Colliding squeeze MD3

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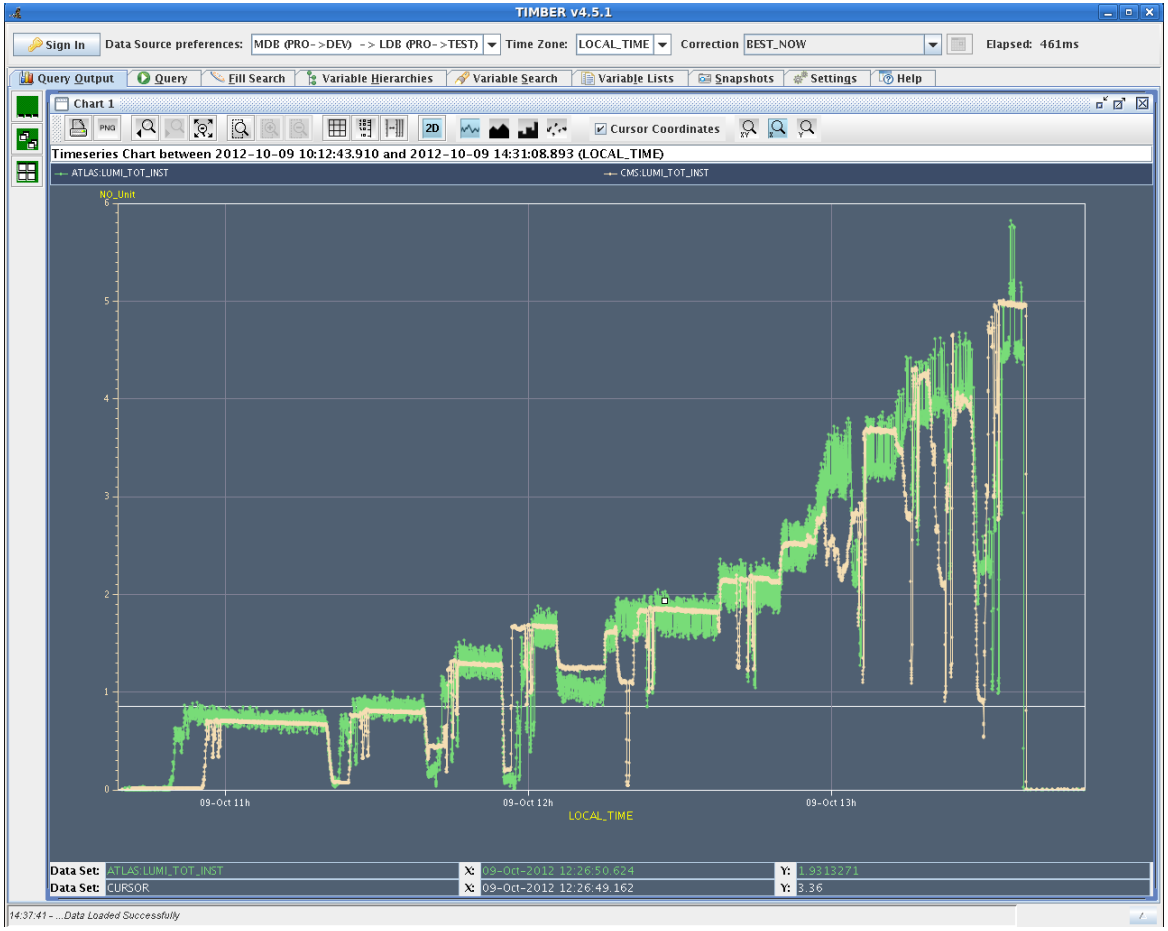
Aim & efficiency

- Collide all along the squeeze in IR1 and IR5 to provide stabilization by beam-beam tune spread rather than by octupoles.
  - For practical reasons, beams were put into collisions at 9 m after the Q change in this MD.
  - We tried to re-use settings and references from the previous beta* leveling MDs for the squeeze range 3 m to 0.6 m.
- The MD started late (~3 hours) and ended a bit earlier as there was not enough time for a second cycle.
  - A test of beam stability was performed with the colliding bunches at 0.6 m.

