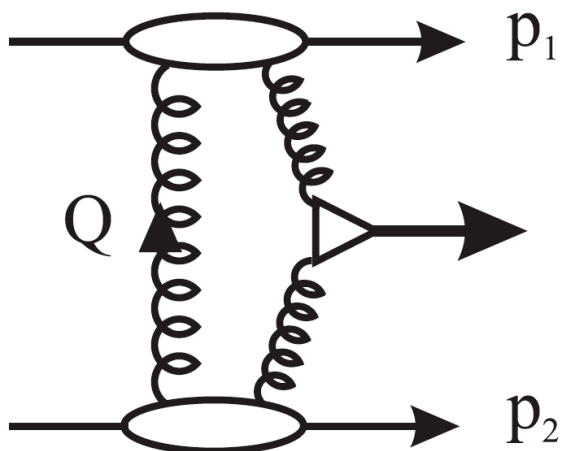


Status of FP420

Andy Pilkington – on behalf of FP420



Motivation from **KMR calculations (e.g. hep-ph 0111078)**

- Selection rules mean that central system is (to a good approx) 0^{++}
- If you see a new particle produced exclusively with proton tags you know its quantum numbers
- Proton tagging may be the discovery channel in certain regions of the MSSM
- Tagging the protons means excellent mass resolution ($\sim \text{GeV}$) irrespective of the decay products of the central system

FP420 R&D Funding (ATLAS & CMS)

FP420 R&D Collaboration

- **Spokespersons** : Brian Cox (Manchester, ATLAS) and Albert DeRoeck (CERN,CMS)
- **Technical Co-ordinator** : Cinzia DaVia (Manchester)

Collaboration : FNAL, [The University of Manchester](#), University of Eastern Piedmont, Novara and INFN-Turin, [The Cockcroft Institute](#), University of Antwerpen, [University of Texas at Arlington](#), [The University of Glasgow](#), University of Calabria and INFN-Cosenza, CERN, Lawrence Livermore National Laboratory, University of Turin and INFN-Turin, University of Lund, [Rutherford Appleton Laboratory](#), Molecular Biology Consortium, Institute for Particle Physics Phenomenology, Durham University, [DESY](#), Helsinki Institute of Physics and University of Helsinki, UC Louvain, University of Hawaii, [LAL Orsay](#), [University of Alberta](#), [Stony Brook University](#), [Boston University](#), [University of Nebraska](#), Institute of Physics, Academy of Sciences of the Czech Republic, Brookhaven National Laboratory, University College London, Cambridge University

