
CERN

Simulations and Measurements of Long Range Beam-Beam Effects in the LHC

Coronagraph implementation choice of beam

E. Bravin, A. Goldblatt, G. Trad
CERN – BE/BI

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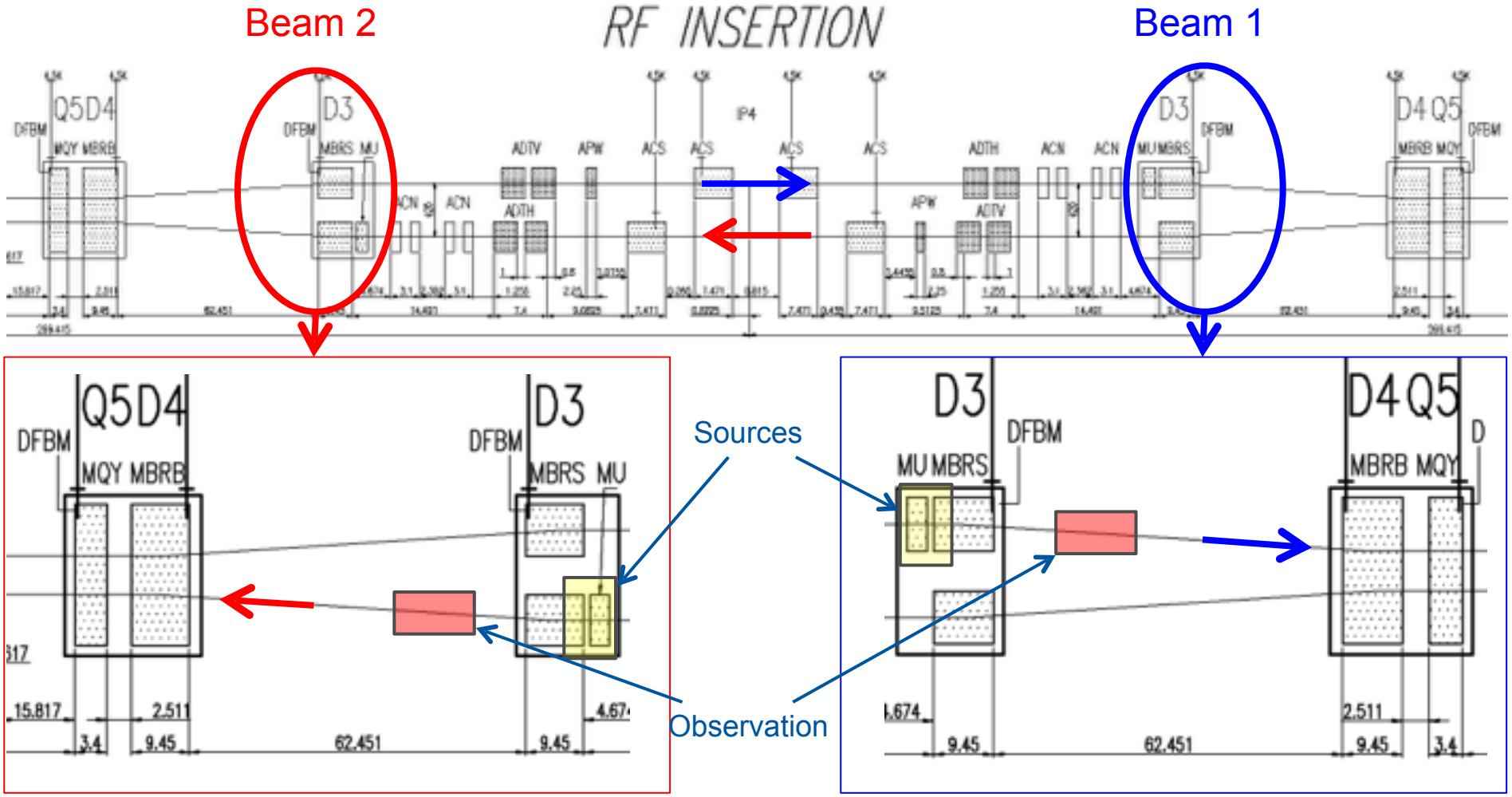
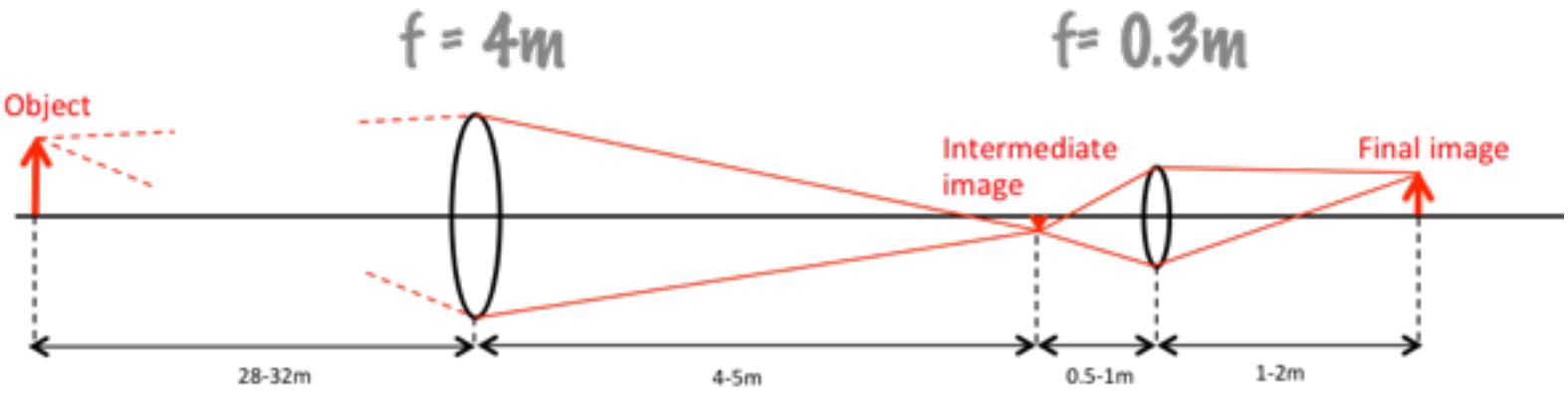
Outline

