

# 2024 MD4/5 requests



On behalf of the OMC team:

**J. Dilly, E.H.Maclean**, T.H.B Persson, Y. Angelis, F. Burkhardt, F. Carlier, V. Ferrentino,  
M. Le Garrec, W. Van Goethem, S. Horney, J. Keintzel, E. Kravishvili, K. Paraschou,  
K. Skoufaris, F. Soubelet, R. Tomas, K. Ujani

Many thanks to the EICs, OP, Collimation, and BI teams!



## High priority activities for OMC carried over from previous requests:

- **MD9543 – Failing IR correctors (T.Persson)**

- previously scheduled in 2023: multiple availability issues
- high-priority to demonstrate correction strategy in case of failure of IT correctors (coupling, octupoles,...) due to radiation damage

- **MD12724 - Phase knob optimization and MO response at injection (S. Horney)**

- RDT measurements show up to factor 2 discrepancy in MO response at injection (presented at LMC last week)
- high-priority as if HW issue MO response would affect many studies throughout cycle
- want to check individual circuit responses

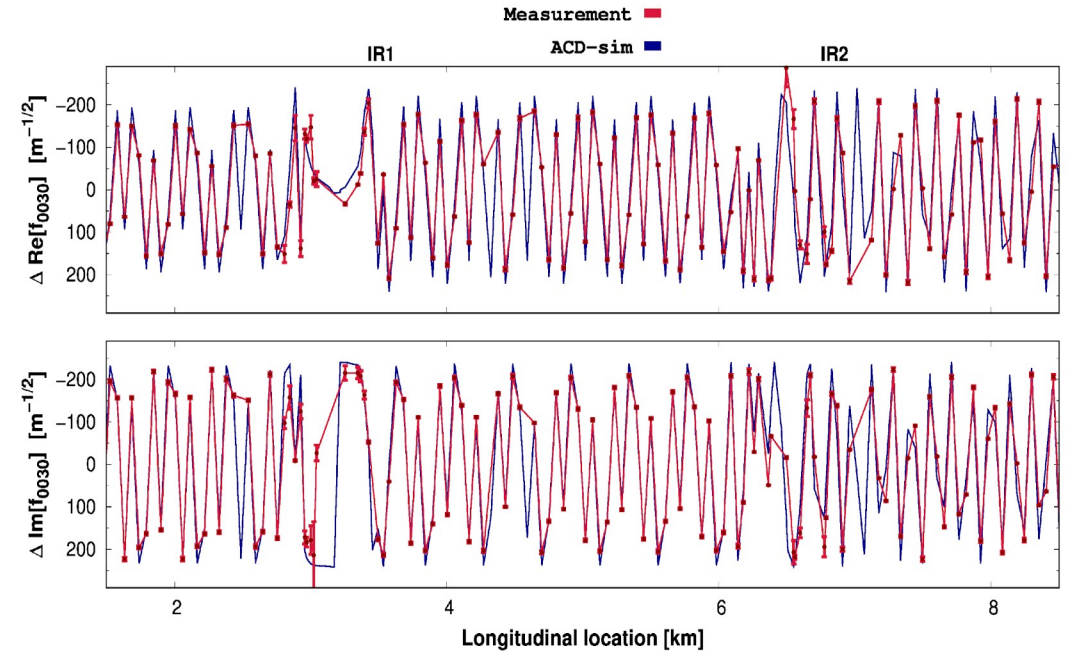
## MD13547 – Measurement/correction of weak-strong long-range, continued.

# MD13547 – Measurement/correction of weak-strong long-range, continued.

Continuation of MD12263, which demonstrated possibility of linear/nonlinear optics measurements with long-range beam-beam collisions in LHCb2

