Stability and New Operating Modes

G. Decker

- 24-bunch mode
- ID xbpm feedforward / feedback implementation status and plans
- Insertion device gap control algorithm

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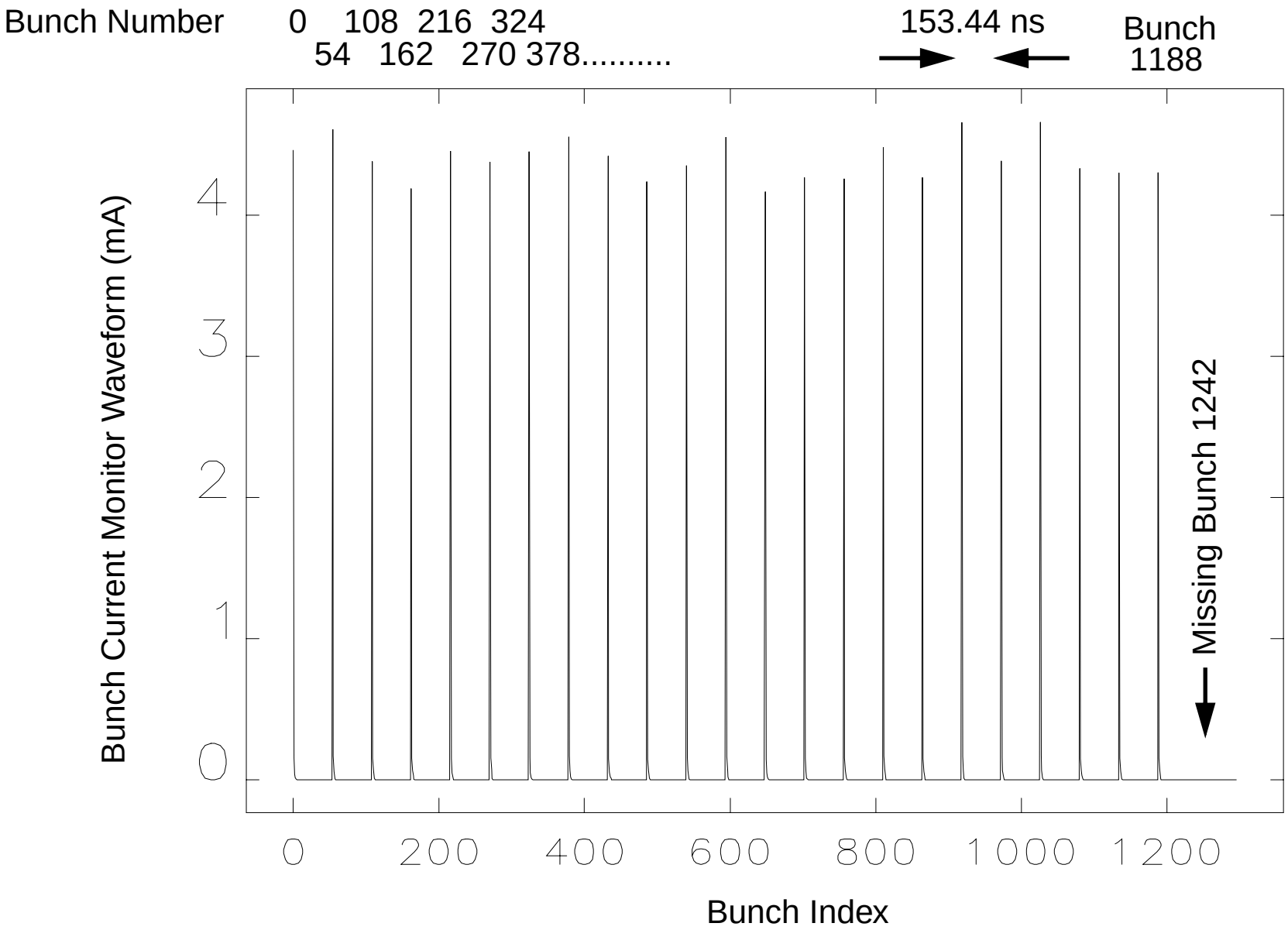
23-Bunch Fill Pattern from Bunch Current Monitor



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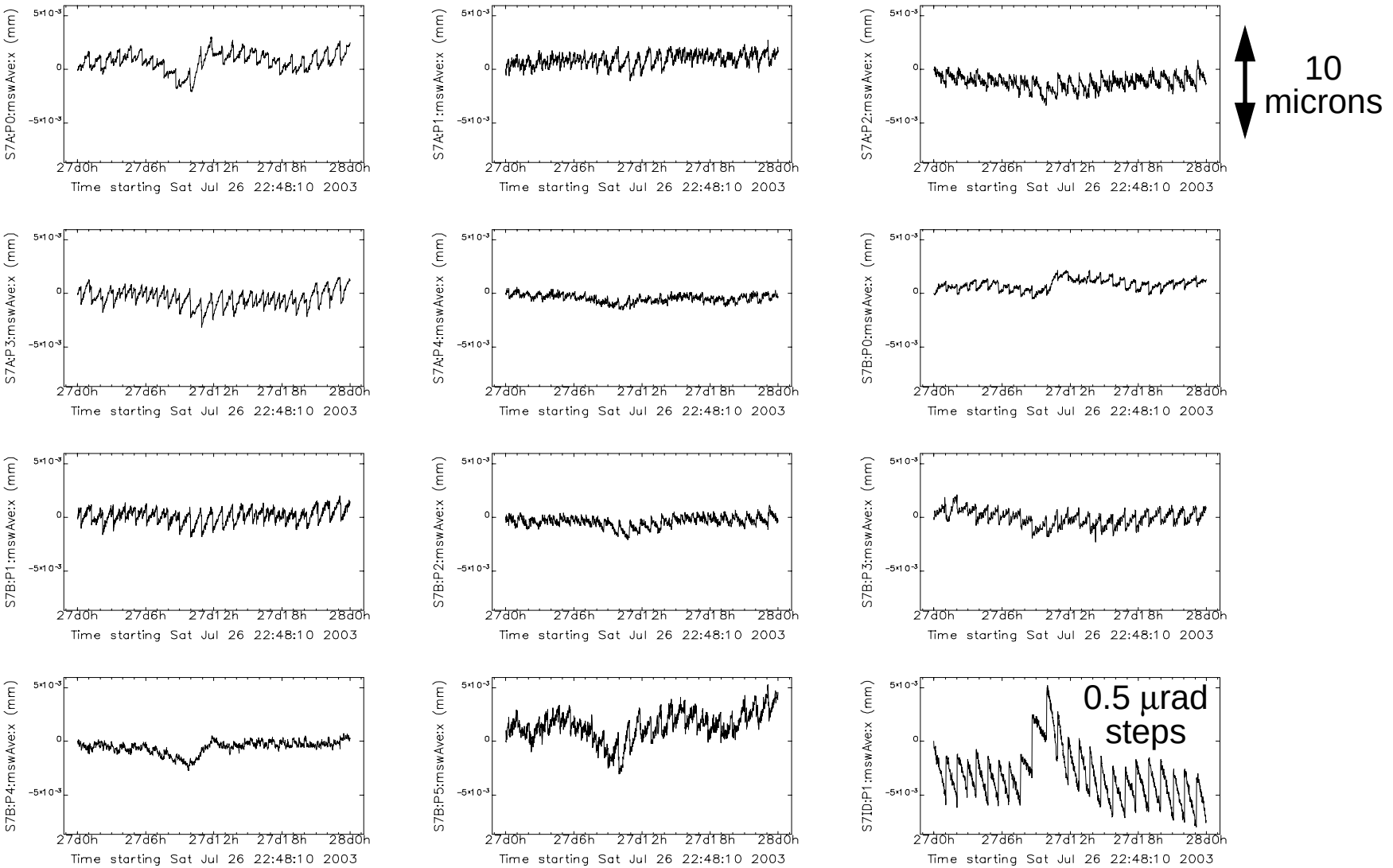
Some History

