

Update on 2003 Forward Calorimeter Beam Test Analysis / Simulation

Submitted to the Lisbon Hadronic Calibration
Workshop, June 2009
FCal Group

Additional Slides

Electron Results Data / MC

Description of Simulation

Description of Testbeam Setup and Data Samples

Comments on Data / MC Agreement

Status of Testbeam Analysis

- Electrons and pions from 10-200 GeV in H6 beamline, summer 2003.
- Five beam impact points on detector face (see backup slides):
 - 1,2,3 are inner edge scan positions for leakage studies (L. Heelan).
 - 4H,4L are points at $\eta \sim 3.7$ for full containment of shower energy.
 - at 4L position had minimal amount of material in front of the calorimeter
 - at 4H position had some upstream material in order to model ATLAS-like environment: (cryostat bulkhead, JM shielding).
 - 4L results for electrons and hadrons published in 2008 (note though that carrying EM-scale calibrations to ATLAS requires modeling of final ATLAS electronics since these were unavailable for the beam test in 2003).
 - Analysis of inner edge data in progress (L. Heelan, Carleton).
 - Analysis of 4H data in progress (P. Thompson, Toronto).
 - Hadronic calibration scenarios to be investigated.
 - Will not describe details of the analysis (~same as for published 4L results)
 - Purpose of slides submitted to Lisbon is to illustrate ongoing work on the comparison of the 4L/4H results with the G4 simulation.

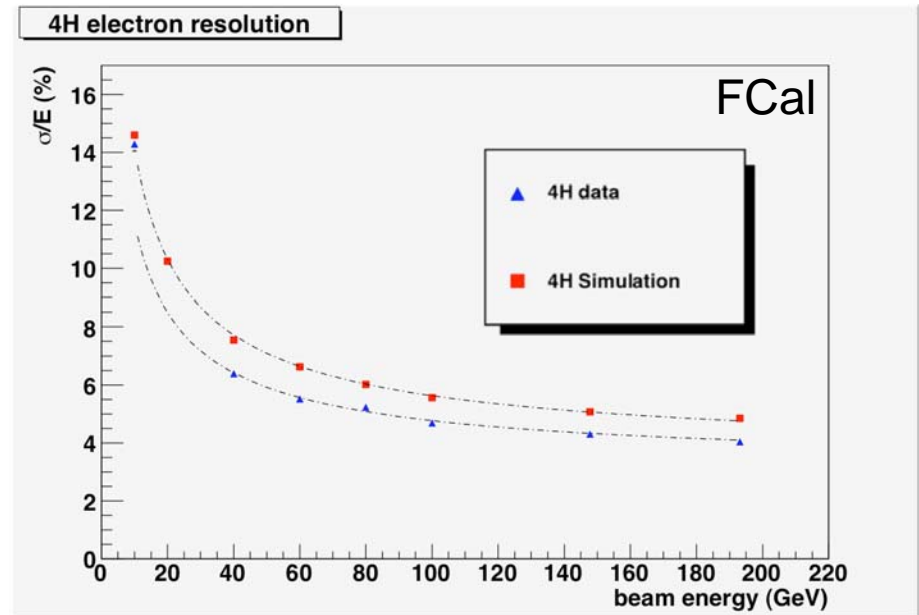
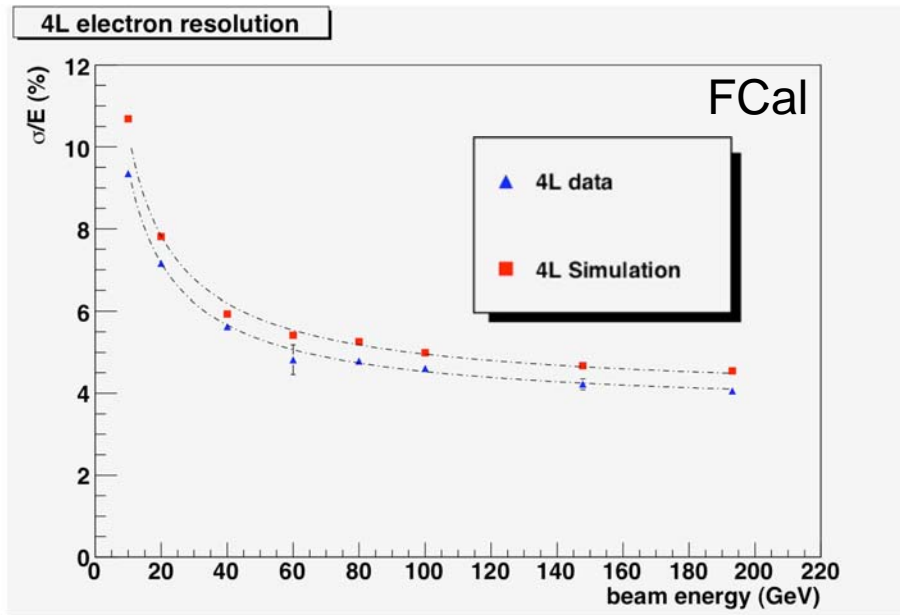
Current Status of FCal 2003 Testbeam Simulation

