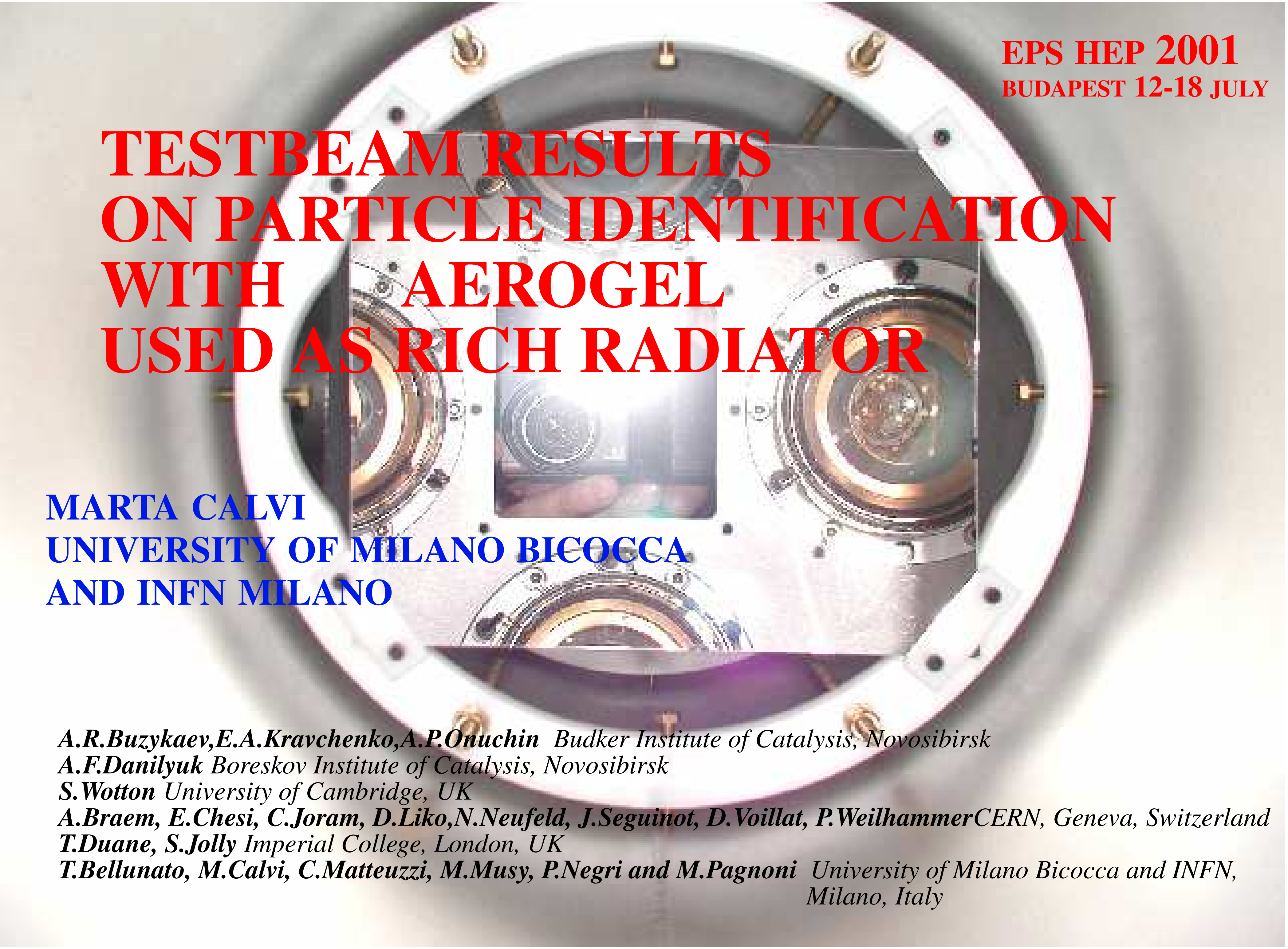

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TESTBEAM RESULTS ON PARTICLE IDENTIFICATION WITH AEROGEL USED AS RICH RADIATOR