- Original monopulse RF beam position monitoring system utilized a beam-derived trigger
  - Trigger walk caused unacceptable bunch current dependence - 20 to 50 microns / fill
  - A new trigger system employing ASD-CTL bunch clock generator design was commissioned in early 2001. This was responsible for an order of magnitude improvement in beam stability.
  - The capability to sample all bunches and generate a bunch-averaged beam position signal was included in the design phase of this upgrade. This timing mode is known as cogging.
  - Perhaps two individuals in the world know how to make this work at the nuts and bolts level. I'm one.
  - Cogging was intended to eliminate systematic errors associated with small variations in fill pattern during top-up in the 23 (or 24) bunch operating mode. Specifically, every hour or so bunch zero receives a pulse from the injector equal to approximately 1 mA. This represents a 20% step change in bunch current. This step change induces an apparent few-micron change in the monopulse beam position readbacks.
  - Cogging is already used for the 324-bunch mode, due to unavoidable bunch pattern variations from fill to fill.

52 Minute Correlation of Horizontal Orbit Motion and Injection into Bunch Zero
Beam Position Monitors in Sector 7



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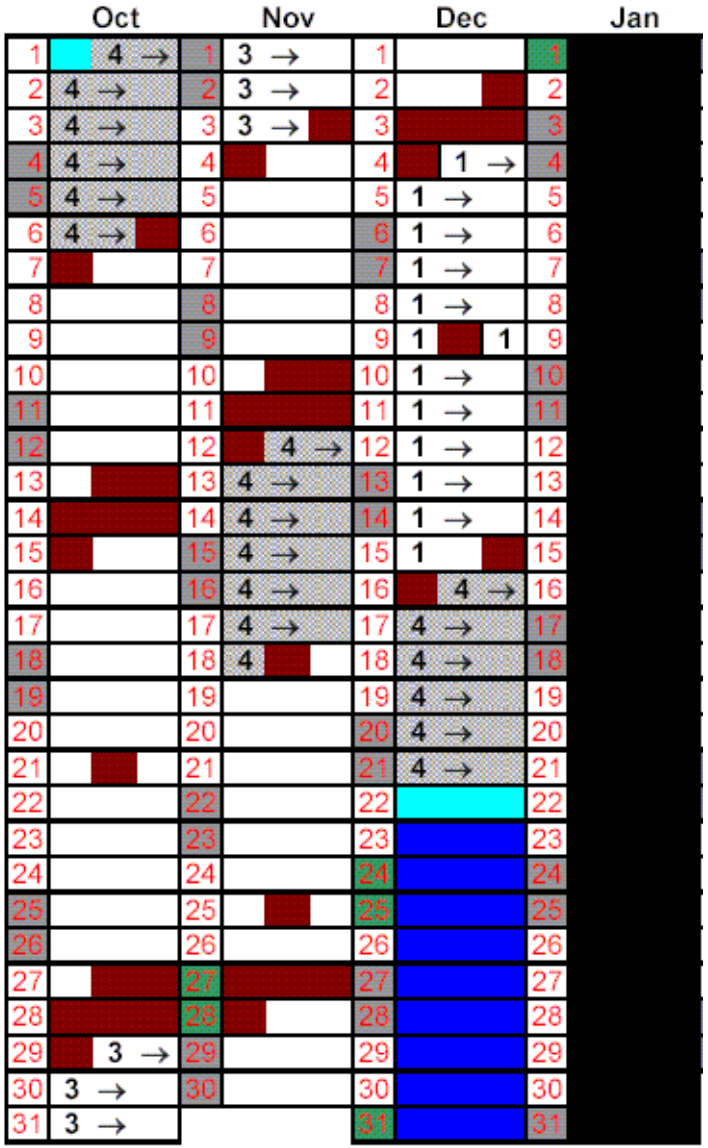
24-Bunch Operation Proposal

- Implement cogging asap (today) (I'm writing this two days ago so by then this should be true)
- Achieve stable steering configuration during Run 2003-3 week 2 using 23 bunch mode.
- Changeover to 24-bunch mode during the 48 hour machine study / intervention period October 13-15