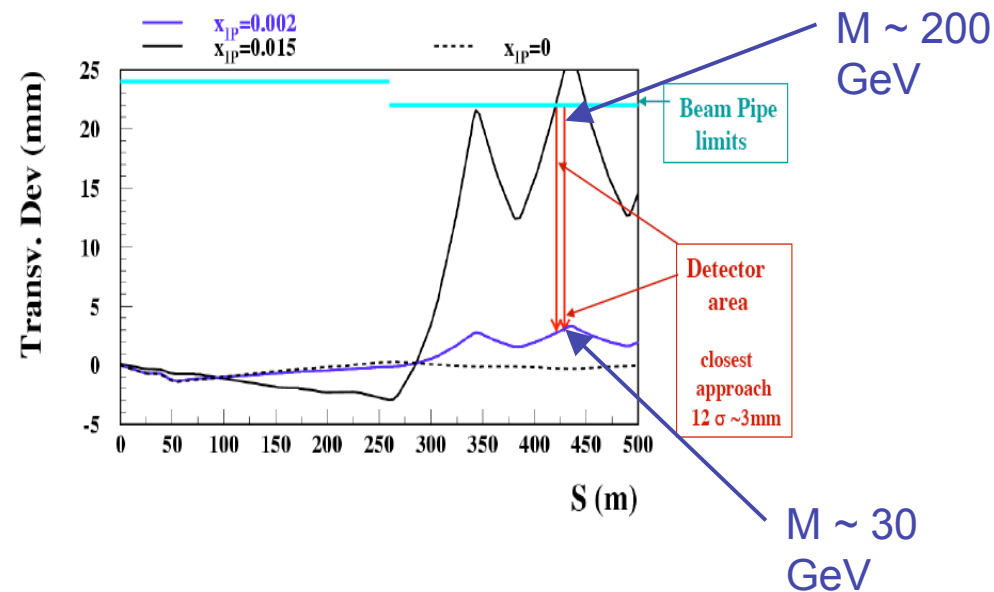
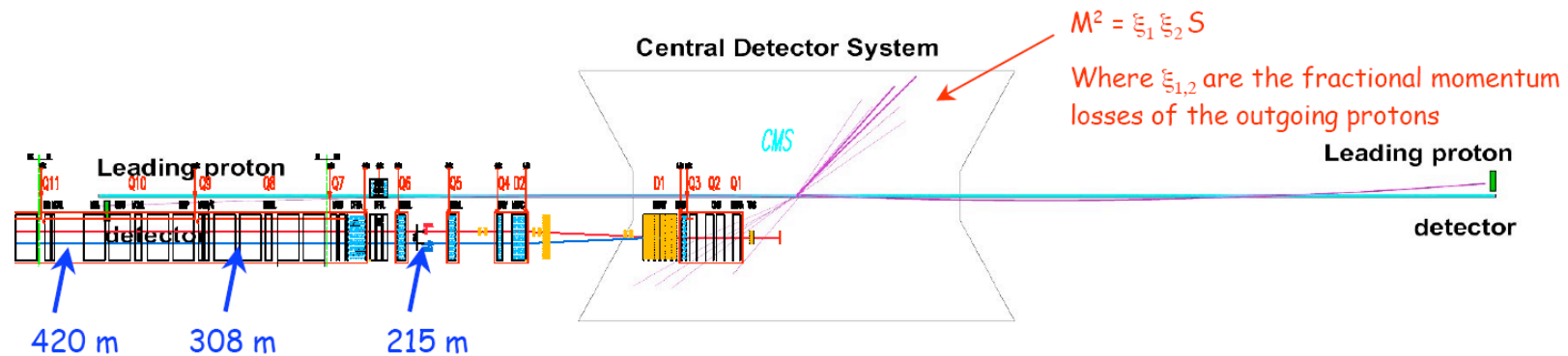
Note also Roman Pots at 220 m from IP1 and IP5 - TOTEM and FP220. Combined 220/420 systems have improved acceptance.

NOTE.....

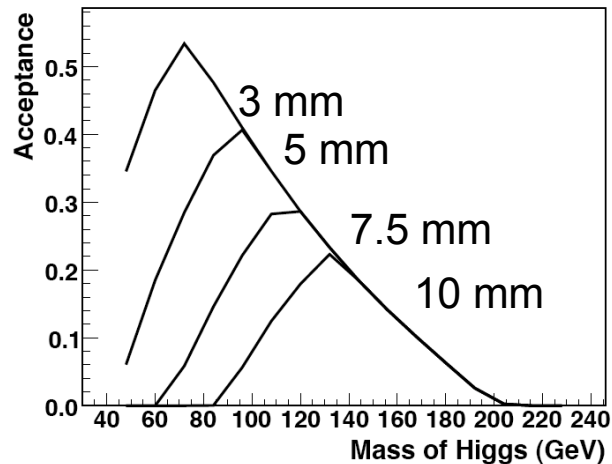
Thanks to Brian Cox, Cinzia DaVia, Steve Watts for many of the slides.

Schematic Outline

Spectrometer using LHC magnets to bend protons with small momentum loss out of the beam



Acceptance and Resolution

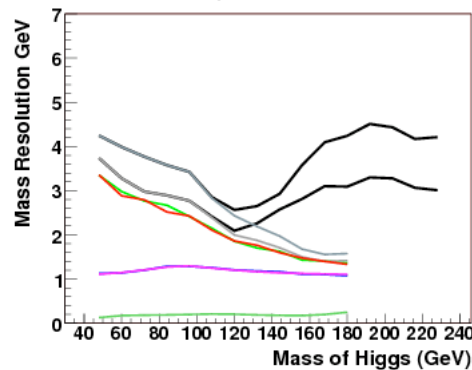


Mass given by momentum loss:

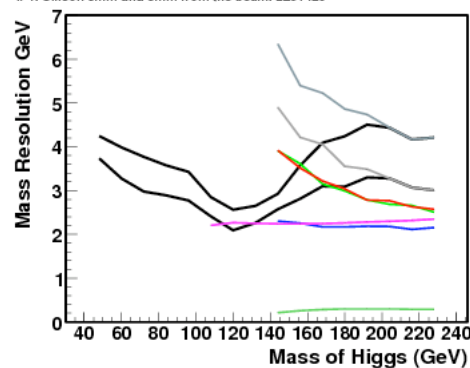
$$M^2 = \xi_1 \xi_2 s$$

Acceptance depends on how close detector is to beam,

IP1. Silicon 3mm and 5mm from the beam. 420+420



IP1. Silicon 3mm and 5mm from the beam. 220+420



Lower to Higher curves...

