



LHCb VELO High Rate “Zap” Test

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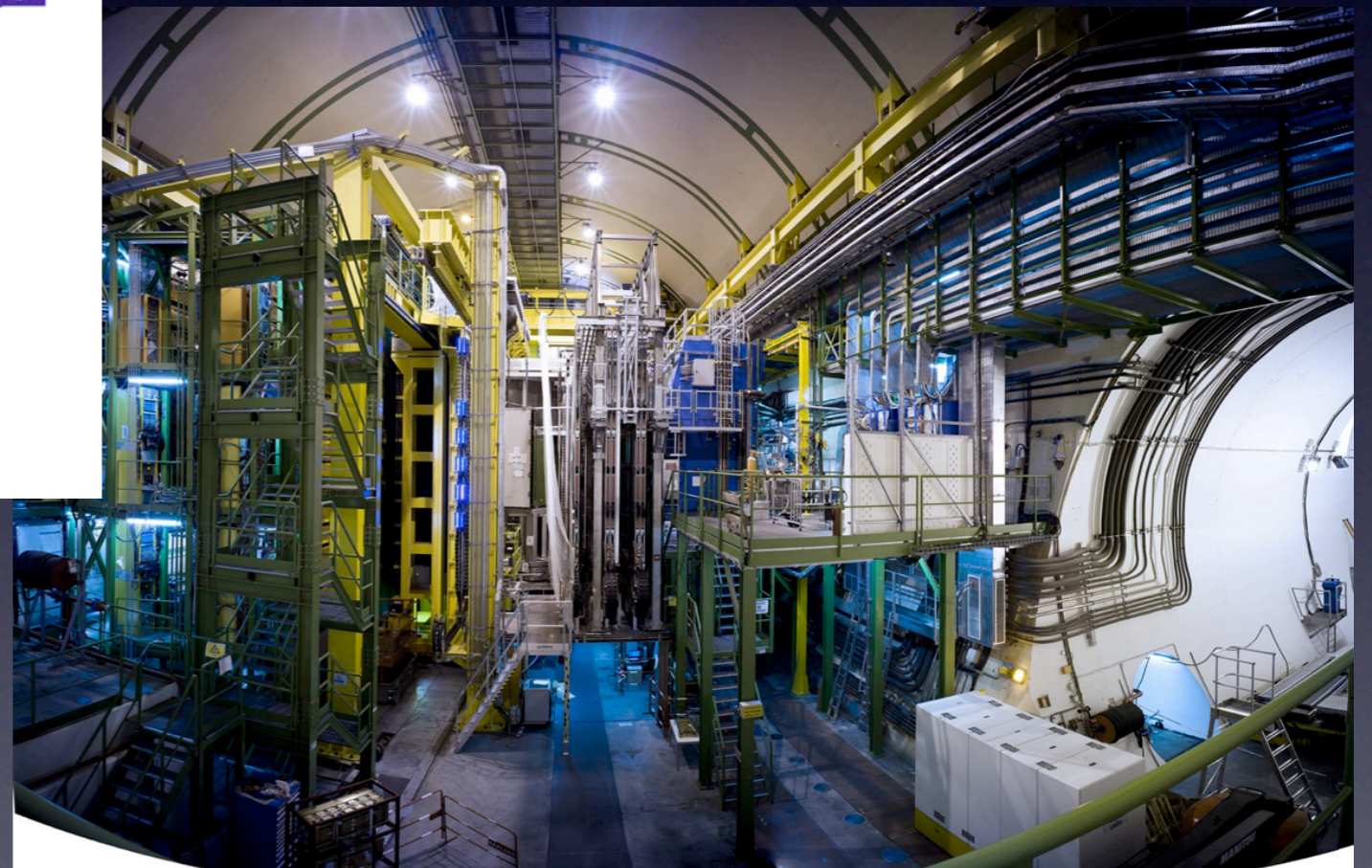
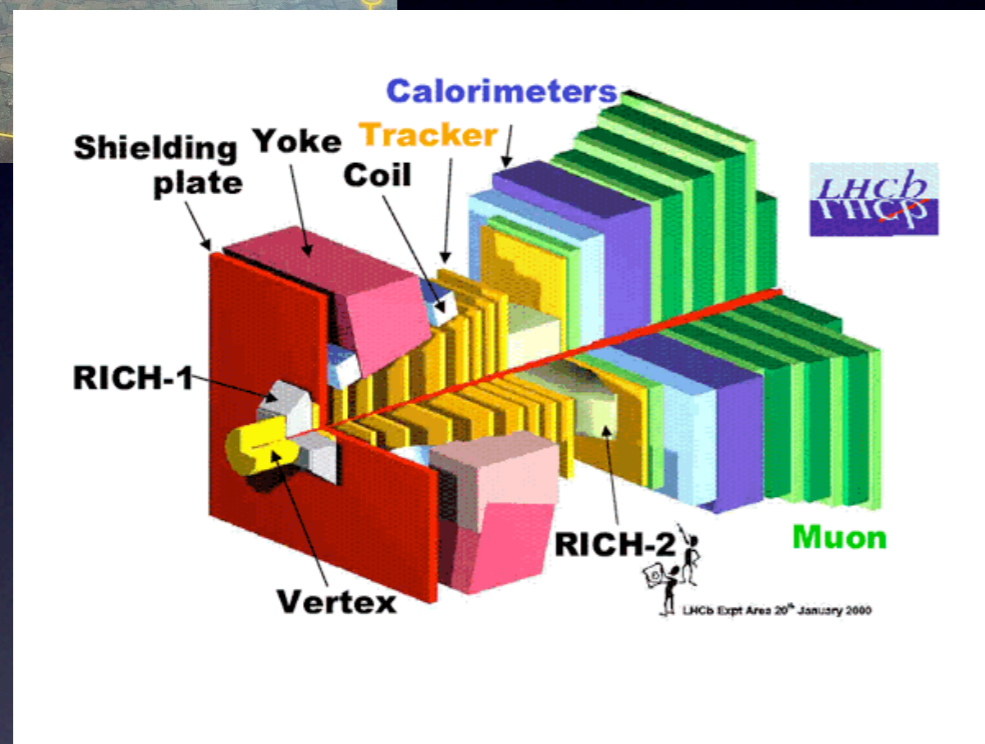
IOP HEPP & AP 29-31 March 2010[†]