23 Singlets Top-up →

24 Singlets Top-up →



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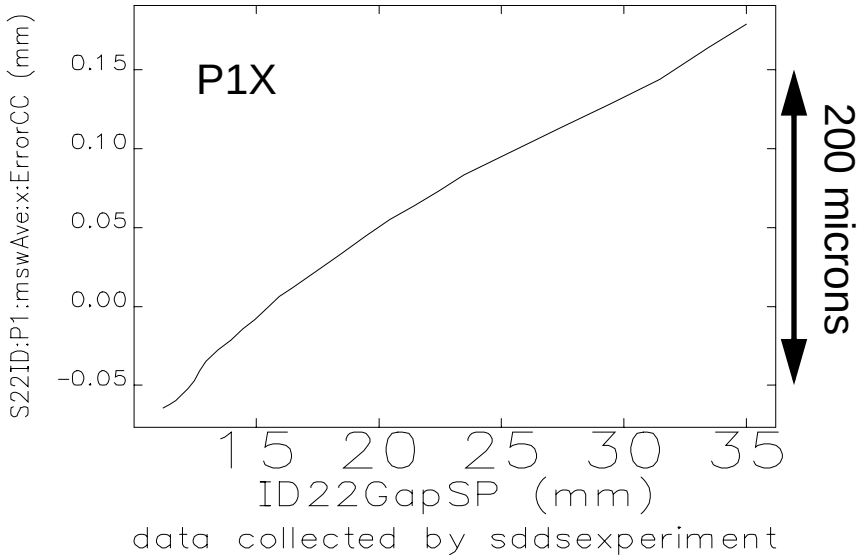
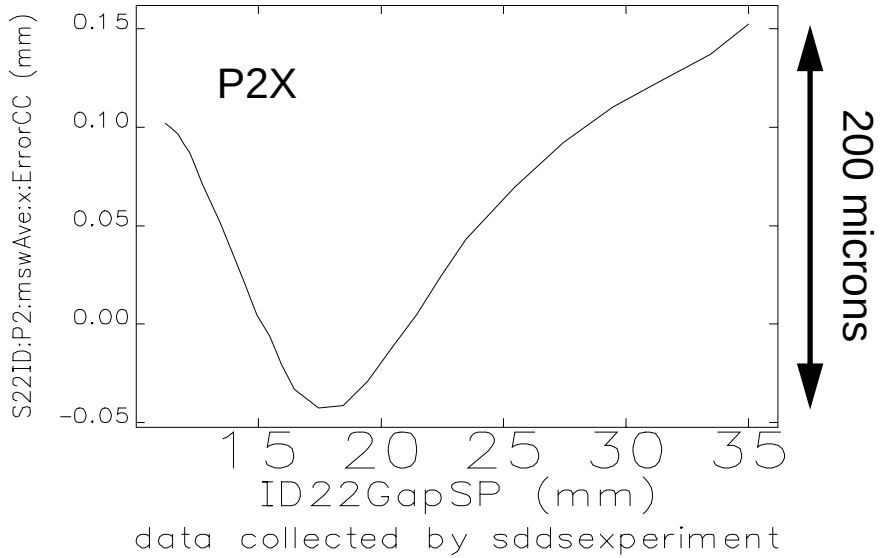
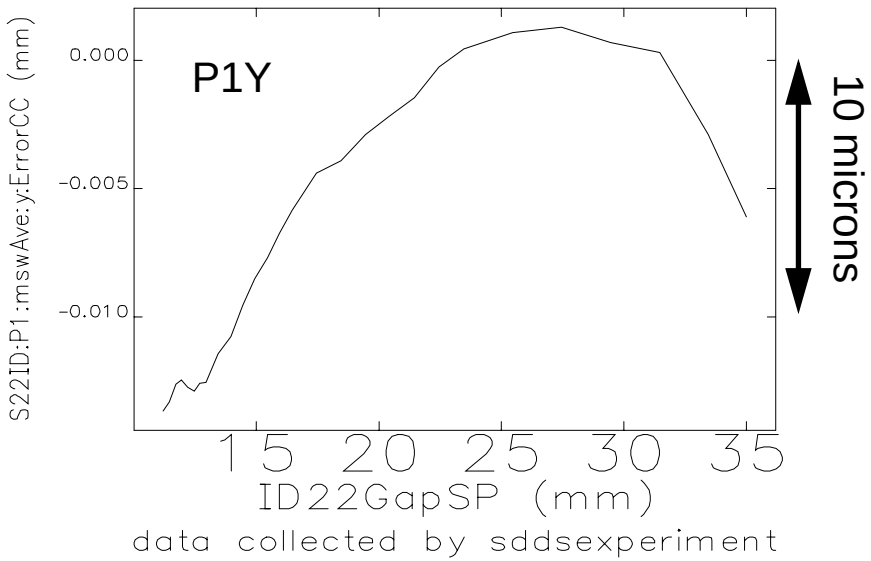
Insertion Device X-ray BPM Feedback / Feedforward Implementation Status

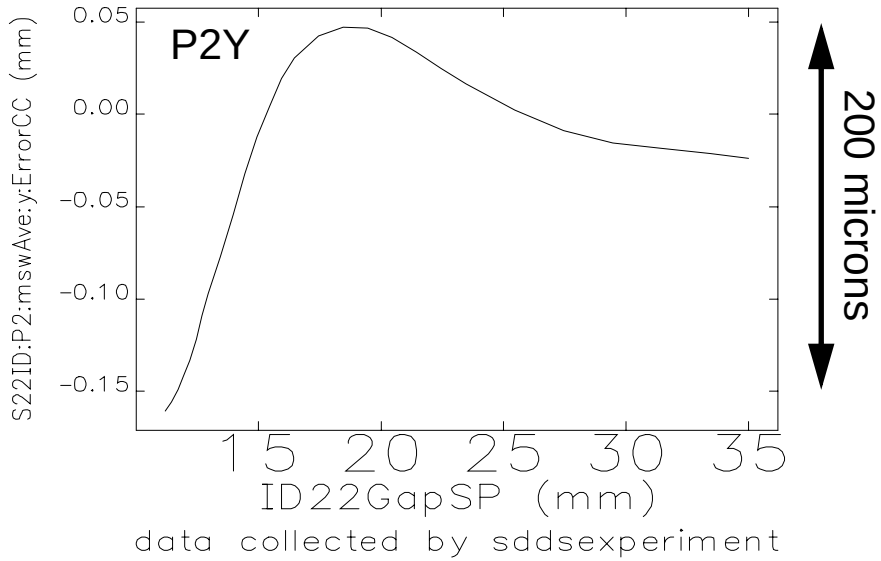
- X-ray beam position monitors in beamlines 18 ID, 22 ID, and 34 ID have been used for DC orbit control, at 10 Hz, since July 16.
- A background feedforward process compensates for residual x-bpm gap-dependent systematic errors.
- The orbit correction algorithm stops if the insertion device gap is too large.
  - Signal / noise ratio < 1 past about 30 mm gap (approx. 13 keV)