- The synchrotron radiation monitors of LHC
- Differences between B1 and B2
- Light sources at 450 GeV and 6.5 TeV
- Schedule and constraints

LHC IR4

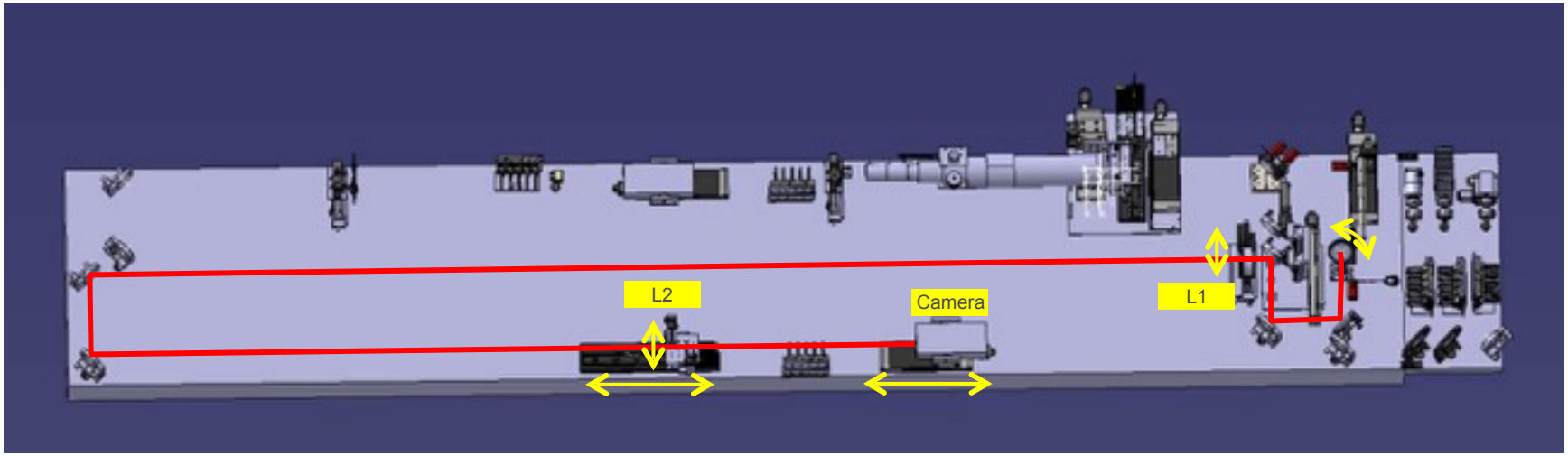

Beam 2
RF INSERTION
Beam 1
Q5D4
DFBM
MQY MBRB
D3
DFBM
MBRS MU
IP4
ADTV
APW
ACS
ACN
ADTH
D3
DFBM
MU MBRS
D4 Q5
DFBM
MBRB MQY
Sources
Observation
15.817
2.511
3.4
9.45
62.451
9.45
4.674
2.511
9.45
62.451
9.45
3.4

The BSRT in short



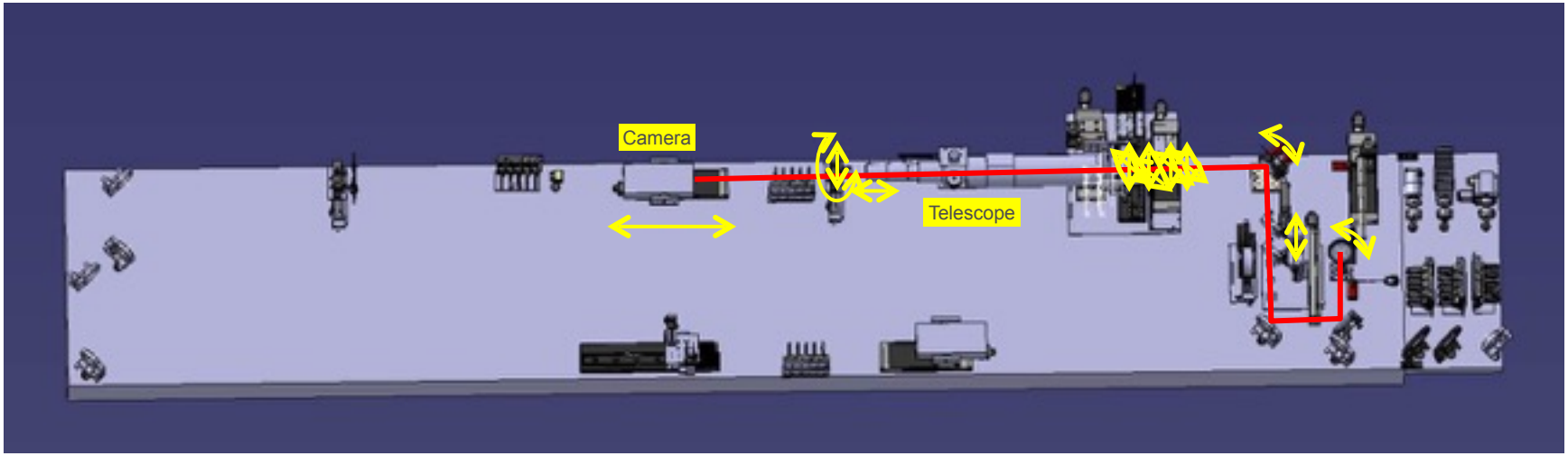
A telescope that images the synchrotron light emitted by the beam