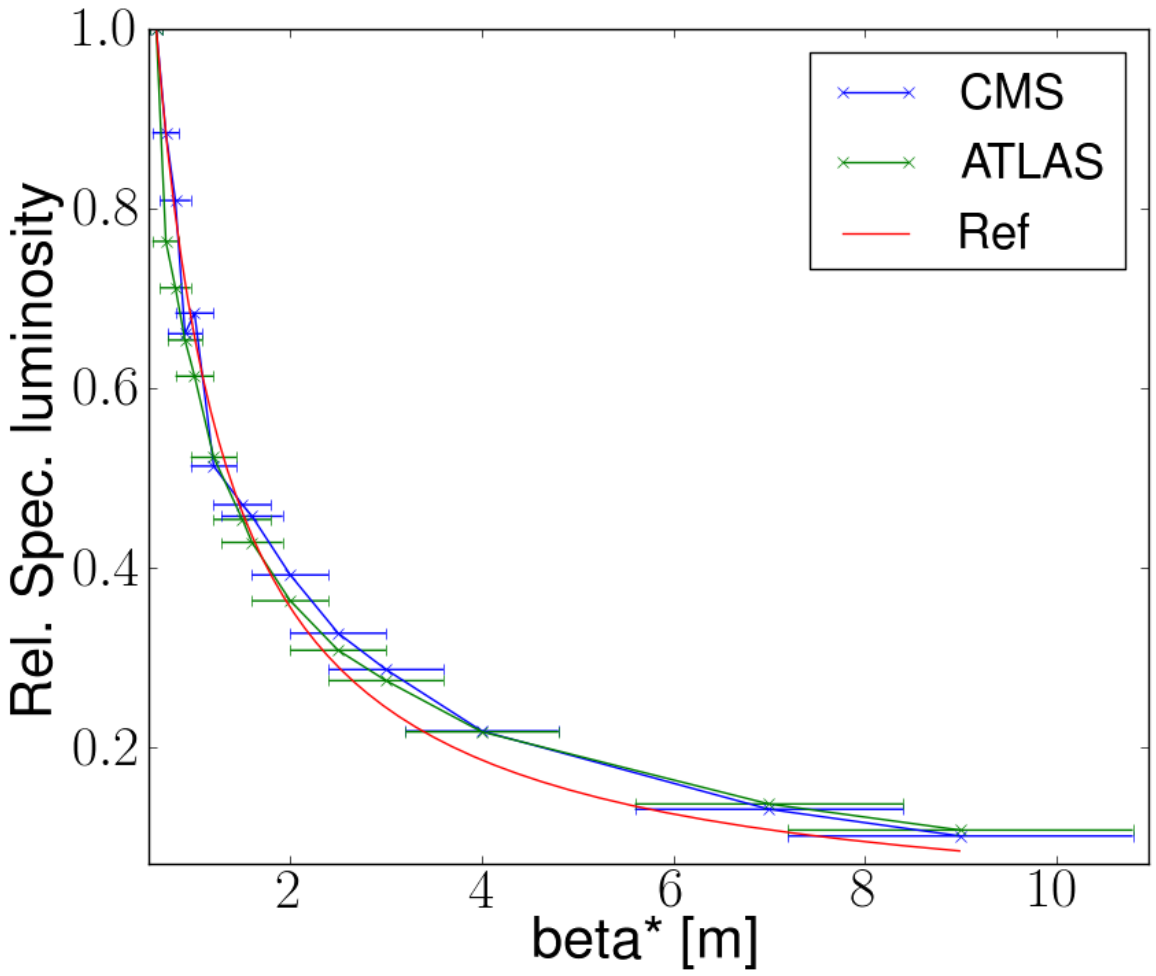
Luminosity evolution

- The ups and downs indicate that the orbits moved a bit more than what was hoped for.
  - It was not to easy to join up with the settings/reference at 3m.



