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Operation of the new synchrotron radiation extraction

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MPP 1 April 2022

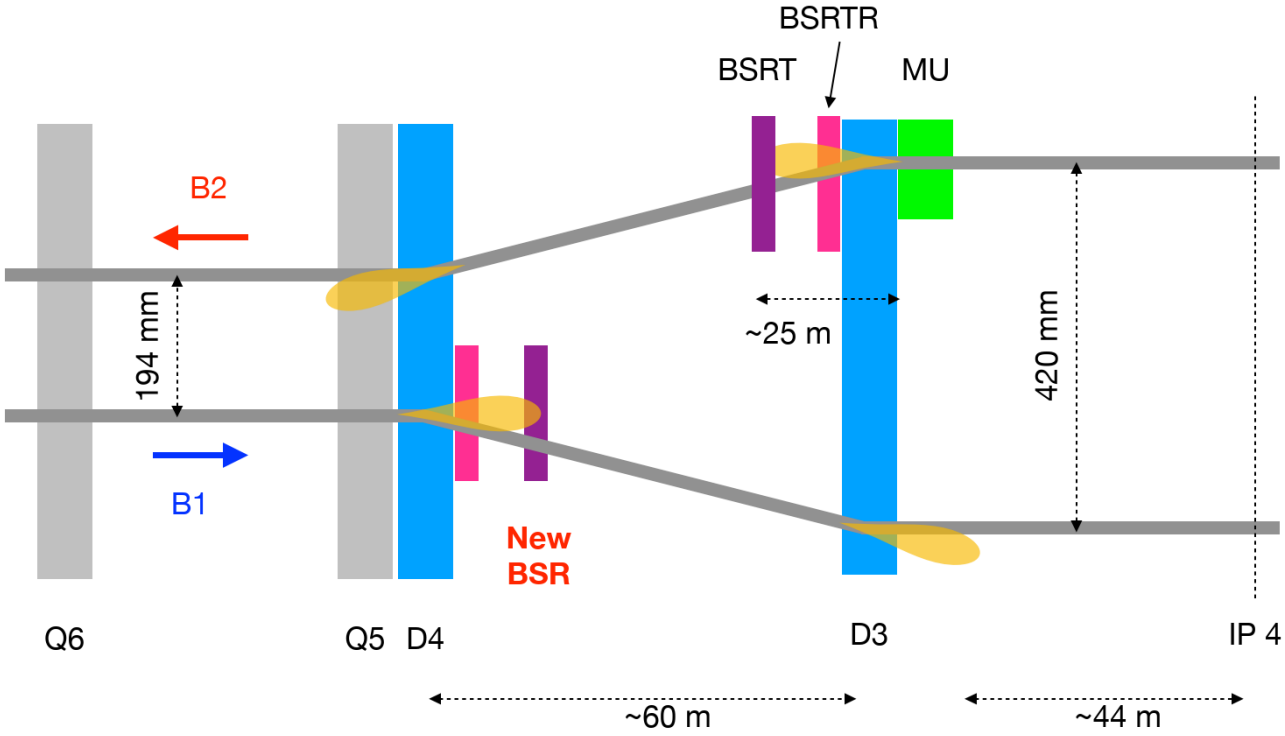
New BSRTM motivations

- For the HL-LHC era the synchrotron radiation based diagnostics need to be extended
- Need a second SR extraction point
- Identified location requires a new tank design
  - Taking advantage to improve functionalities