Real BSRT - Imaging



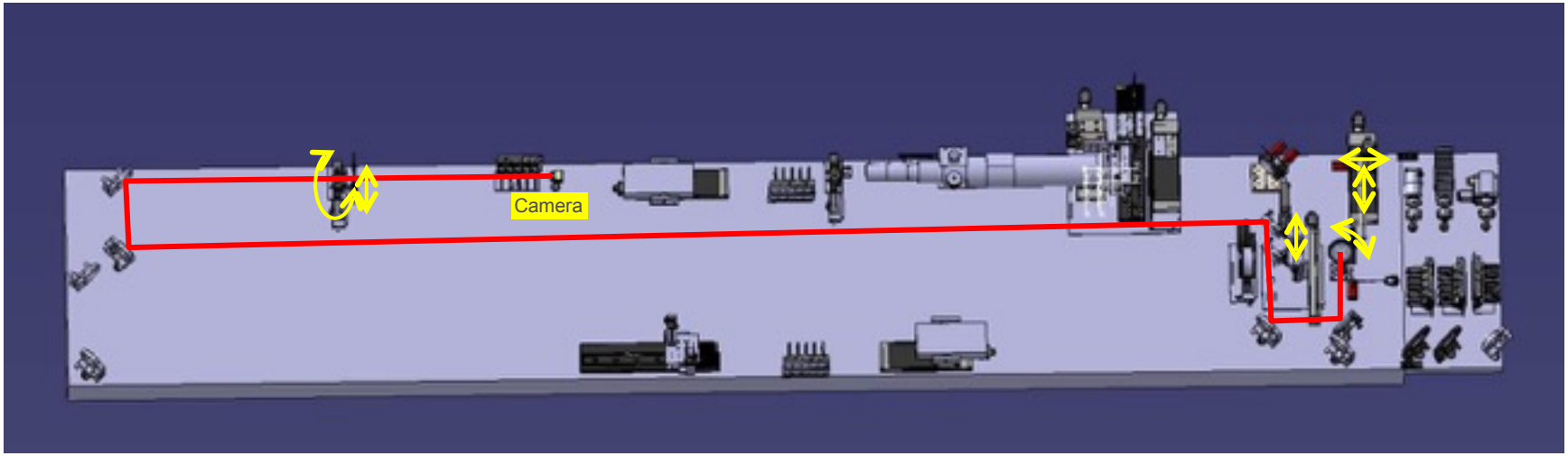
- Adjustable telescope for two wavelengths (400nm and 250nm)

Real BSRT - Interferometer



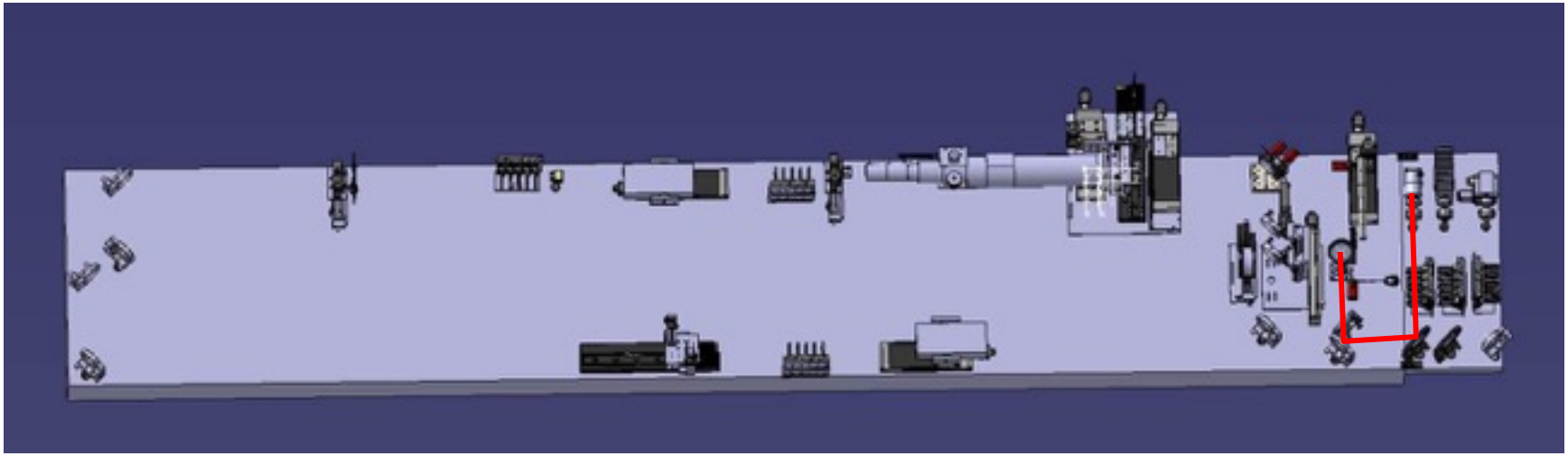
- Adjustable telescope for two wavelengths (400nm and 250nm)
- Two slits interferometer