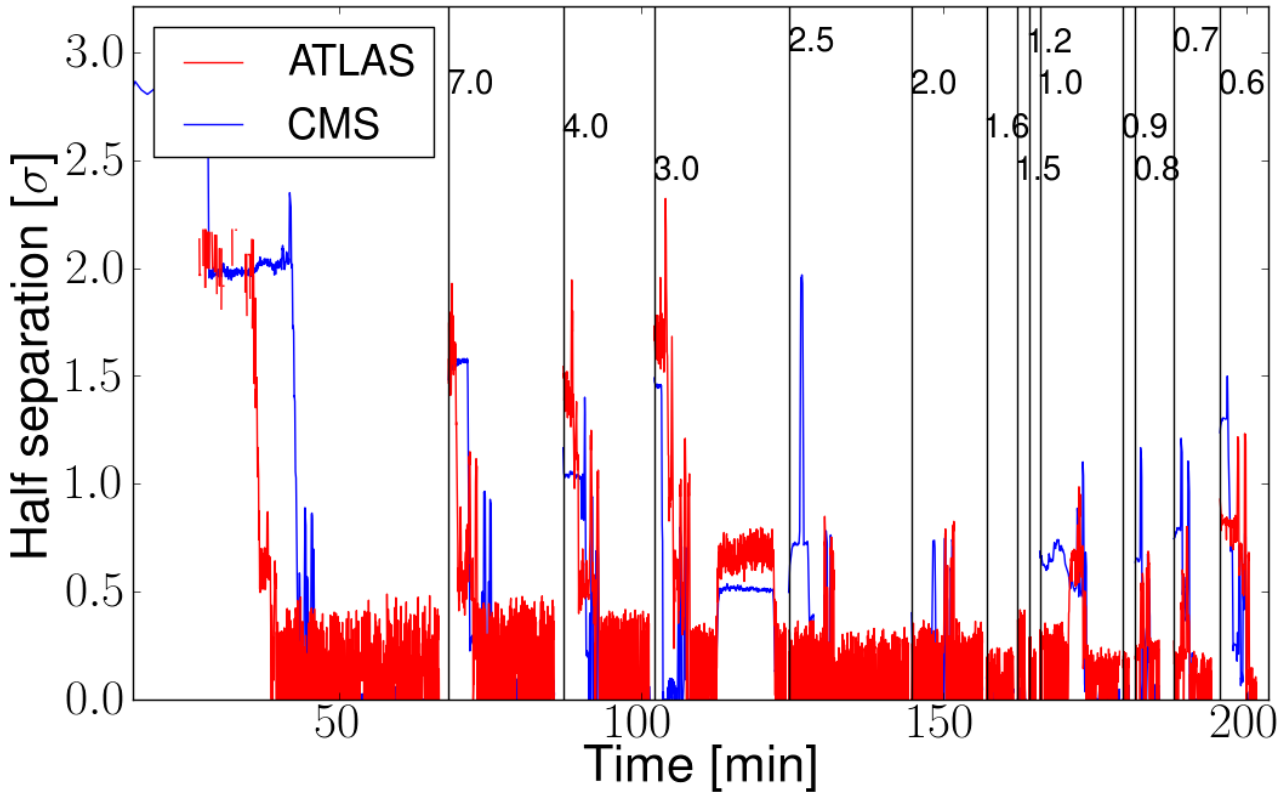
Luminosity versus β*

- L versus β*, assuming 20% beta-beat – consistent.