S22 ID Gap Scan, Closed Loop using RF bpm's









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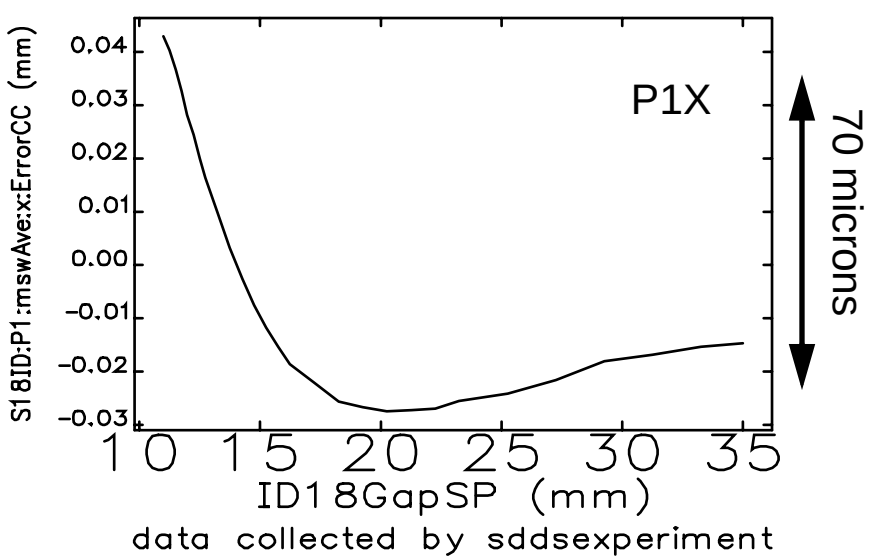
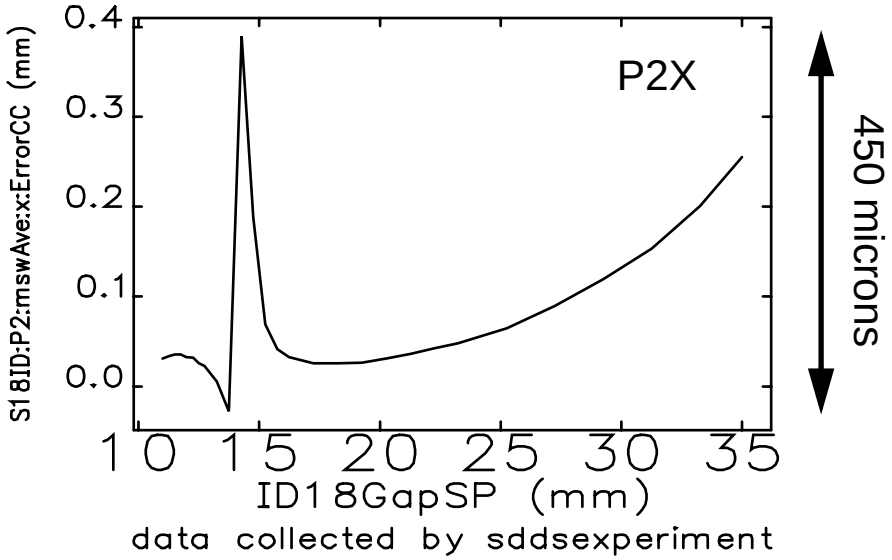
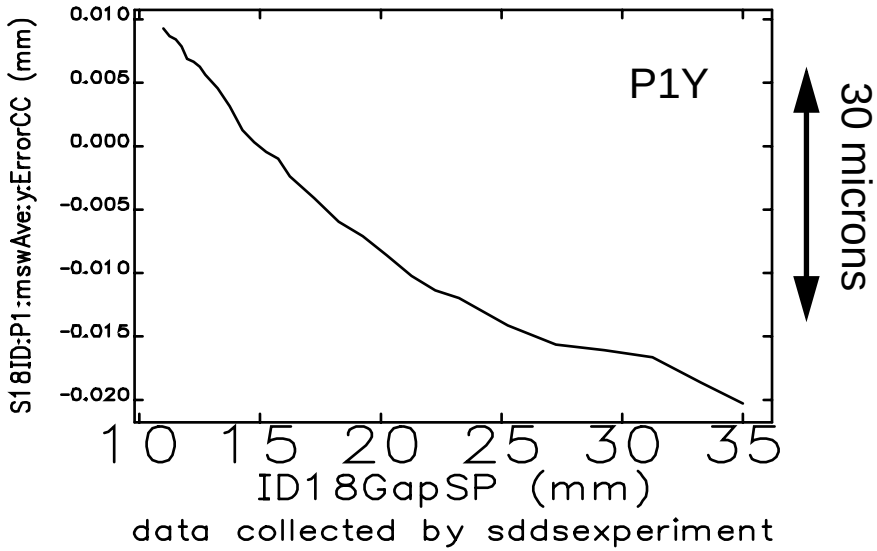
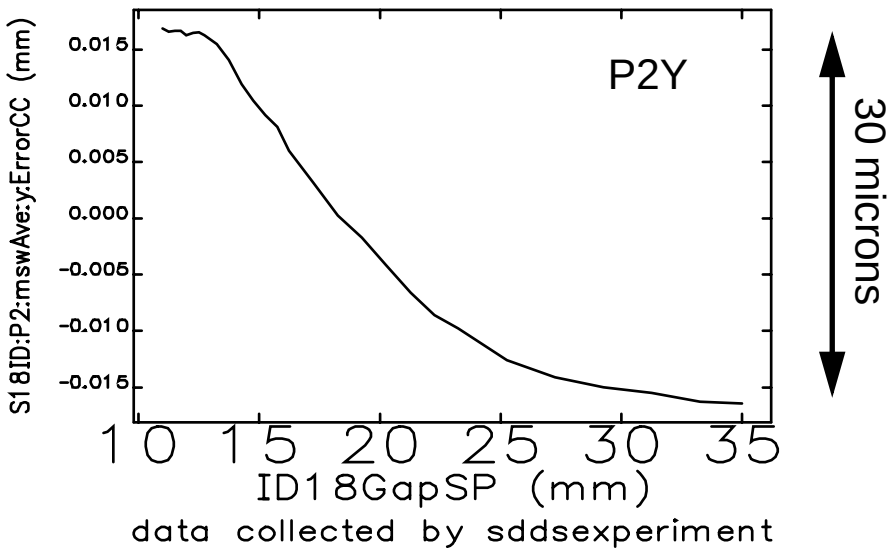
S18 ID Gap Scan, Closed Loop using RF bpm's









