



# Method for phase advance and aperture margin validation between IR6 and IR5 TCT for machine protection

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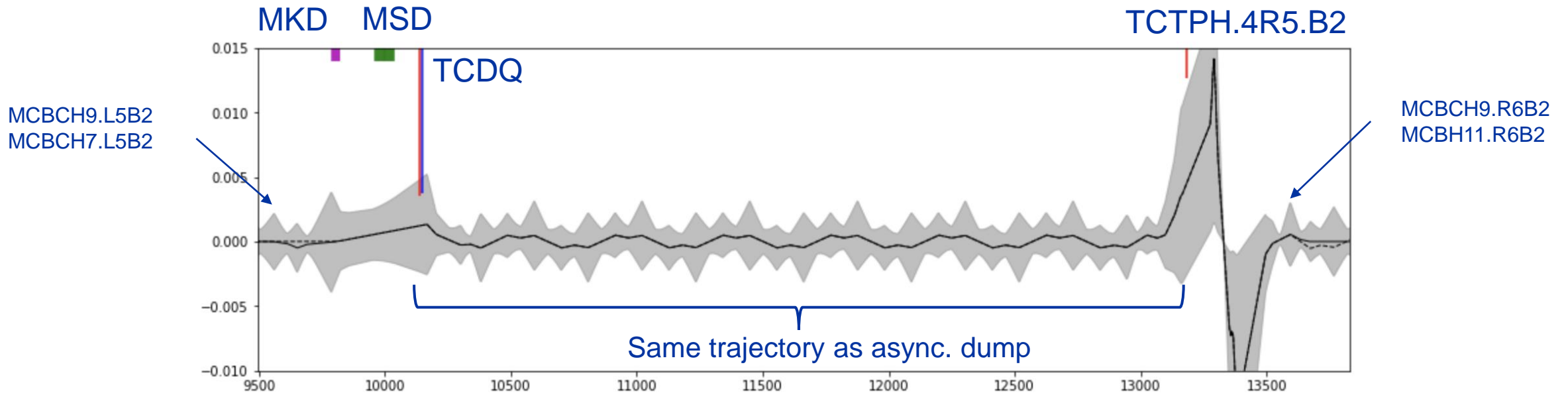
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# Outline

- **Method and objectives**
- **Results from 2022 MD (MD #7008)**
- **Proposal for 2023 commissioning**
- **Conclusions and outlook**

# Method and objectives

- **Validate the retraction of the TCT in IR5 with respect to the TCDQ / TCSP**
  - Direct method to provide information about the correct phase advance for the most critical MKD - TCT relation for Beam 2 using a closed bump and BPM readings
  - Uses a **long closed-orbit bump extending from IR6 to IR5** for Beam 2 with circulating beams
  - Validate correct protection of the TCT from direct impact in case of asynchronous dump
  - Provides additional **aperture margin measurement** from optional beam-based collimator alignment



# Results from 2022 MD (MD #7008)

- Extend results from MD #2186 (2018) where the method was tested and validated for nominal optics
- Validate the method with intentionally detuned phase advance between IR6 and IR5
- **Collimator BPM readings provides direct information on IR5 TCT retraction margin** in case of asynchronous dump

Optics		Amplitude at TCSP ( $\sigma$ )	Amplitude at TCT ( $\sigma$ )	Loss of TCT retraction in case of ASD ( $\sigma$ )
Nominal	Measured	3.0	1.5	3.65
	Model	3.0	1.4	3.4
Detuned using MQ45-56	Measured	3.0	2.1	5.11
	Model	3.1	2.4	5.65

Results from MD #7008

# Proposal for 2023 commissioning

- **Perform the measurements at all lumi-levelling optics steps from 120 cm to 30 cm (matched points) for Beam 2 TCT in IR5**
  1. Perform **BPM-based measurement** for all lumi-levelling optics from 120 cm to 30 cm for Beam 2 in IR5
  2. In case non-nominal situation is found, perform **beam-based alignment** to obtain direct measurement of aperture margin
  
- **2023 commissioning to serve as reference data**
  - Data will be complemented and validated against direct phase advance information from OMC measurements and will serve as reference data for these optics
  - Measurements to be **repeated after Technical Stops** and compared against the reference data set

# Proposal for 2023 commissioning

- **Bump knob coefficients computed for all optics and ready to be shared**
- **Procedure, using pilot bunch**
  - For a given optics matched point (given  $\beta^*$  value)
    1. Switch off the orbit feedback
    2. Increase the amplitude of the bump to  $1.5 \sigma$  at the TCSP (in steps of  $0.3 \sigma$ )
    3. Assess the closure of the bump
      - In case the bump is not closed, close it using orbit correctors outside the bump region (as tested during MD #7008)
    4. Use collimators DOROS BPMs at the TCSP.A4L6.B2 and TCTPH.4R5.B2 to read the bumped-orbit amplitude
    5. Validate nominal conditions with online comparison with the model
    6. Collapse the bump
    7. Switch the orbit feedback on
    8. Proceed to the next  $\beta^*$  step

# Conclusions

Two MDs validated that this method provides the information about the correct phase advance for the most critical MKD - TCT relation for beam 2 using a direct method.

## ➤ Past MDs (#2186 and #7008) tested and validated the method for nominal and non-nominal optics conditions for Beam 2 in two steps:

1. Collimator BPM data provides direct information on the IR5 TCT retraction margin in case of asynchronous dump
2. Additional TCSP and TCT beam-based alignment provides direct information on aperture margin

## ➤ 2023 commissioning and upcoming TS

- Perform **step 1** for all lumi-levelling optics from 120 cm to 30 cm for Beam 2 in IR5
- In case non-nominal situation is found, perform **step 2** for that optics to obtain direct measurement of aperture margin
- Data will be complemented and validated against direct phase advance information from OMC measurements and will serve as reference data for these optics
- Measurements to be repeated after Technical Stops and compared against the reference data set

Thank you very much for your attention!



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