

IR Aperture Scans

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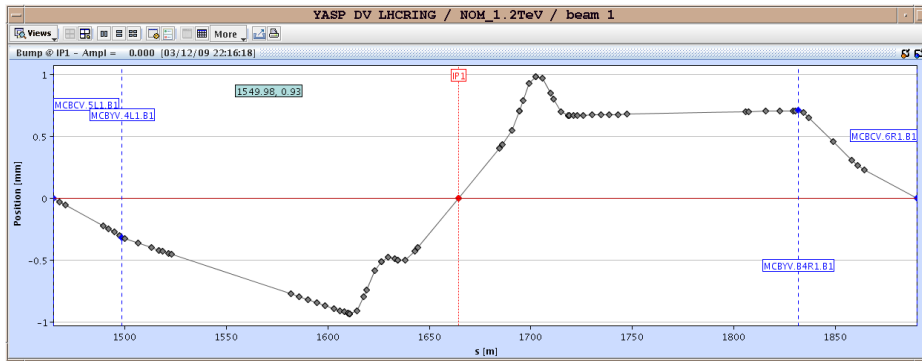
IR aperture scans

- Beams : 1 pilot ~ 5e9 p.
- Most scans were performed with beam1, some were checked with beam2 (ALICE and ATLAS).
- Dates :
 - LHCb 02.12 23:00 - 03.12 1:40.
 - CMS 03.12 15:00 - 17:20
 - ALICE 03.12 17:30 - 19:40
 - ATLAS 03.12 19:50 - 23:00 and 16.12 12:30-14:45.

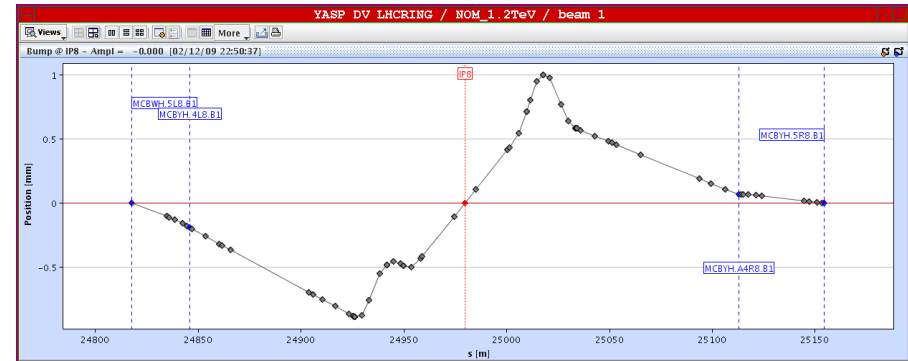
Bumps for aperture scans

- ❑ Asymmetric bumps acting on a single beam (using correctors at Q4-Q6) are the most effective.
 - One 'unit' of bump : angle at IR of $20 \mu\text{rad}$ and peak excursion in Q2 of $\sim 1 \text{ mm}$.
 - Bump details vary from one IR to the other.

Example of vertical bump in IR1.
Bumps in H plane & IR5 are similar in shape (asymmetry L-R)



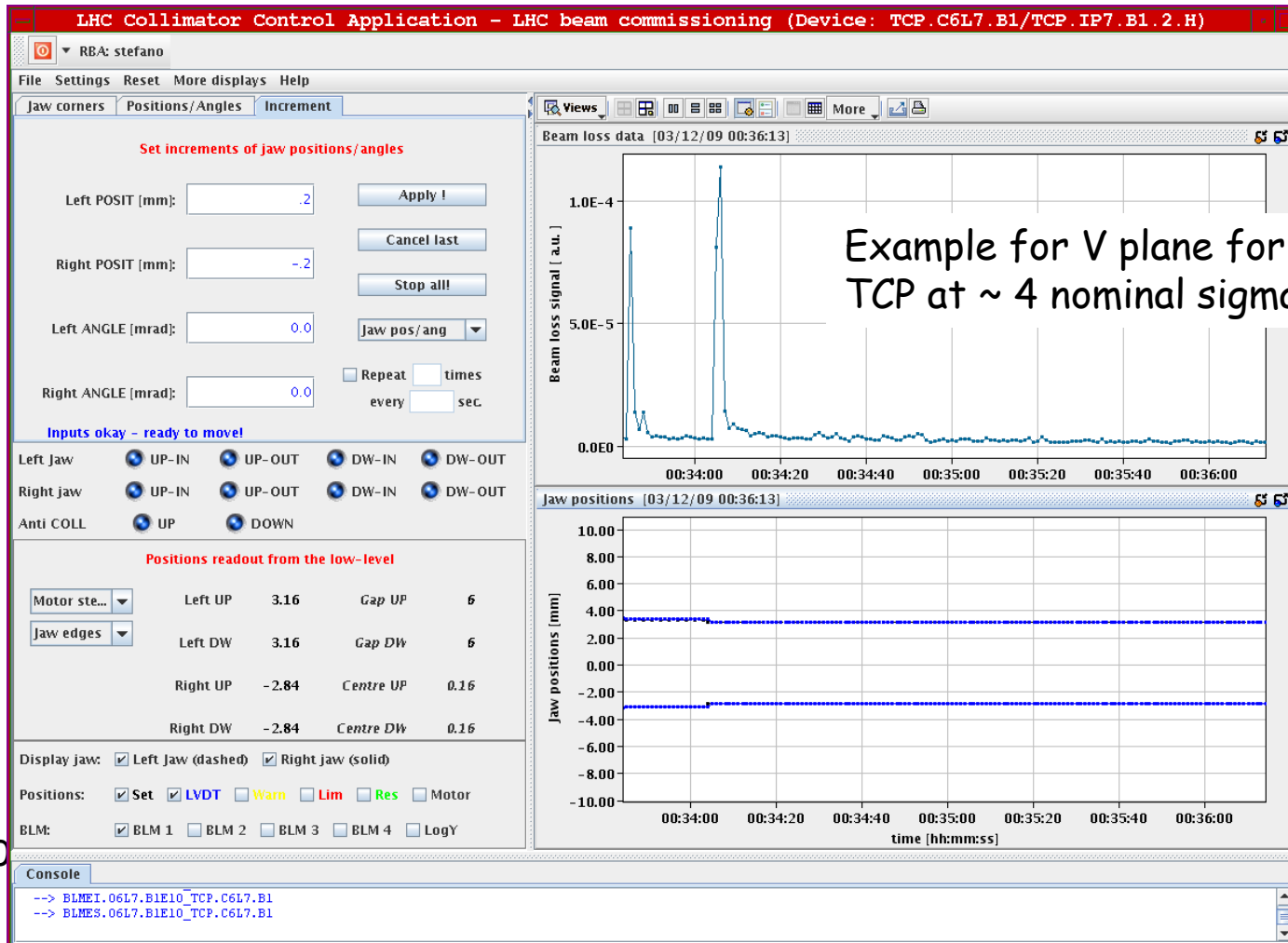
Example of horizontal bump in IR8.
Bumps in V plane & IR2 are similar in shape (asymmetry L-R).



- ❑ Symmetric bumps to touch the TAS in IR1 and IR5 are not feasible (excess of strength on MCBX and aperture in Q4-Q5 region).