No smear

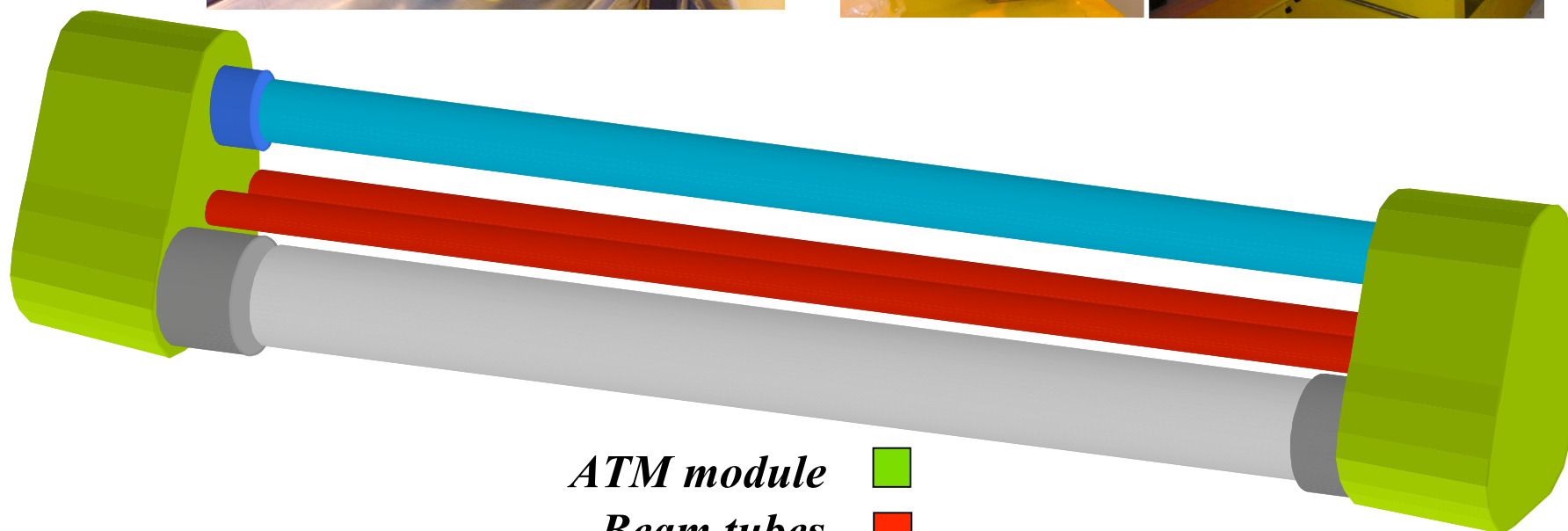
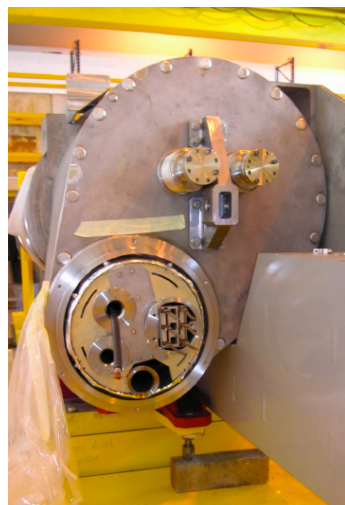
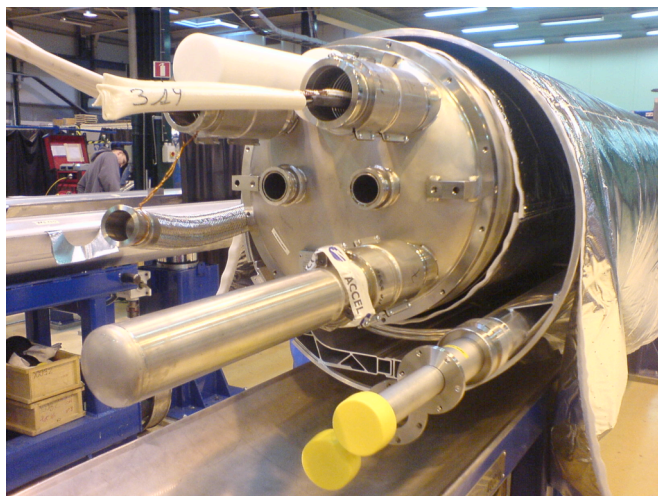
Primary proton mom. (0.77GeV)





