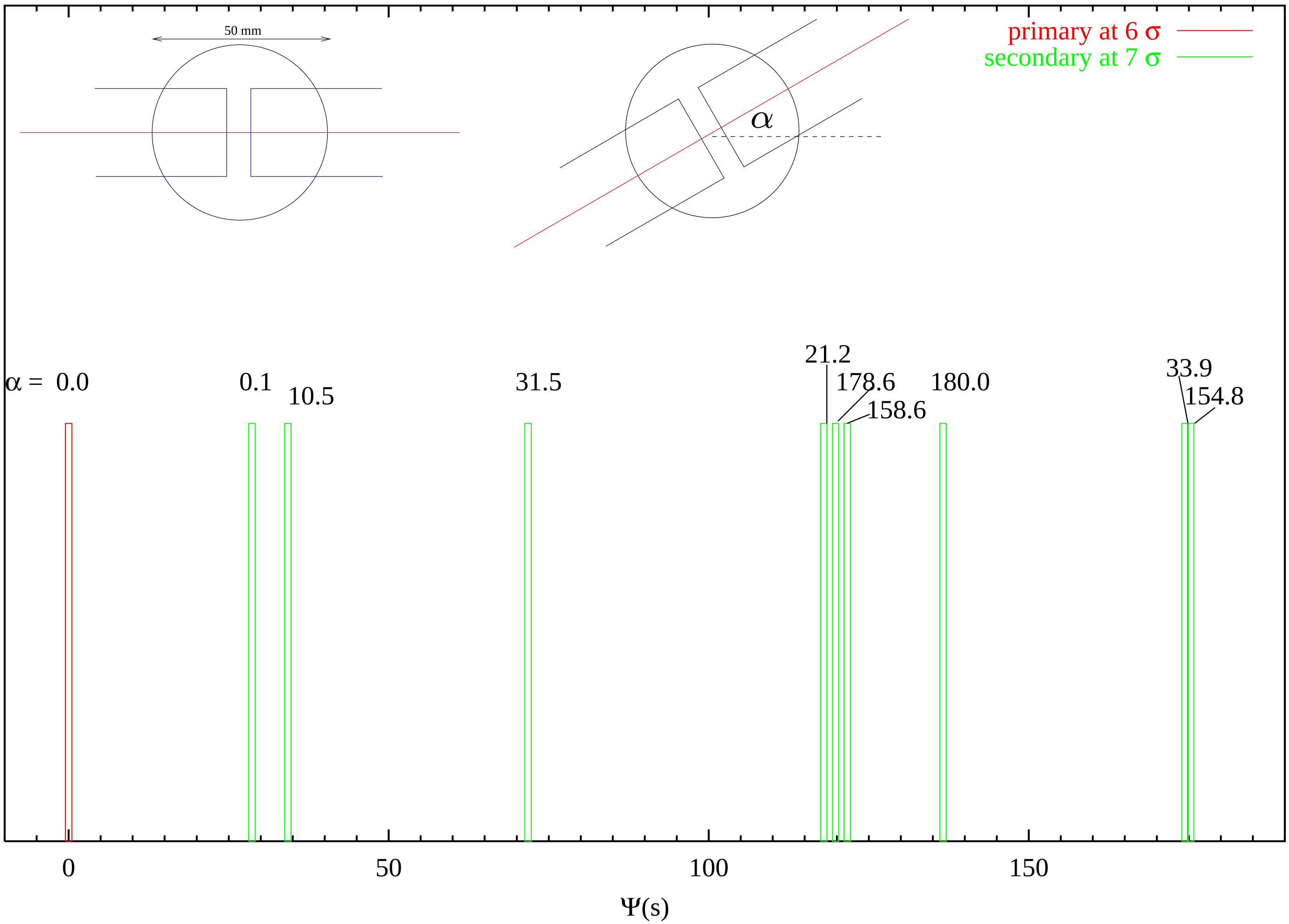
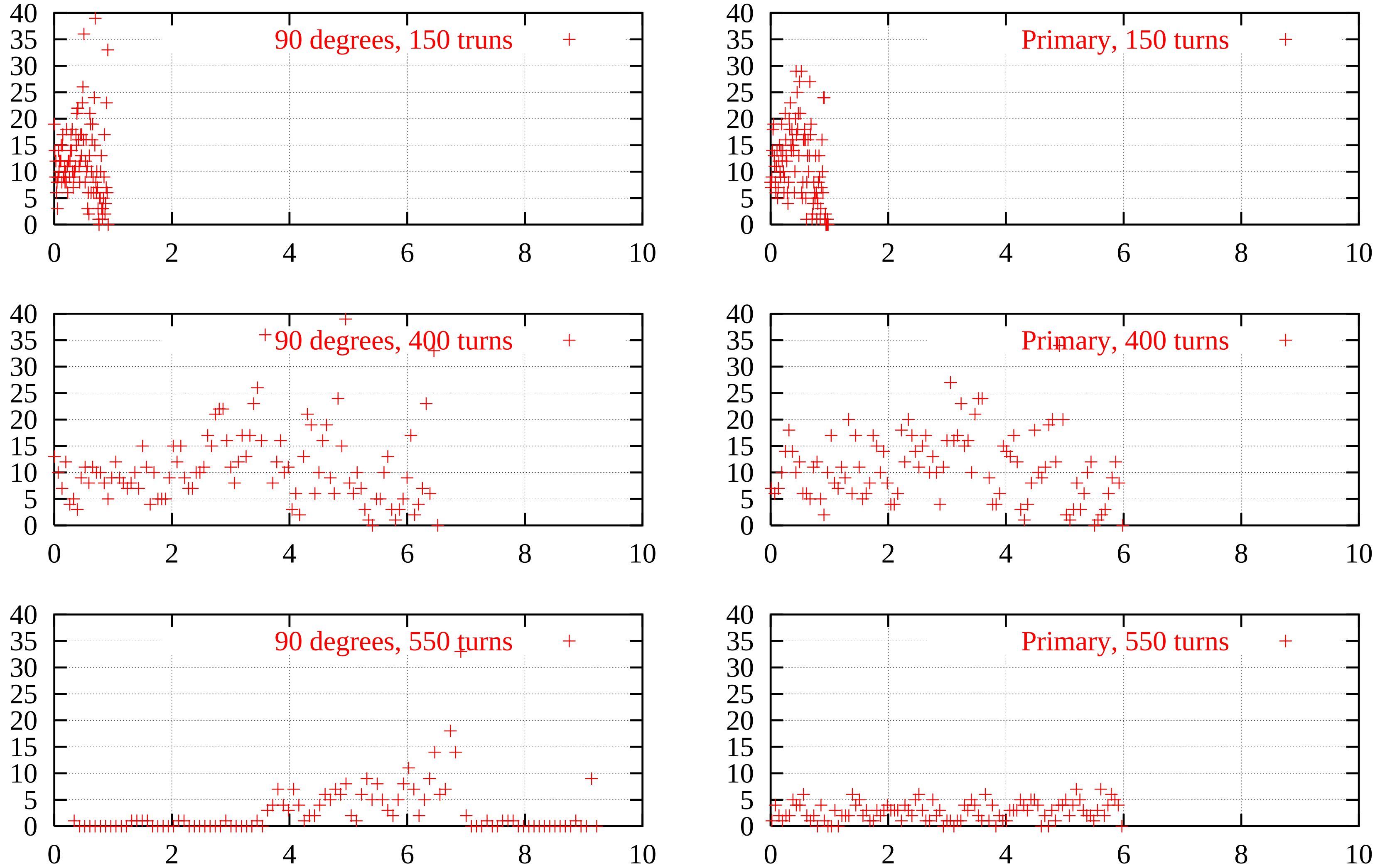
Collimator Layout used for Particle Tracking



