Wire tests at injection energy

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with helpful discussions at the BB WG and with M. Fitterer, D. Gamba, A. Levichev, S. Redaelli, A. Rossi and M. Poyer.

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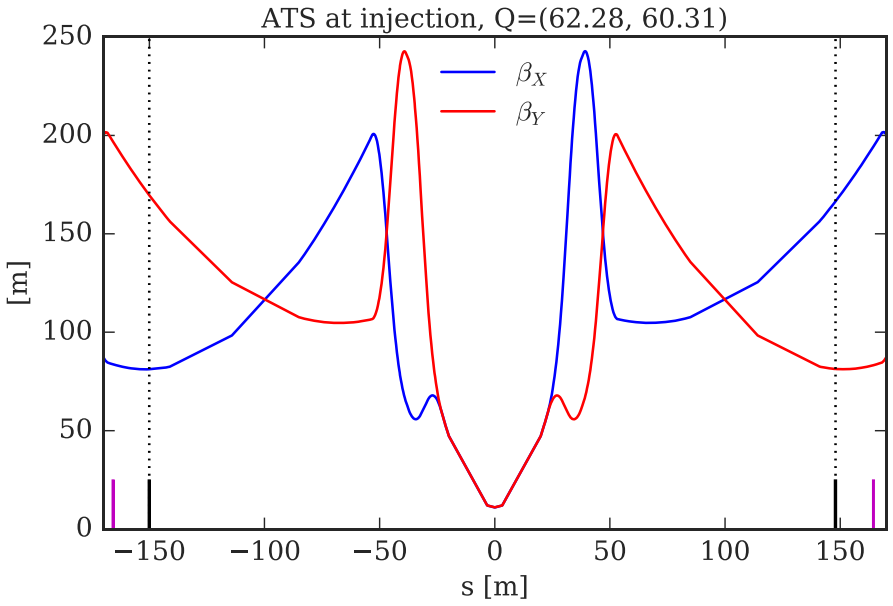
Outline

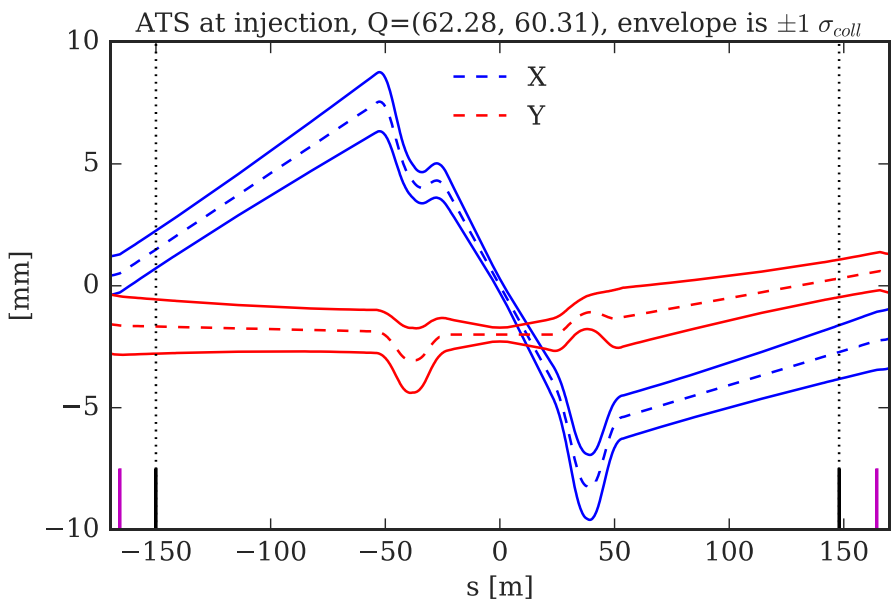
What can we learn using the wire at **injection energy**?

1. Calibrating the wires → 1 beam and 1 wire
2. Compensation btw wires → 1 beam and 2 wires
3. Mimic the LR → 1 beam and 1 wire
4. LR compensation → 2 beams and 1 wire

Most of these tests (1,2,3) can be done with 1 PILOT at 450 GeV if compatible with the required BI precision.

