

Pulsed Multipole Injection for the MAX IV Storage Rings

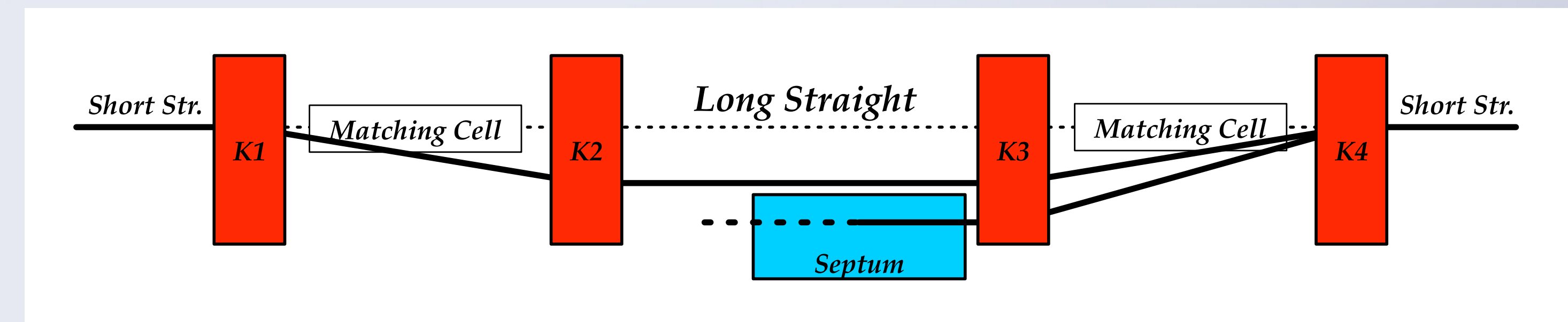
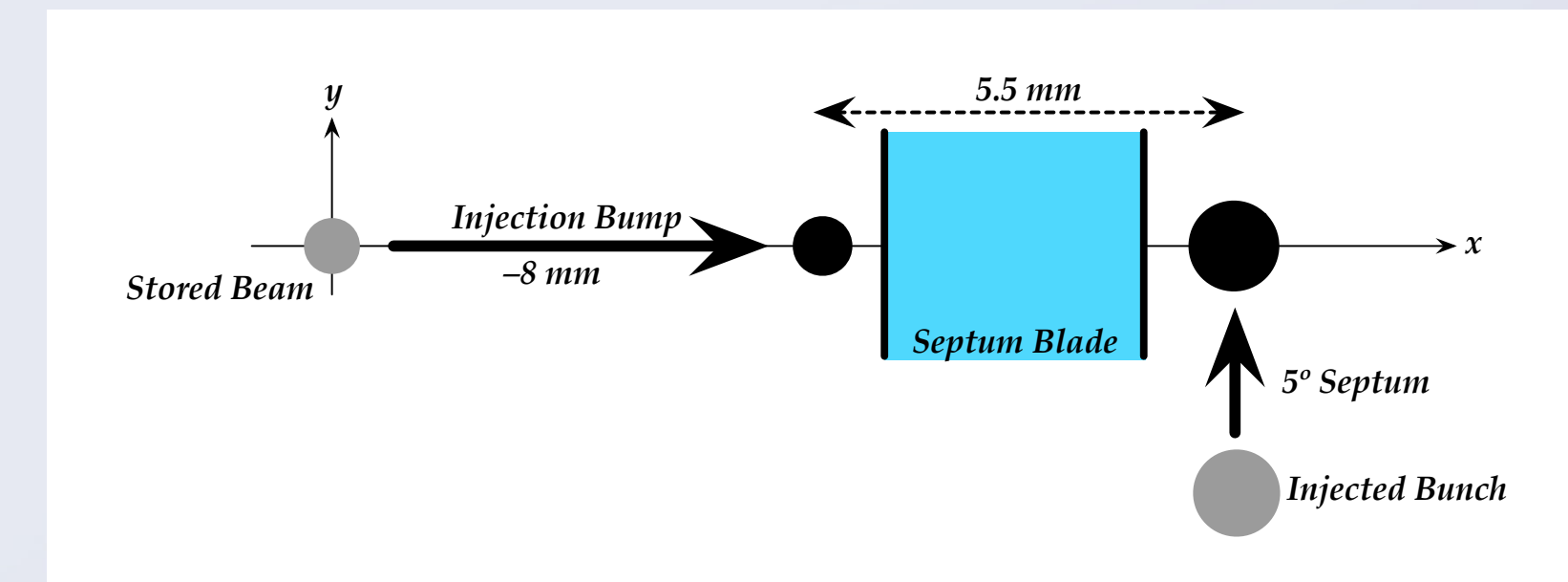
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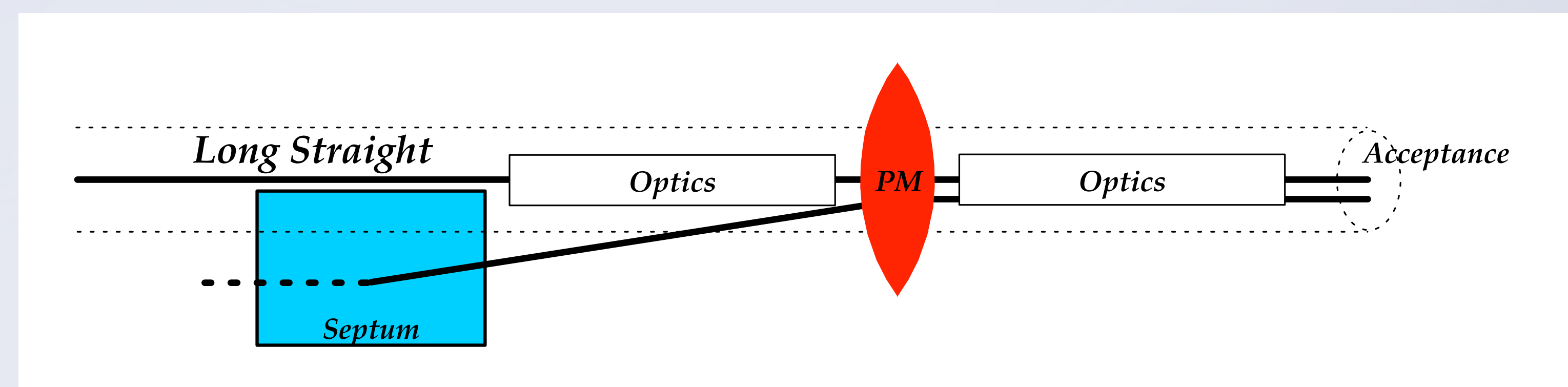
Conventional Injection with a Four-Kicker Bump

- Four dipole kickers & pulsers need to be perfectly matched, synchronized, and aligned to close local bump