Real BSRT – Shack-Hartmann



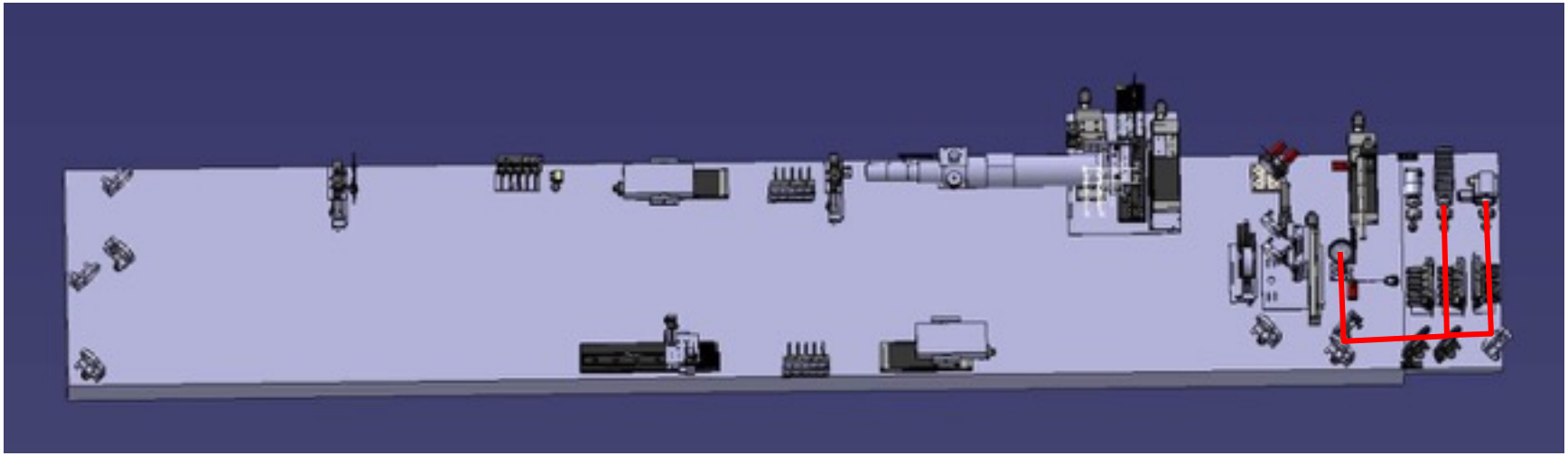
- Adjustable telescope for two wavelengths (400nm and 250nm)
- Two slits interferometer
- Shack-Hartmann wave-front sensor (monitor mirror deformations)