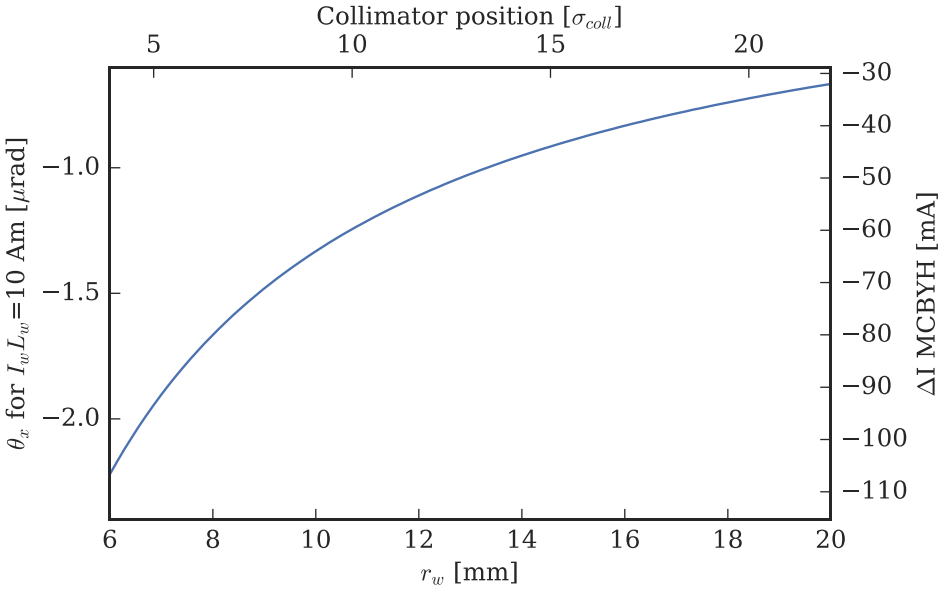
Calibration tests: dipolar kick (I)

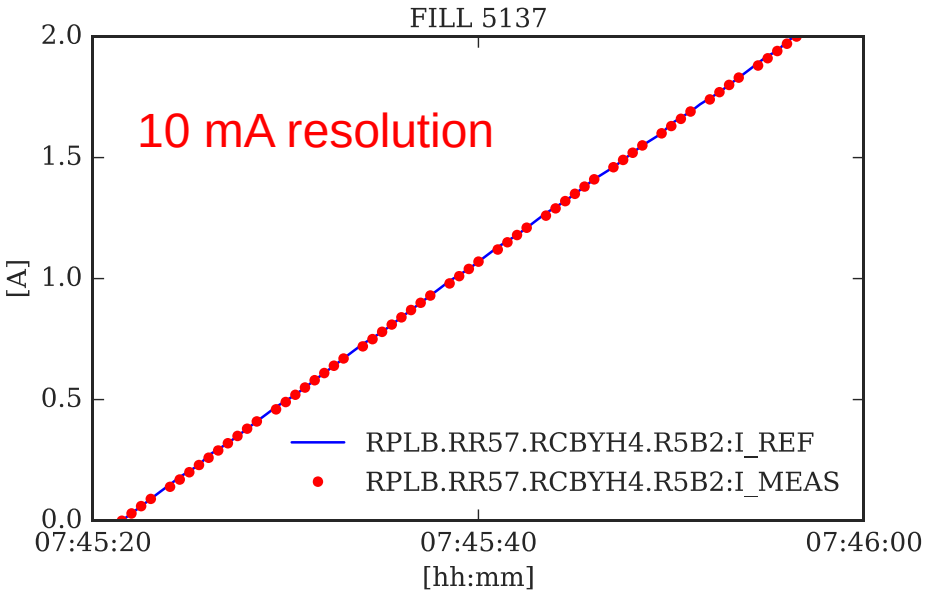




- For both L/R wires, compensate with collimator the beam V displacement (starting from 4R5).
- Preliminary checks:
  - Noise level at I=0 and closest approach.
  - Verify on the wire position with the beam (no effect on V orbit)
  - linearity vs current and independence on the jaw position that does not carry the current.