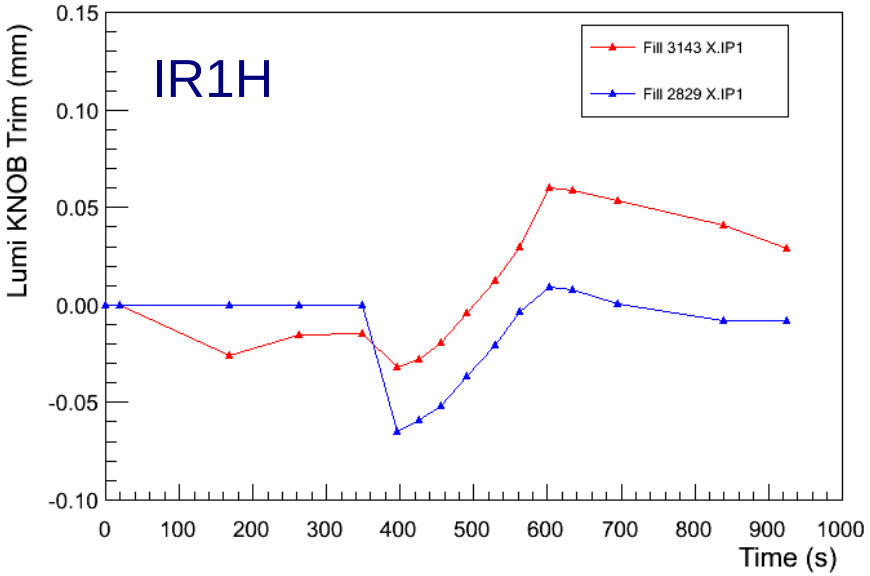
Luminosity versus β*

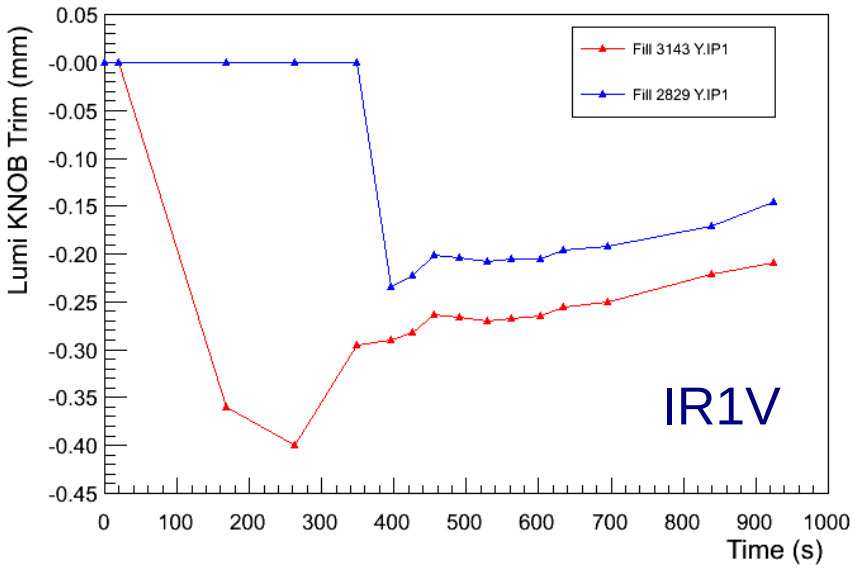
- Using the luminosity after optimization, it is possible to deduce the beam offset from the L drop during transients.
  - Generally worse for CMS.
  - Quite good between 2m and 0.9 m.

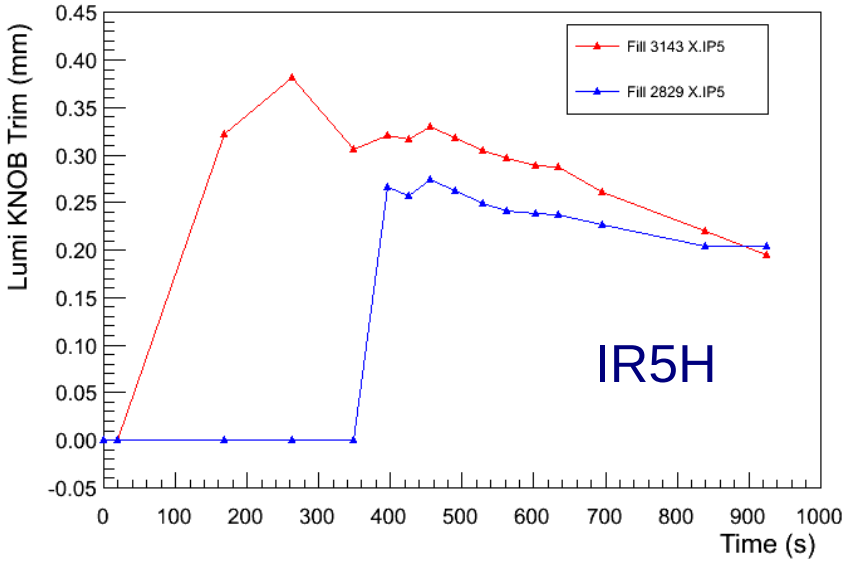


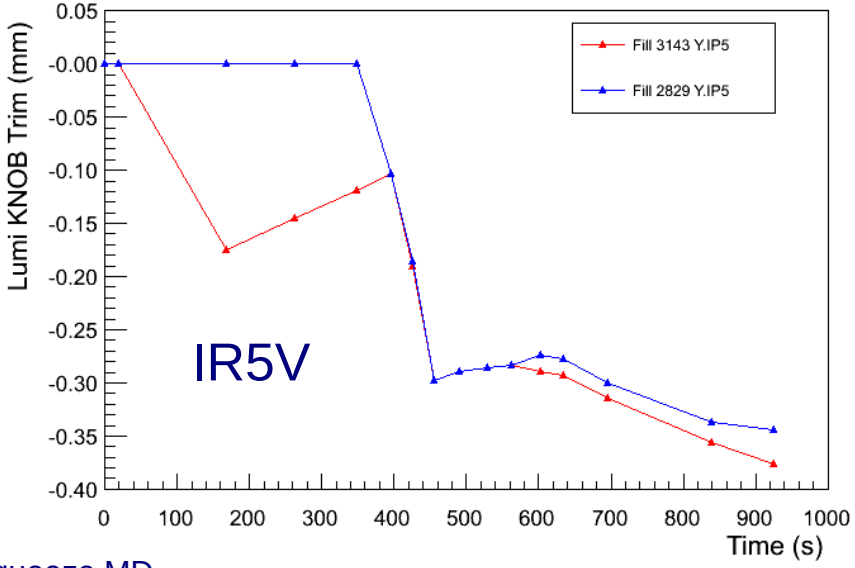
Lumi knob trims

Compare this MD (red) with last β* leveling from 3 m (blue).