10 micron beam spot

1 and 2 μ rad smear in tracking

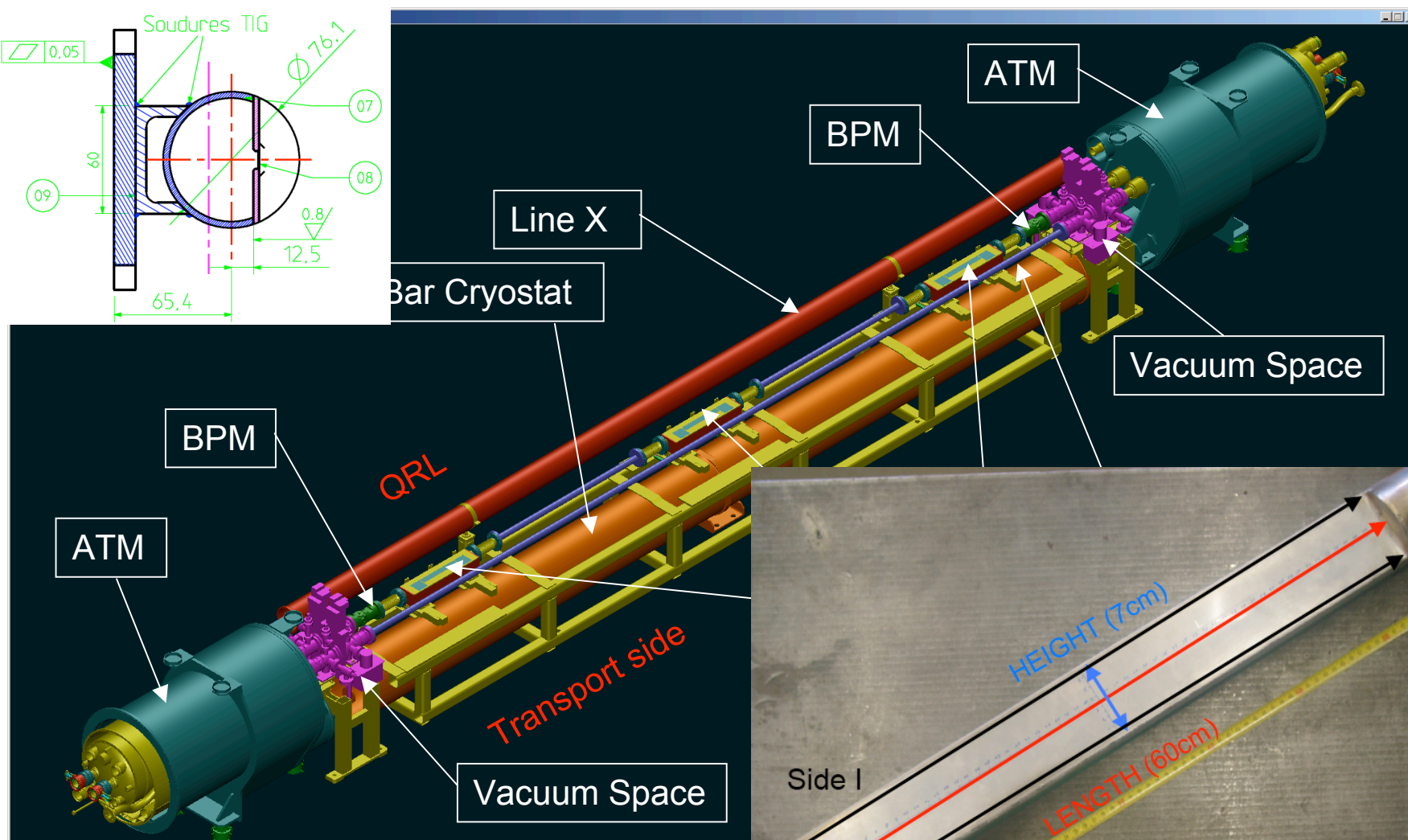
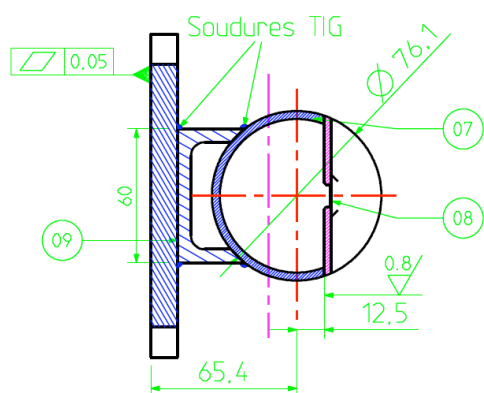
Figure 6: Mass resolutions obtainable in ATLAS for the 220 m region and for the 420 m region. For explanation, see text