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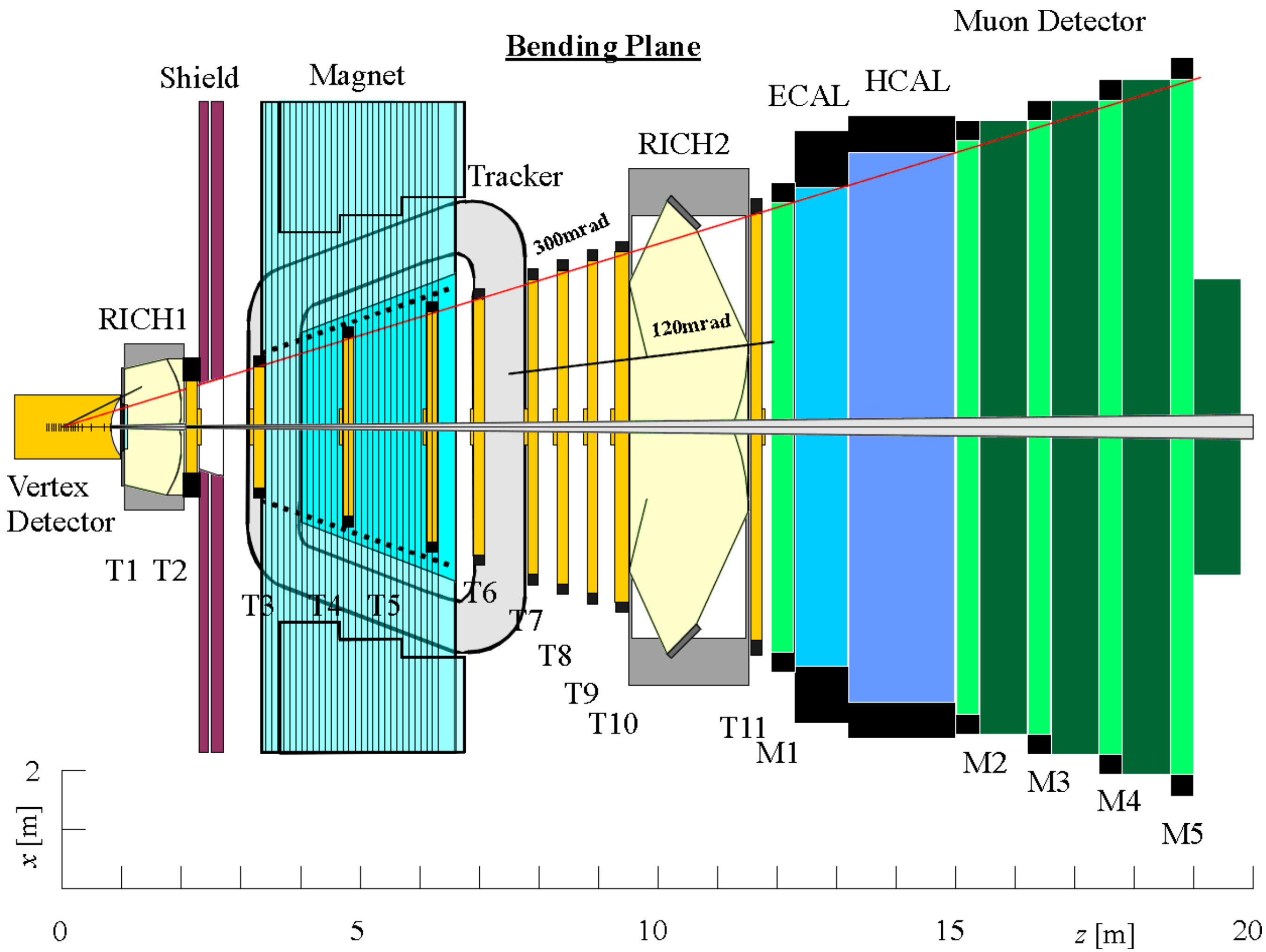
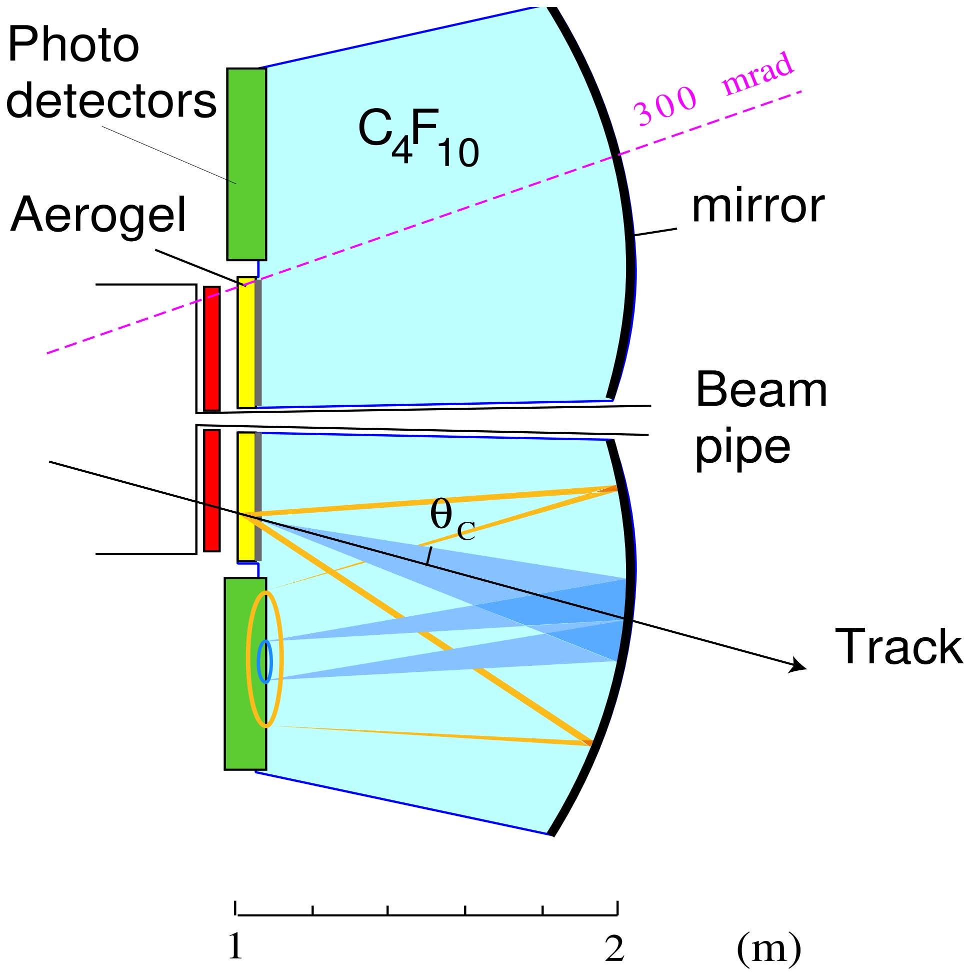
LHCb: a single arm spectrometer at LHC (pp collision at $\sqrt{s}$ = 14 TeV) for CP violation measurements in the B sector