Beam shaping with collimators

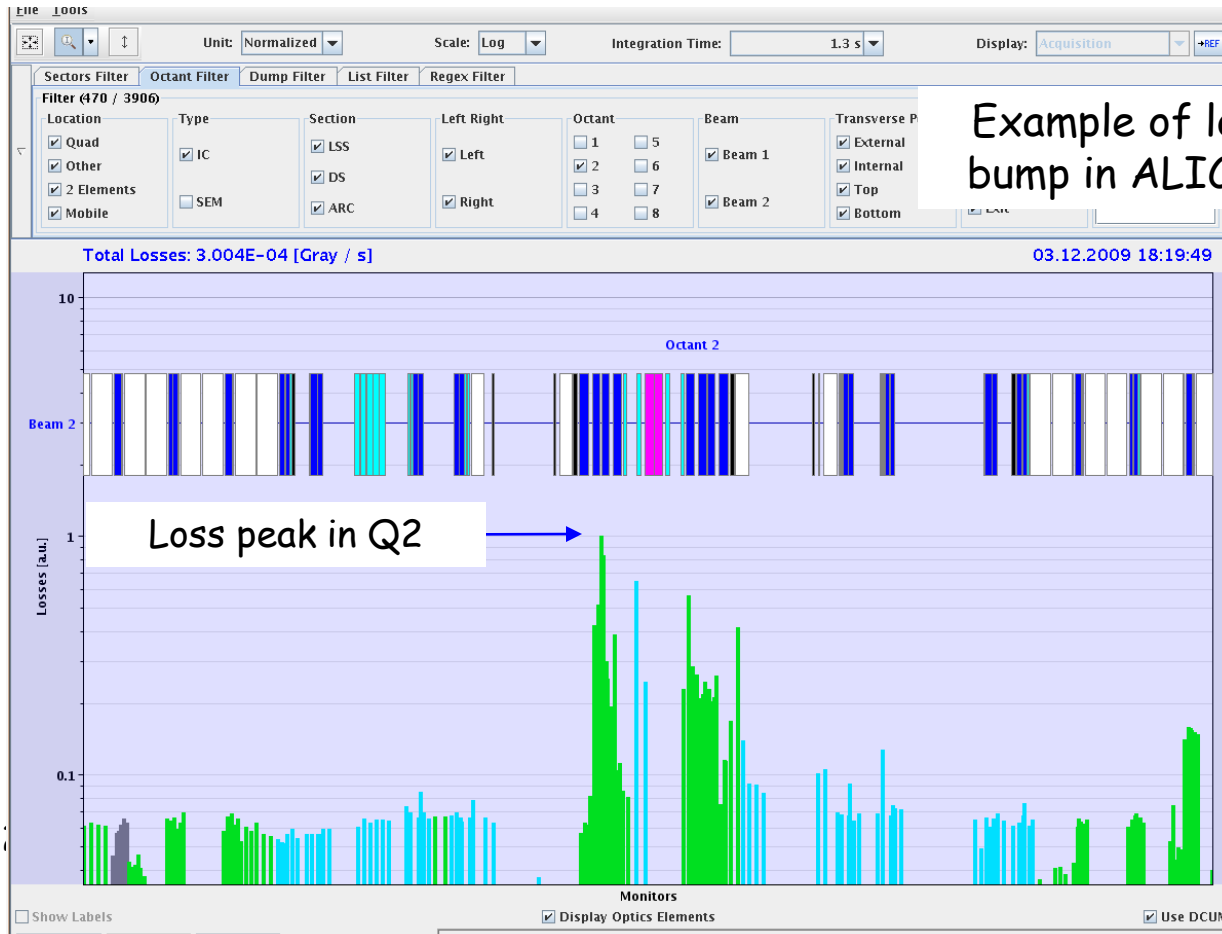
- All results (except ATLAS scan on December 16th) were performed with a TCP in place to define the beam edge, typically ~ 4 nominal sigma.



2/8/20

Finding the aperture

- Bumps amplitudes are increased in steps of 0.2-0.5 units/mm in the vicinity of the aperture until losses of $\sim 1\text{-}20 \mu\text{Gray/s}$ are visible on the 1.3 s or 5.2 s BLM time windows (depends on IR...). This correspond to
 - a loss signal ~ 10 or more above 'background'.
 - a loss of $\sim 10^8$ protons $\Leftrightarrow \sim 5 \mu\text{Gray/s}$.

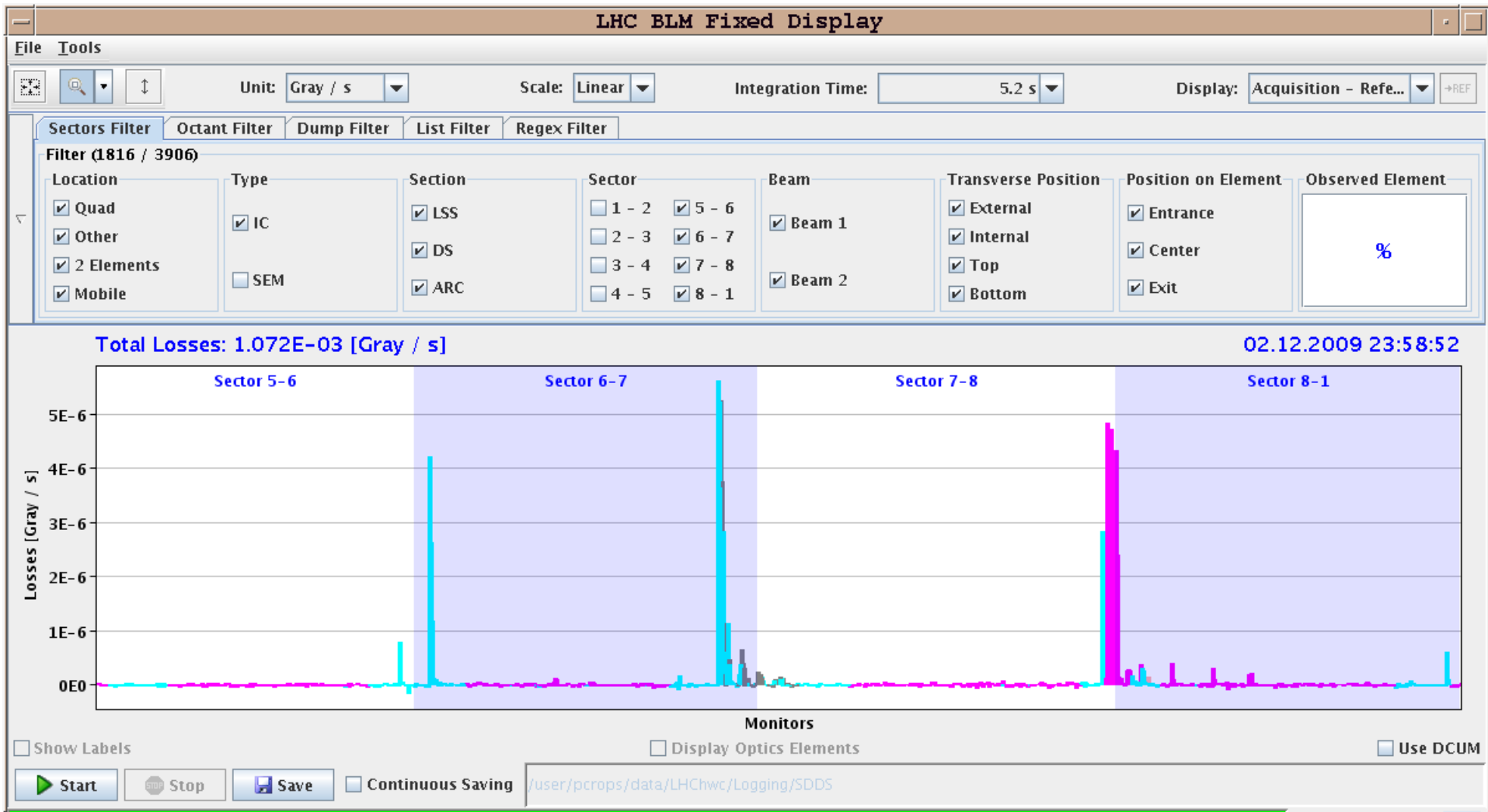


Example of loss map for V bump in ALICE (1.3 s sum).