Calibration tests: dipolar kick

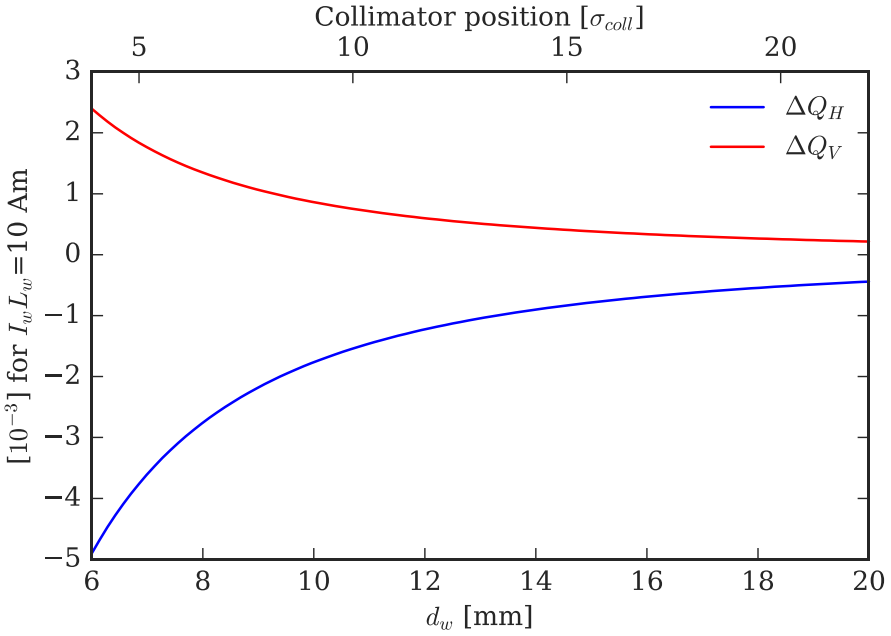


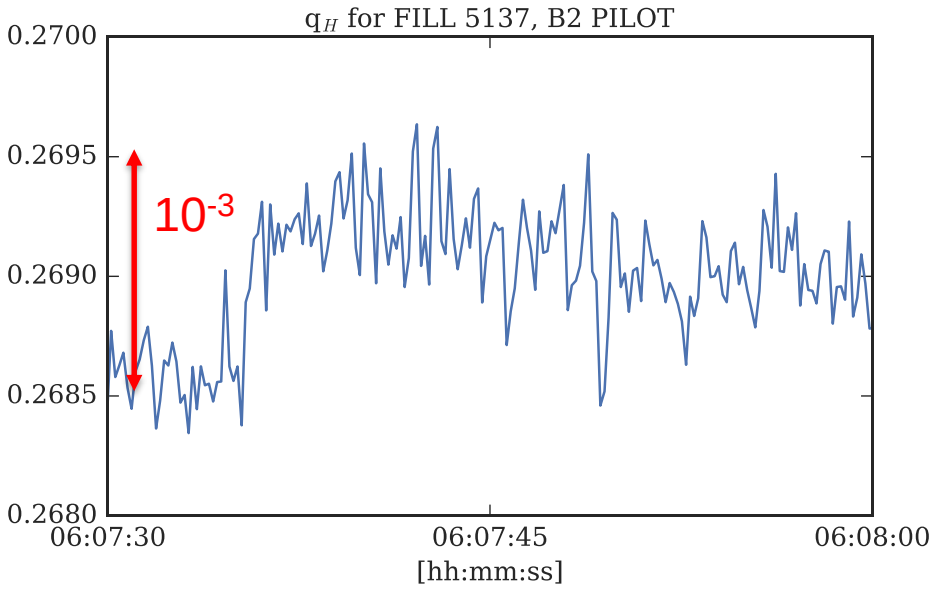


- Proposal: use the MCBYH corrector ($\Delta\mu$ #~ 5 deg) to compensate the induced dipolar kick.

- Goal: implement a simple feed forward to trim this corrector as f(x_w, I_w).