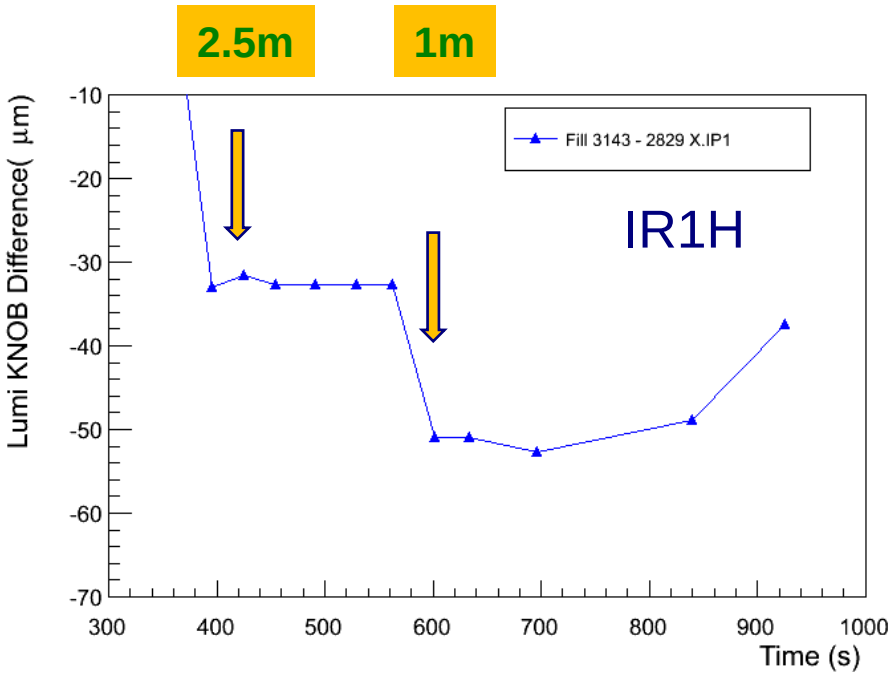


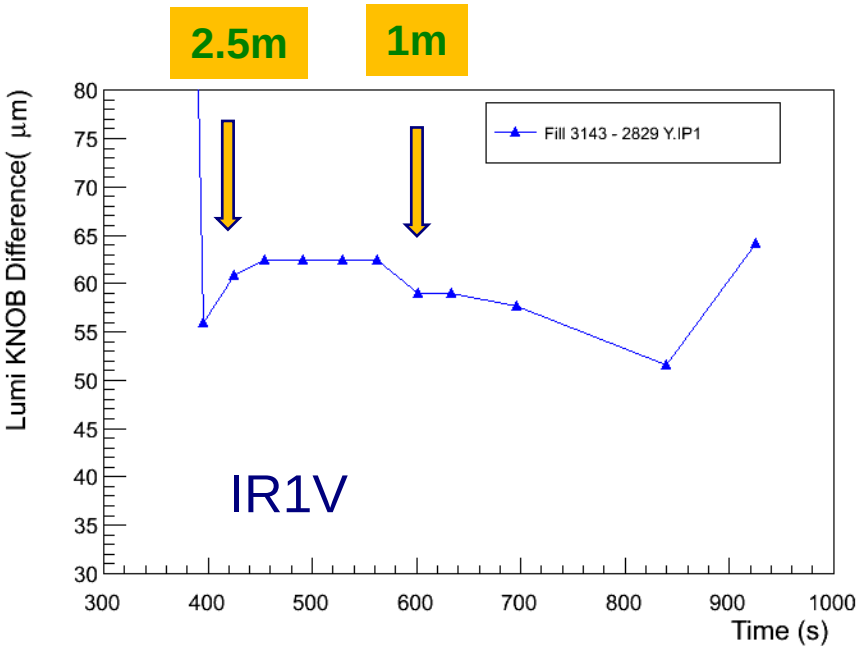






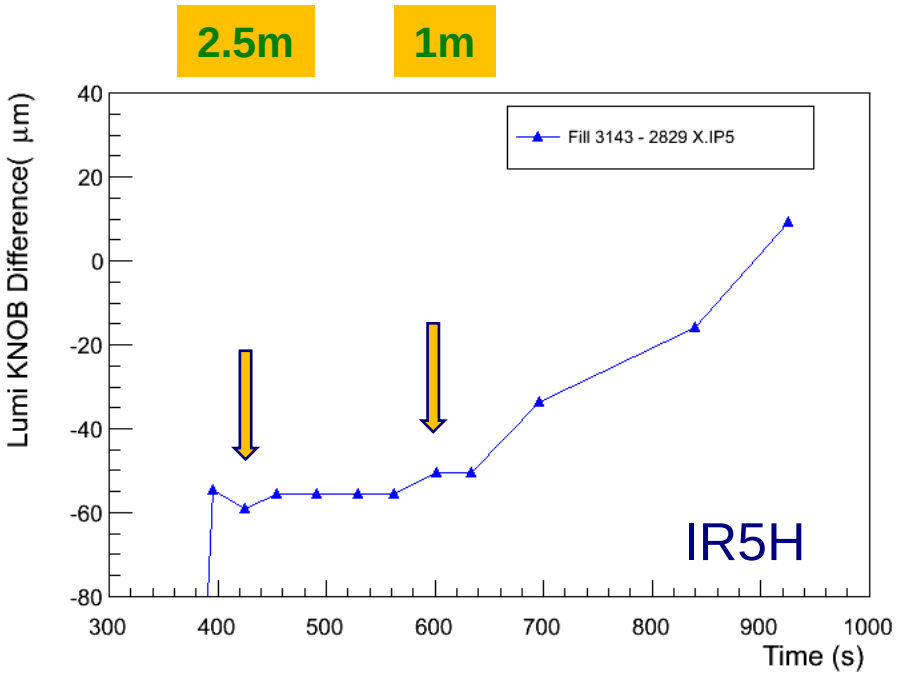
Lumi trim differences – IR1

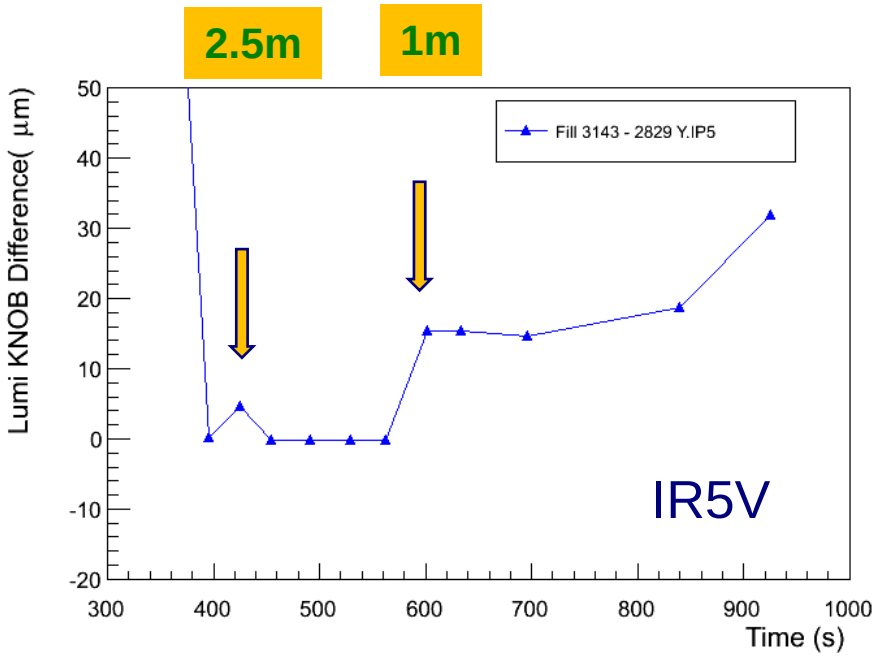




- Arrows indicate orbit corrections at 2.5m and 1m.
  - 2.5m: harsh orbit correction brings back lost IR5 luminosity. Little effect on IR1 (as visible on small change of IR1 lumi trims).
  - 1m: large orbit correction to bring back IR5 luminosity. Correction is not so good for IR1 – clearly visible on lumi trims (H).