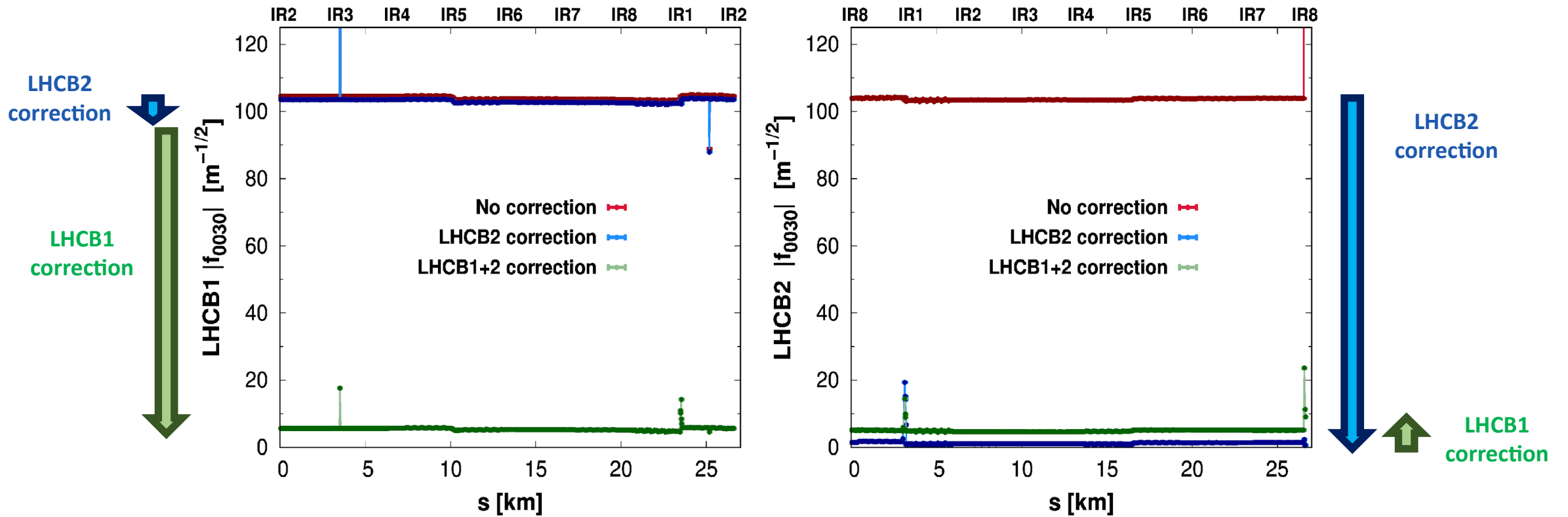
## Objectives:

- MD12263 showed good benchmarking of LHCb2 LRBB.  
→ for MD13547 want to study benchmarking of other beam
- MD12263 studied bunches experiencing full set of LRBB interaction → here would also aim to benchmark partial LR config



## Objectives:

- Find appealing corrections for LR-BB driven 3Qy in simulation.
- This MD would aim to make first tests of independent LHCb1/2 3Qy LR-BB corrections

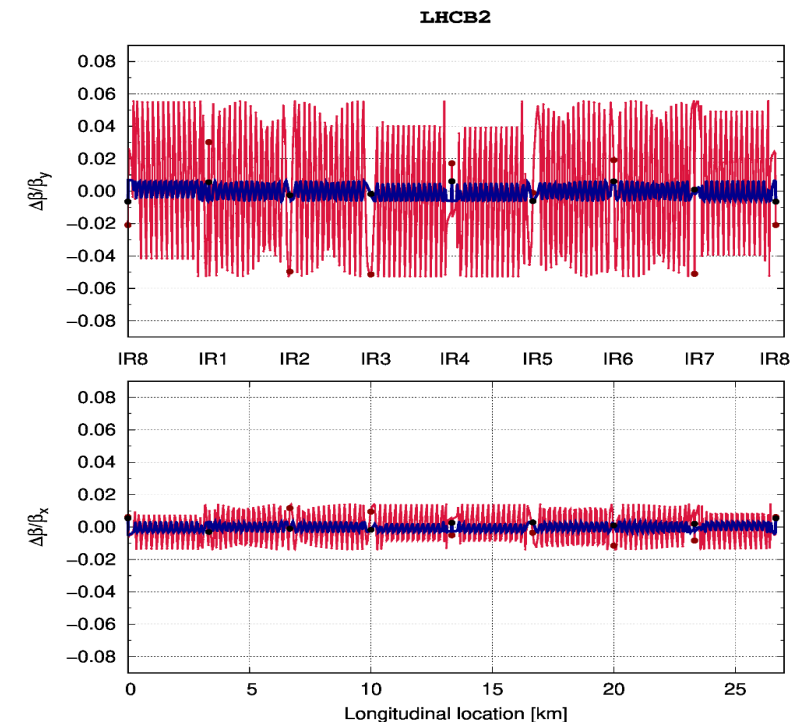


## Procedure:

- Similar operational procedure as MD12263.
- MD @ top energy, 30cm
- **Measure with AC-dipole:** kicking 3 weak pilots on 1 beam, while in collision with (unkicked) trains  
→ exact filling scheme TbD: 1 pilot with no collisions / 1 pilot with full LR in IP15 / 1 pilot with partial LR in IP15
- **Request 8h, for 2 ramps (similar to previous MD):** 1<sup>st</sup> ramp has weak beam (measurement) on LHCB1, 2<sup>nd</sup> ramp has weak beam (measurement) on LHCB2
- In each fill will test prepared 3Qy corrections on the corresponding measurement beam