Outline

- LHCb and the VeLo
- Motivation for Beam Studies
- Set-up and Measurements
- Results
- Conclusions

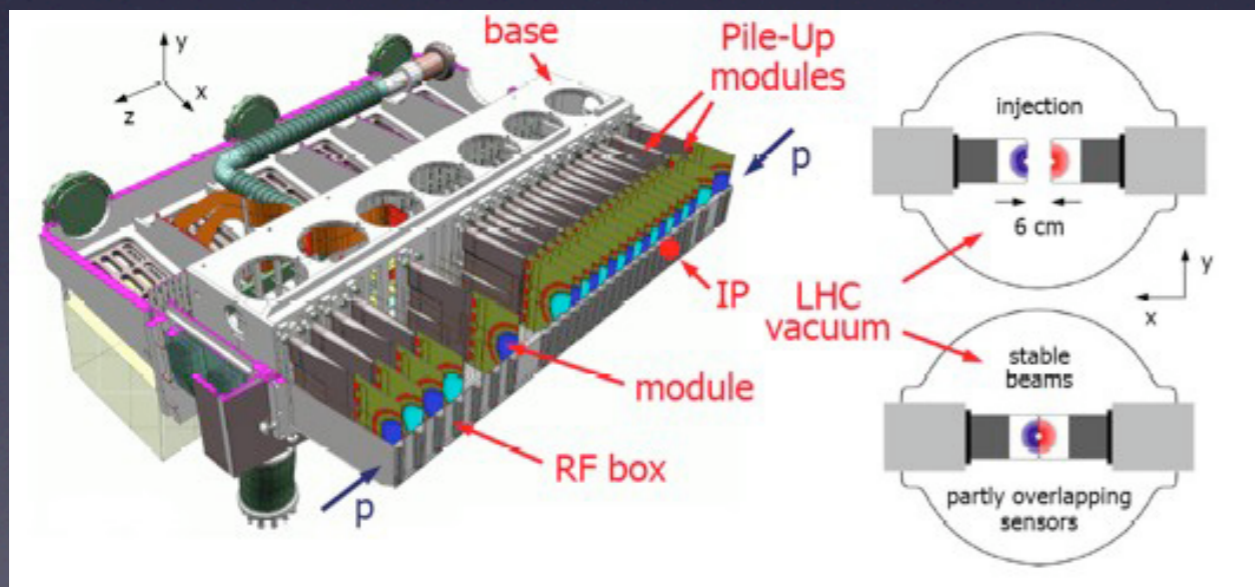
LHCb

Precise measurements of
Charm and B decays



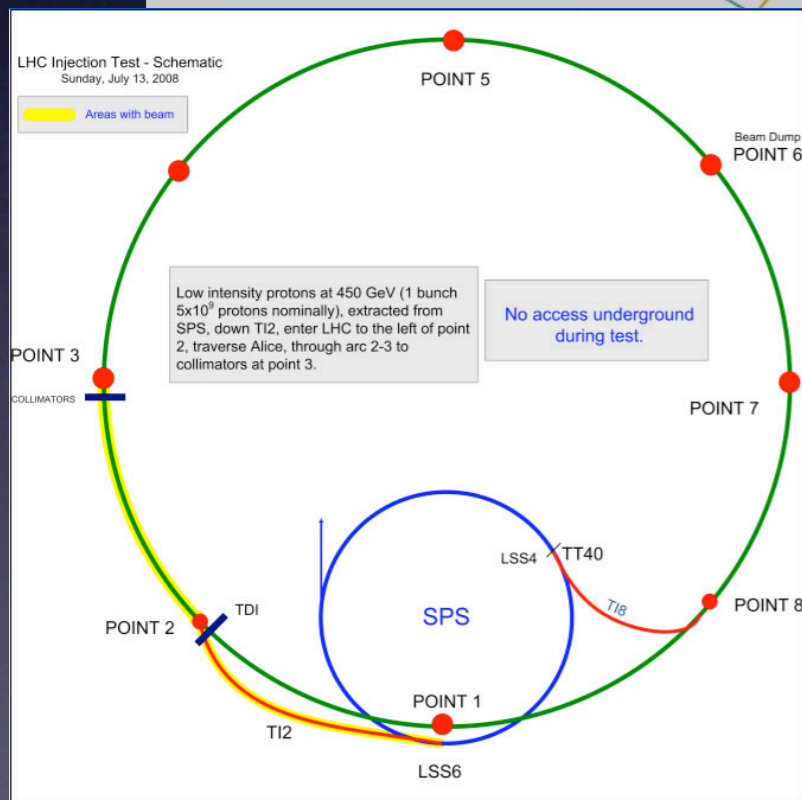