Lumi trim differences – IR5





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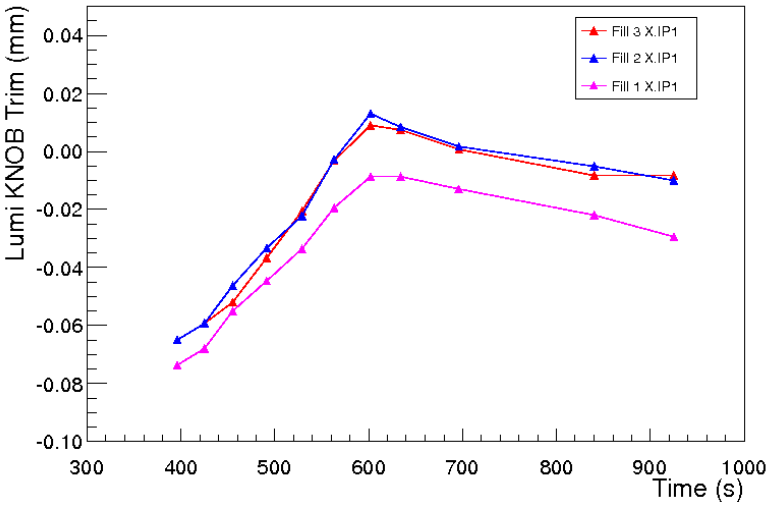
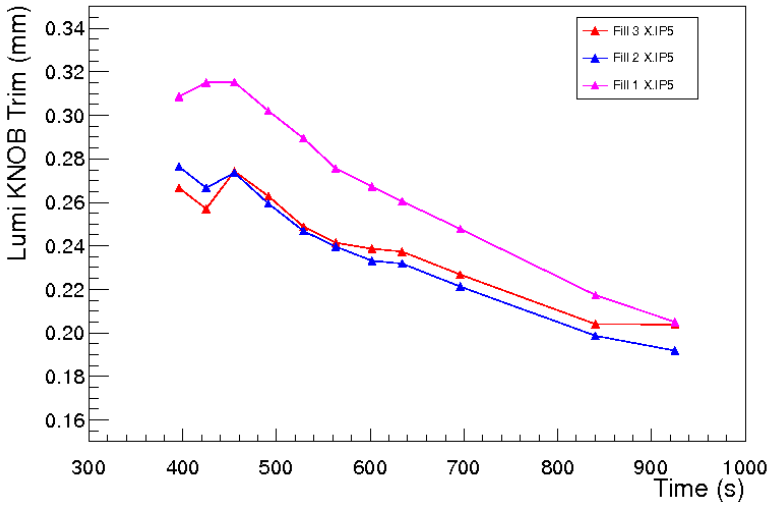
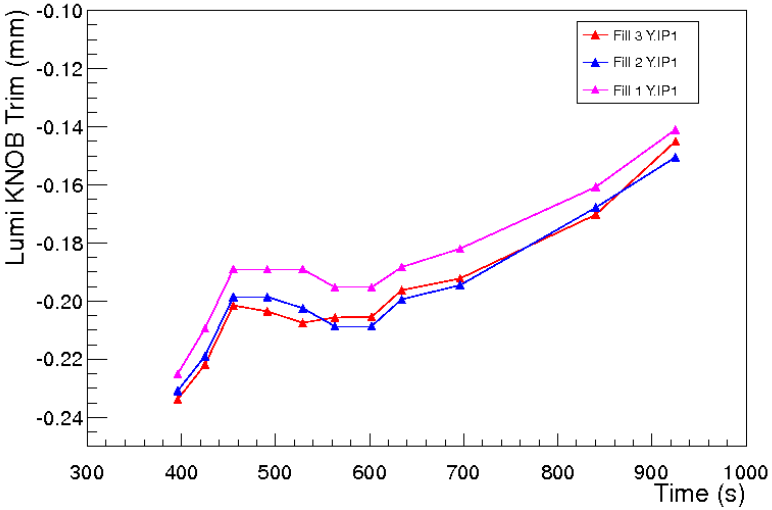
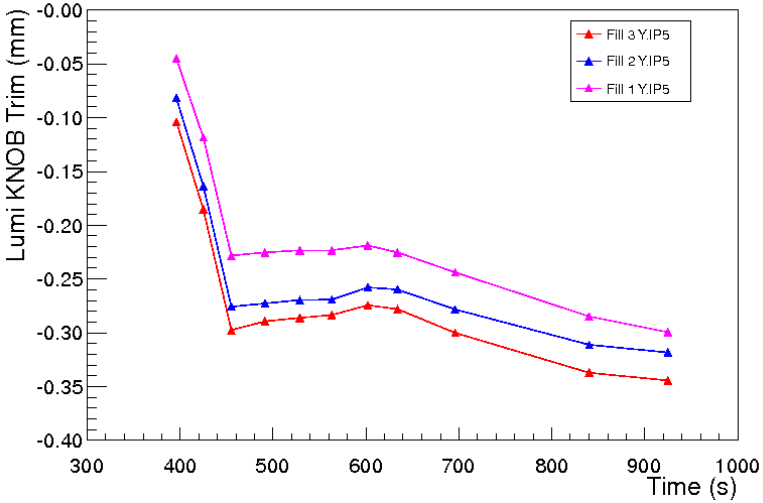
Comparison with β* leveling from 3m

- Comparison of 3 fills (first 2 on same day).
  - Was very good at the time (interval ~ 2 weeks).