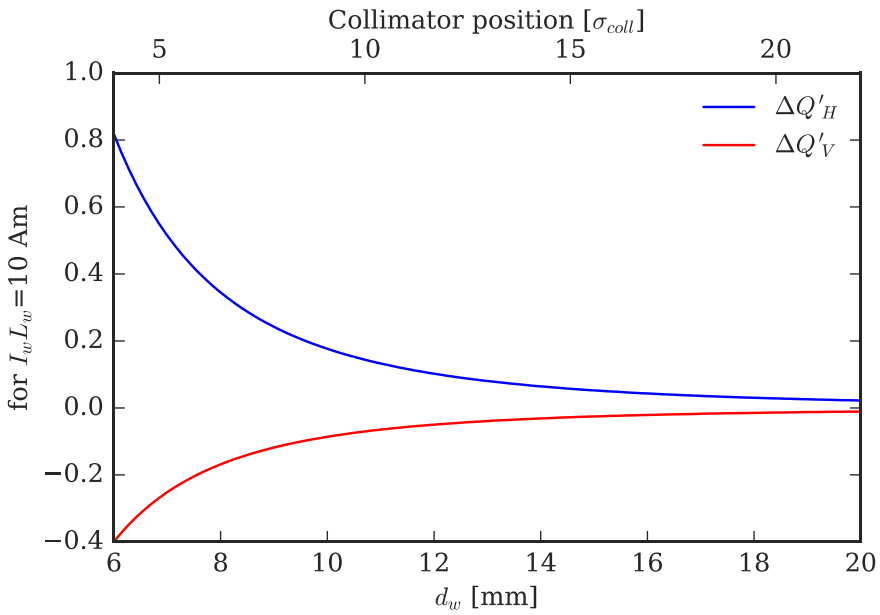
Calibration tests: quadrupolar effect

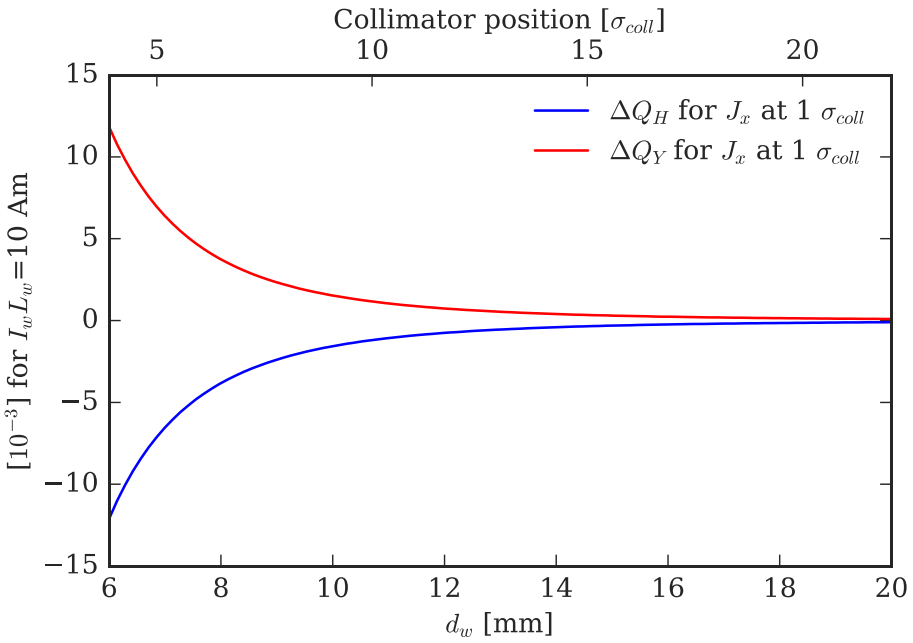




- Verify the quadrupolar magnetic length of the wire: a PILOT should be sufficient for appreciating the tune shift.
- Make a feed-forward for the quadrupolar effect using the standard tune trimming quads

Calibration tests: sextupoles and octupoles

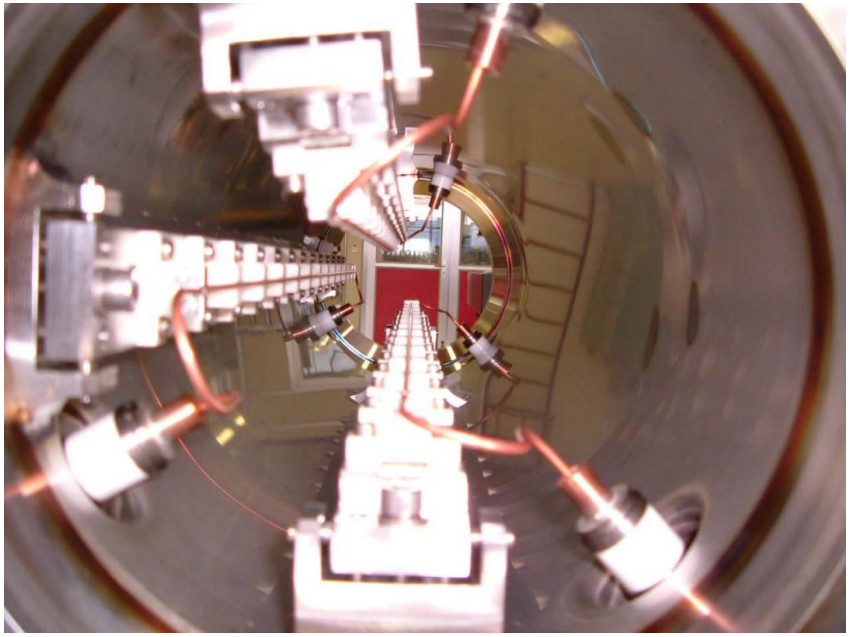




- Once having corrected the linear effects of the wire we can explore the non linear ones:
  - Effect on linear chromaticity
  - Effect on detuning with amplitude
  - Effect on the non-linear chromaticity