y-axis: number of MBs which would cause a closed orbit displacement of $n \cdot \sigma$ (x-axis) at the collimator during a quench; no collimator at 90° phase advance from the primary

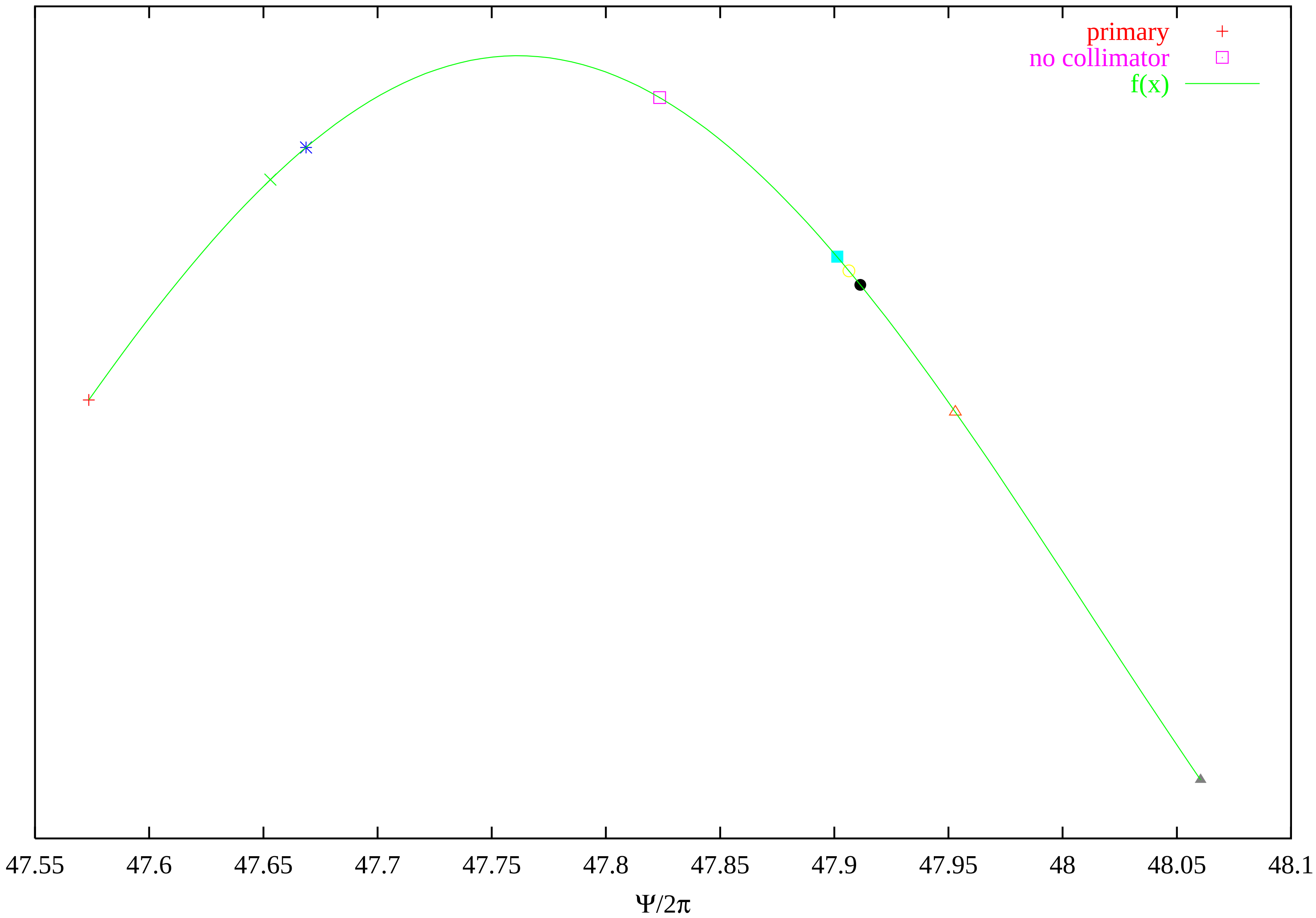


Horizontal Displacement of the Closed Orbit at Collimator-Position

$$x_{closed}(t) = \frac{\Theta(t)}{2} \sqrt{\beta_{dip}\beta_{coll}} \cdot \frac{cos(\pi Q - \Delta\psi)}{sin(\pi Q)}$$