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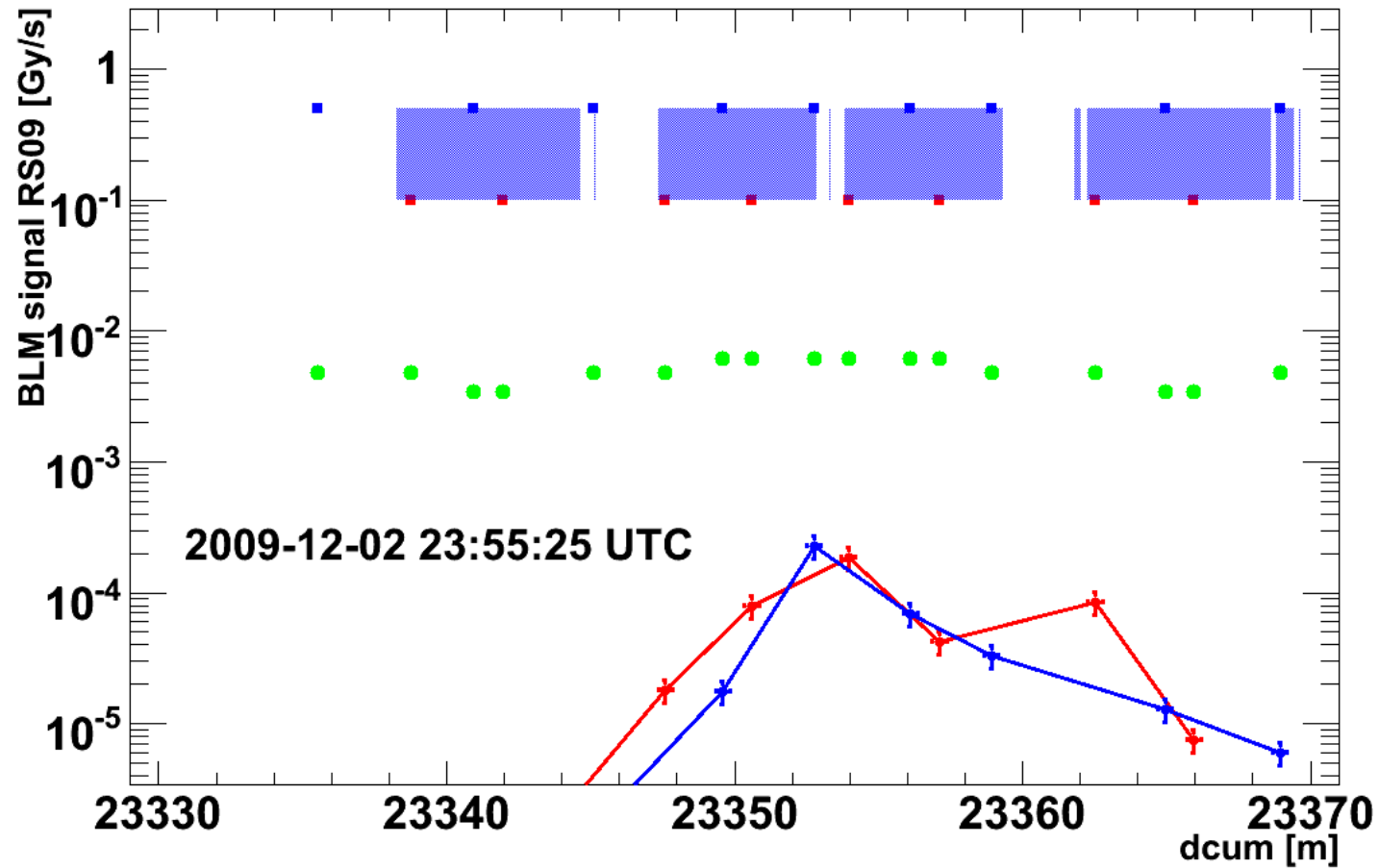
Loss pattern IR8 scan V plane

- Loss pattern in IR6, IR7 and IR8 with loss of $\sim 1E8$ p in IR8.



Partial beam loss IR8

- Partial loss of $\sim 2E9$ in triplet L8 (over \sim second). The threshold corresponds therefore to $\sim 1E11$ p lost over ~ 1 second.