- Simulation recently ported to Athena 14.5.0, geant4.9.1.patch03.atlas01
- QGSP-BERT, 30 μ m range cut, Birk's Law ON
- EM sampling fractions recalculated
- Noise is OFF in simulation (DB for simulation is incorrect by a factor of ~ 2 for most channels and we have had some difficulties overwriting this).
- ATLAS-H6-2003-02 geometry:
 - Polyethylene added upstream for 4H runs (see slide 8)
 - FCal2/3 absorber matrix density reset from 15.36 g/cm³ to 14.39 g/cm³
 - Tungsten rod material changed from WFeNi (slug material) to tungsten (changes density from 18.6 to 19.2 g/cm³).
- Distributed beam spot simulated (but not yet with beam profile from data)

FCal 2003 TB Data/MC Summary (4H/4L)

- Resolution for electrons slightly worse in Monte Carlo than in data (slide 5)
- Resolution for pions too good in Monte Carlo (see submitted pion slides)
 - Data weights used for MC pion energy reconstruction
 - Data/MC longitudinal profiles in imperfect but ~OK agreement
 - Radially, FCal2/3 showers wider in Monte Carlo than in data
- Continuing simulation studies (4L,4H positions):
 - inclusion of correct cell noise (run by run from data if necessary)
 - effect of different physics lists
 - effect of Birk's Law ON/OFF
 - shower profile variations with FCal2/3 absorber matrix density
- Investigation of hadronic weighting schemes using testbeam data / MC.
- Also some remaining data analysis issues (not discussed here).

