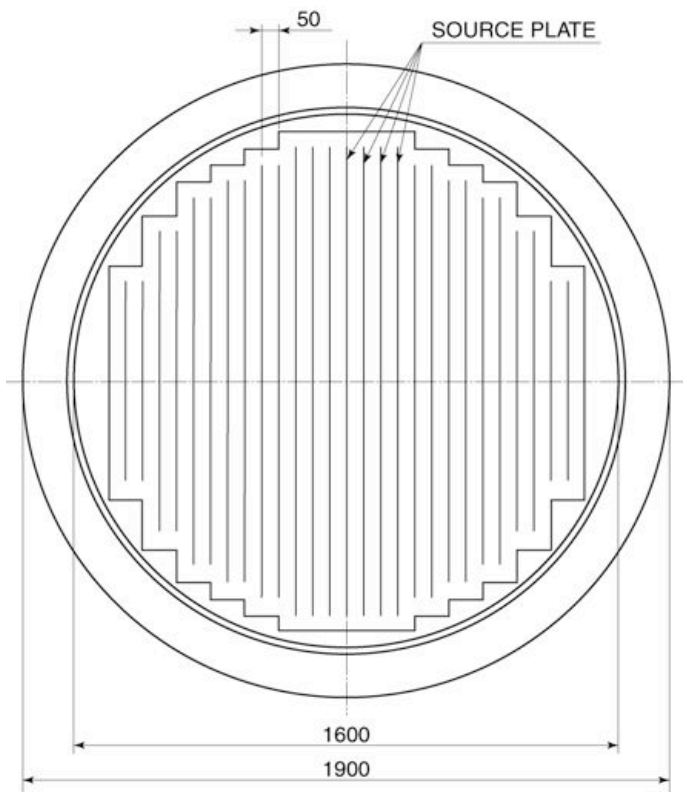
Future plan DCBA-F

Source plate: 84 m^2/module
Thickness: 15 (40) mg/cm^2
Weight: 12.6 (33) kg/module
10 module → 126 (330) kg