Real BSRT - AGM



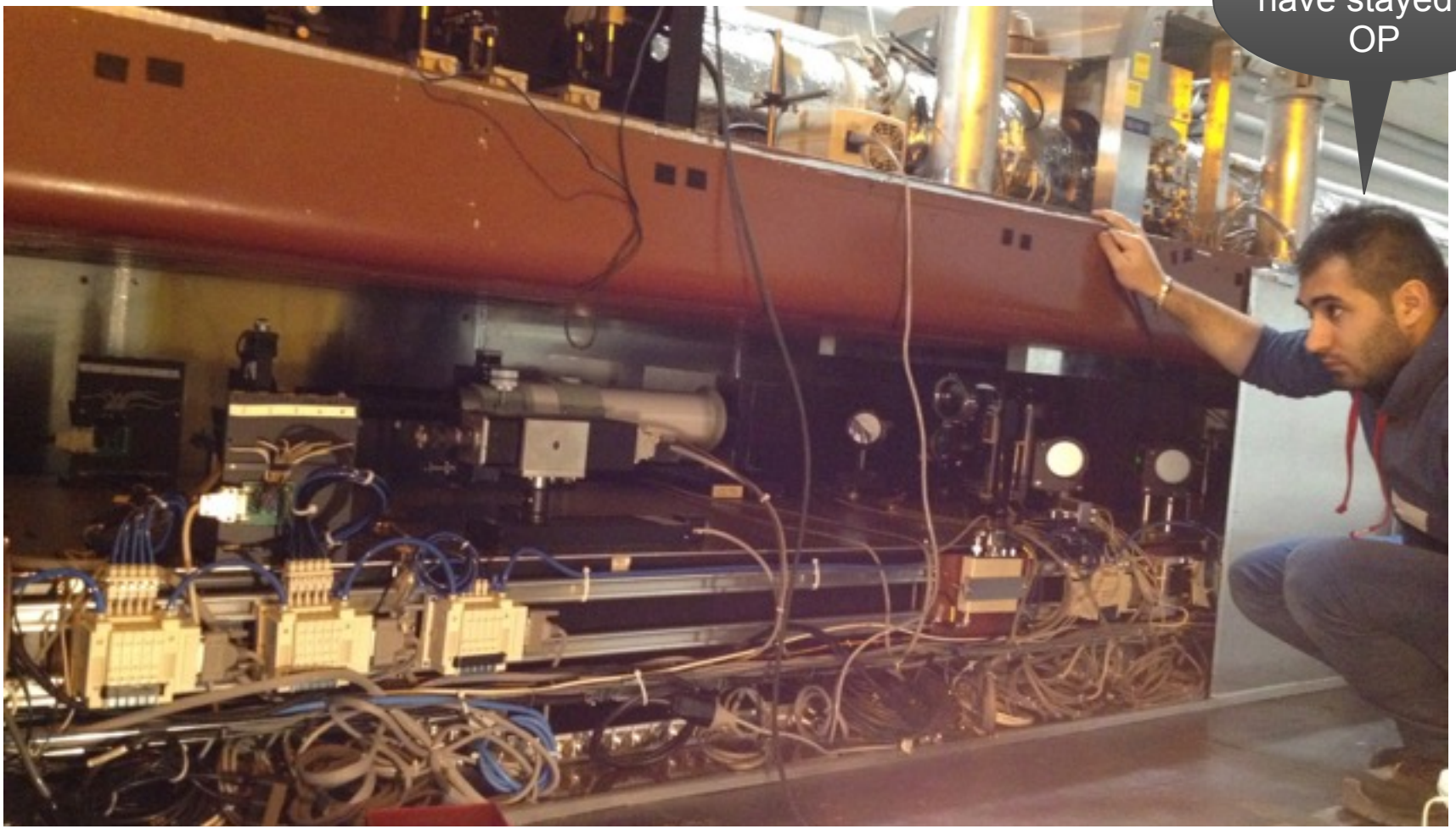
- Adjustable telescope for two wavelengths (400nm and 250nm)
- Two slits interferometer
- Shack-Hartmann wave-front sensor
- Gated MCP-PMT for abort gap monitoring

Real BSRT - LDM



- Adjustable telescope for two wavelengths (400nm and 250nm)
- Two slits interferometer
- Shack-Hartmann wave-front sensor
- Gated MCP-PMT for abort gap monitoring
- Avalanche photo diode and/or hybrid PMT for longitudinal density monitor