Arbitrary MB: Dependancy of the closed orbit displacement on the phase advance ψ

Displacement at the collimators at a fixed point of time devided by $\sqrt{\beta(s)}$



Displacement and angle of a particle after k turns in a ring with N defective Dipoles

$$\begin{pmatrix} x(k) \\ x'(k) \end{pmatrix} = \mathbf{M}_{k\,turns} \cdot \begin{pmatrix} x_0 \\ x'_0 \end{pmatrix} + \sum_{q=0}^{k} \sum_{l=1}^{N} \mathbf{M}_{(k-q)\,turns} \cdot \begin{pmatrix} 0 \\ \Theta(q,l) \end{pmatrix}$$

$\mathbf{M}$ is the transfer matrix.

$$\Rightarrow \Delta x(k) = \sum_{l=0}^{k} \sum_{q=1}^{N} \sqrt{\beta_q \beta_{coll}} \sin(2\pi Q\,(k-l)\, + \,\Delta\psi_{q\rightarrow coll})\Theta(l,q)$$

The Horizontal Displacement of the closed orbit at the N^{th} defective Dipole is the solution of this equation:

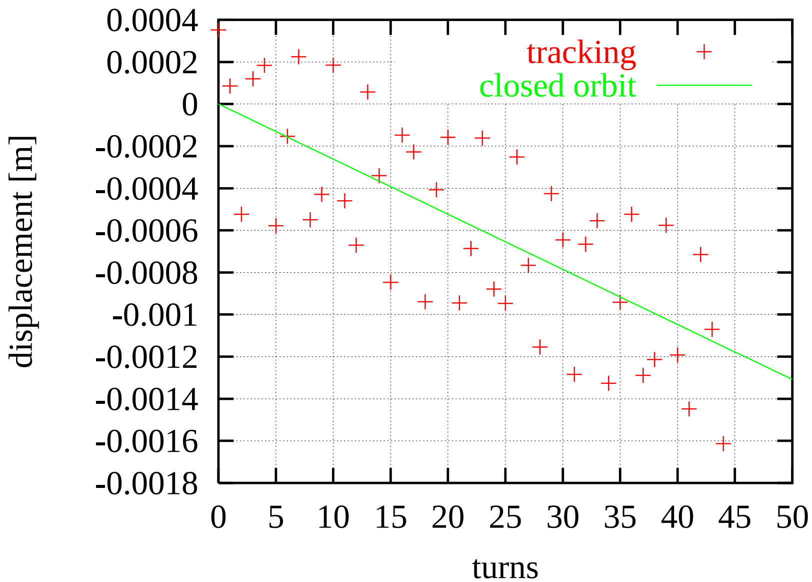
$$\begin{pmatrix} x \\ x' - \Theta_N \end{pmatrix} = \mathbf{M}_u \cdot \begin{pmatrix} x \\ x' \end{pmatrix} + \sum_{i=1}^{N-1} \mathbf{M}_{i\to N} \begin{pmatrix} 0 \\ \Theta_i \end{pmatrix}$$

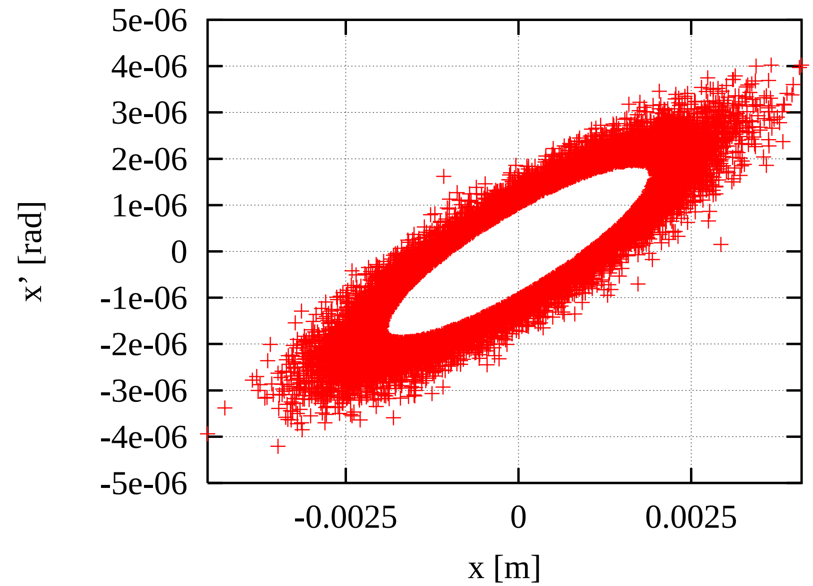
6 D1 magnets on each side of the interaction point; single aperture; all 12 magnets are supplied by one power converter