Anode wire: 10720/module
Pickup wire: 13160/module



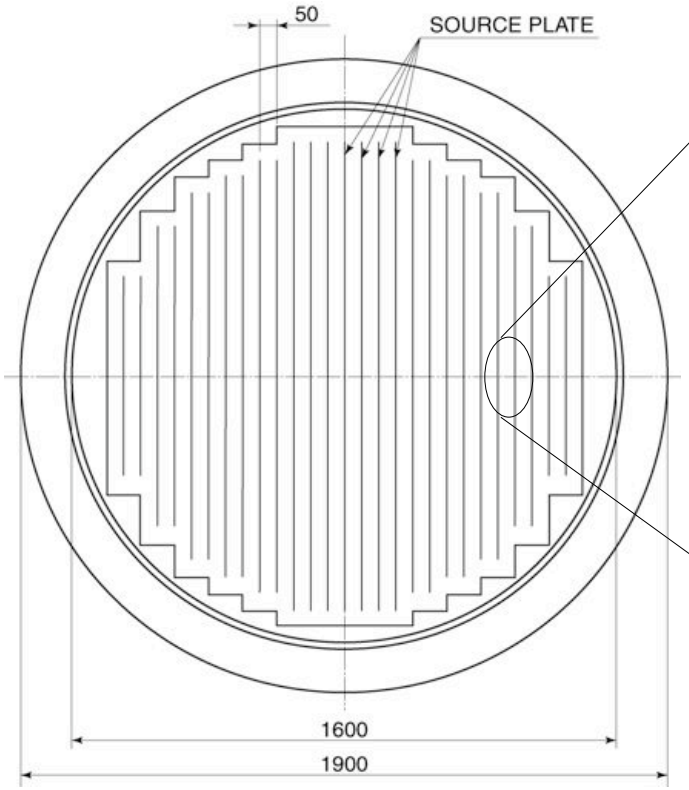
DCBA-F module
Weight ~ 20 t
S.C. magnet

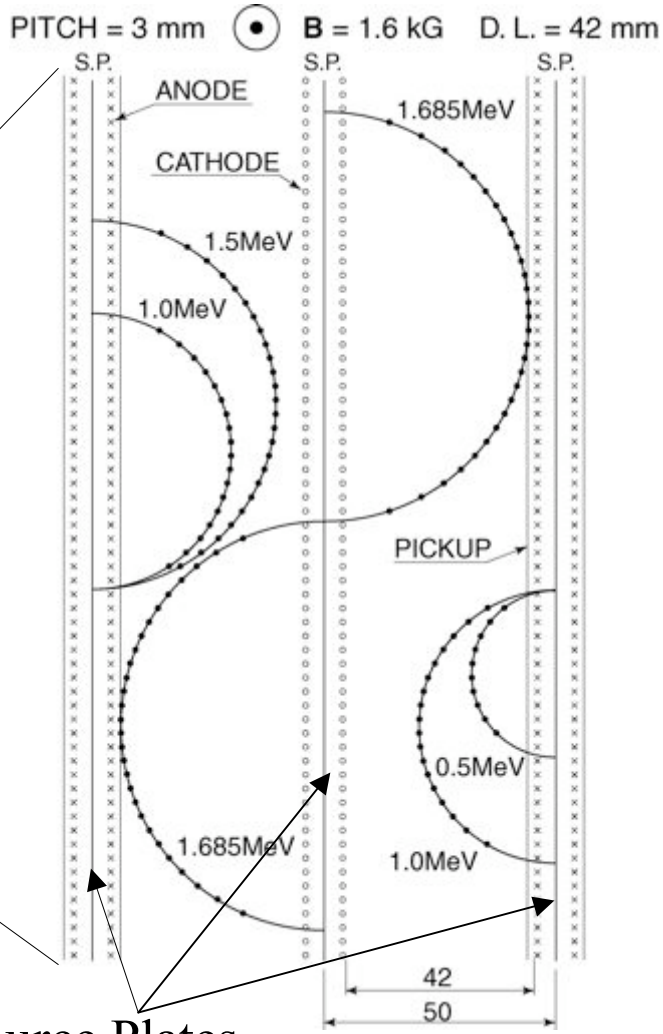


$< m_\nu > \approx 0.4\,\mathrm{eV}$ for natural Nd/module.year

$< m_\nu > \approx 0.1\,\mathrm{eV}$ for 90% ^{150}Nd/module.year

Configuration of DCBA-F Module





Source Plates

Half-life and Effective Mass Sensitivities of DCBA for ^{150}Nd, ^{100}Mo and ^{82}Se (Tentative)

	Natural Nd (5.6% ^{150}Nd)	^{150}Nd (80% enr.)	^{100}Mo (90% enr.)	^{82}Se (90% enr.)
DCBA Amount (mol) (600 kg : 20 modules of 40 mg/cm^2)	190	2700	5400	6600
$T^{1/2}_{0\nu}$ sens. (yr)	9×10^{24}	1×10^{26}	2×10^{26}	3×10^{26}
$\langle m_\nu \rangle$ sens. (eV)	0.06	0.02	0.07	0.04

Nucl. Matrix Element: A. Staudt et al. Europhys. Lett. 13 (1) (1990) 31

Summary

1. Kinetic energy of an electron in the region of 200 – 2500 keV has been obtained by DCBA-T2 from the momentum measurement in a uniform magnetic field.

2. Events from a point source of ^{207}Bi show two peaks. One peak is around 500 keV and the other is around 950 keV. They are consistent with i.c.e. energies.

3. Background events show a peak around 800 keV. More events are required to investigate the origin of background events.

4. Energy resolution of DCBA-T2 is under study now.

5. It is expected that 20 modules of DCBA-F will have the effective neutrino mass sensitivity of 0.05 eV.

6. Everybody is welcome for the future project.