## MPP:

- 3Qy corrections use common MCSSX: necessarily correction of measurement beam will change a3 correctors seen by strong beam (156 bunches as in previous MD)
- Predicted MCSSX 3Qy correction will generate up to 6% betabeat – to be corrected with quad trims
- Can we trim directly the MCSSX during the MD? Or do we need a fill with pilots in both beams to validate optics with MCSSX knobs first  
→ in this case we would request 12h to allow 3 ramps, with first for optics validation  
→ if not possible in schedule, request 8h but only study correction/benchmarking in LHCB1



## MD13545 – ballistic optics

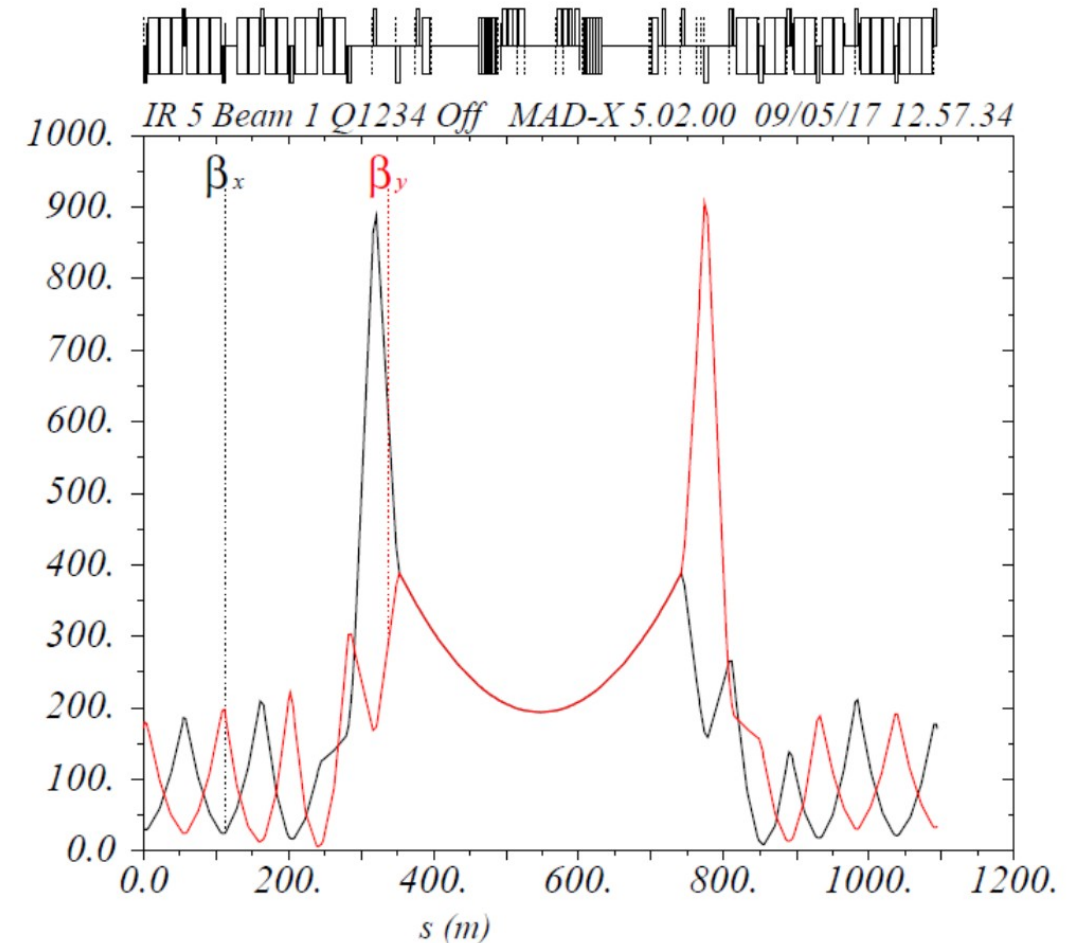
## MD13545 – ballistic optics

### Objectives:

- Perform beam-based calibrations of IR BPMs, including DOROS
- Compare to results from 2022 commissioning (without DOROS)
  - Check if calibration factors are drifting over the Run/LS ?
- help localize optics errors left/right of the IRs
  - input to help prepare for HL-LHC commissioning