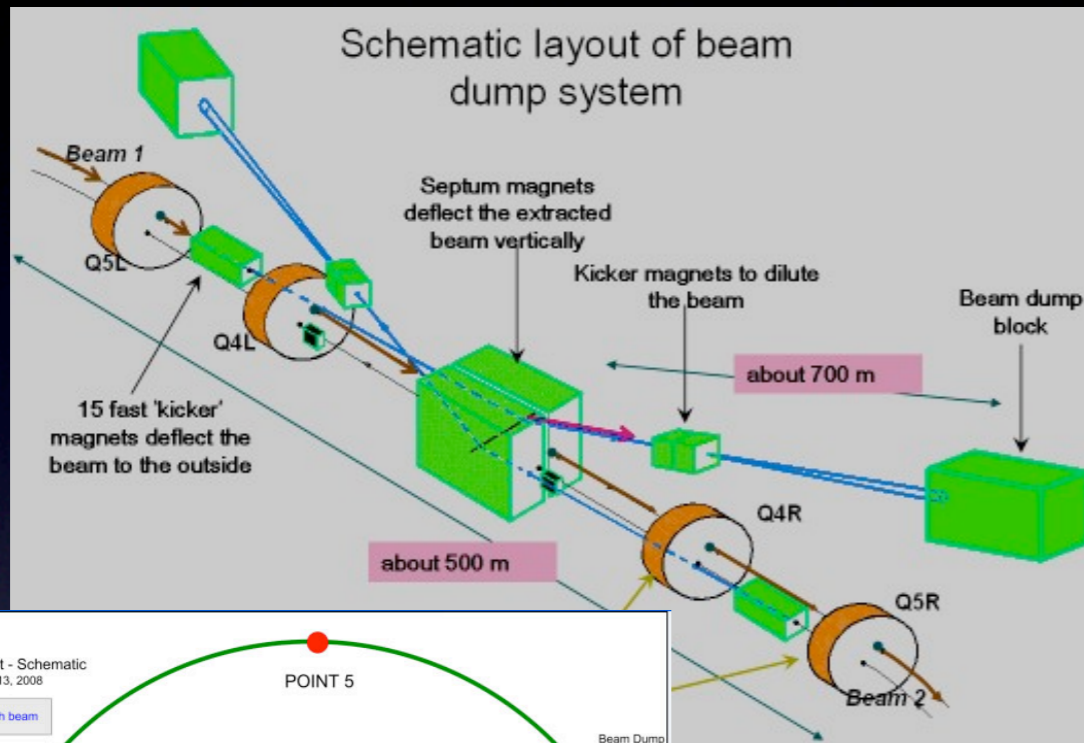
CP Violation and New
Physics

The VErtext LOcator



- B decay length ~ 1 cm
- Good vertex resolution
- Retracted during beam injection
- 8mm from beam during operation
- More vulnerable to unstable beams?