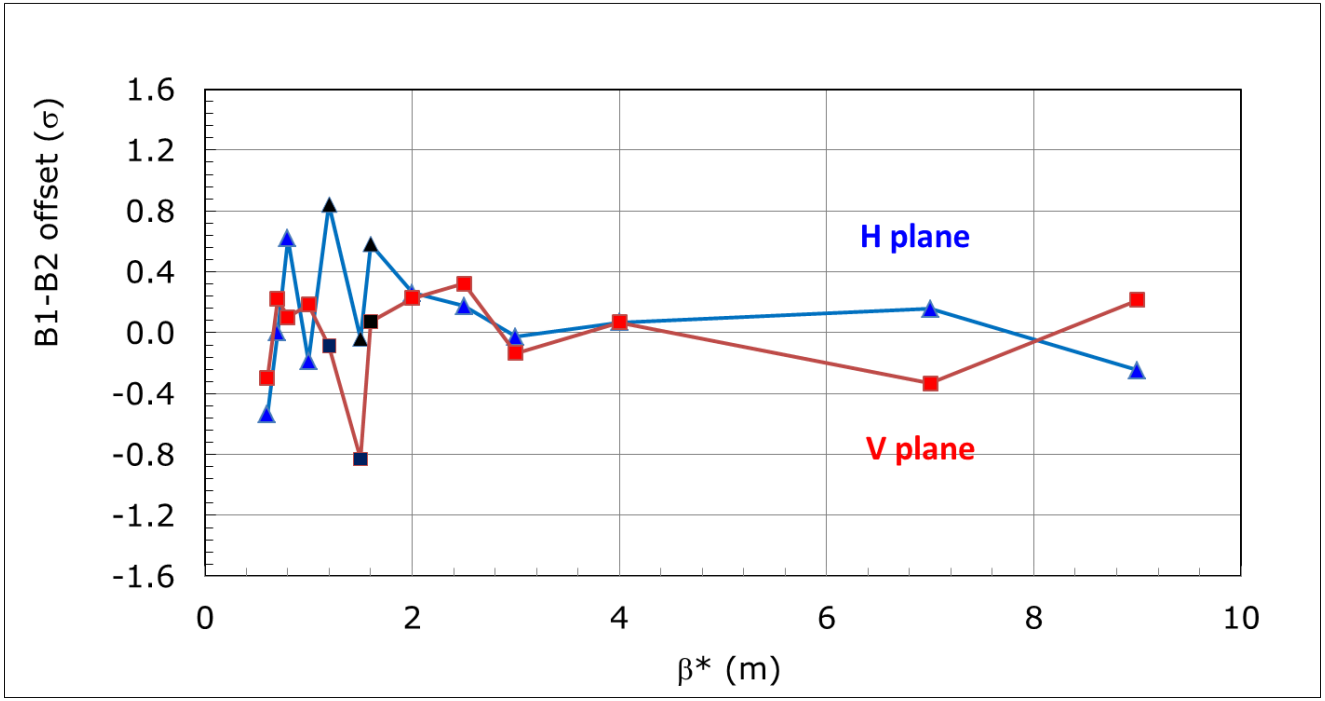






IP offset from BPMs

- The IR1 BPMWF BPMs, where both beams are measured with the same buttons, were phased in.
  - In principle with smaller systematic errors.
- The beam positions were recorded whenever the luminosity was optimized. The predicted offsets (expect = 0) are not too far off !



Conclusion

- Technically the colliding squeeze is working.
  - But for ease of operation more time must be invested in the orbit setup early on. Need 2-3 extra orbit cleaning cycles at startup.
- The challenge will be to keep the beams in collision without stopping too frequently.
  - Relying on reproducibility could work, but…
- One interesting last test would be to go once through the squeeze again, 9m to 0.6m, and see how much things degrade (or not) over a period of many weeks.