BSRT hands on



BSRT hands on

BSRT hands on

B1 vs. B2 – Present HW

B1

- Imaging
- Interferometry
- Shack-Hartmann
- AGM
- LDM

B2

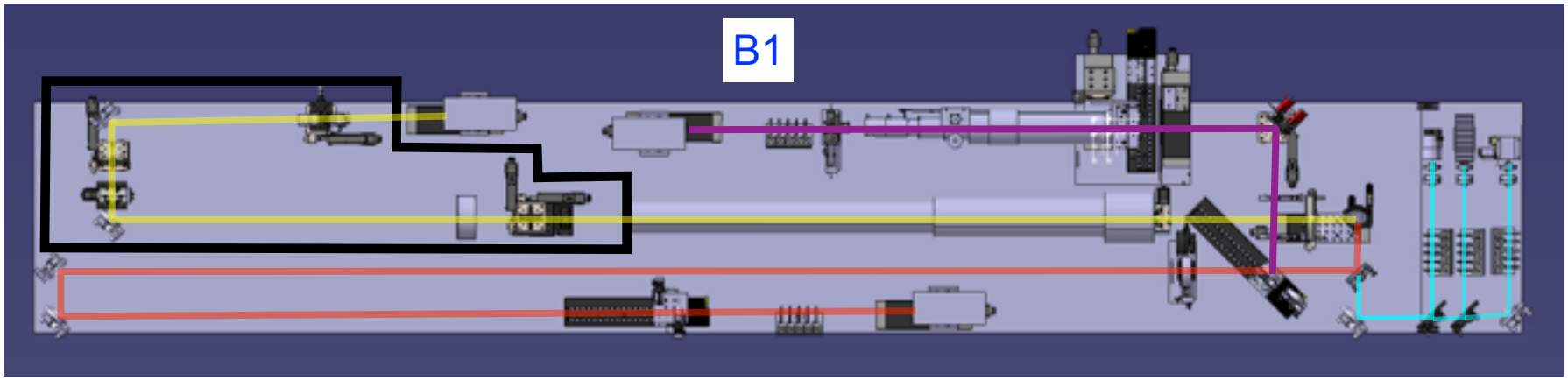
- Imaging
- Calibration line
- AGM
- LDM

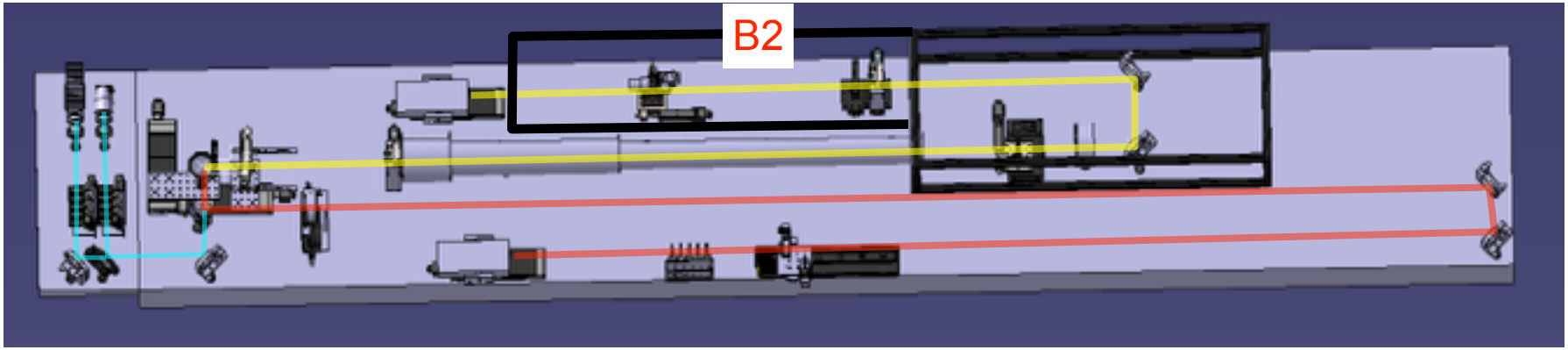
The coronagraph

Size matters!

It will take up most of the space and render access difficult

B1 vs B2 - Layout





B1 vs. B2 – Modification

B1

- Remove Shack-Hartmann
- Redesign coronagraph black box

B2

- Remove calibration line

B1 vs. B2 – Comparison

B1

-- No access to interferometer

- No Shack-Hartmann

- Large number of motors

+ External calibration line

+ Can use PC of BSRI?