Beam Loss Scenarios



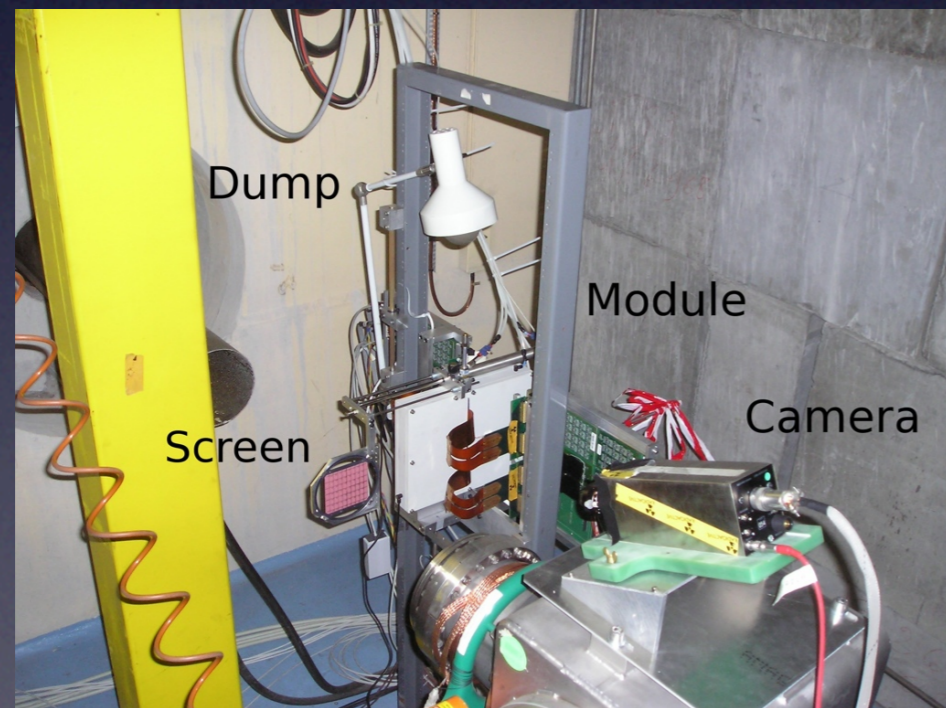
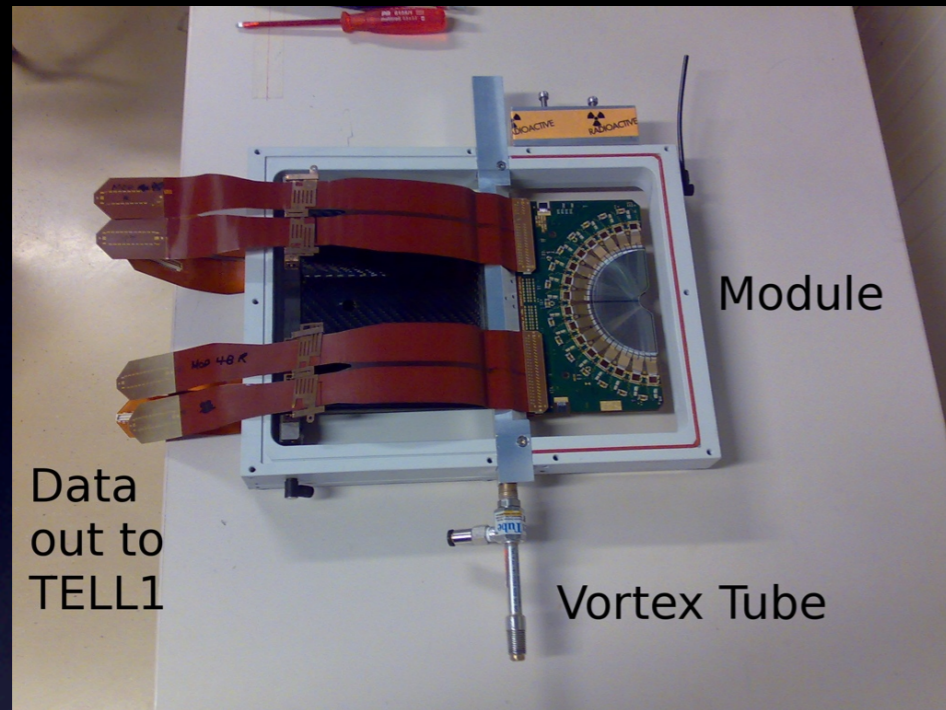
- **Multi-turn losses**