FP420 Connection Cryostat

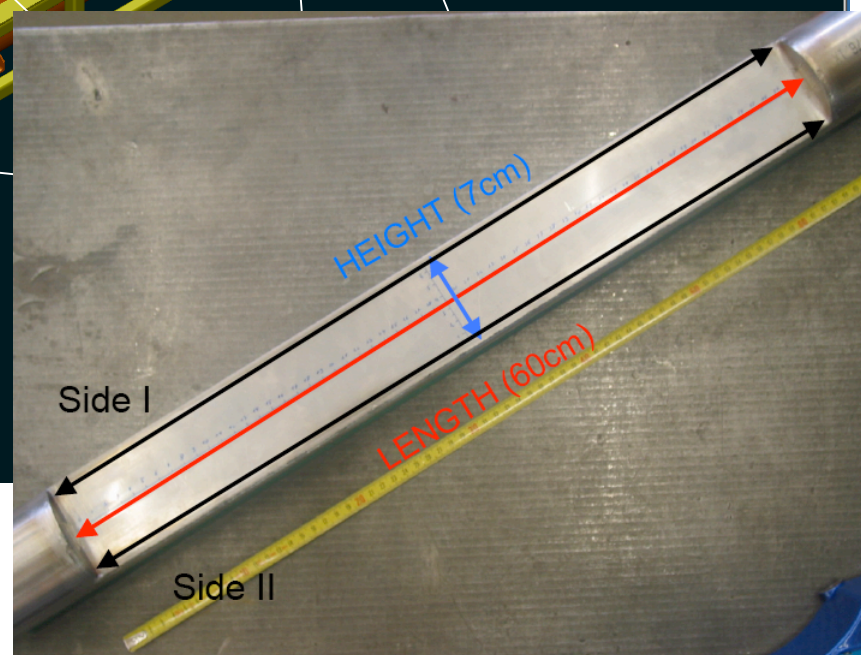


ATM module 
Beam tubes 
Line X vacuum vessel 
Connection Module 

Integration of the moving beampipe and detectors

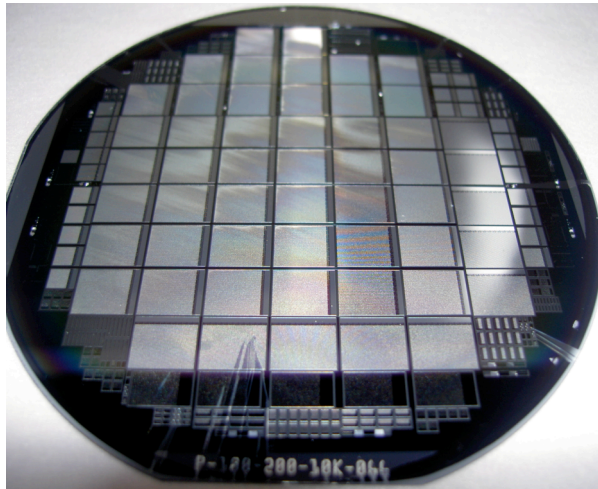
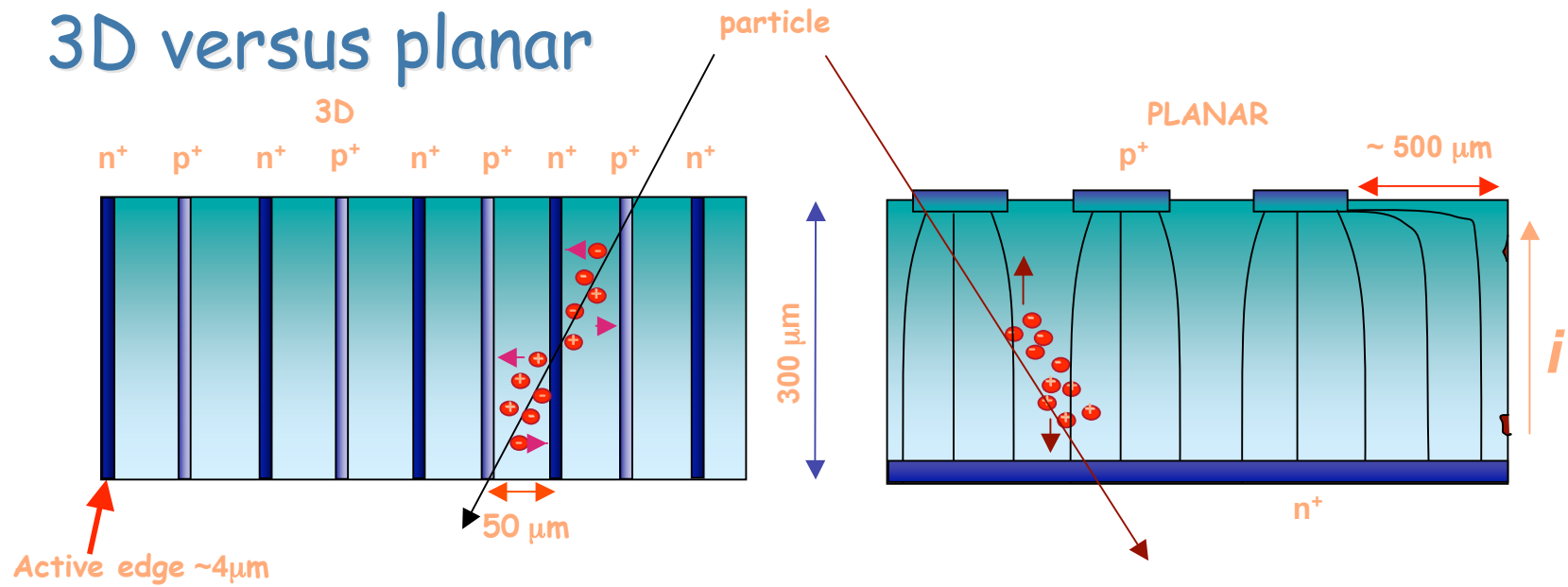