 - If local injection bump not fully closed
 - coherent betatron oscillation of stored beam
 - degrades photon beam at experiments
 - Need space for four strong dipole kickers and septum
 - injection may take up space otherwise reserved for IDs
 - If sextupoles and/or octupoles in injection bump
 - cannot perfectly close bump for all particles in stored beam
- *Less favorable for new ultralow-emittance rings*



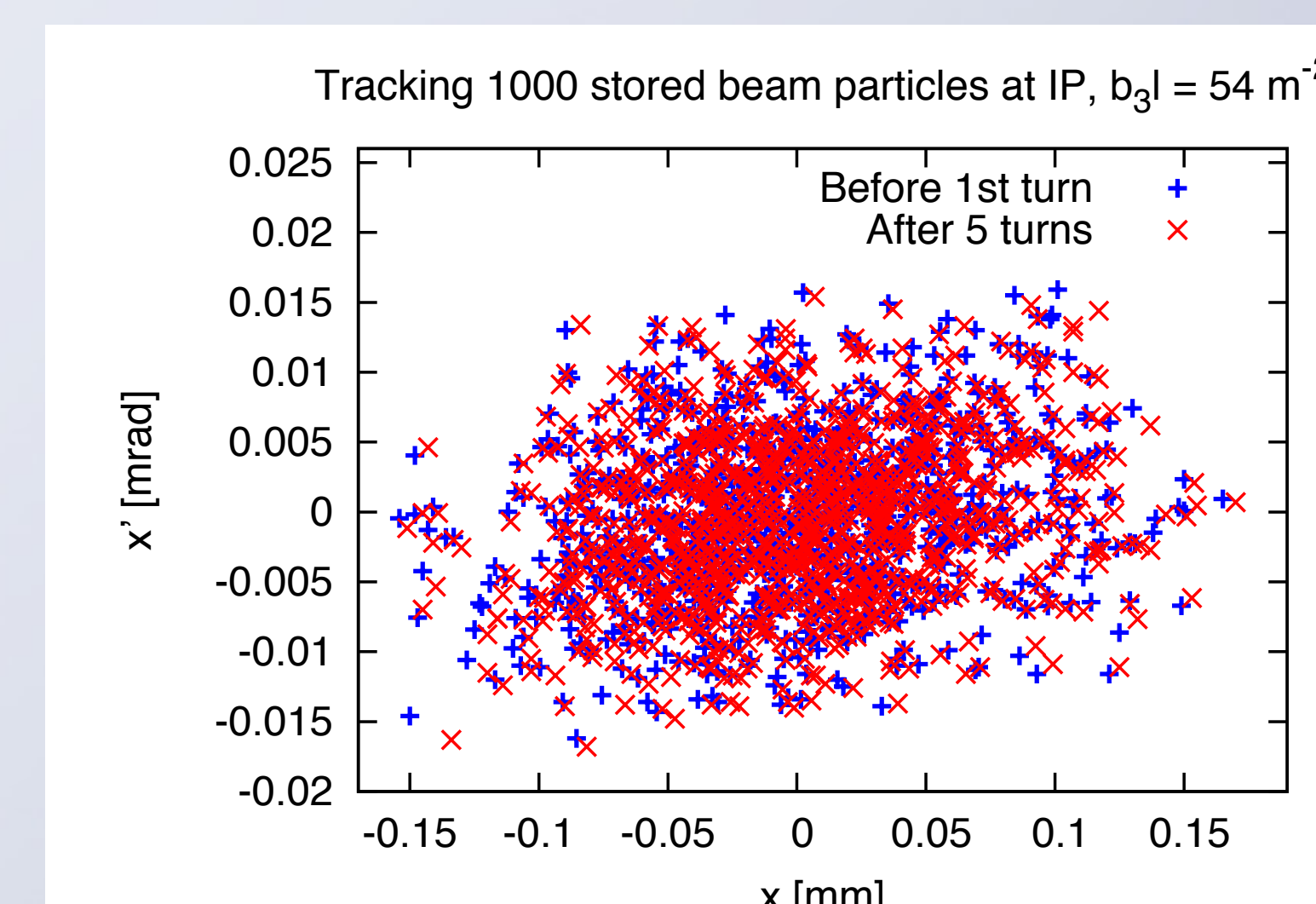
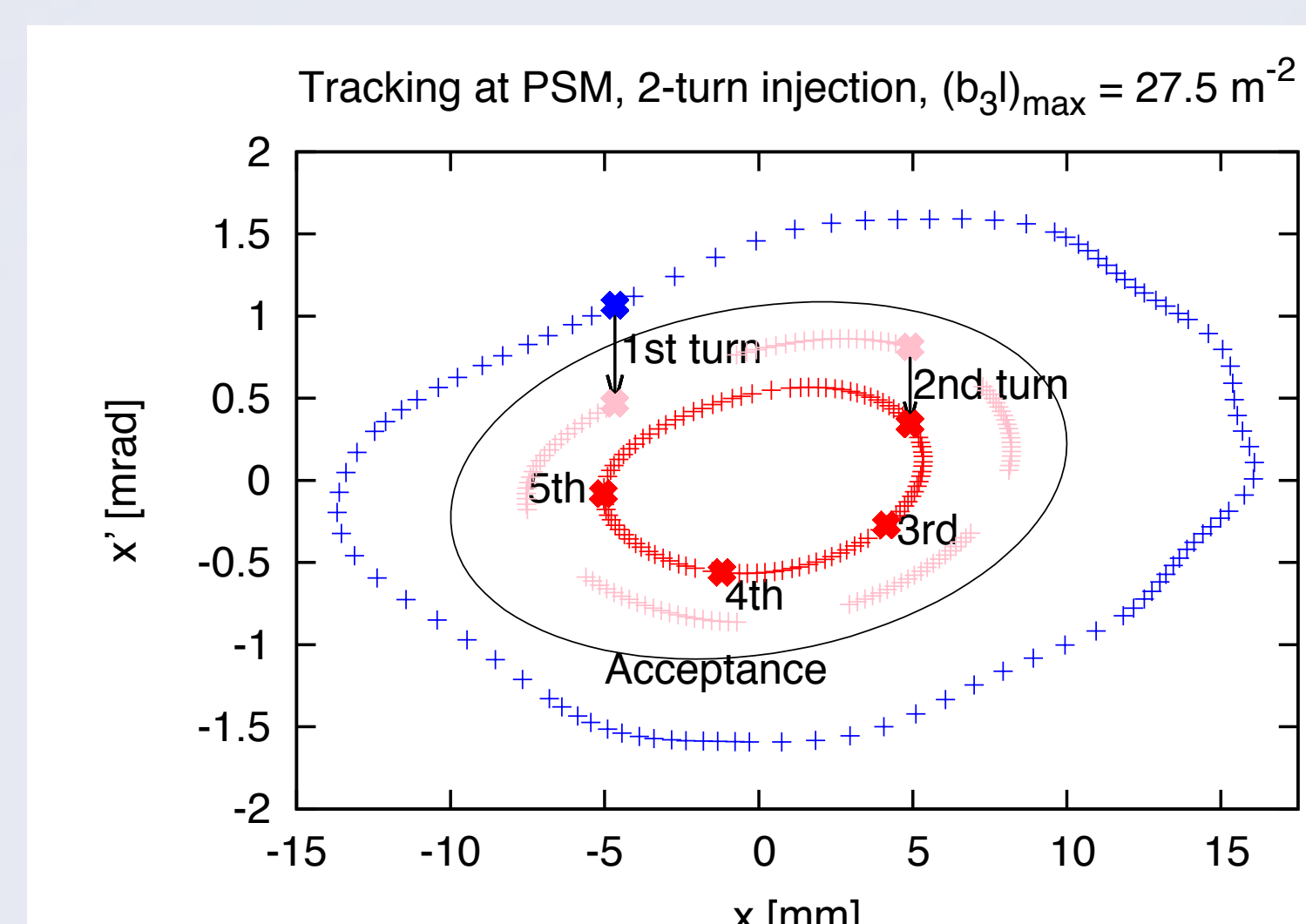
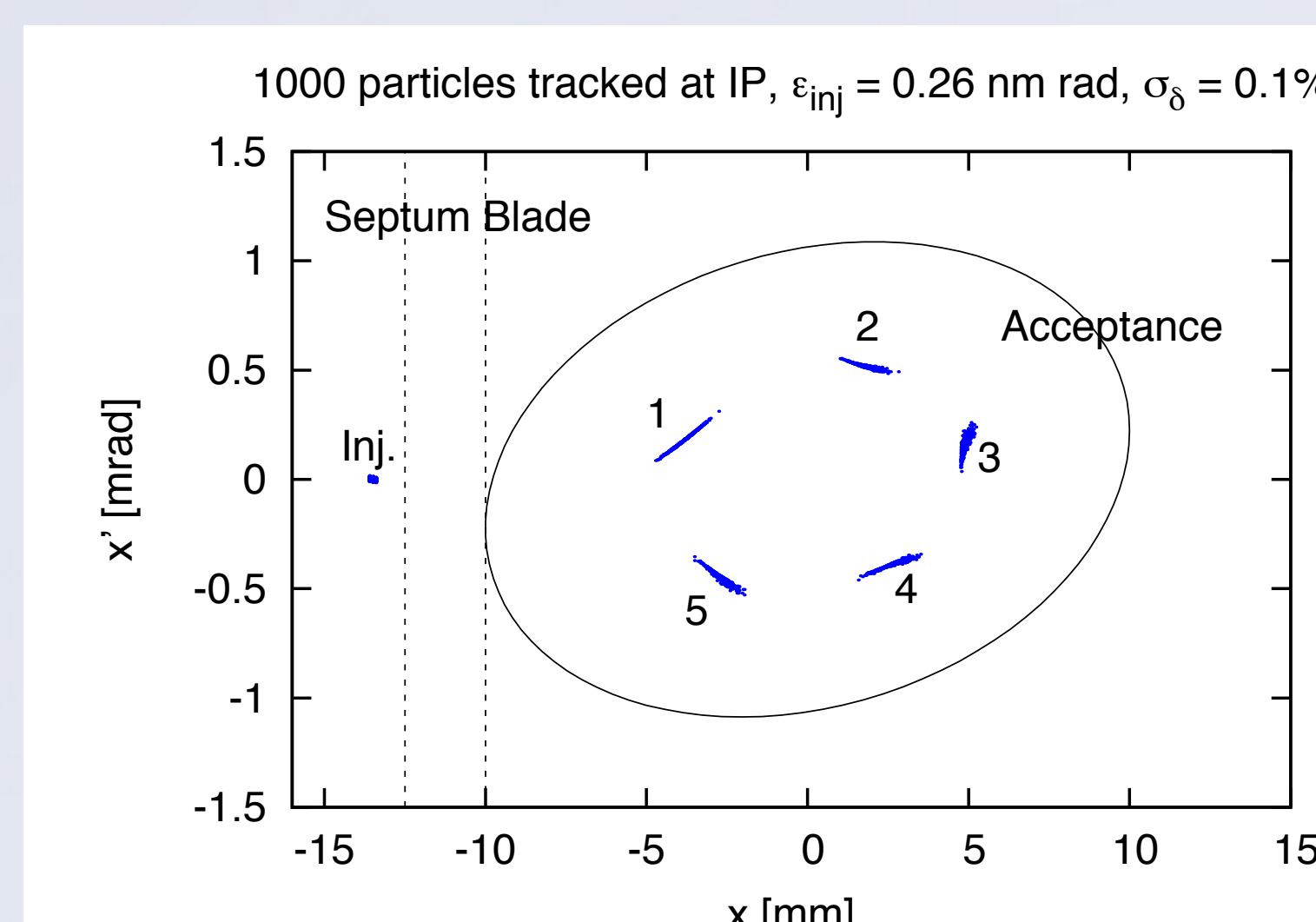
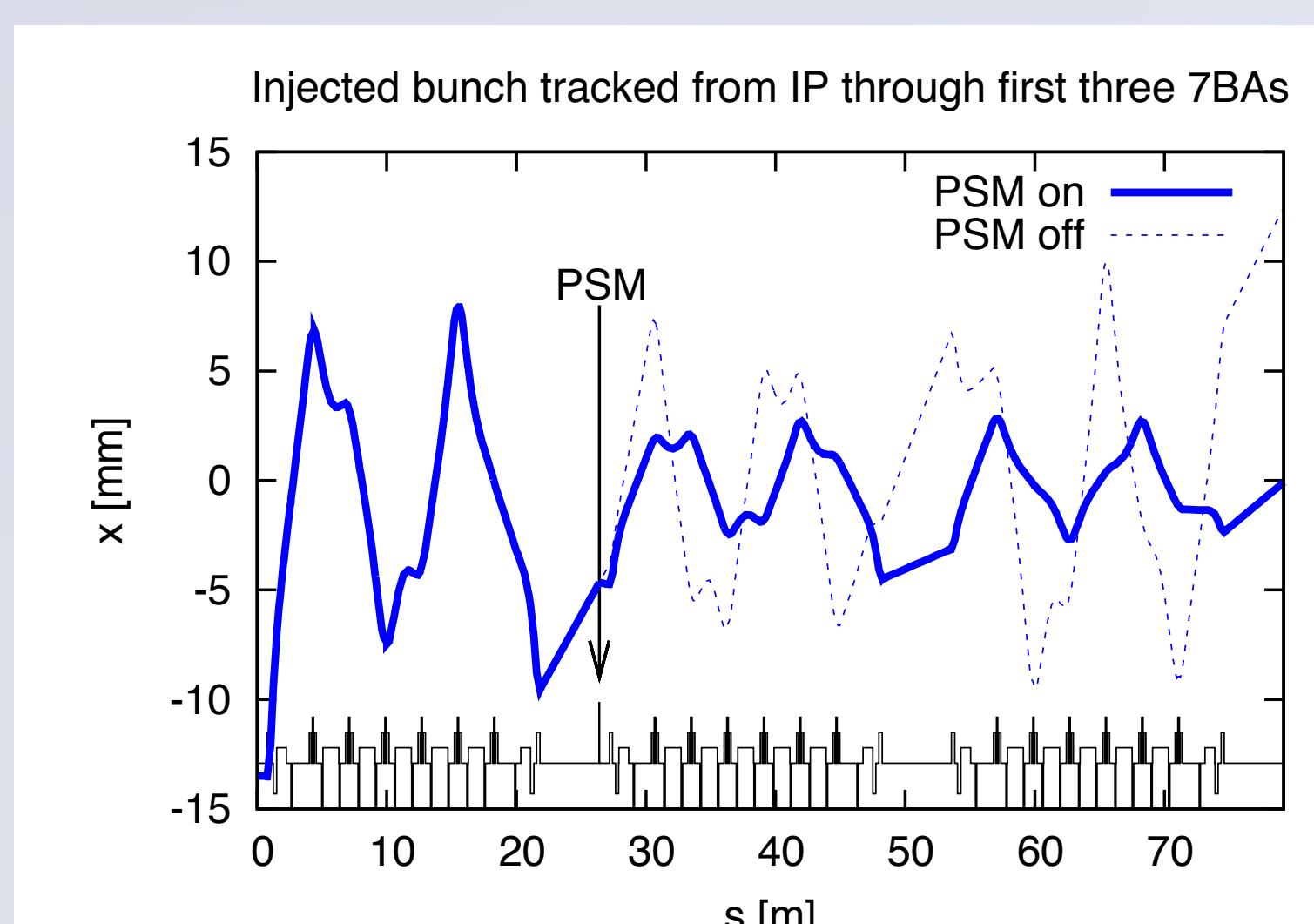
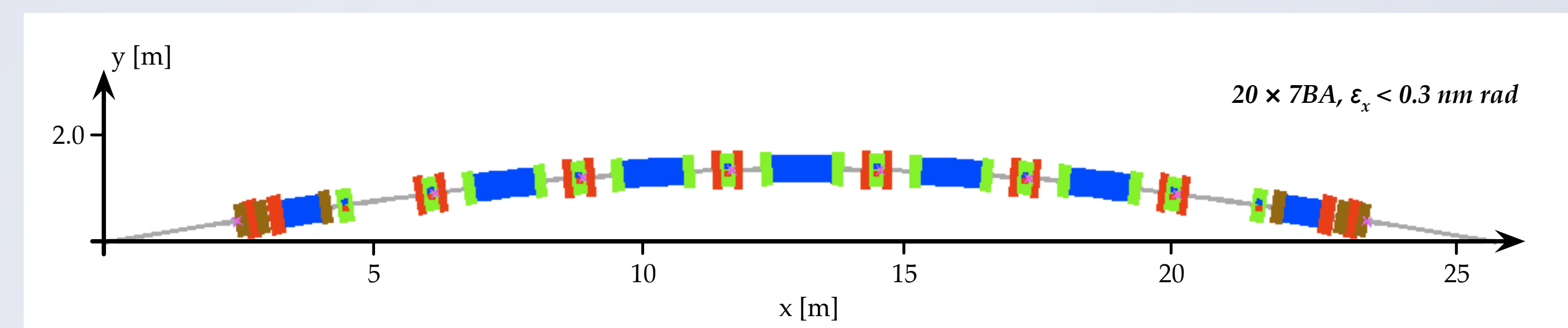
Advantages of Pulsed Multipole Injection