- beam orbit closely monitored
- can extract beam within 1ms

- **Single turn losses**

- failure at injection or extraction
- could happen a few times per year

Test Setup

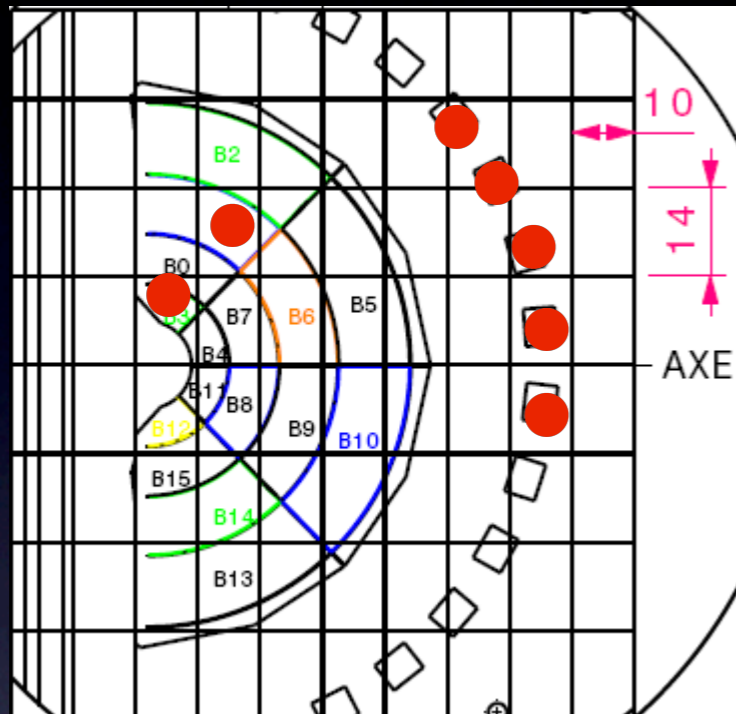


- 450 GeV $\sim 2e9$ Protons per bunch

Sequence

- Beam positioned on screen
- Module moved in and shot taken
- Camera captures an image for each shot
- Record dose between shots