FCal Electron Energy Resolution



Athena 14.5.0, QGSP_BERT, G4.9.1.patch01.atlas03, Birk's Law ON

$$a = 27.7\% \quad b = 3.6\% \quad [\text{data}]$$

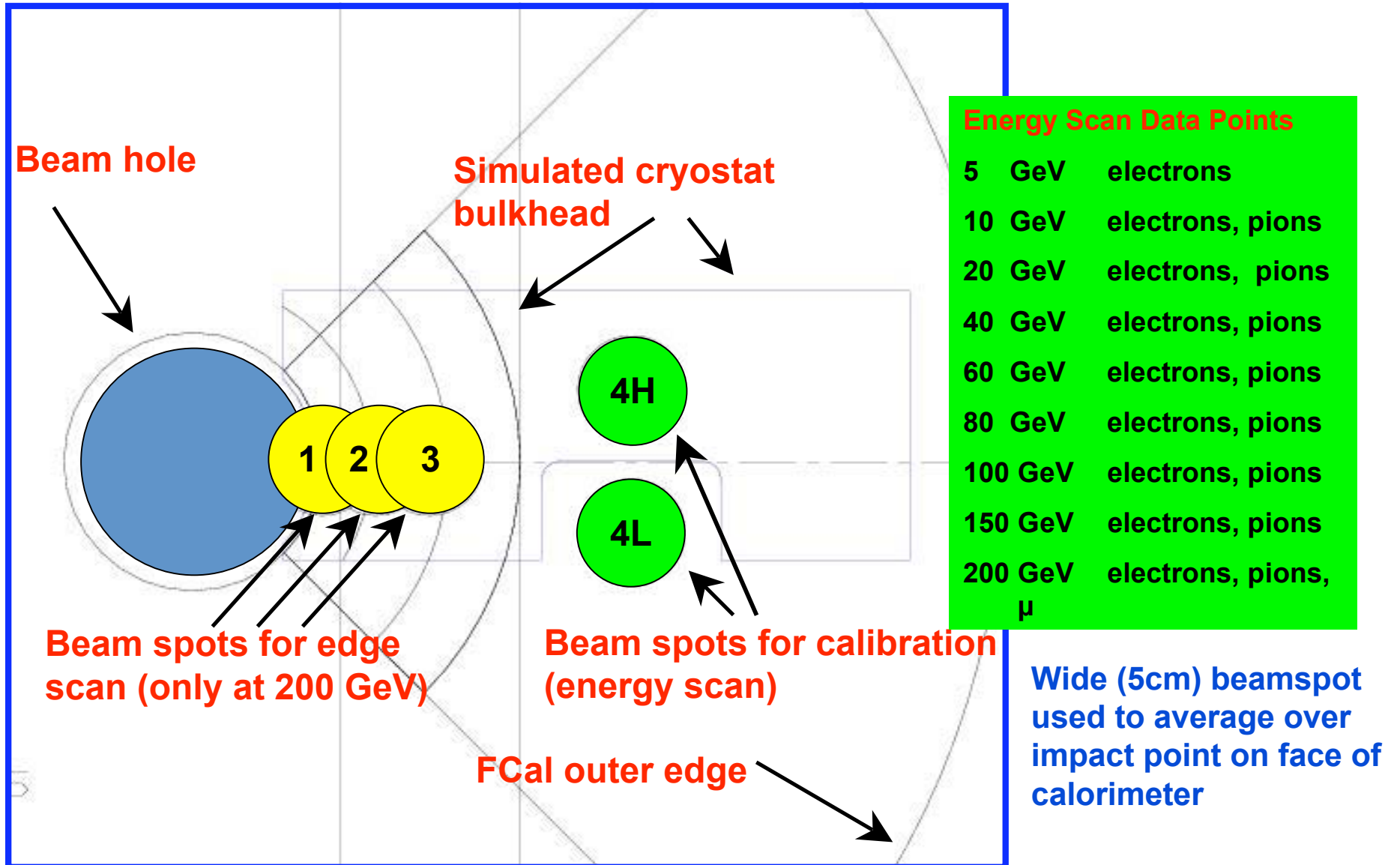
$$a = 30.3\% \quad b = 3.9\% \quad [\text{MC}]$$