BCM signals

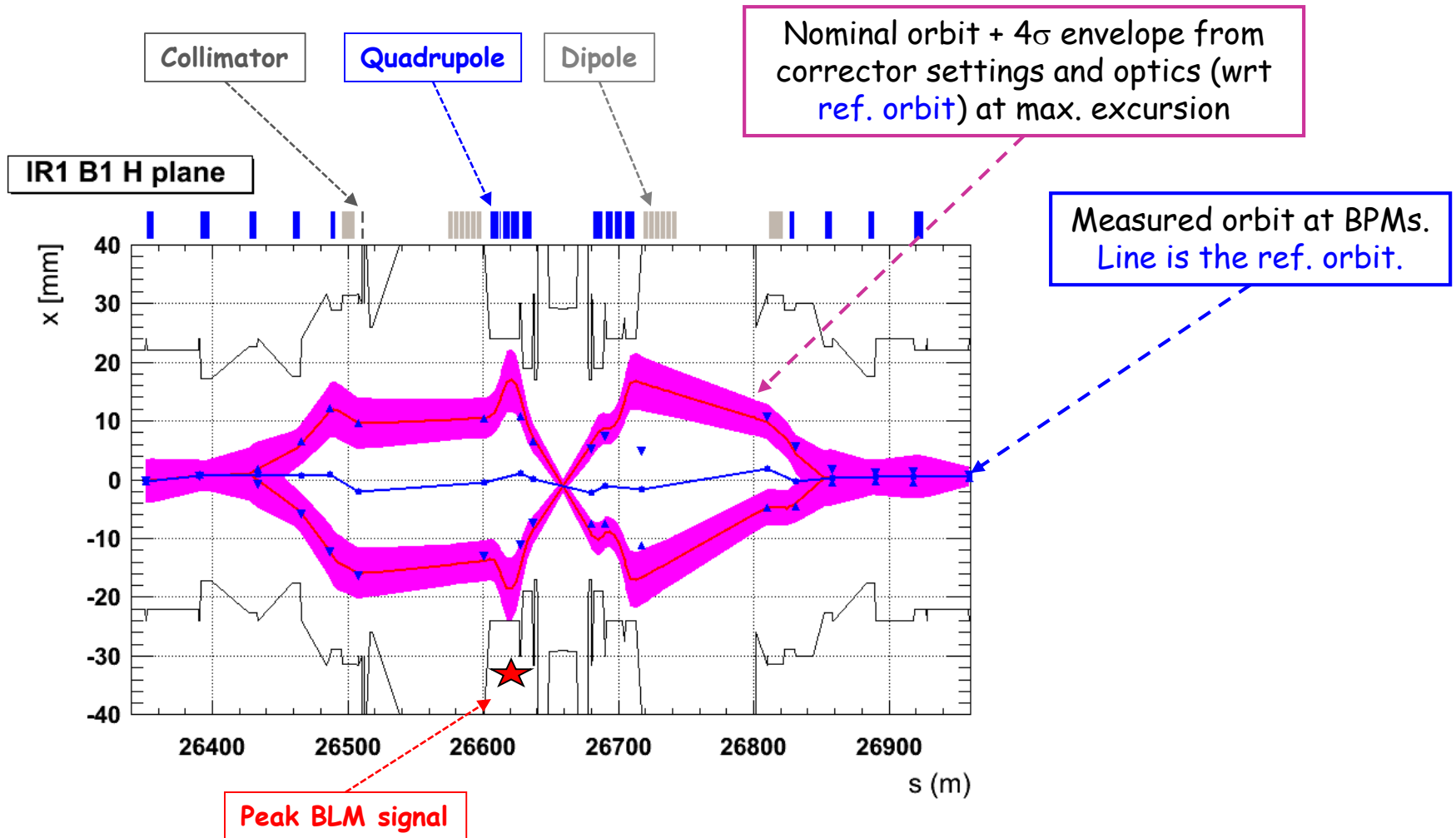
- No problems to scan aperture in IR2, IR5 and IR8.
 - Clear BLM signals.
 - Peak BCM signals at the level of ~% of dump threshold.
- At IR1 the scans triggered beam dumps by ATLAS for losses on the incoming side.
 - No significant BLM signal above background.
 - aperture problem or BCM threshold very low?
- The scan in IR1 was repeated December 16th with thresholds increased by a factor ~10 for the ATLAS BCM.
 - BLM signals of up to ~1 $\mu\text{Gray/s}$ were observed.
 - Beam dumps were again triggered by ATLAS for losses of ~1 $\mu\text{Gray/s}$.

BCM signals

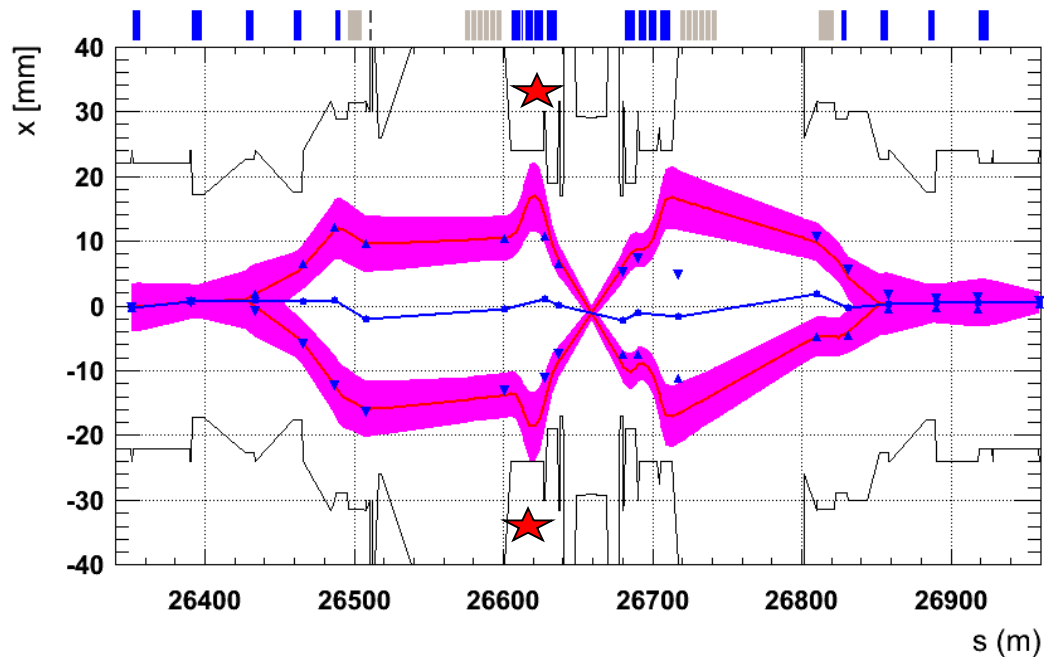
Exp	Max. signal	Running sum
ATLAS	3000 hits/s \sim 1 nA	--
ALICE	5 nA	RS2
CMS		
LHCb	2.5 nA	80 μ s

- ATLAS current is estimated (M. Ferro-Luzzi) and corresponds to the setting of December 16th.