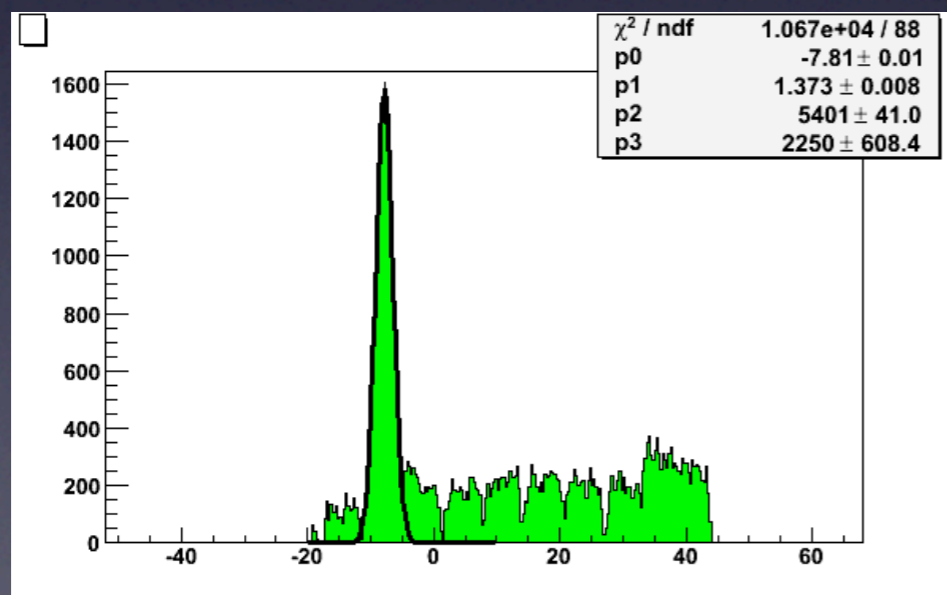
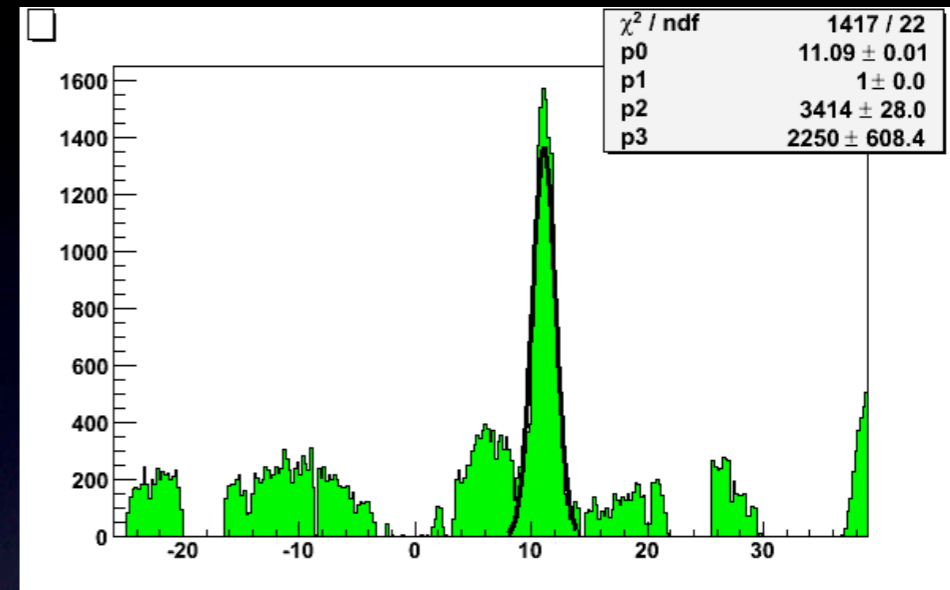
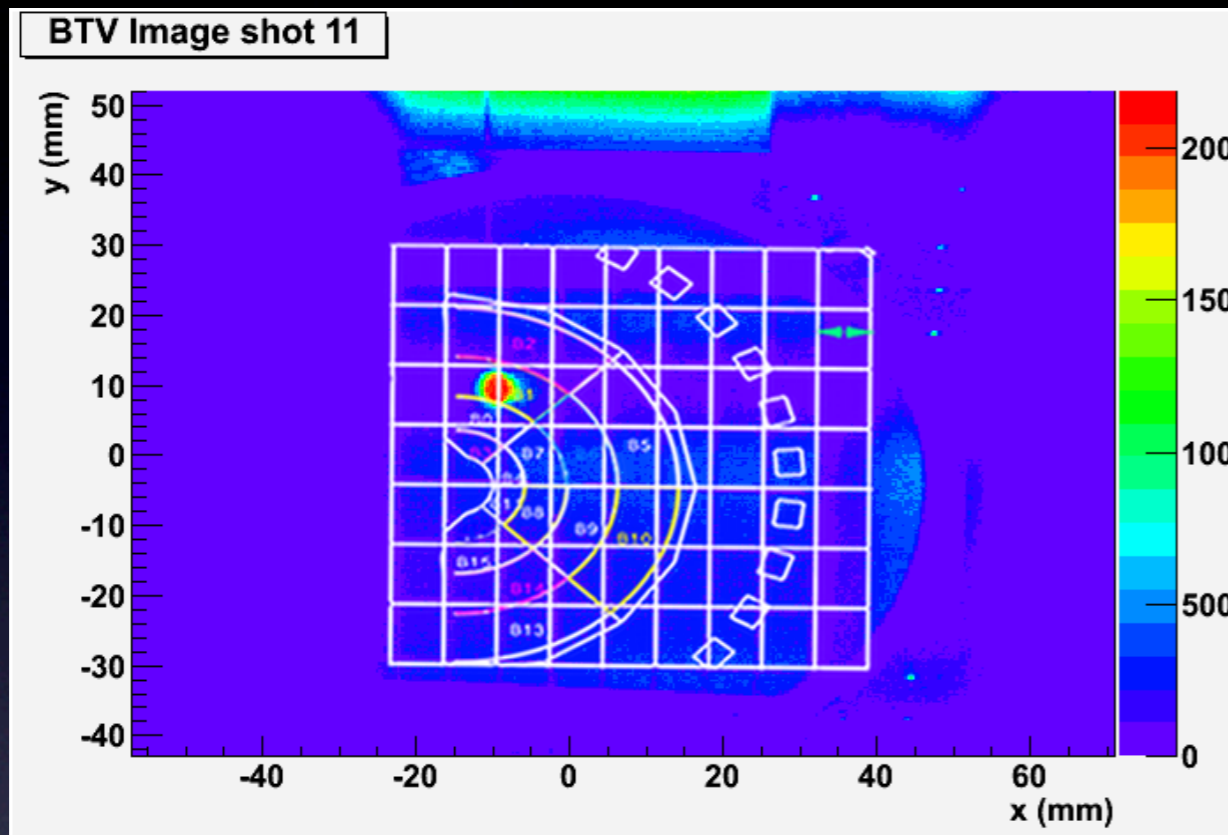
Shot Summary