$$a = 35.6\% \quad b = 3.2\% \quad [\text{data}]$$

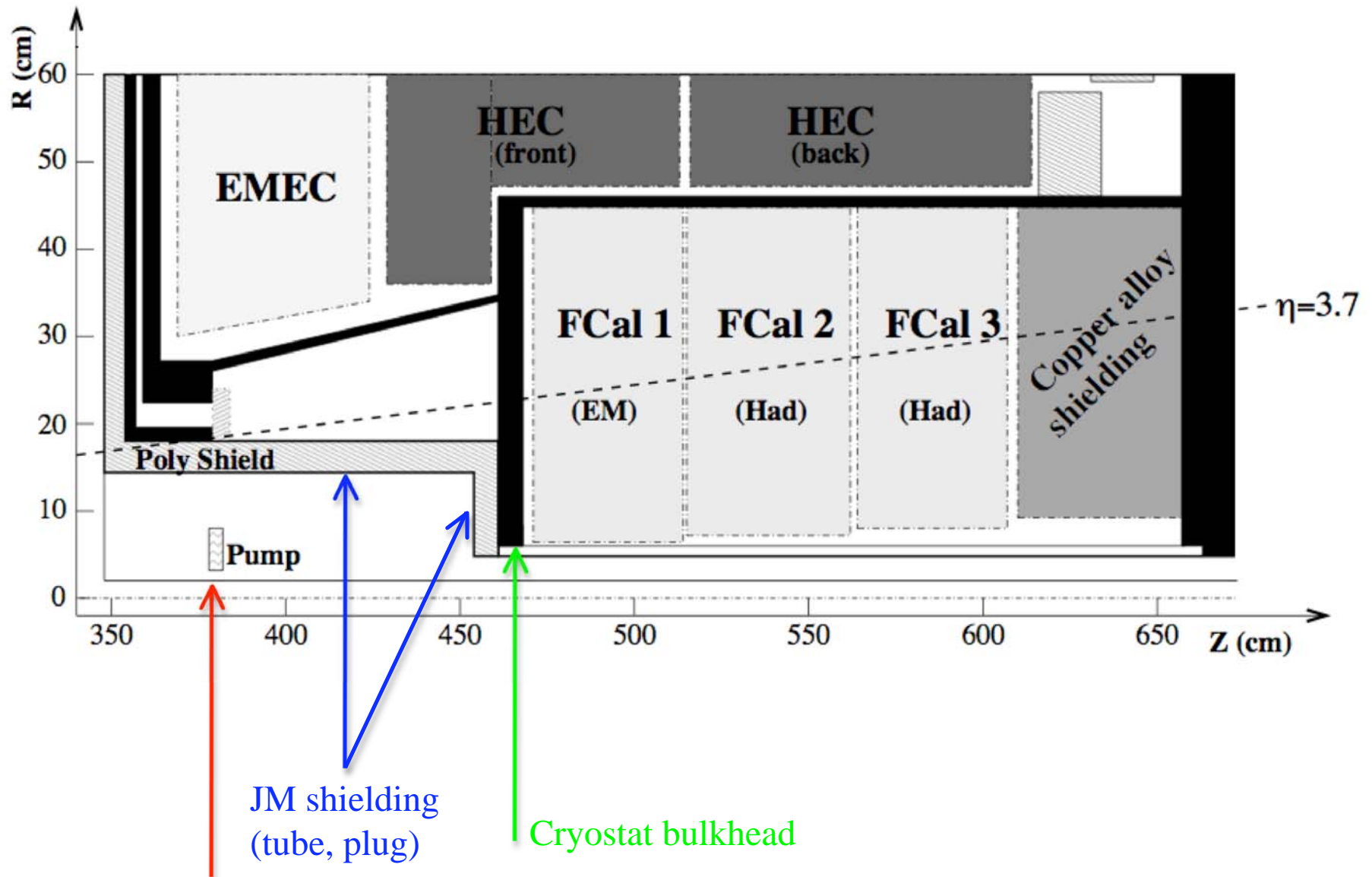
$$a = 43.2\% \quad b = 3.6\% \quad [\text{MC}]$$

Data are noise subtracted. Simulation is with no noise. Fit values are for usual parametrization: $\left. \vphantom{\frac{\sigma_E}{E}} \right\} \frac{\sigma_E}{E} = \frac{a}{\sqrt{E}} \oplus b$