Aperture results : example



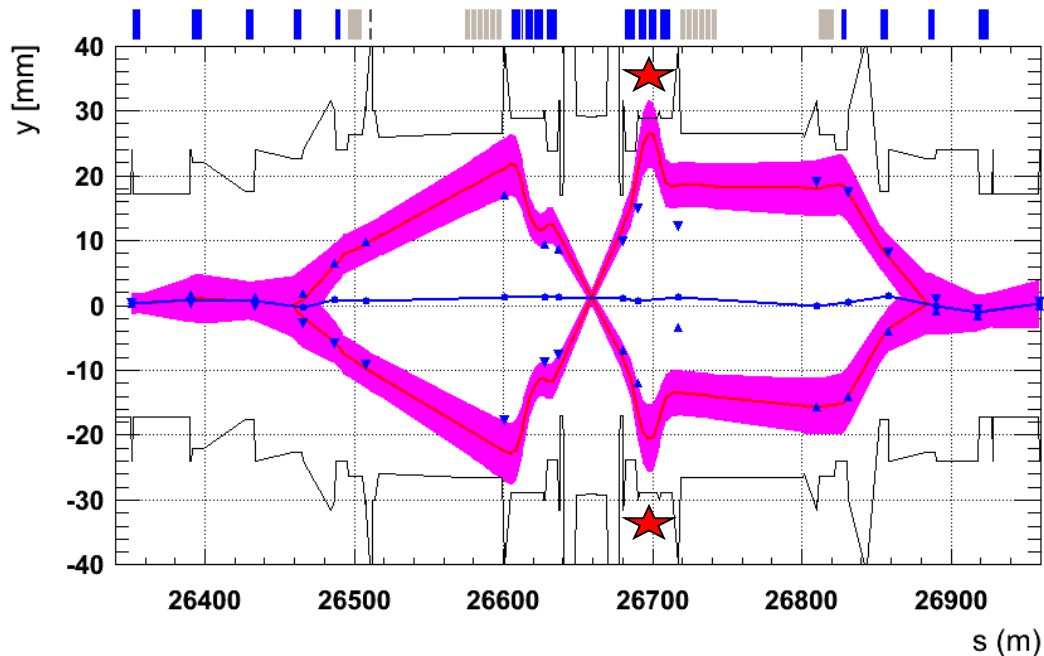
IR1 B1 H plane



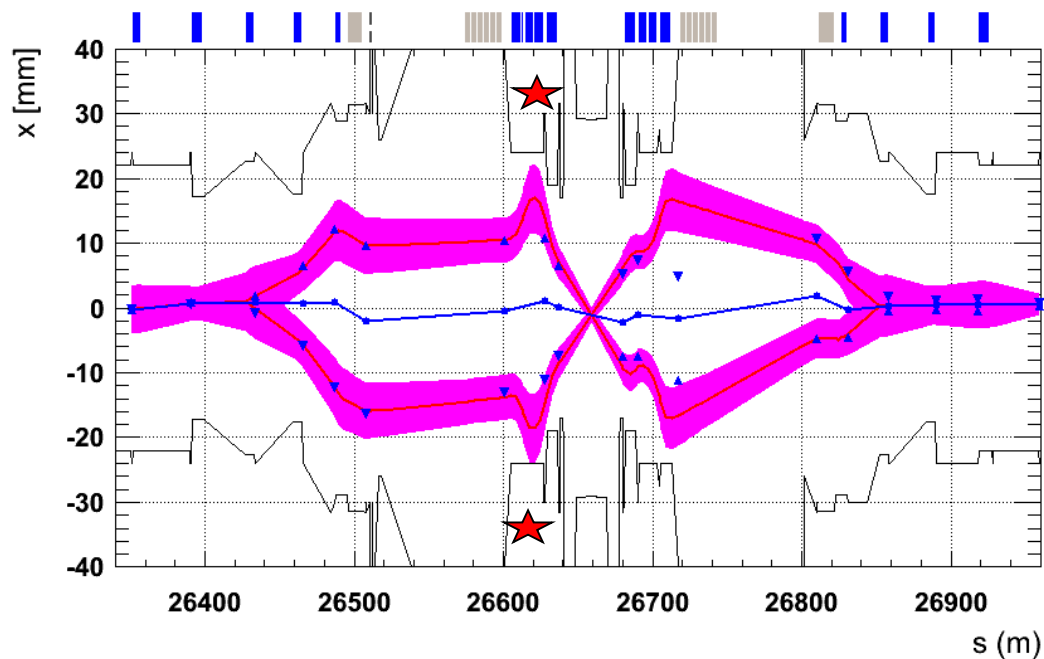
IR1 / B1

- Good agreement of model aperture and extreme beam excursions.
- Loss peak appears at the expected AP limit.
- In V plane the BPMs at Q1-Q3 give a smaller than expected reading.

IR1 B1 V plane



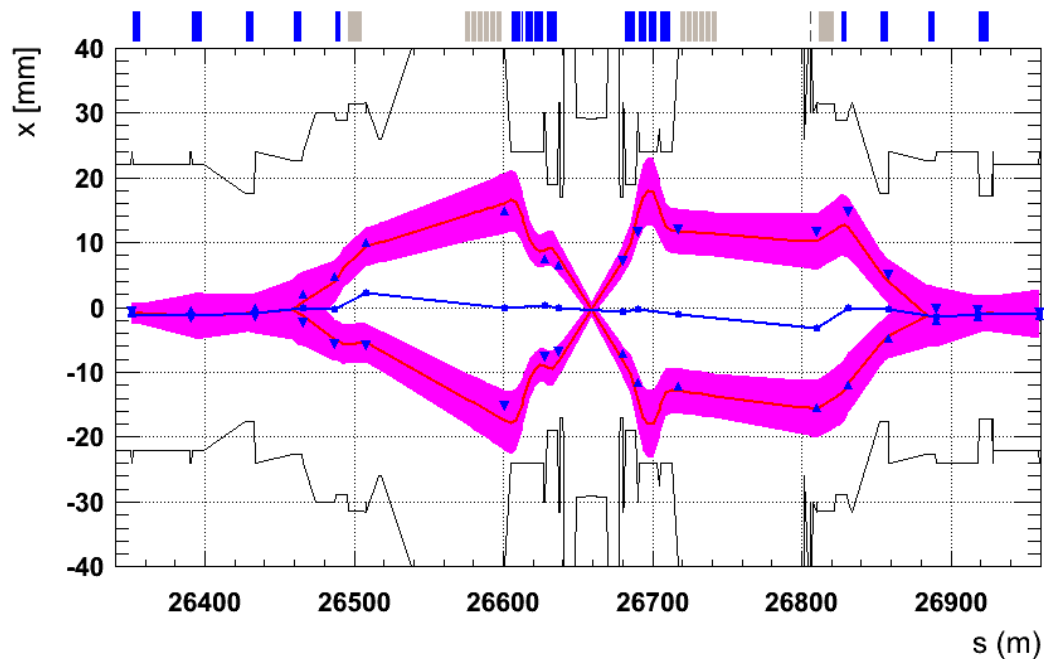
IR1 B1 H plane



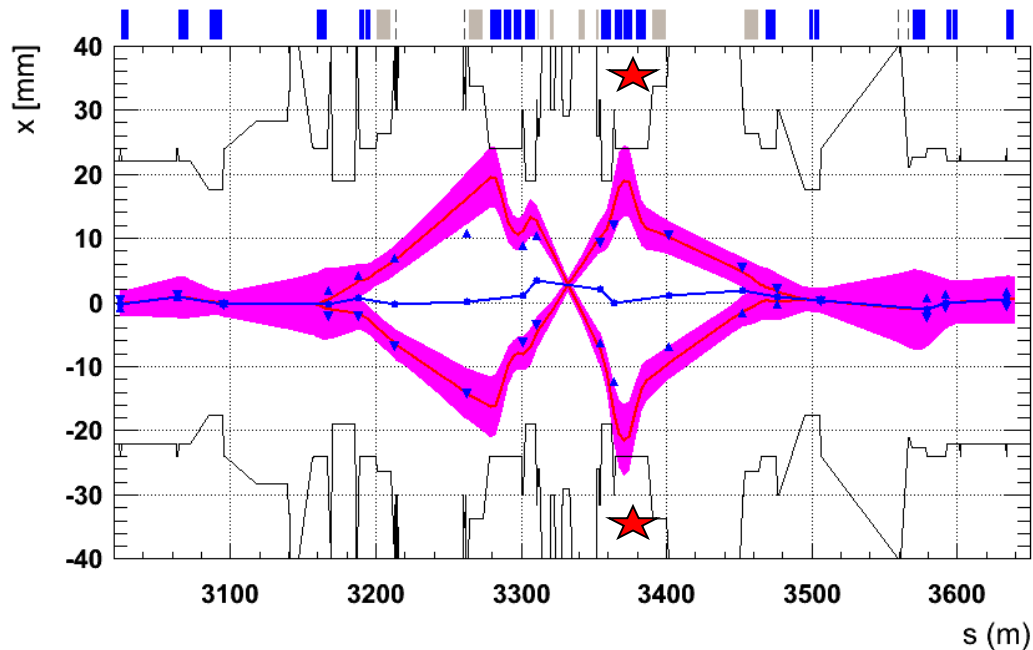
IR1 H / B1 & B2

- B1/B2 symmetry and agreement are OK.
- For B2 no BLM signal was observed (first scan). Good agreement of model aperture and extreme beam excursions.