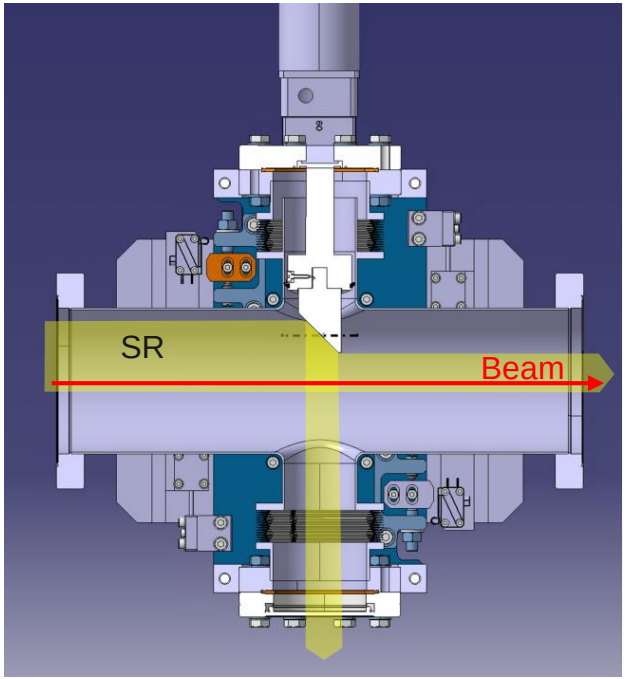
Scope of present installation

- Verify with beam that the RF heating is under control
- Study the properties of the new SR source
- Validate the design in general
- One device (B1 in 4L) is sufficient for this
- ECR document https://edms.cern.ch/document/2610870/1.0

New SR source(s) location



New BSRTM



New source timeline

- Design and install new extraction tank ✓
- Validate RF impedance ✓
  - Simulations, stretched wire, beam tests
- Enlarge beam pipe between D4 and new BSRTM <LS3
- Install shielding, optics and instruments LS3

Aperture restriction

- Mirror can be moved IN/OUT
  - Max IN ~11mm from beam axis
  - Max OUT ~35mm from beam axis
- Mirror can become an aperture restriction
- Need to control and interlock the actuator that controls the position of the mirror
- Mirror will be always placed in safe position

Beam aperture at injection

- Aperture limits calculated by APB
  - emittance_norm = 2.5e-6 um
  - sigma error = 5%
  - dispersion error = 14%
  - orbit_error = 0.002
  - energy = 450 GeV
  - energy_error = 0.00086
  - N1 = 13 sigma

	BSRTM.5L4.B1	BSRTM.5R4.B2
Aperture [mm]	**22.9**	22.9
Beta x [m]	**381.2**	381.2
Beta y [m]	263.4	243.1
Sigma x [mm]	**1.409 (16.2 sigma aperture)**	1.409 (16.2 sigma aperture)
Sigma y [mm]	1.172	1.1255

Beam aperture at FLATTOP

- Aperture limits calculated by APB
  - emittance_norm = 2.5e-6 um
  - sigma error = 10%
  - dispersion error = 10%
  - orbit_error = 0.002
  - energy = 6500 GeV
  - energy_error = 0.0002
  - N1 = 20 sigma

	BSRTM.5L4.B1	BSRTM.5R4.B2
Aperture [mm]	**11.2**	11.2
Beta x [m]	**381.2**	381.2
Beta y [m]	263.4	243.1
Sigma x [mm]	**0.371** **(30.2 sigma aperture)**	0.371 (30.2 sigma aperture)
Sigma y [mm]	0.308	0.296

Actuator

- Actuator controlled by stepping motor
  - Resolver on motor axis
  - Two limit switches to limit the stroke and indicate the fully retracted/inserted position
  - Two linear potentiometers that monitor real position of mirror support
  - Mechanical stop limits insertion to ~10 mm (can be adjusted)

Control

- Motor, resolver and potentiometers controlled by two PXI (Motion and potentiometer) systems from BE-CEM
- StepperAxis FESA class
- Mirror position controlled by sequencer tasks
- Position vs. energy limits stored in LSA as MCS
- Mirror temperature monitor by SY-BI FESA class and logged in NXCALS
  - One probe inside mirror itself
  - One probe on mirror support (both inside vacuum)

Interlock

- The interlock is based on the potentiometer readings
  - Two redundant sources (two FESA devices)
- If the position read is outside of limits a maskable BIS channel is triggered
  - Limits are functions of beam energy
    - For now we only need one value < FT and one value >= FT
  - MCS role allowed to change the settings?

Operation

- Before injection mirror sent to injection position: 23mm + δ
- At FLATTOP (after end of ramp) mirror sent to FT position: 11.2mm + δ
- δ to be determined based on readout noise of potentiometers (avoid spurious dumps)

Conclusions

- A new BSRTM device has been installed for validation
- New design can pose aperture restriction danger
- Actuator position precisely monitored and connected to BIS
- Safe position values calculated by ABP vs. energy
- System fully installed
- Software configuration ongoing (LSA, sequencer etc.).
- MP document being prepared.

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