- Injected bunch kicked into ring acceptance by a single pulsed multipole magnet
 - Stored beam passes multipole magnet center → no perturbation
 - Pulse shape not crucial (but keep fall time short)
 - PMI demonstrated at KEK → unprecedented beam stability during injection
- Potential to make continuous top-up operation transparent to users
- Synchronization and alignment of only a single magnet (complexity & space!)
- *Both MAX IV storage rings will use pulsed sextupole injection*



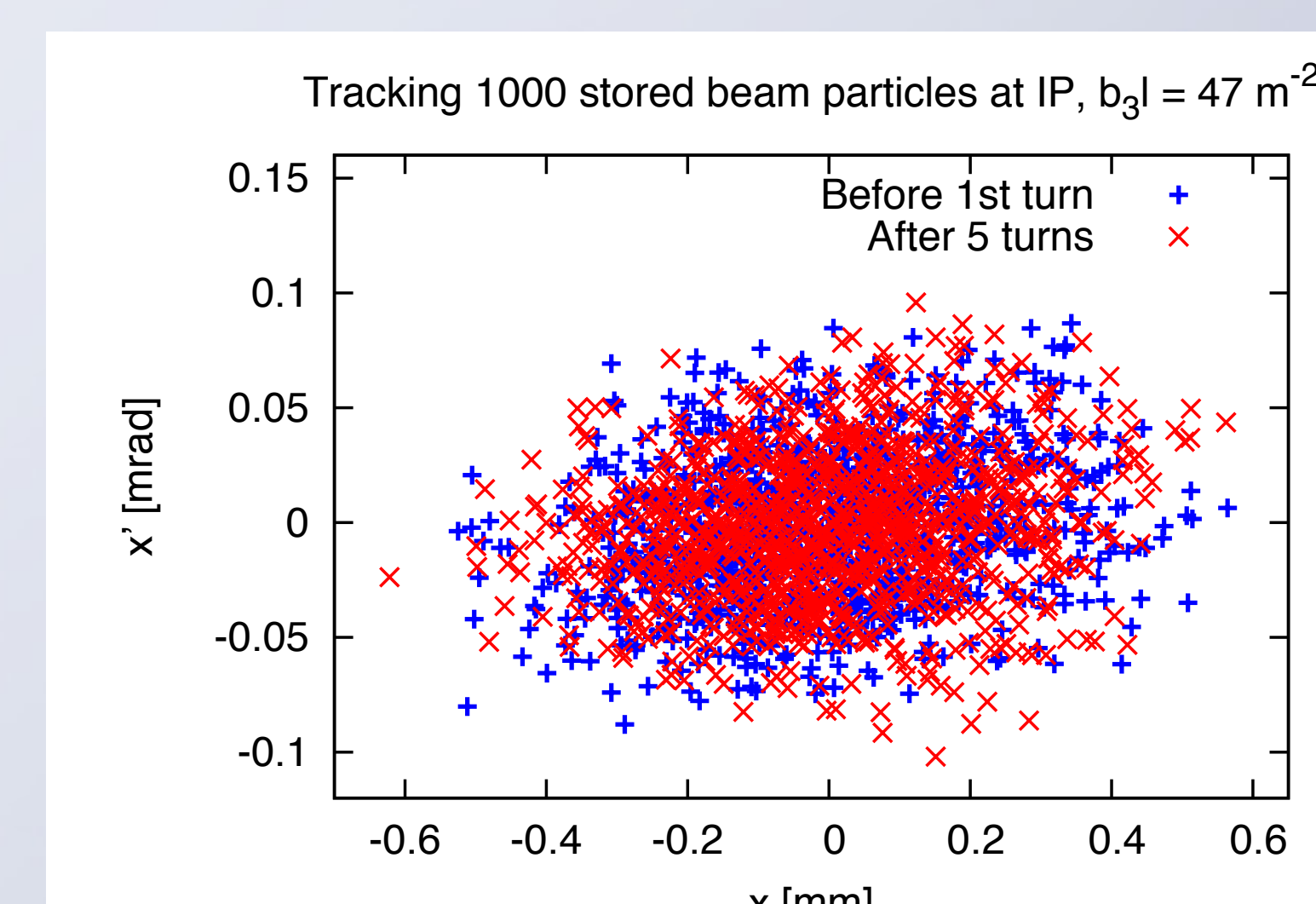
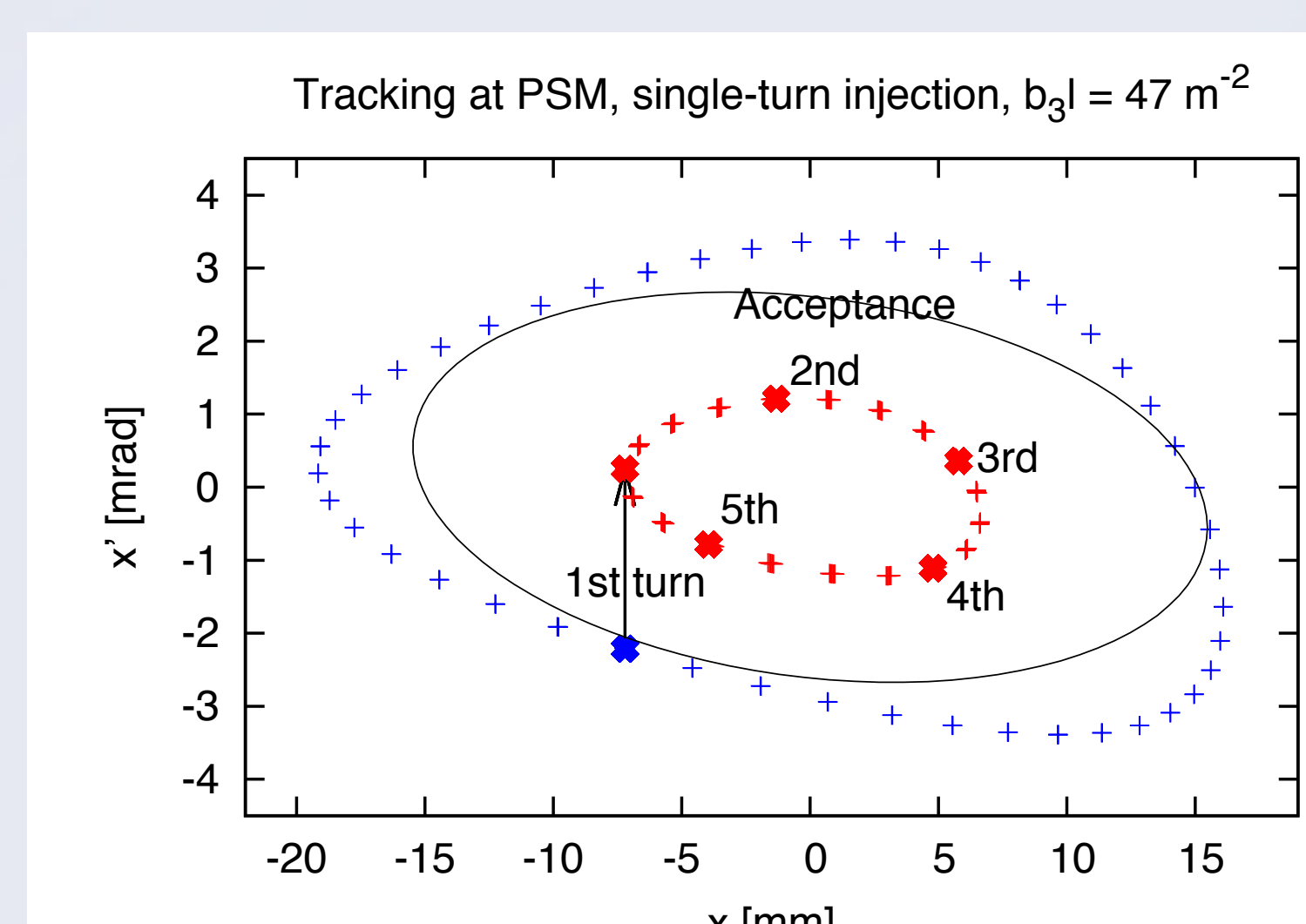
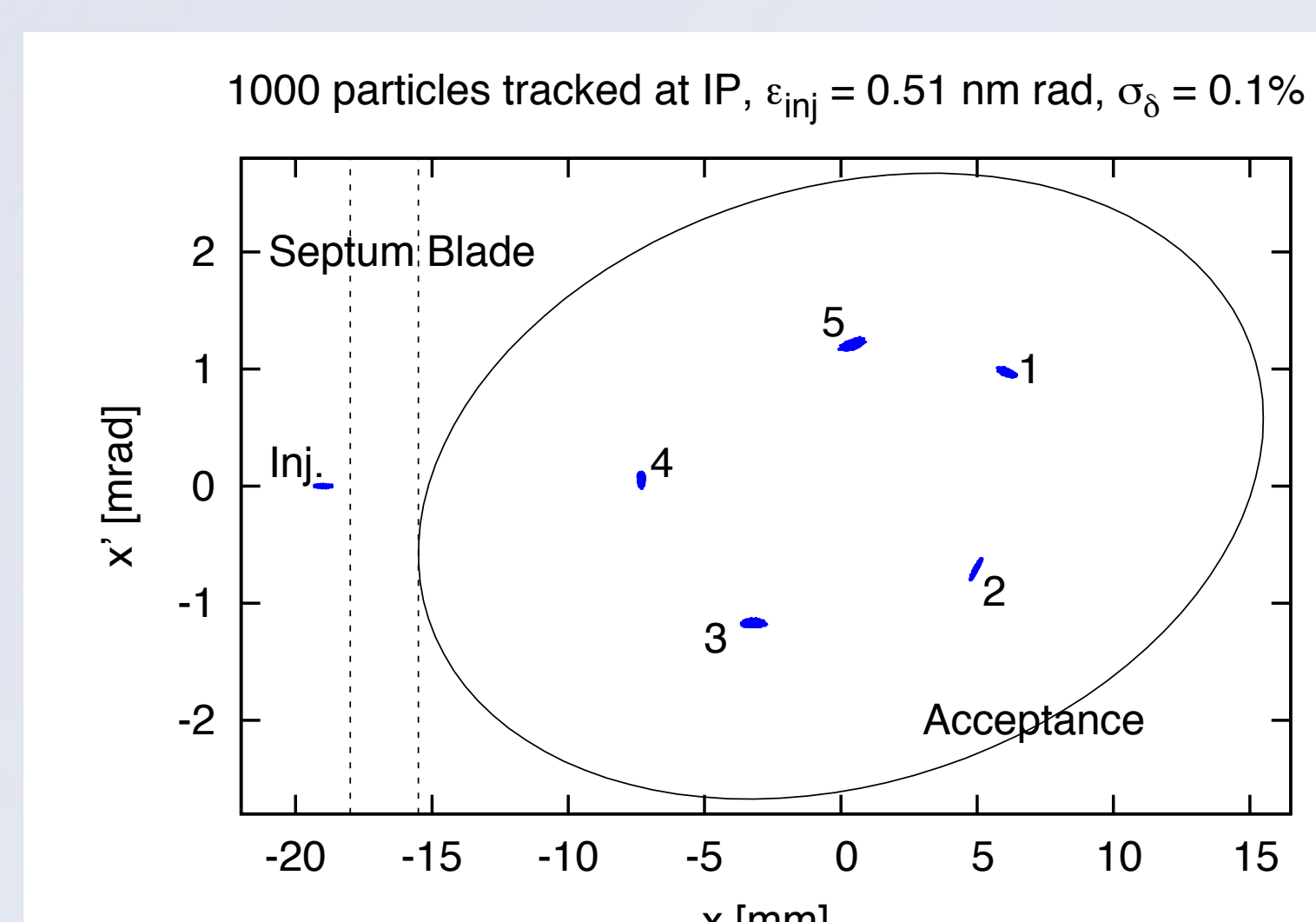
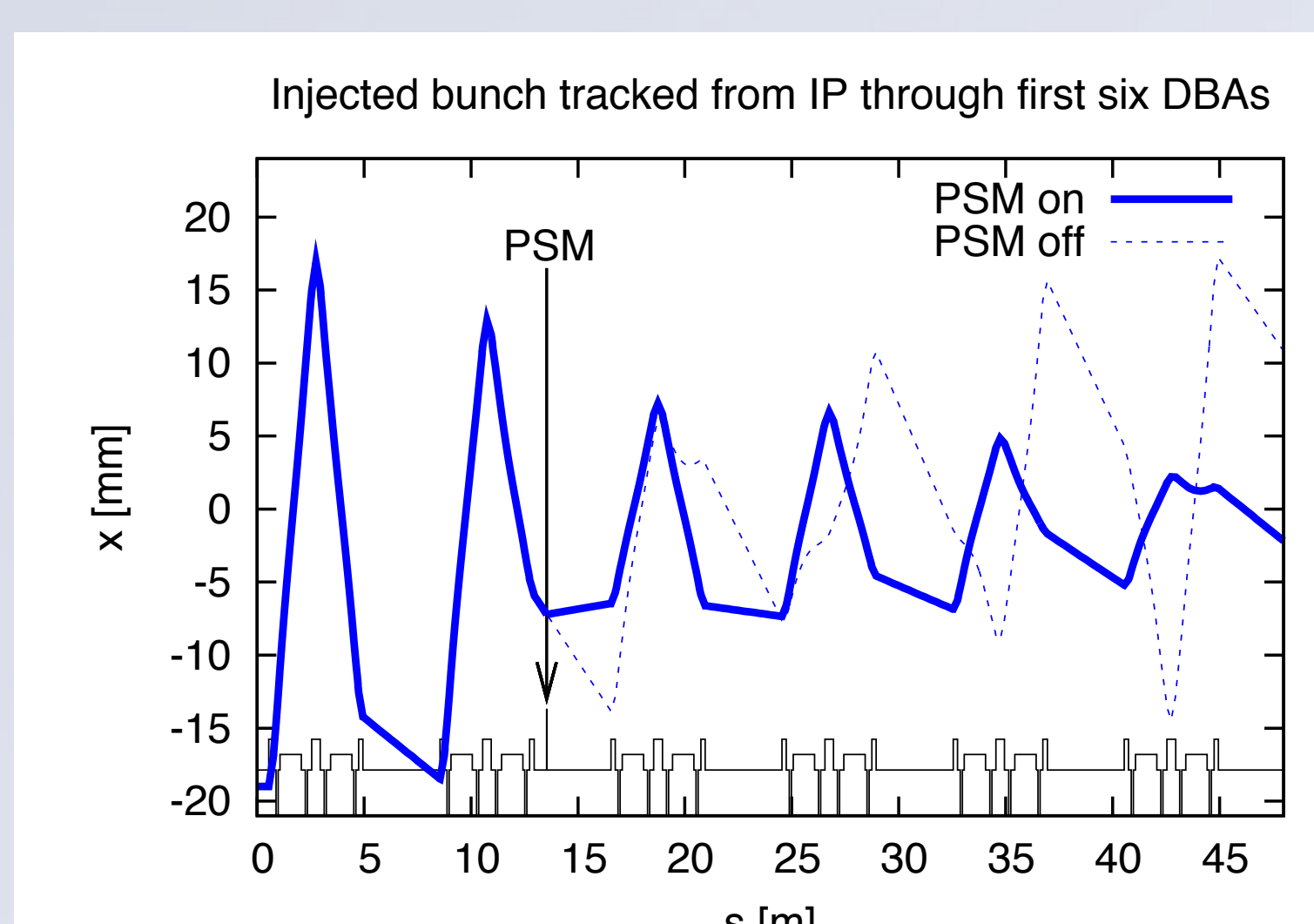
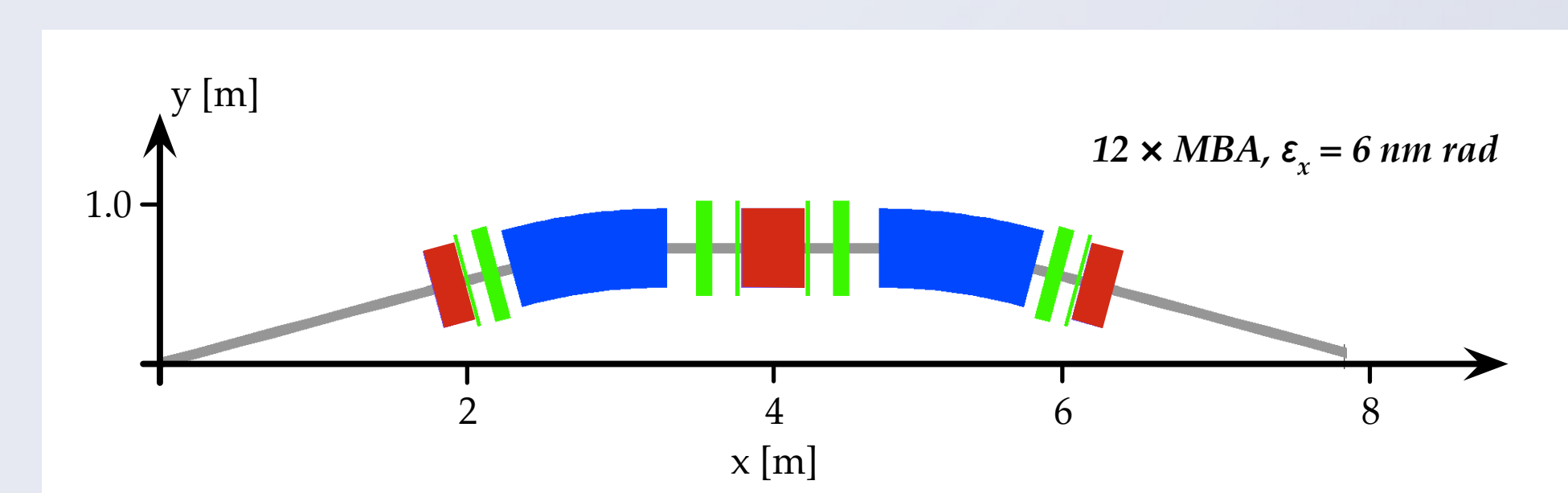