63 shots on the
sensor
56 shots on the FE
“beetle” chips

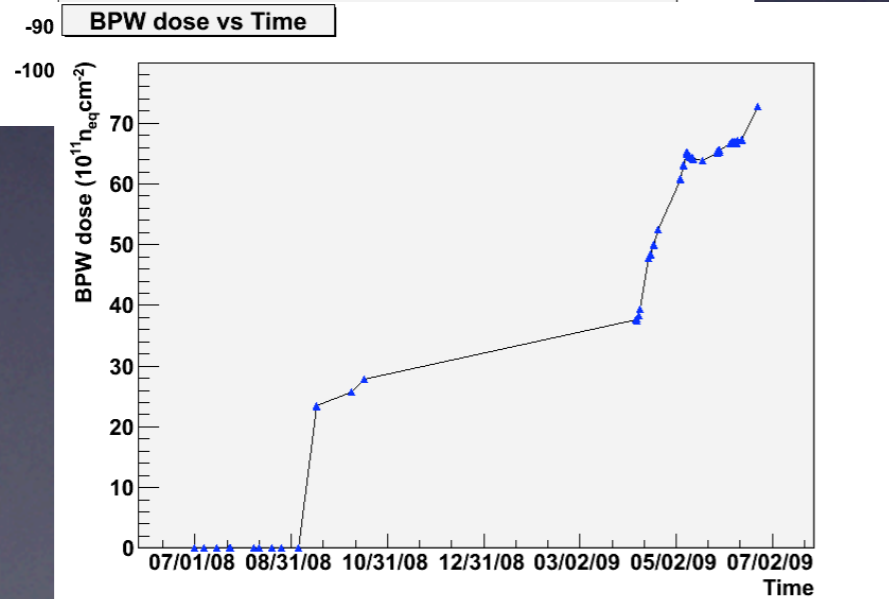
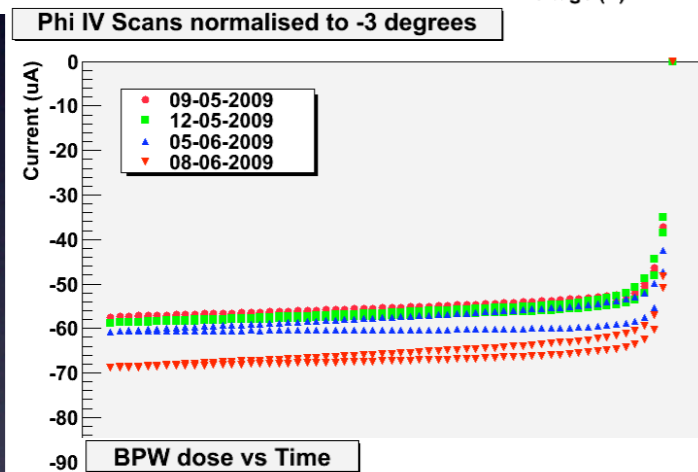
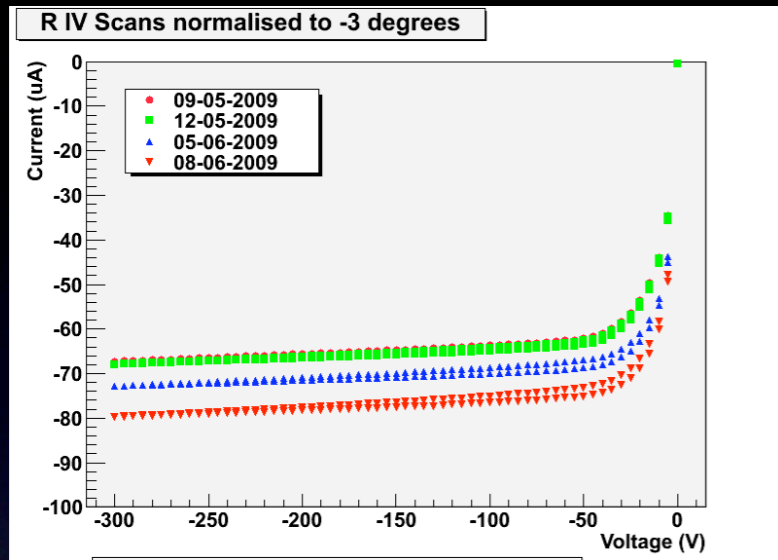
Intensity	LV off HV off	LV on HV off	LV on HV 150V	LV on HV 300V
$2 \text{ e}9$	1	2	29	2
$2 \text{ e}10$	1	1	1	1
$2 \text{ e}11$	1	1	1	1
$2 \text{ e}12$	1	1	1	1
$9 \text{ e}12$	2	2	5	5