Datasets for 2003 FCal Calibration Testbeam

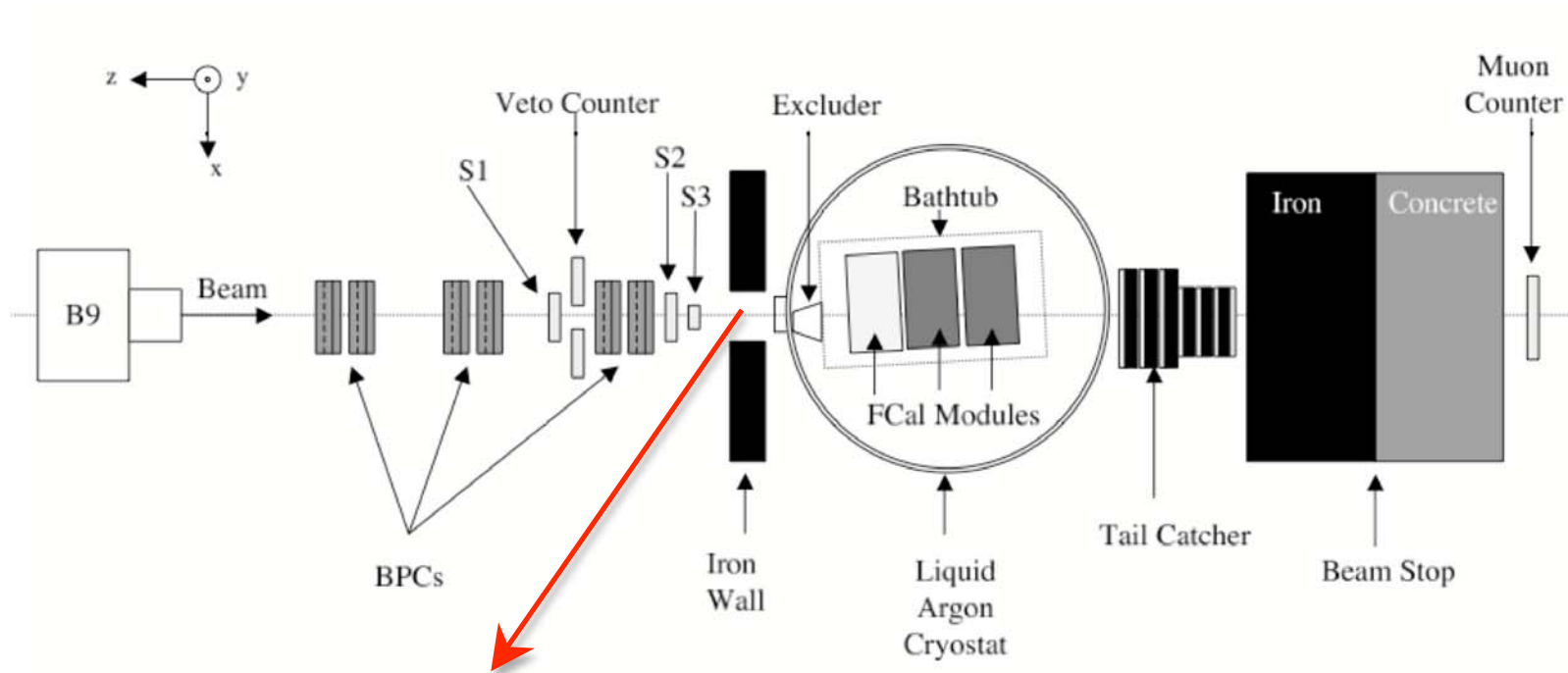


FCal Environment in ATLAS

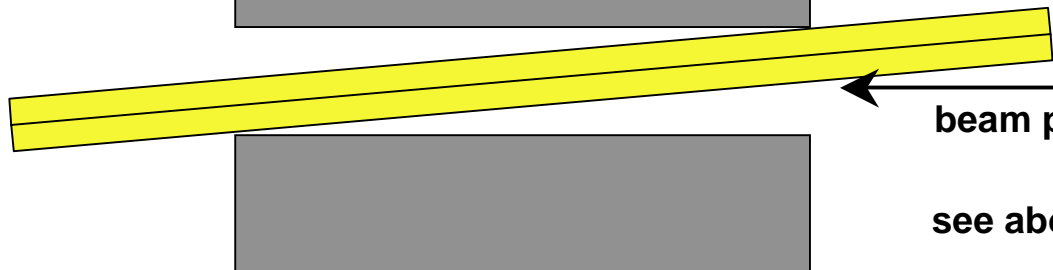


Ion pump (modeled for position 1)

Mockups of Upstream Material in 2003 FCal TB



view from above



beam particles (5cm diameter beam spot):
 see about 40 cm of polyethylene (JM tube)
 angle in atlas is somewhat shallower

Mockups of Upstream Material in 2003 FCal TB