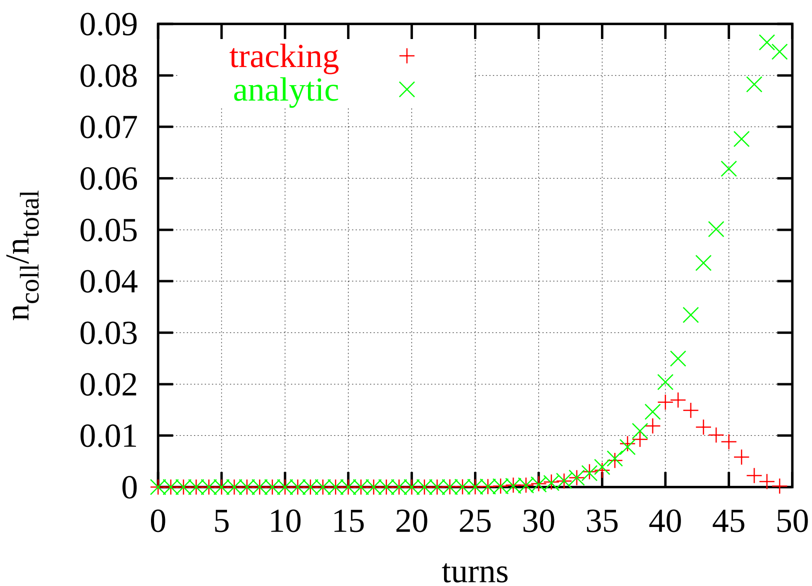
energy	7 TeV
emittance	0.503 nm
Q	64.31
τ	2.53 s
Θ_{max}	$\pm 201 \mu rad$

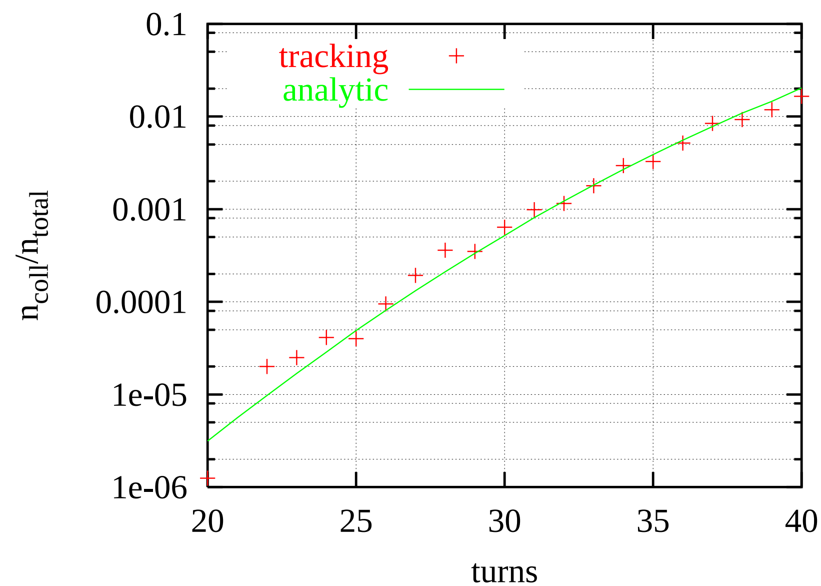
$$\Theta(t) = \Theta_{max} \cdot \left(1 - e^{-\frac{t}{\tau}}\right)$$

