D1 BPM and aperture

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D1 BPM

Sources of dipole errors

Without BPM in D1 unobservable close bump:
- Assuming 20 units transfer function error and 1 mrad tilt: orbit error 320 µm (inj.) and 32 µm (flat top)

For statistically distributed error at flat top, it is possible to restore the correction performance by updating the strategy (more weights on the BPMs close to D1)

BPM useful for redundancy or large than expected errors
Aperture at edge of D1 cold mass already at the limit.

Envelope not symmetric, misalign D1 towards the outside of the machine helps.
New D1 B.S.

Design criteria:
All apertures should be in the shadow of the triplets by >0.5 σ, ideally.

<table>
<thead>
<tr>
<th>Aperture [σ]</th>
<th>Round Optics</th>
<th>Flat optics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triplet</td>
<td>13.1</td>
<td>12.7</td>
</tr>
<tr>
<td>D1 Magnet</td>
<td>13.9 (+0.8)</td>
<td>13.0 (+0.3)</td>
</tr>
<tr>
<td>D1 BS 81826</td>
<td>13.5 (+0.4)</td>
<td>12.7 (0)</td>
</tr>
<tr>
<td>D1 BS 82386</td>
<td>13.3 (+0.2)</td>
<td>12.5 (-0.2)</td>
</tr>
<tr>
<td>New BS 82386</td>
<td>13.8 (+0.7)</td>
<td>12.9 (+0.2)</td>
</tr>
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</table>

Increased aperture restore aperture hierarchy by ~0.5 σ
Further improvement

Further gain could be achieved by increasing the aperture by misaligning D1 by ~1.5 mm inside the ring. Consequences to be evaluated.
Alignment options

External

CP

↑ 1.5 mm

D1

Internal

External

CP

↑ 1.5 mm

D1

Internal

~0.2 mrad
Back-up
Summary of strengths with remote alignment

Knobs and correction for:
- ±295 µrad crossing angle in H/V plane (H in the figure)
- ±0.75 mm separation in V/H plane (V in the figure)
- ±2 mm IP offset Q1-Q4 displaced by 2 mm + Q5 1 mm + and correctors
- ±0.1 mm IP movement independent for B1/B2 for luminosity scan
- 2σ correction of ±0.5 mm residual quad. misalignment and ±0.5 mrad dipole tilt.
- Short range orbit adjustments (±0.2 mm CC adjustment)

Assume remote alignment for IP shift and orbit corrector minimization during beam commissioning.