HAMBURG PIPE METHOD!!



3D Silicon Detector Development

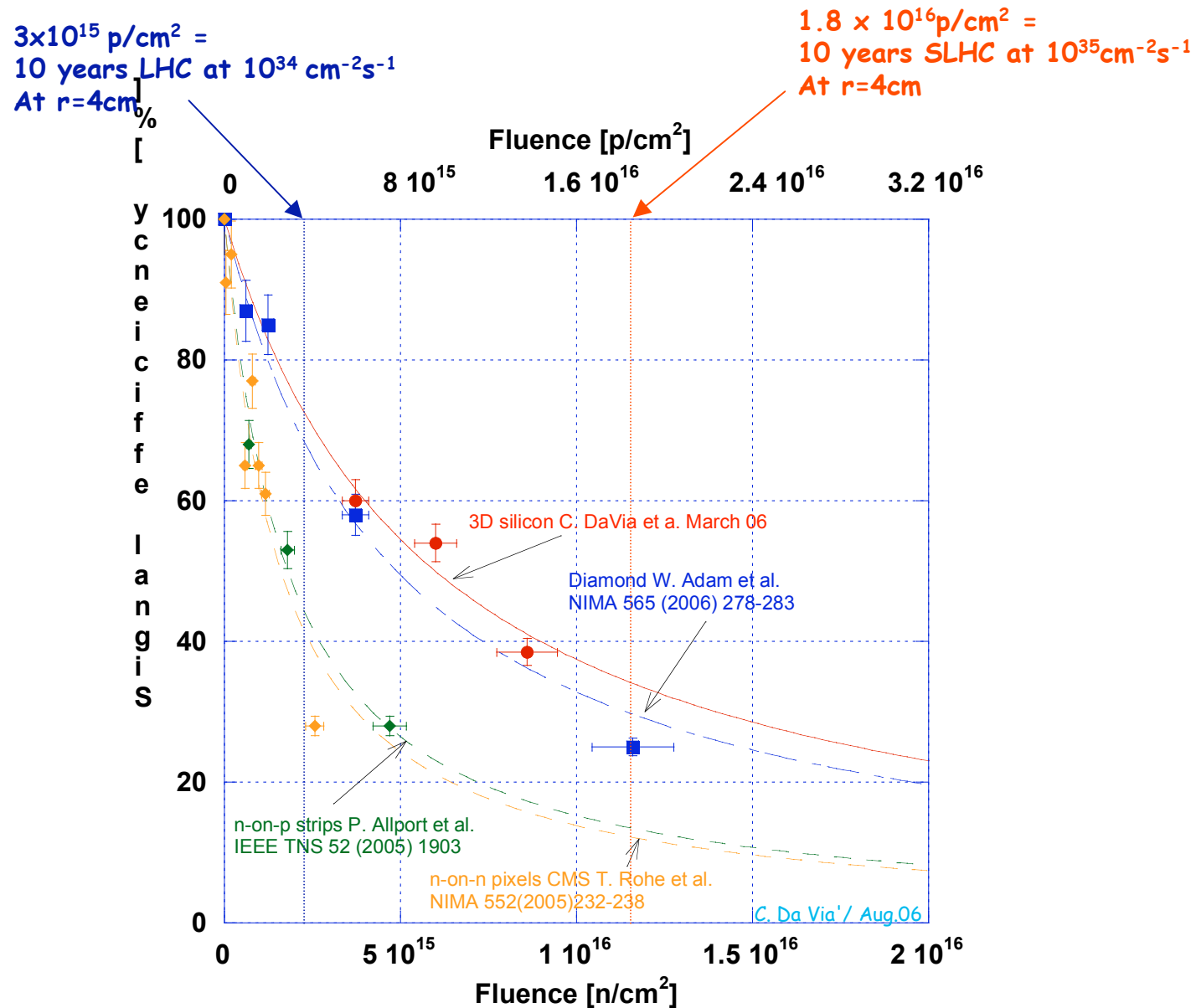
3D versus planar



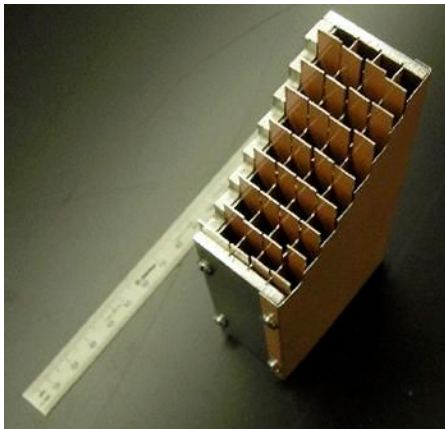
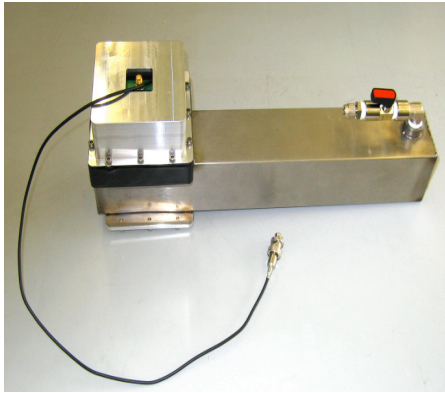
Expect to have 8-10 planes of 3D silicon per detector station.

Test beam at CERN in September