12 warm D1 magnets in IR5, primary collimator in IR7 at 7 σ

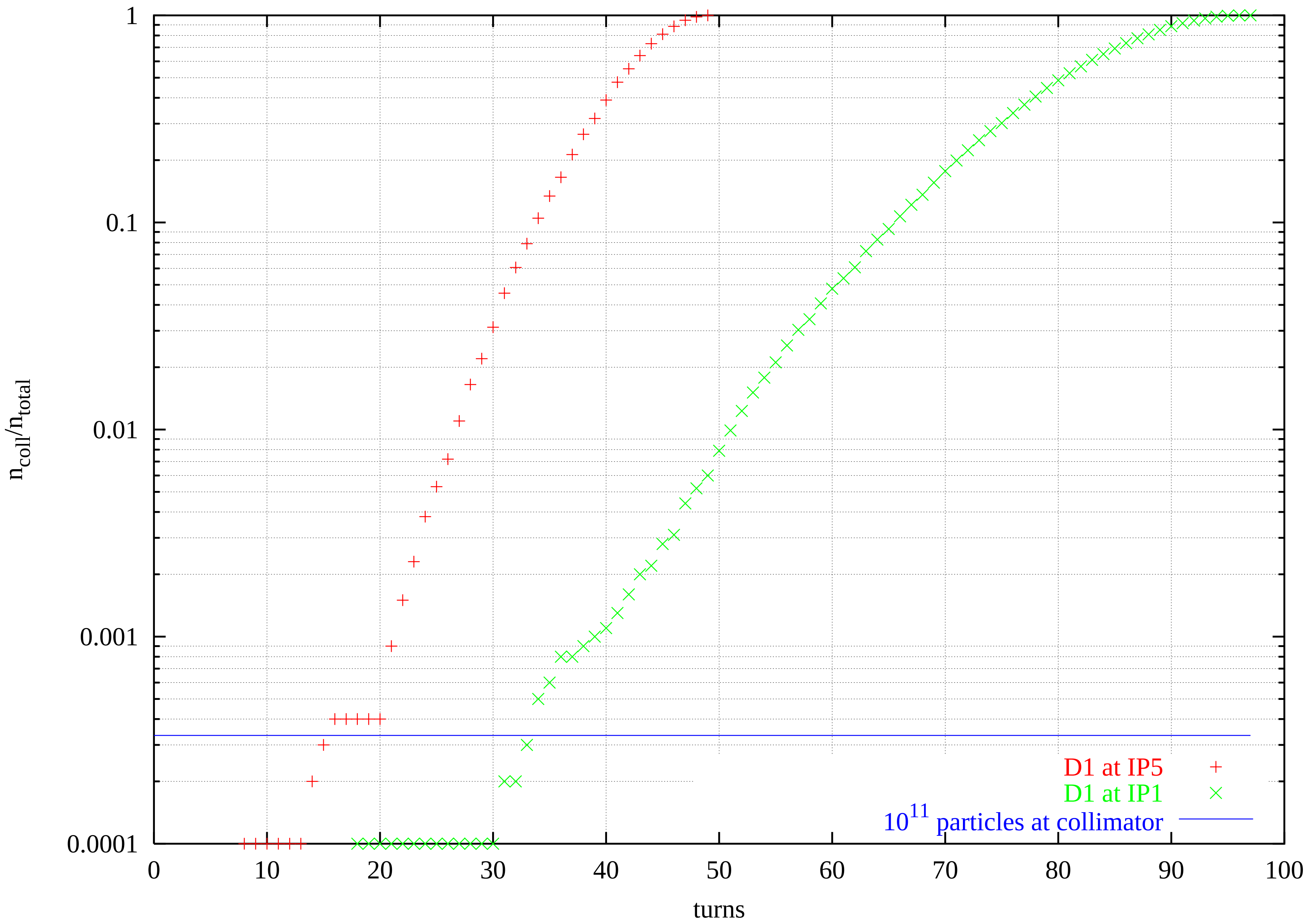








D1 magnets at IP1 and IP5, prim. collimator in IR7 ($6\,\sigma$): Total number of particles at the collimator relativ to initial number of particles in the ring



All superconducting main dipoles (total number 154) in the arc are supplied by one power converter.