Mimic the effect of the BBLR with a wire

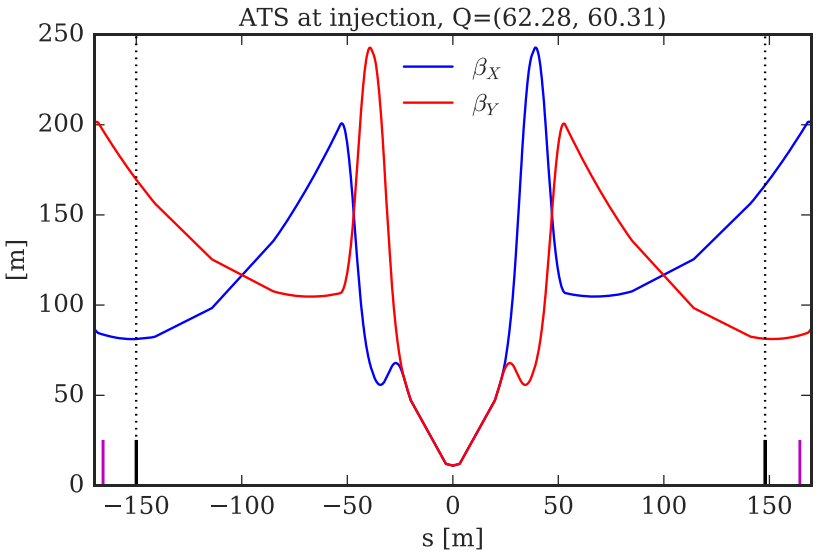
- Using the scaling laws in [4] one could excite a BBLR-like effect as done in the SPS. One has to scale the I_w for the beam normalized emittance (not with beam energy).
- What is the minimum I_w with a detectable effect on lifetime?
- What is the effect of ramping the current (increasing the number of BBLRs)? What is is effect with the tune? Benchmarking with simulations [see Miriam's talk].

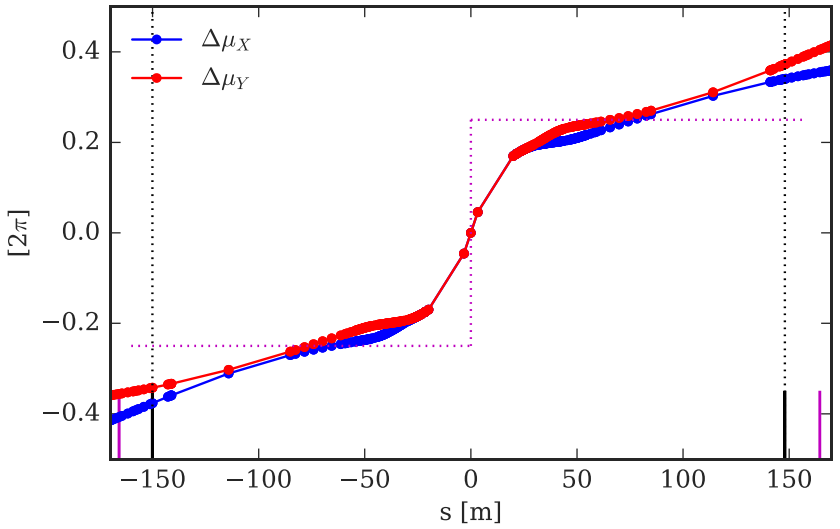


Wires in SPS to mimic a "B2"