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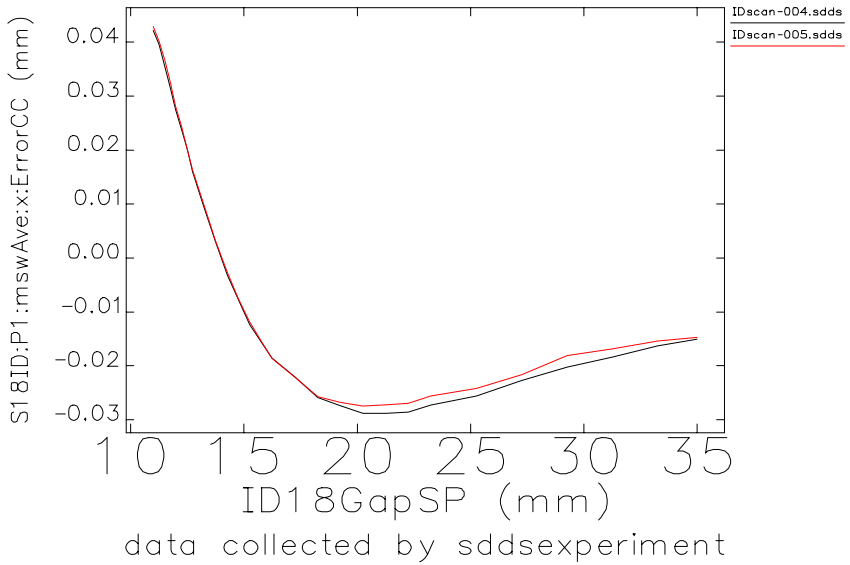
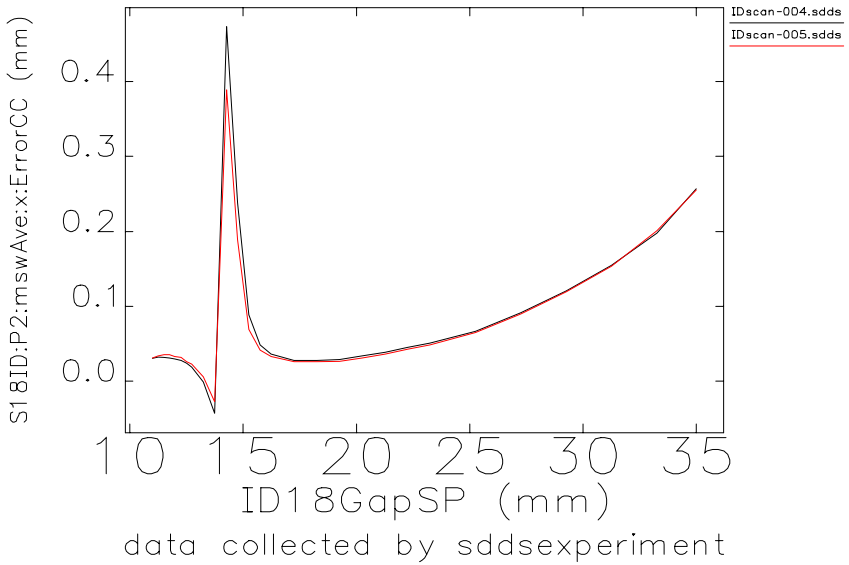
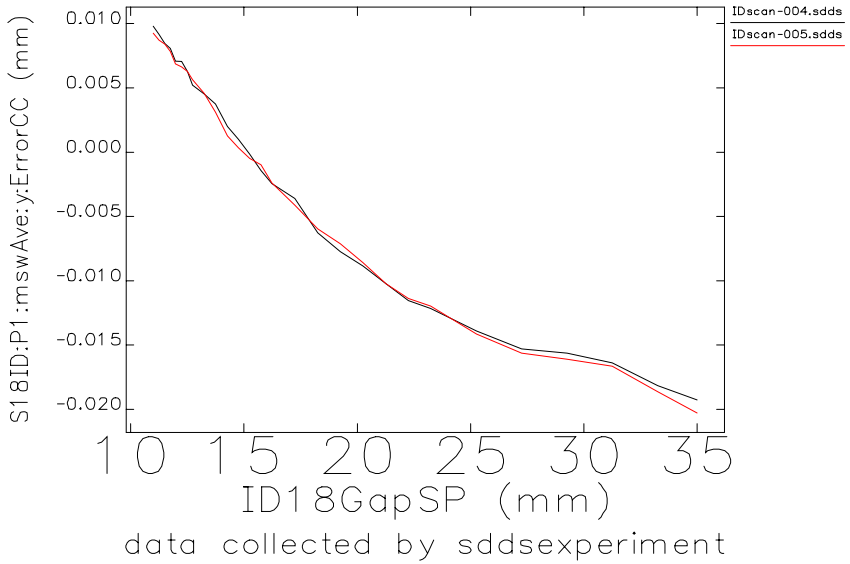
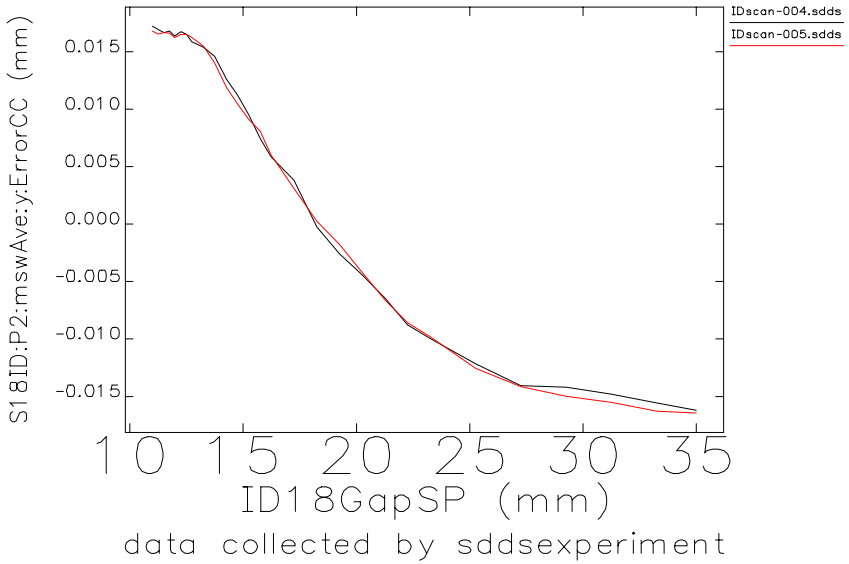
Gap Scan Repeatability, 18ID









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Insertion Device Gap Control

Use of insertion device x-ray beam position monitors for orbit control

Gaps are opened in several cases:

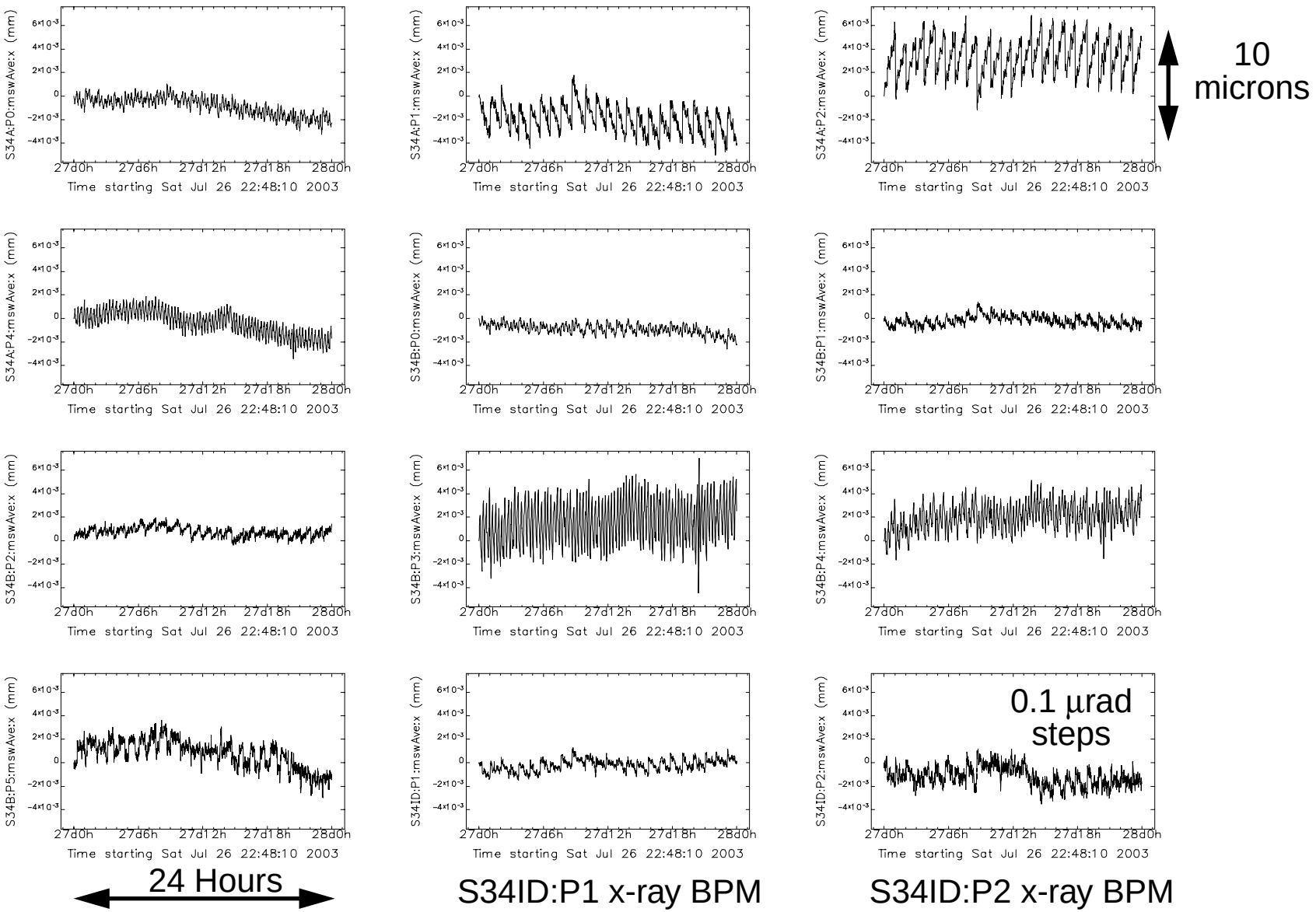
1. Beam is lost: all gaps are opened by the beam dump script to minimize radiation damage to the insertion devices. In this case, the orbit control programs are suspended, no operator intervention is required.

2. If the front end PS2 shutter remains closed for > 2 hours the gap is “opened” by an automatic process running in the ioc, to minimize gas load on front end pumps. So long as the gap remains within the range of the lookup tables, no operator intervention is required. The present open gap setting of 60 mm is incompatible with proper ID x-bpm operation. 30 mm is a suggested “open gap” setting for this purpose.

3. If the device gap is kept fully open due to an equipment problem, the X-ray bpms for that sector need to be removed from the orbit correction configuration (by a physicist / engineer).

4. In case a gap is manually opened beyond 35 mm for any reason. Operations will contact EFO to have it closed to the nominal 30 mm “open gap” setting.

Sector 34 ID x-bpm's closed loop, top-up operation



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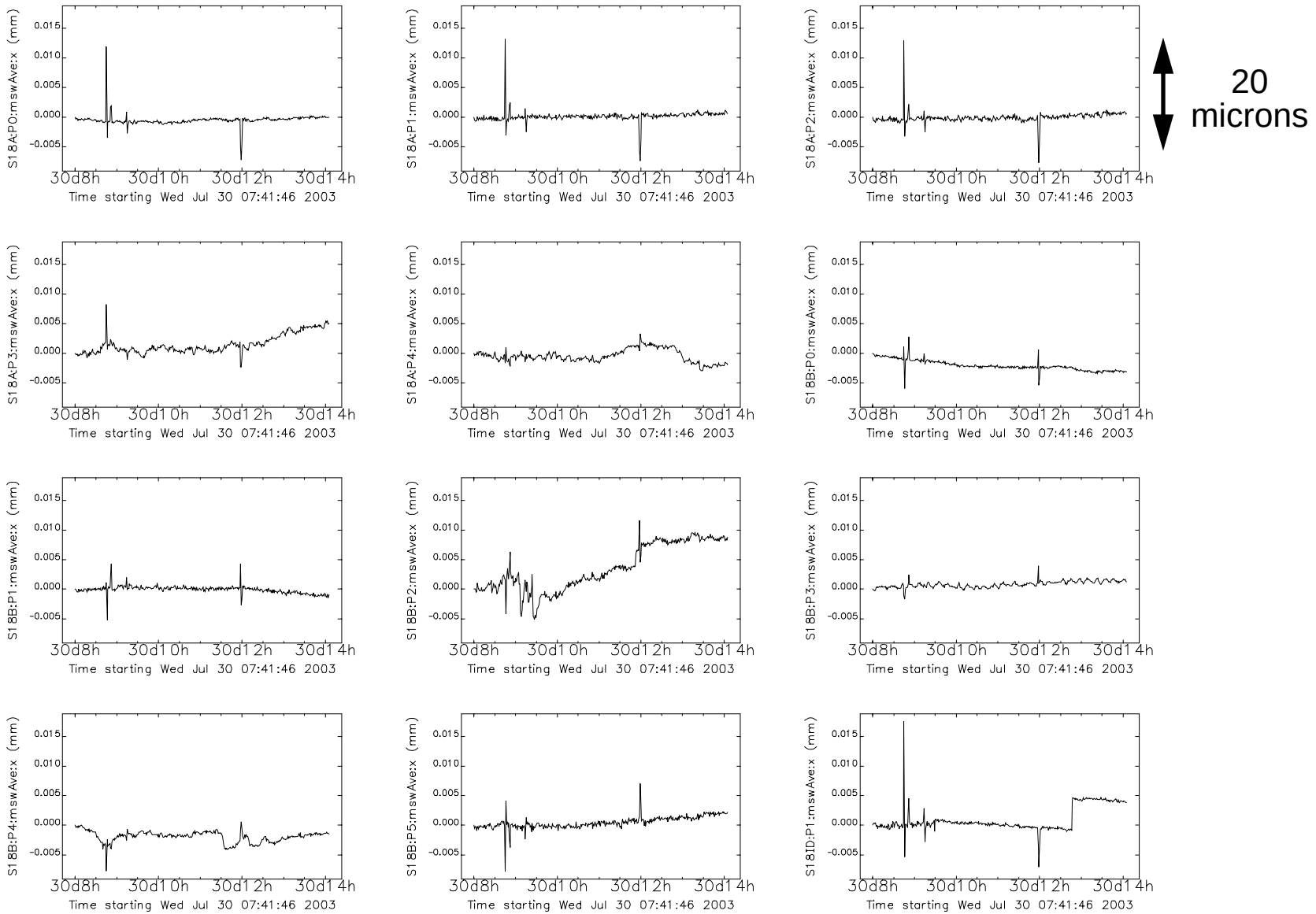
Sector 18 ID bpm's closed loop, top-up operation