Radiation Hardness



FP420 Fast timing Detectors

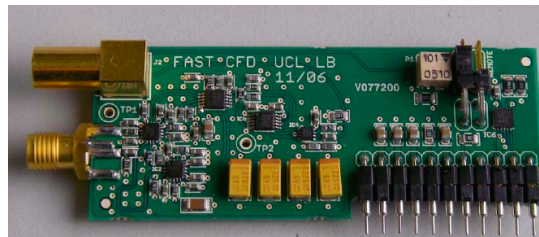


Why ? Pileup Background Rejection

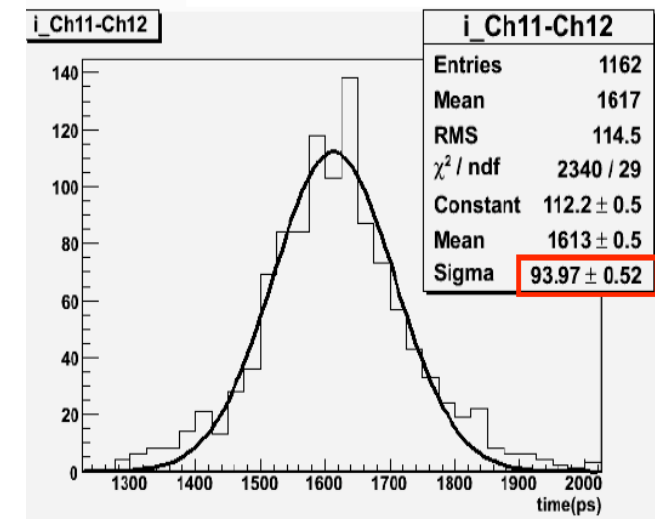
How? Compare z-vertex for SVX with TOF

10 psec resolution -> x40 rejection of background

Expect 30ps with new electronics.