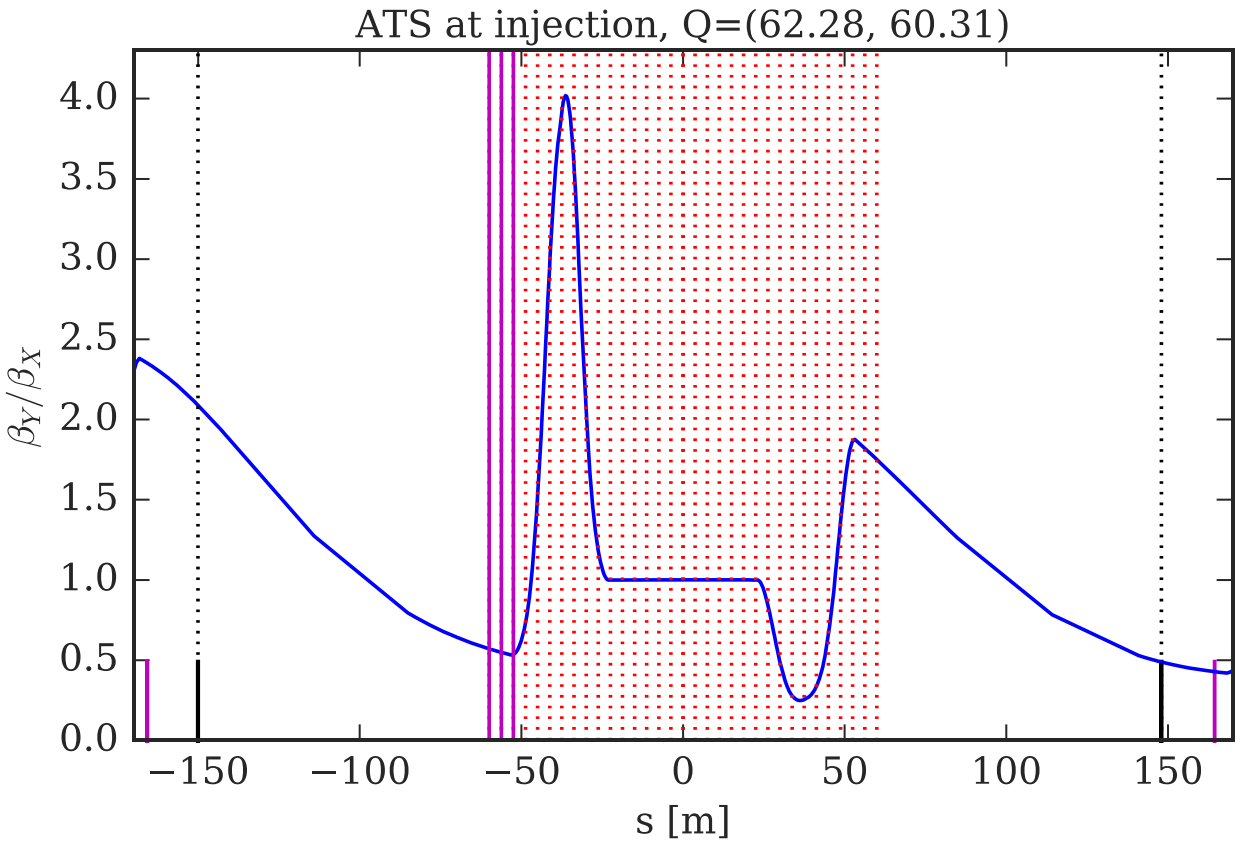
Use 1 wire to excite and the other to compensate

- In the ATS nominal configuration is possible to compensate the wire effect in only one plane.One could compensate the octupolar detuning in the H plane.
- To compensate one wire with the other we need r=1.
- Simulations of the compensation to be done.





BB LR compensation and 1 wire



- In the ATS nominal configuration one could try to compensate the effect of 3 LR with the wire. By using a $r_W=r_{IP}$ optics one could test the compensation of 12/24 BB encounters.

Summary

We presented a set of possible tests and measurements at LHC injection energy using the wires.

We can operate using the ATS injection optics for

- Calibrating the wires → 1 beam and 1 wire.
- Mimic the LR effects → 1 beam and 1 wire.
- Compensation btw wires on one plane.
- 3 LRs compensation → 2 beams and 1 wire.

An injection optics with r_W=1 has to be prepared for

- Compensation btw wires → 1 beam and 2 wires.
- 12 LR compensation → 2 beams and 1 wire

Synergies with other experiments will be explored

- Halo experiments in the collimation team.
- RDT measurements.
- …

Thank you for the attention.

References:
[1] J.-P. Koutchouk, LHC Project Notes 223
[2] J.-P. Koutchouk et al, Experiments on LHC Long-Range Beam-Beam Compensation in the SPS
[3] S. Fartoukh et al, https://doi.org/10.1103/PhysRevSTAB.18.121001
[4] F. Zimmermann, 10 years of wire excitation experiments in the CERN SPS