IR1 B2 H plane



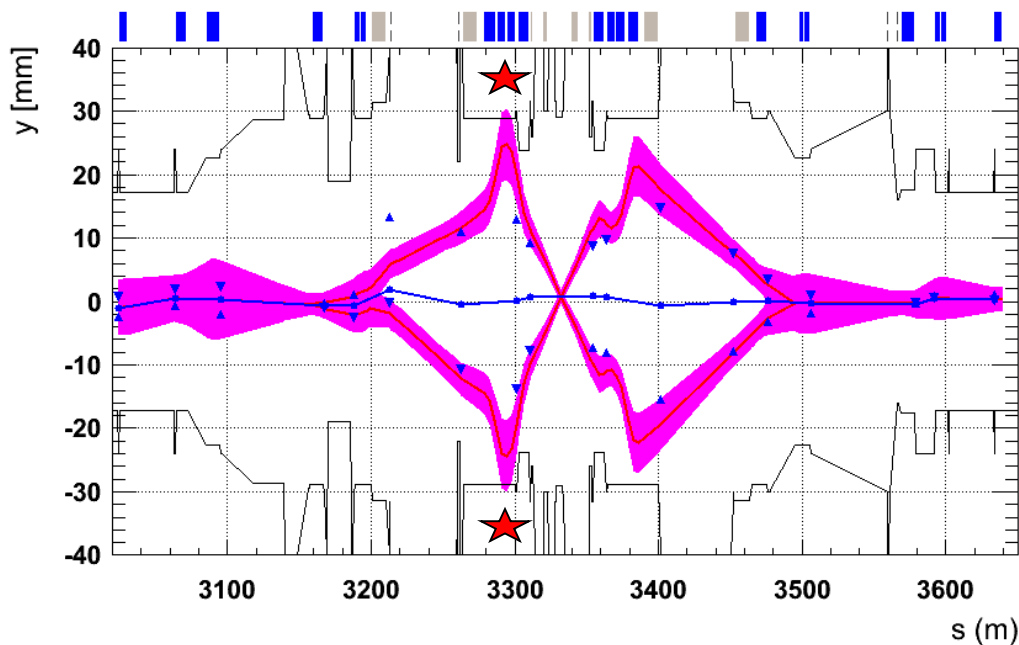
IR2 B1 H plane



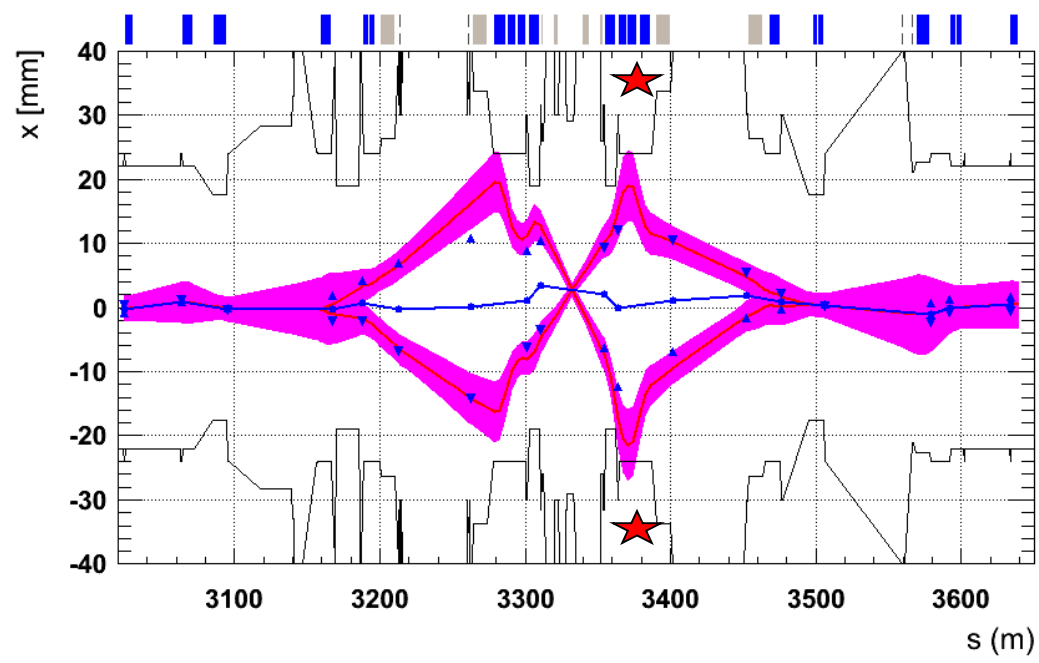
IR2 / B1

- Good agreement of model aperture and extreme beam excursions.
- Loss peak appears at the expected AP limit.
- In both planes the BPMs at Q1-Q3 give a smaller than expected reading.