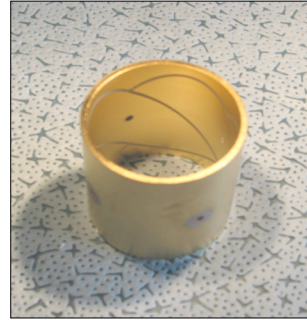
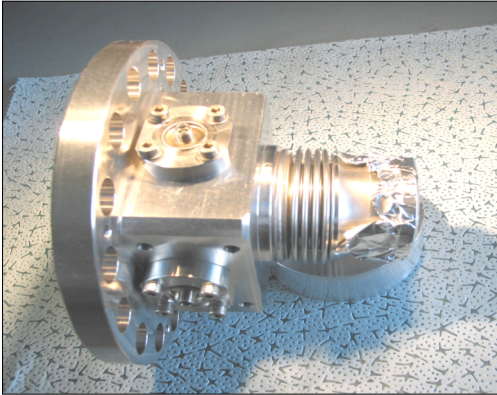


T958 (FNAL)



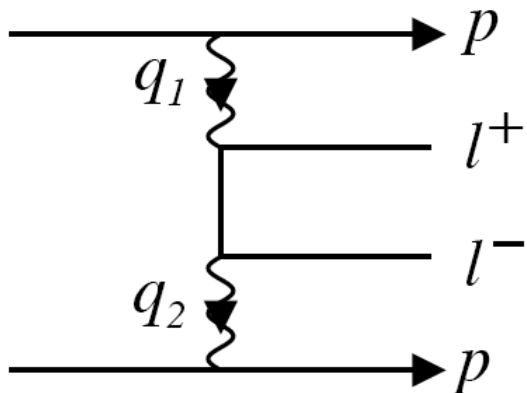
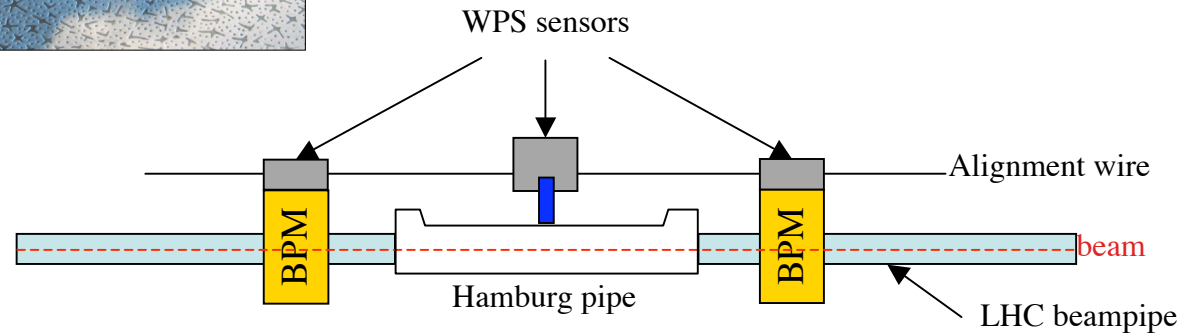
- 1% events at LHC have diffractive proton track in FP420
- @ $2 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$, 7 interactions / bunch crossing
- -> 30% of FP420 events have an additional track
- Matching mass and rapidity of central system removes large fraction of these
- Of the remaining, 97.4% rejected by fast timing detectors with 10ps timing resolution (2.1 mm)

FP420 Alignment



CLIC BPMs + wire positioning
system : aim for 10 microns
relative to beam

BPM Workshop CERN 19 April



@ $10^{33} \text{ cm}^{-2}\text{s}^{-1}$ with standard ATLAS
triggers, have ~ 30 di-muon events / fill
in FP420 acceptance

Projected FP420 Timetable

- FP420 is currently an R&D collaboration between ATLAS, CMS and non-affiliated groups.
- Separate proposals to ATLAS and CMS for a sub-detector upgrade in Spring / Summer this year
- If accepted this would lead to a TDR (from each/either experiment) to LHCC in summer 2007
- The FP420 design phase is fully funded, and will be completed in summer 2007
- If funding is secured by Autumn 2007, cryostats (built by TS-MME) and baseline detectors could be ready for installation in Autumn 2008
- 220m and 420m tagging detectors have the potential to add significantly to the discovery reach of ATLAS and CMS for modest cost, particularly in certain regions of MSSM parameter space
- There is a rich QCD and electroweak physics program in parallel with discovery physics