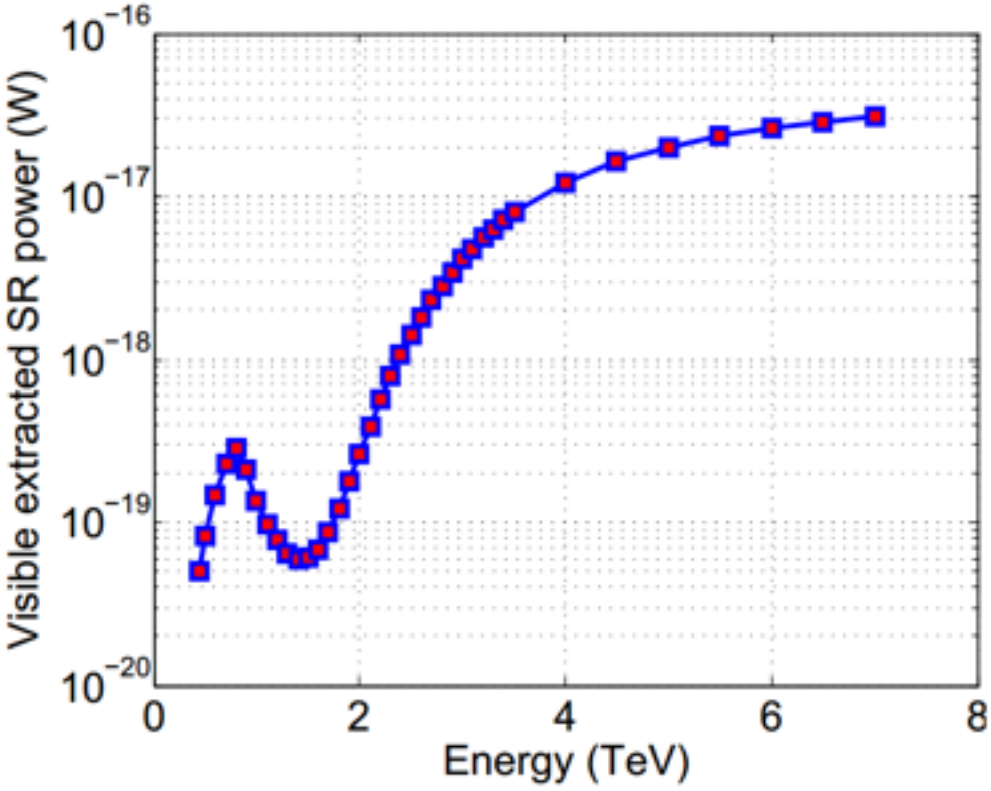
B2

-- No calibration line

+ More space / less constraints

Light emission

- About 3 orders of magnitude between 450 GeV and 6.5 TeV considering full visible range
- At 450 GeV just enough light for pilot bunch single turn measurement
- For 10^5 DR with 10^{11} p @ 450 GeV need to integrate ~500 turns·bunches i.e. 50 ms with single bunch and gating at 11 kHz



Camera

- Ideally camera similar to the one of the BSRI (Andor Zyla 5.5 + Hamamatsu intensifier)
- Will place an order for 5 cameras (BSRT, Halo, SPS) >200 kCHF
- Long lead time for the intensifier (>4months)
- Will take a while with FI as well…
- Need a temporary solution
  - Old Proxivision S/N much worse (like BSRT)
  - Digital non intensified camera

Schedule

- All major work on BSRT has to be terminated by beginning of February.
- To install coronagraph need to extract the optical table, install the optical components then reinstall and align the table.
- Cables already ordered (motors and camera), should be OK for both beams (to be confirmed)

Constraints

- IR4 to RF on 22 February!
- If installing on B1 need extra margin to allow fixing eventual issues on interferometer (need to extract the table again)

Conclusions

- Installation of coronagraph possible on both beams
- Schedule is quite tight, need to decide before start of YETS
- Installation on B2 would be easier and would have less impact on the BSRT
- Can not get the camera for this year, need to decide on a backup solution