### Procedure:

- Re-use the ballistic optics tested during 2022 commissioning
- ~2.5 hours is required for degaussing of the triplets (and IR5 Q4)
- inject/circulate pilots with the 2024 reference orbit and coarse collimator settings
  - Usual setup for optics measurements: safe beam flag, mask BLM, collimators, kickers (AC-Dipole keys), ATLAS BCM.
- Measure with AC-dipole: kicking 1 or 3 non-colliding pilots at 450 GeV and then ramp to top energy
- Request 10h: If everything works well 7h could be enough





## MD13548 – doughnut beams for detuning

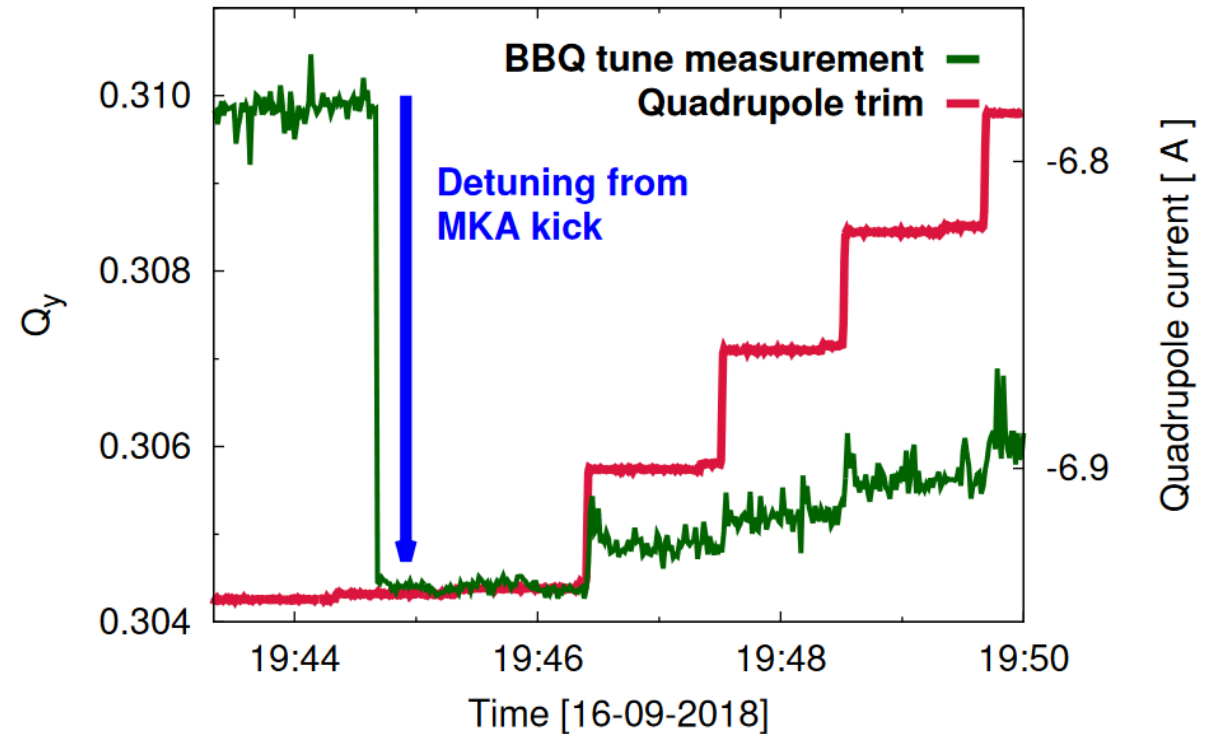
## MD13548 – doughnut beams for detuning

### Objectives:

- Amplitude detuning measurements are very time consuming to perform
- In old Run2 MDs we saw persistent tune shifts in the BBQ following MKA kicks
- Potential to use BBQ tune measurement to measure detuning of doughnut beams which have been allowed to decohere following kick with MKA → could be more rapid way of measuring detuning with octupoles
- Aim would be to test this in more detail: in particular try and measure detuning from shifts in octupole powering, by comparing tune change between doughnut and un-kicked pilots as circuits are varied

### Other objectives:

- Efficiency of RDT based optics corrections hampered by poor understanding / limited benchmarking of difference between forced-RDT (measured with AC-dipole) and free-RDT (measured after single kicks). Would take additional ACD kicks to allow comparison to RDT measured following the ACD kicks.