IR2 B1 V plane



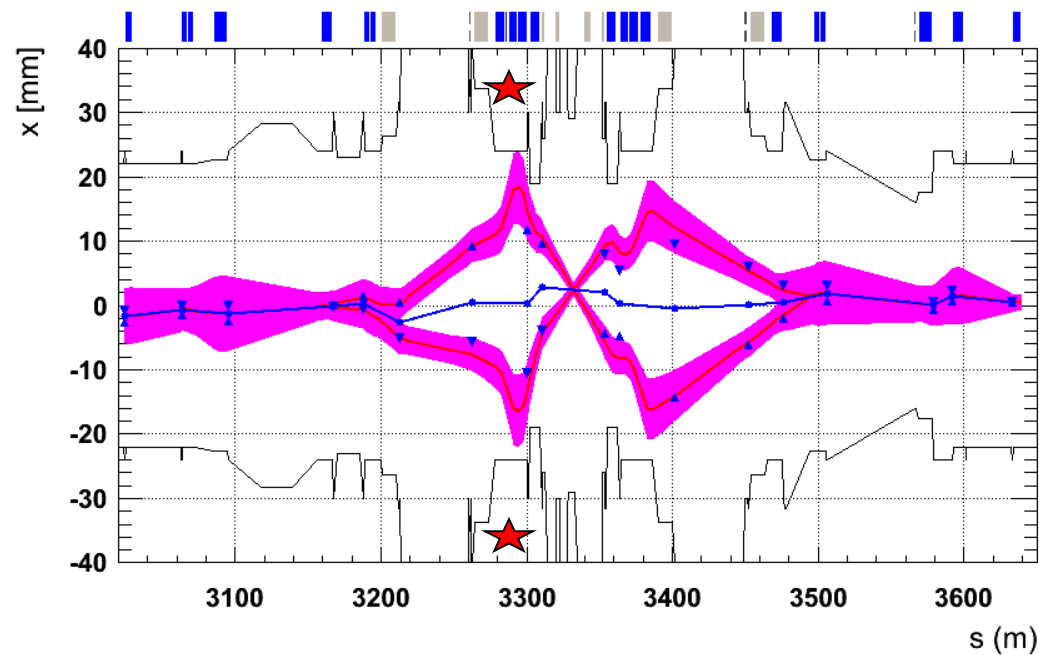
IR2 B1 H plane



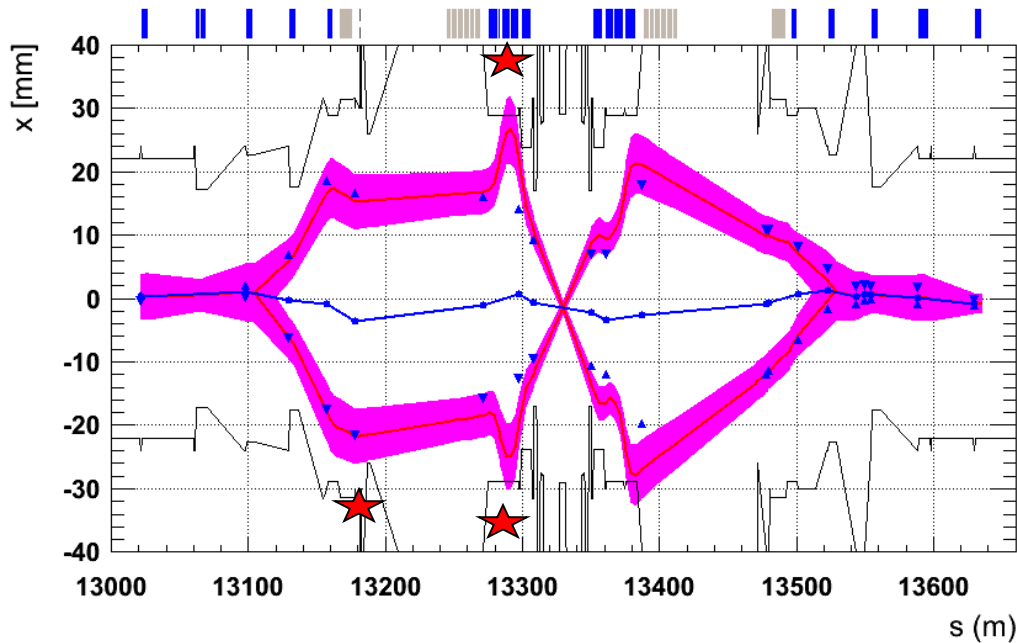
IR2 H / B1 & B2

□ B1/B2 symmetry and agreement are OK.

IR2 B2 H plane



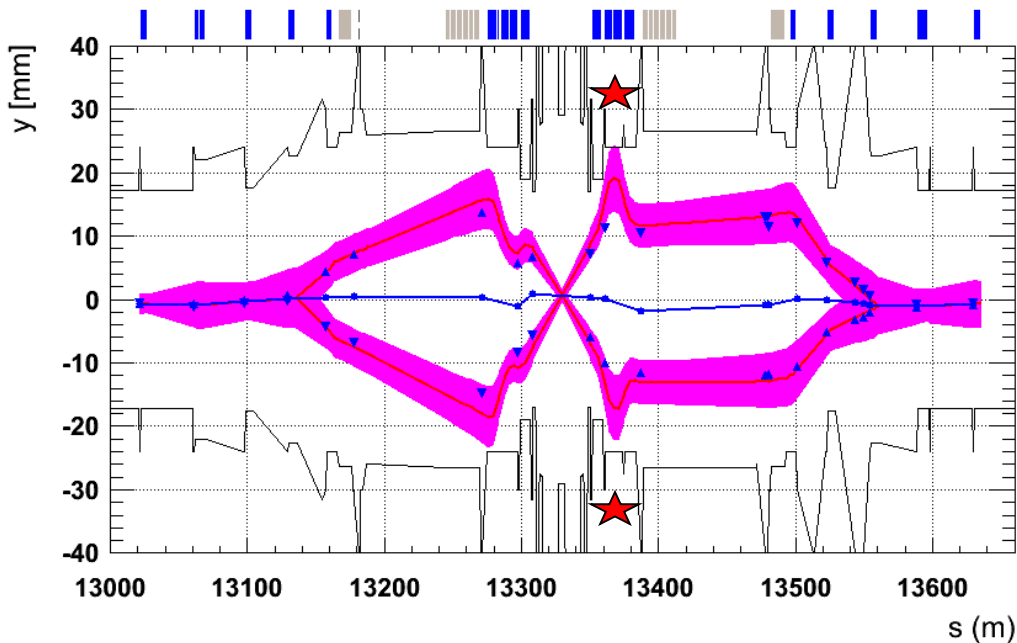
IR5 B1 H plane

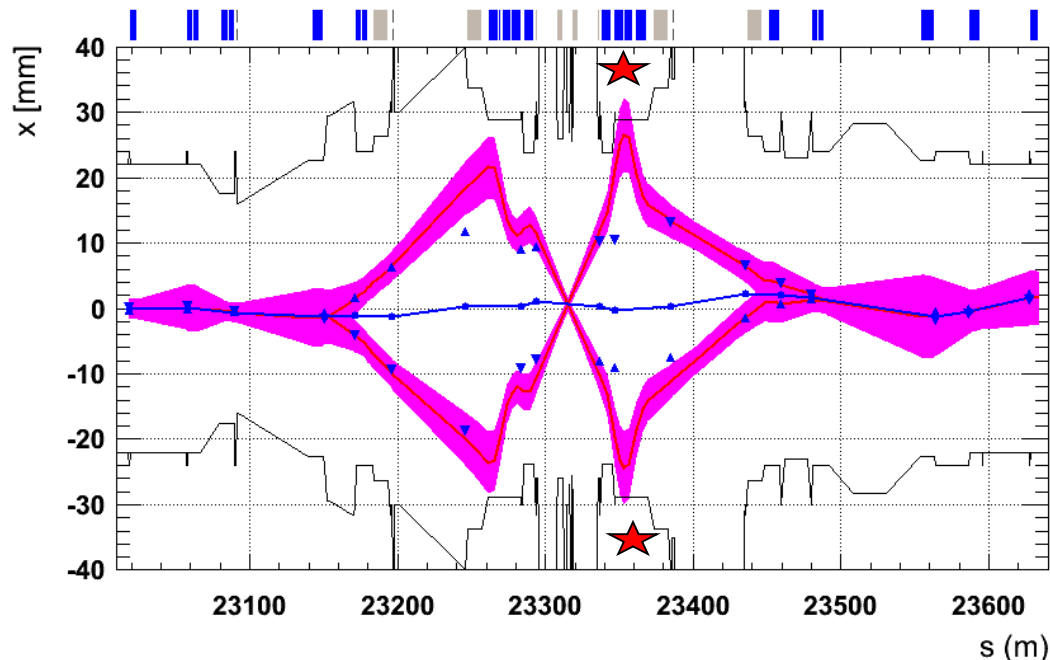


IR5 / B1

- Good agreement of model aperture and extreme beam excursions.
- Loss peak appears at the expected AP limit.
- In both planes the BPMs at Q1-Q3 give a smaller than expected reading.