Pulsed Sextupole Injection in the MAX IV 3 GeV Storage Ring

- Inject at -13.5 mm, PSM in second long straight, hor. ring acceptance 10.6 mm mrad
 - Single-turn injection: $b_3 = 54 \text{ m}^{-2}$, $\tau = 3.5 \mu\text{s}$ → injection to 2.3 mm mrad
 - Two-turn injection: $b_3 = 28 \text{ m}^{-2}$, $\tau = 7 \mu\text{s}$ → injection to 3.1 mm mrad
 - PSM does not perturb stored beam (alignment!)
- Pulse length relaxed, magnet strength manageable



Pulsed Sextupole Injection in the MAX IV 1.5 GeV Storage Ring

- Inject at -19 mm, PSM in third straight, hor. ring acceptance 40.5 mm mrad
 - Single-turn injection: $b_3 = 47 \text{ m}^{-2}$, $\tau = 0.6 \mu\text{s}$ → injection to 8.8 mm mrad
 - Two-turn injection: $b_3 = 47 \text{ m}^{-2}$ (or as low as 32 m^{-2}), $\tau = 1.3 \mu\text{s}$ → injection to 9.1 mm mrad
 - PSM does not perturb stored beam (alignment!)
- Pulse length and magnet strength demanding



MAX IV Project → <http://www.maxlab.lu.se/maxlab/max4>

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