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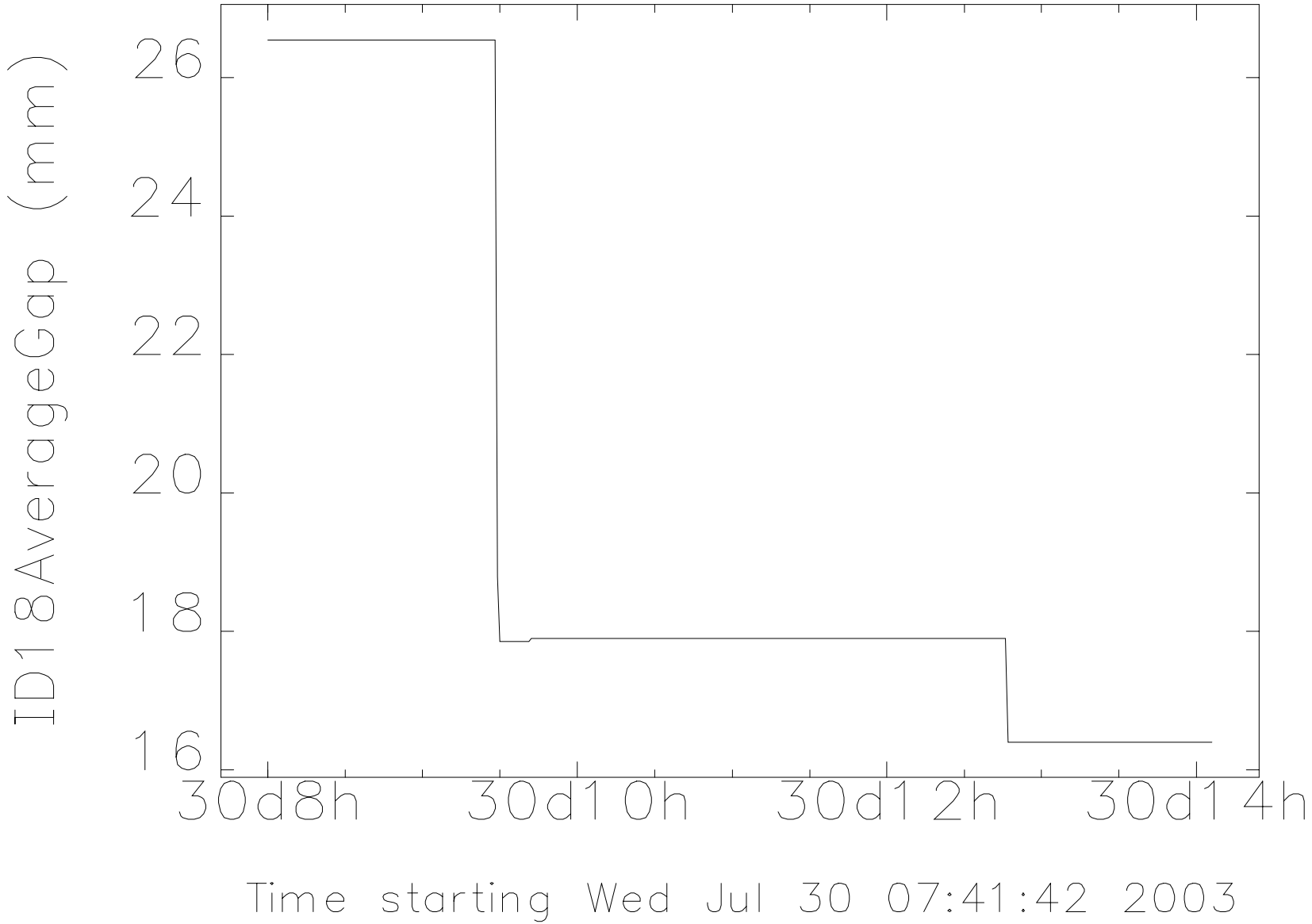

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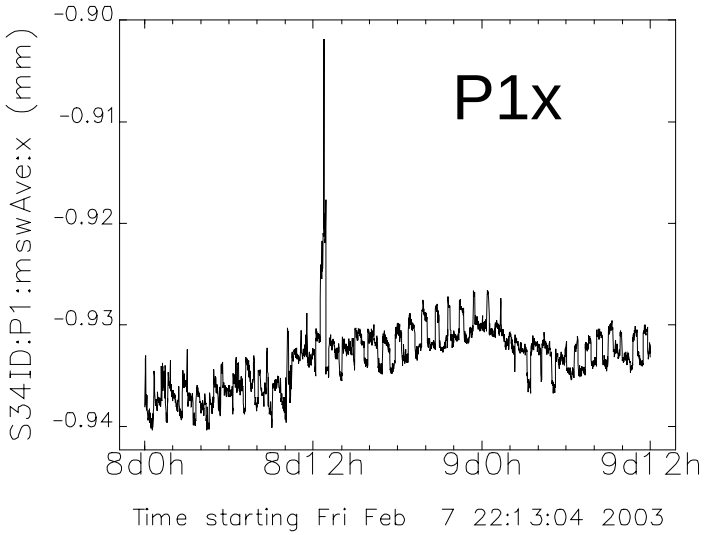
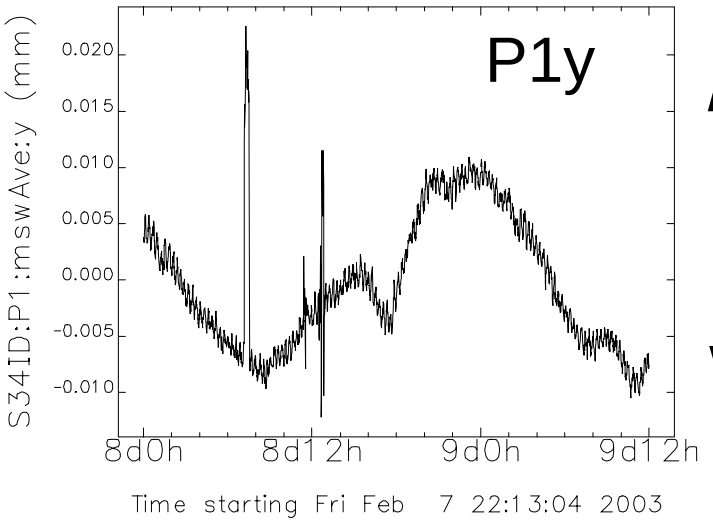
34ID Insertion Device Beam Stability Prior to 2/26/03