## Procedure:

- MD @ injection with pilots. Usual optics measurement setup, with NLO collimators.
- Request 4h
- Perform MKA kicks with pilots
- Measure at various working points, using MKA and ACD, to facilitate comparison of free- and forced- RDTs

## Time permitting:

- Prepare pilot doughnut by kicking MKA with coarse collimator settings. Inject single nominal bunch on other beam. Bring doughnut and nominal into collision to see if we can measure change in detuning from HO-BB at injection
- Prepare single pilot doughnuts in both beams (kicking MKA with coarse collimator settings). Try and ramp the pilots and doughnuts, to see if this can allow a continuous detuning measurement through the ramp, and at top energy.

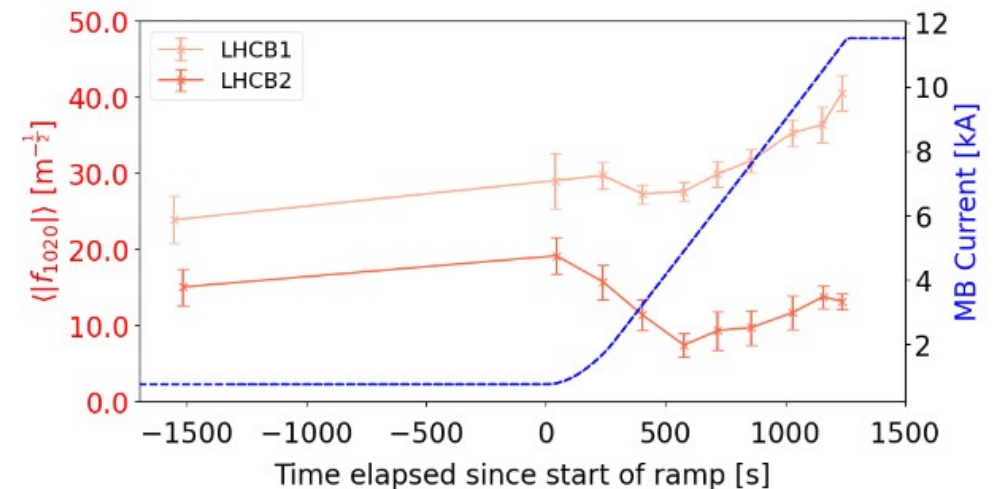
## MD13546 – decay and ramp RDT measurements

# MD13546 – decay and ramp RDT measurements

## Objectives:

- Nonlinear optics measurements in LHC have so far been performed almost exclusively in static machine configurations: injection after long time on plateau, 30cm, ...
- Interested to more effectively probe nonlinear optics during injection decays
  - test optics/RDT measurement procedure during dynamic periods
  - b5 magnetic model discrepancies believed to come from decay not corrected in fidel: would like to try and verify this is the case by observing b5 RDT decay
  - future colliders e.g. FCC anticipate large dynamic errors: would like to show we can measure these effects already in LHC by e.g. benchmarking b3 RDT decay model
- Interested to begin to study nonlinear optics and RDT changes in the RAMP
  - parasitic measurements during linear optics commissioning already show few large RDT changes during the ramp
  - ramp measurements in commissioning very conservative to avoid losing beam before progressing with squeeze commissioning, limits RDTs seen
  - Dedicated high-amplitude kicks at high-repetition in ramp
  - could help define incorporation strategy for nonlinear corrections in future

Large coupling RDT decay measured during commissioning



## Procedure:

- MD @ injection/ramp with pilots
- Needs to be performed after pre-cycle or previous ramp
- **Request 3h for (1 decay + 1 ramp)**
- Usual setup for optics measurements with NLO collimators at injection
  - everything should be well setup in advance of going to injection as want to kick with ACD straight way (first minutes after reaching plateau)
  - kick repeatedly with ACD during decay period. Re-injection may be required if beam intensity drops too low
  - to limit losses and maximize kick aperture want small-emittance pilot from injectors
- Kick regularly with AC-dipole during the decay period. Pause FIDEL prior to injection to allow measurement of b3 decay directly. Feed-backs should be enabled during the optics measurements – relying on automatic functionality in multiturn to disable only during kicks.
- After decay mostly over, reenable fidel, inject 3 pilots / beam and ramp with coarse collimators. WP to be selected.
  - kick regularly with AC-dipole at maximum amplitude until limited by losses
  - kick regularly with 40k turn ADT-ACD to get additional granularity in optics measurements

## Extension Option:

- We would like to probe at additional Working Point, which doubles the MD-time
- **Request an additional 3h for (1 decay + 1 ramp), if MD-planning permits**