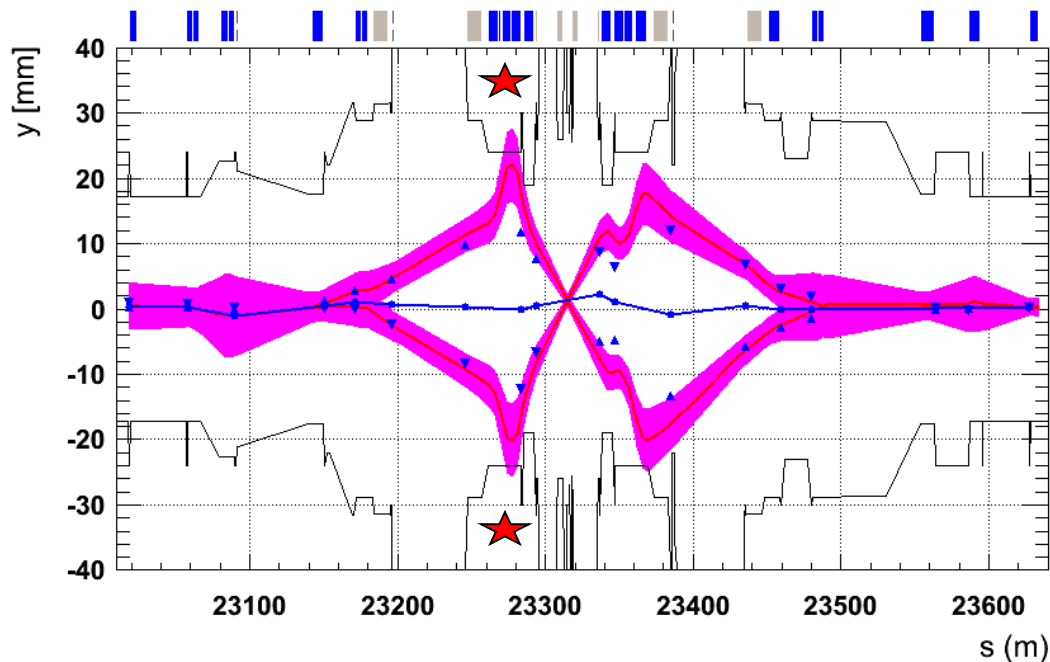
IR5 B1 V plane



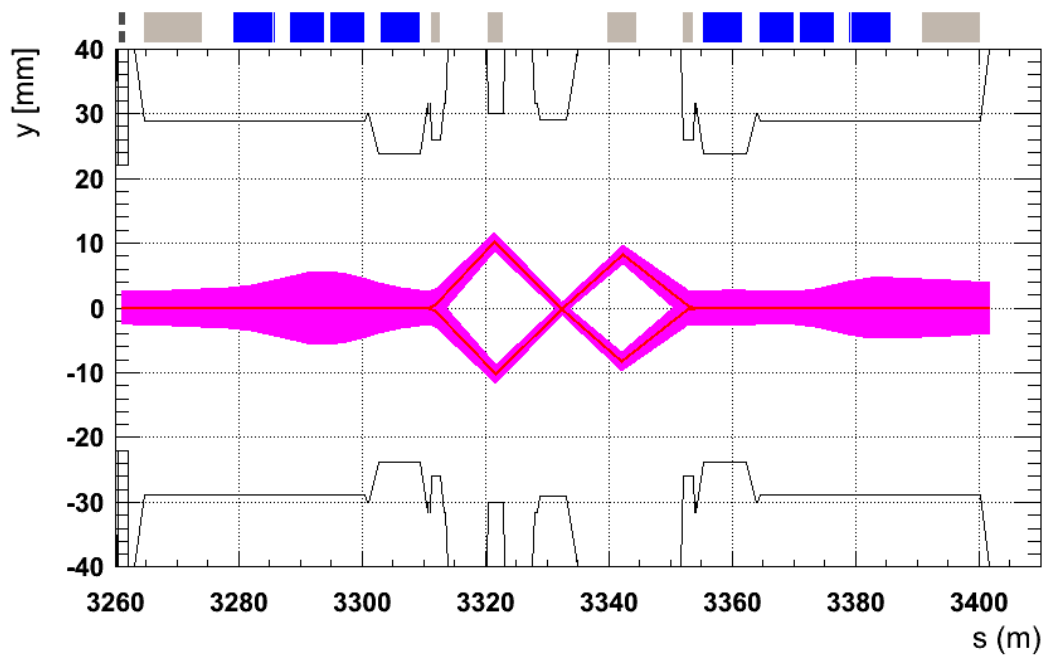
IR8 B1 H plane

IR8 / B1

- Rather good agreement of model aperture and extreme beam excursions. Theoretical bump excursions seem a bit too large.
- Loss peak appears at the expected AP limit.
- In both planes the BPMs at Q1-Q3 give a smaller than expected reading.

IR8 B1 V plane

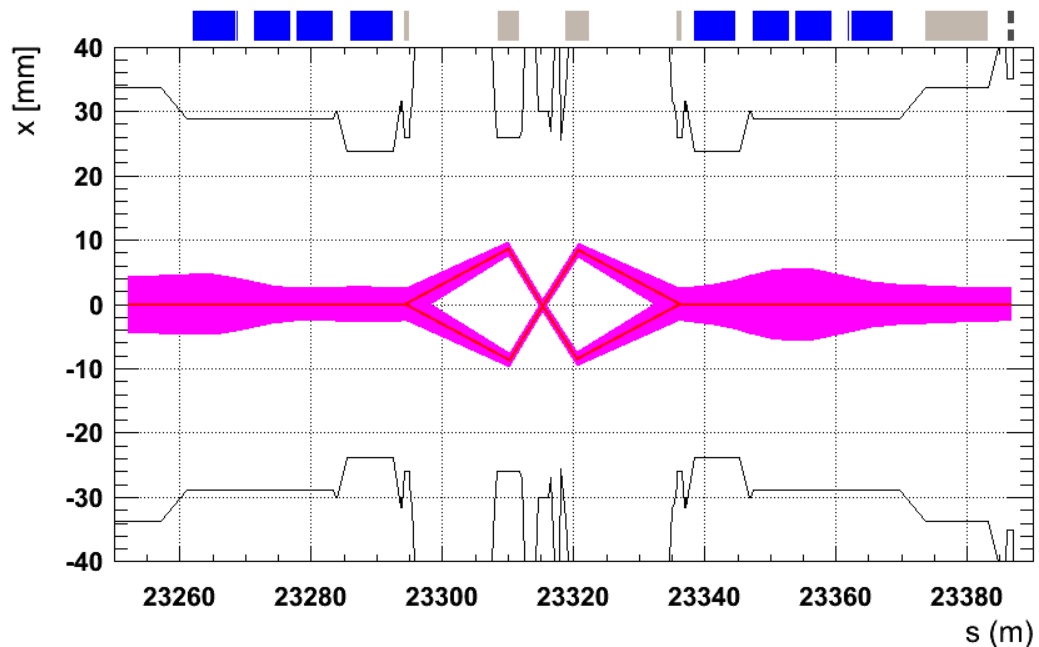
IR2 V plane - spectrometer bump



Spectrometers

- Theoretical spectrometer bumps and beam envelopes @ 450 GeV with nominal spectrometer currents.

IR8 H plane - spectrometer bump



Summary

- ❑ Measured apertures agree (very) well with the model.
- ❑ The measurements seems to indicate that the BPMs at the triplets give readings that are systematically too small (~10%).
- ❑ ATLAS dump threshold is significantly lower than for the other experiments.
No a problem so far...
- ❑ I see no need to repeat this exercise this spring since nothing was opened.
 - Note that triplets in IR2 and IR8 have been re-aligned by ~ 0.5 mm.