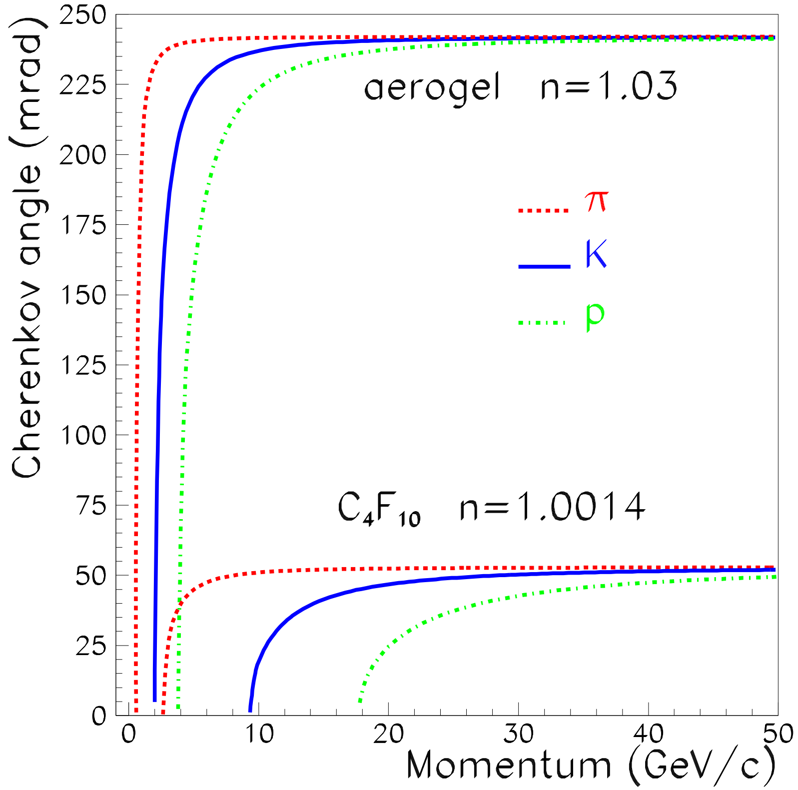


Requirements for particle identification in LHCb :

Hadron identification in 1-150 GeV/c → RICH system with 3 radiators divided into 2 detectors

RICH 1





RICH 1	5 cm	aerogel	n=1.03	PID in 2-11 GeV/c
	4 m^3	C_4F_{10}	n=1.0014	PID in 10-50 GeV/c
RICH 2	100 m^3	CF_4	n=1.0005	PID in 17-150 GeV/c

AEROGEL RADIATOR

Silica aerogel: extremely light solid (SiO_2 +H_2O) with 3-dimensional netlike structure of small scale length (~20 nm)

- radiation index in the range 1.01 - 1.10 → particle identification at low momenta
- low density ($\delta \sim 0.15$ g / cm^3) → no material in front of calorimeters

- optical properties: transparency dominated by Rayleigh scattering

Trasmittance: $T = A \exp(-C\, d / \lambda^4)$

$A \approx 0.95$ trasmittance in the long-wavelength region

$C \approx 100 \times 10^{-4}\ \mu m^4\ cm^{-1}$ Clarity coefficient

d = thickness (cm)

Good clarity is crucial for aerogel use as RICH radiator

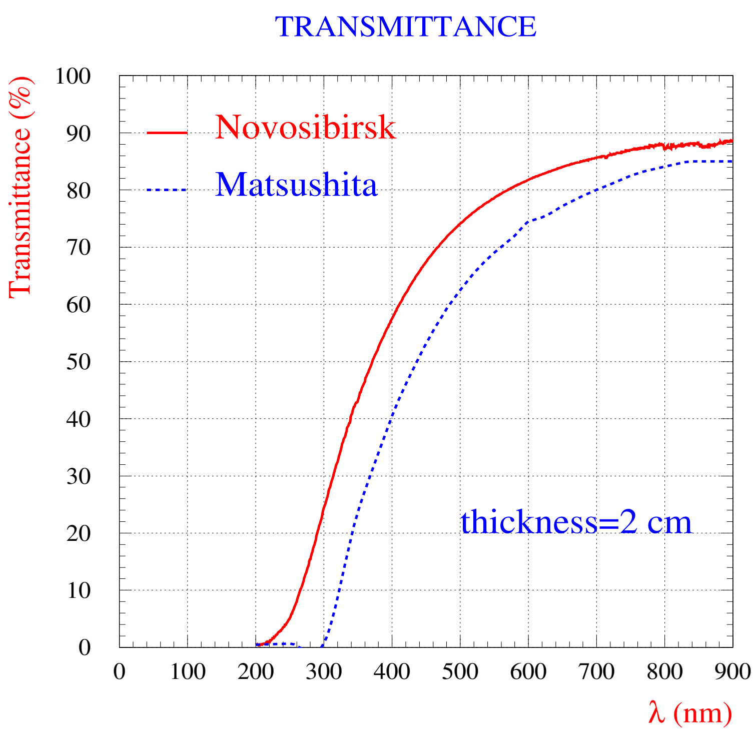
- Cautions:
  fragile, hydrophobic / hydrophillic , dis-uniformities (δ,n), tile dimensions, ageing...