Horizontal X-bpm Readbacks

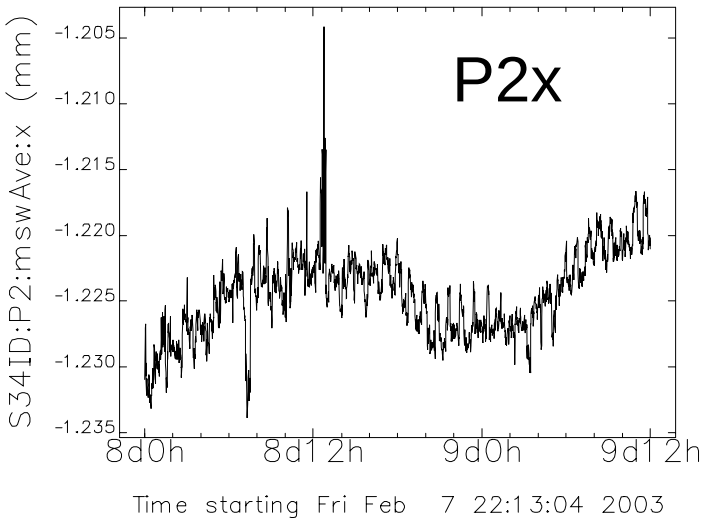


10 microns

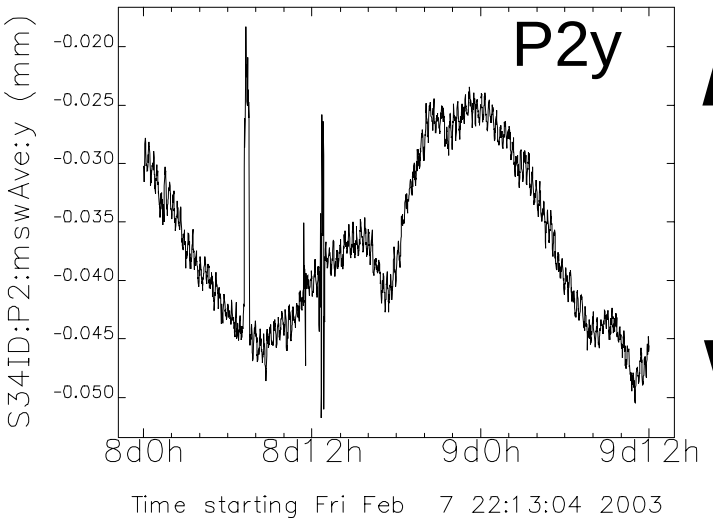
Vertical X-bpm Readbacks



30 microns



20 microns



30 microns

36 hours

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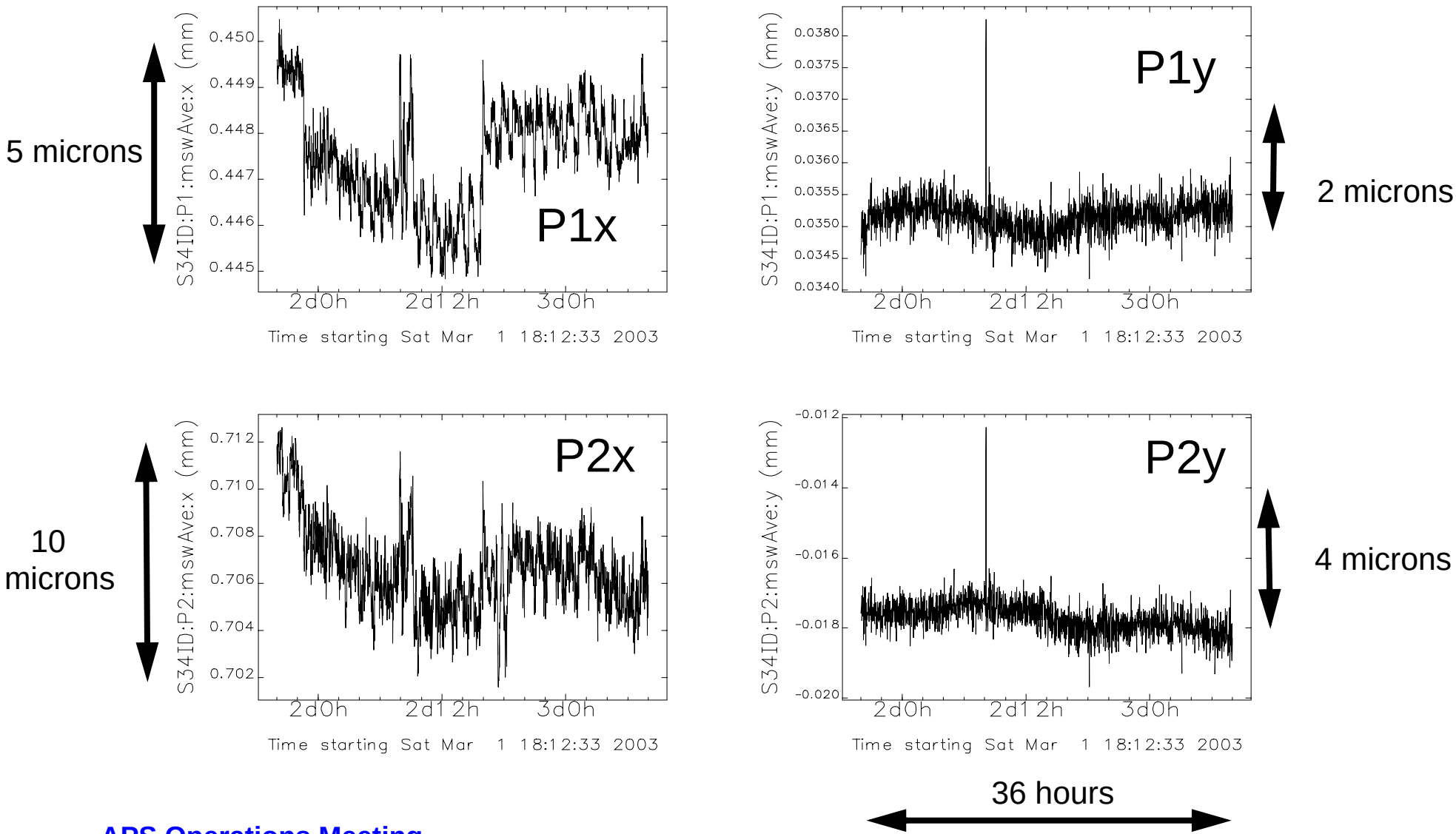
34ID Insertion Device Beam Stability After 2/27/03

Horizontal X-bpm Readbacks

Vertical X-bpm Readbacks



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