Analysing the Beam Images



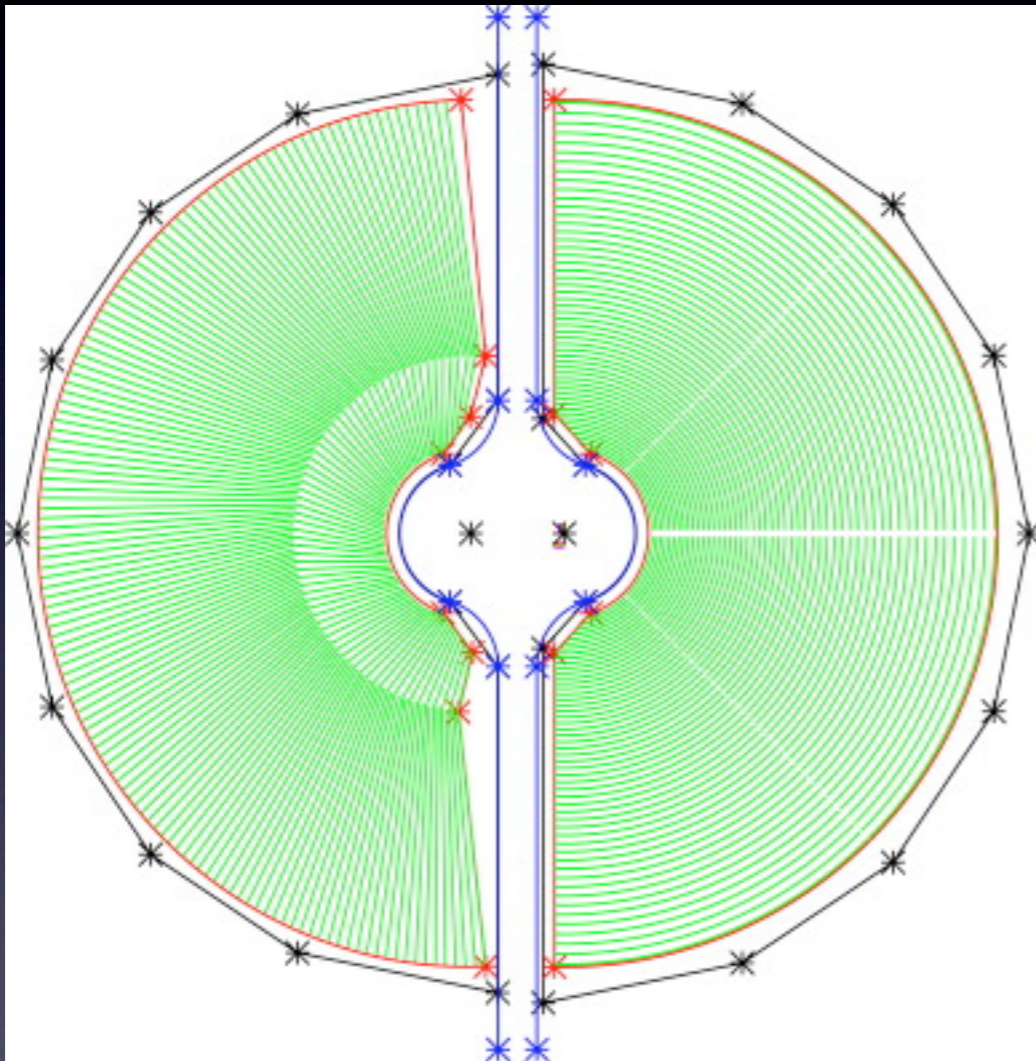
- Subtract background
- CoMass to find centre of spot
- Fit profiles for more accuracy

Leakage Current



- Take IV scans
- Temp correction
- Current increases with dose
- For $2fb^{-1}$ expect fluence of $5 \times 10^{12} n_{eq}/cm^2$ in outer regions
- Requirement - 3 years nominal running

Laser Scanning - In Progress



- No dead strips
- Laser scan each strip individually
- Measure the leakage current **per strip**
- Correlate with shot positions

Conclusions

- Module still operational after several shots on both Si sensor and FE readout chips
- Evidence that VELO module should be able to deal with loss of a pilot bunch into the detector
- Sensor and electrical components protected by fast breakdown of current - preventing build up of charge
- Cautious optimism...