Two aerogel qualities used in the test beam:

- SP30 by **Matsushita** Electric works, Ltd (**Japan**) *(similar to HERMES production)*
  hydrophobic   5.5×5.5×1 cm^3 tiles; 8×8×2 cm^3 (cut from original 20×30×2 cm^3)

- new samples by **Boreskov** Institute of Catalysis (**Novosibirsk**, Russia)
  hydrophillic   10×10×2 cm^3 tiles; 7×8×4 cm^3 and 10×10×4 cm^3 tiles

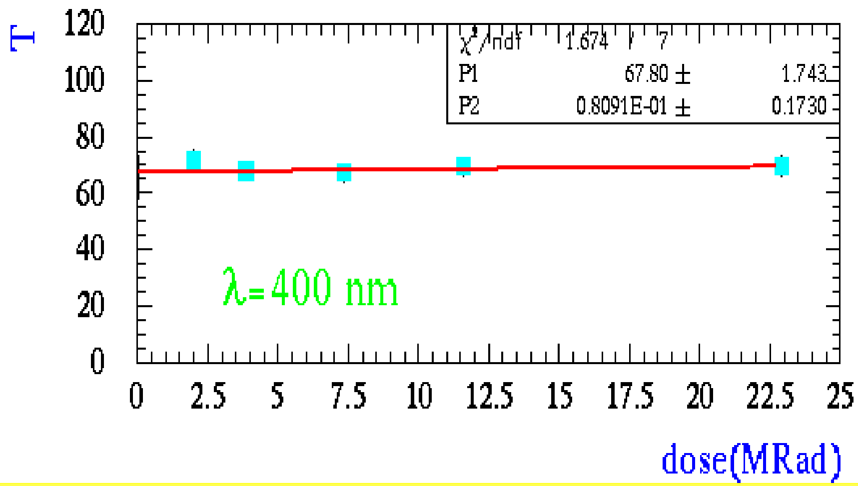
Measurements before test beam:



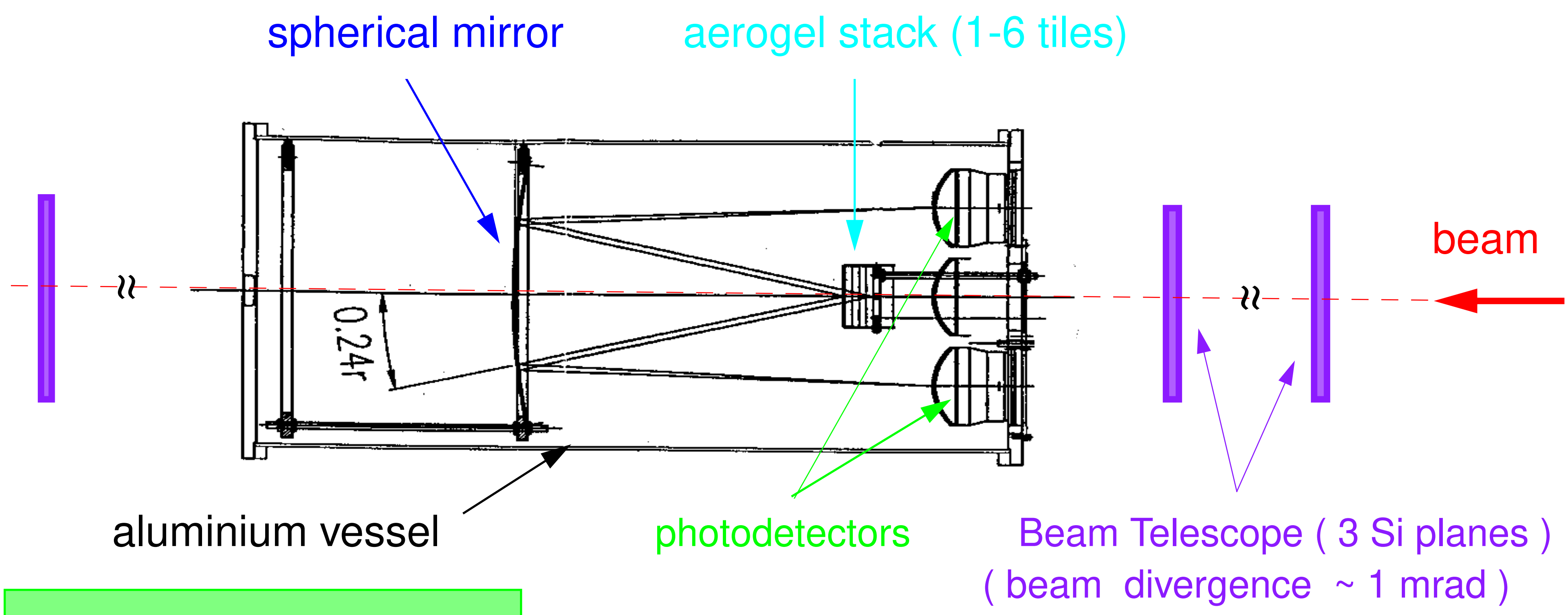
$C_{\text{Nov.}} = 56 \times 10^{-4}\ \mu m^4\ cm^{-1}$

$C_{\text{Mat.}} = 96 \times 10^{-4}\ \mu m^4\ cm^{-1}$

Radiation Hardness



TEST BEAM SET-UP



TWO TESTS:

❶ November 1999
2 HPDs

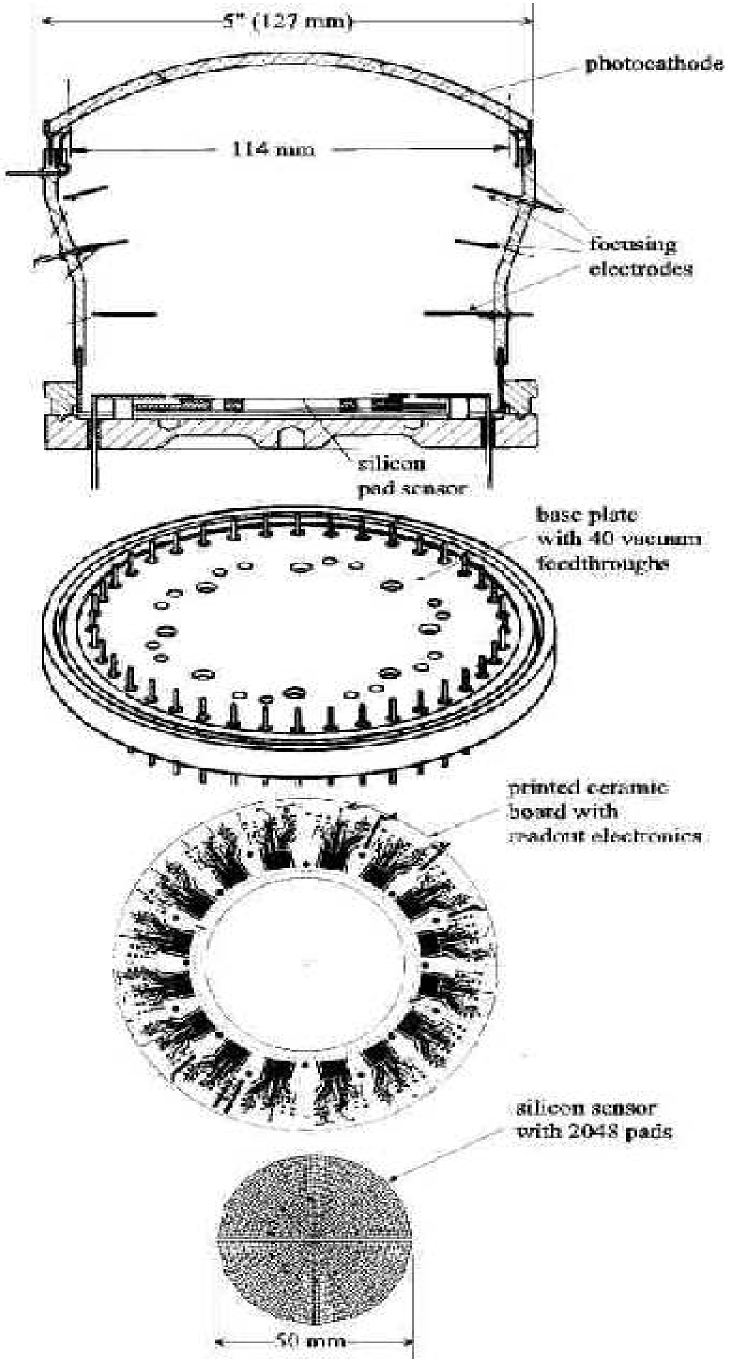
❷ May 2001
4 HPDs

BEAM: T7 secondary beamline from Cern PS
(primary protons 24 GeV/c)

negative polarity: π^- 1-10 GeV/c ($\Delta p/p$ ~ 1%)

positive polarity: π^+, protons (50% → 70%)

PHOTODETECTORS

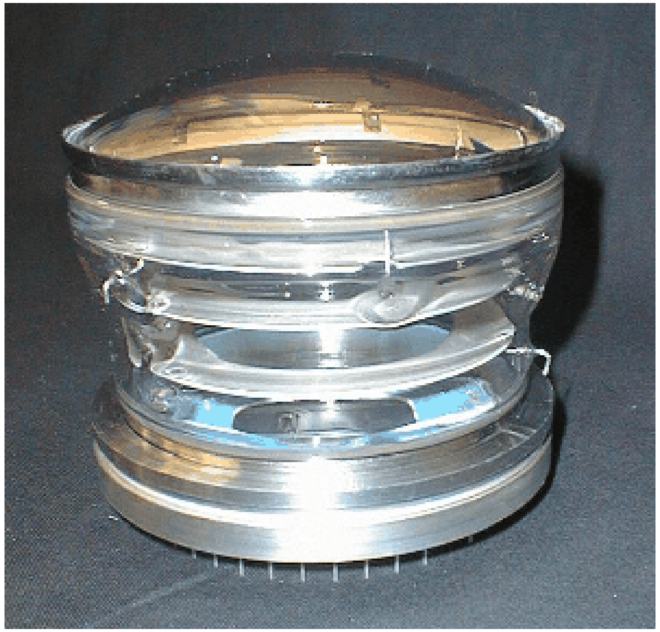


Pad-HPD = large area Hybrid Photodiode with pixelized read-out (CERN project)

fountain shaped electric field,de-magnification ~2.4

Si sensor (2048 pixels 1×1 mm^2)

$\rightarrow$ 2.4×2.4 mm^2 granularity



127 mm diameter

cylindrical vacuum envelope with UV extended borosilicate window