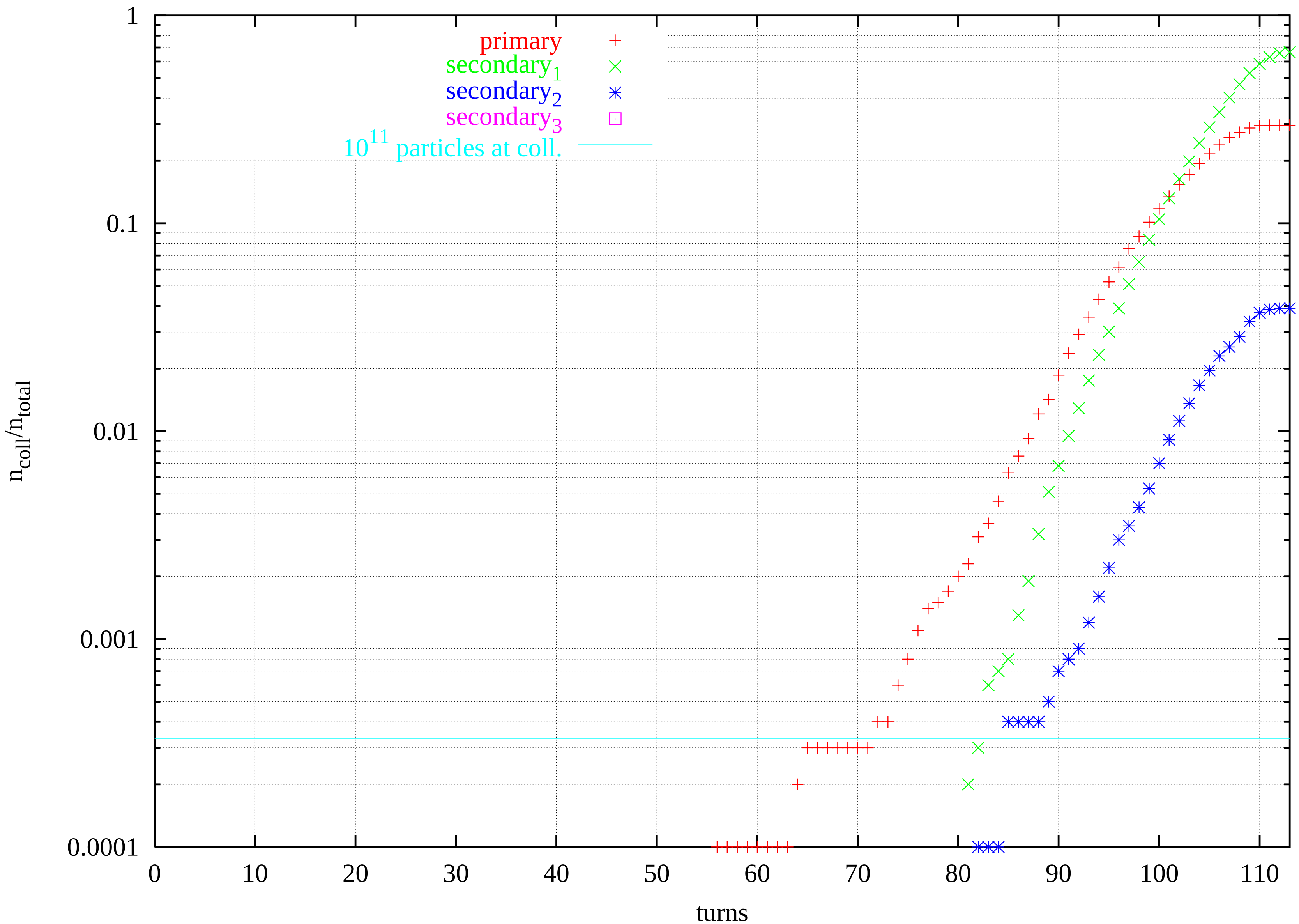
Failure scenarios:

- **power abort, power converter failure**
- **quench**

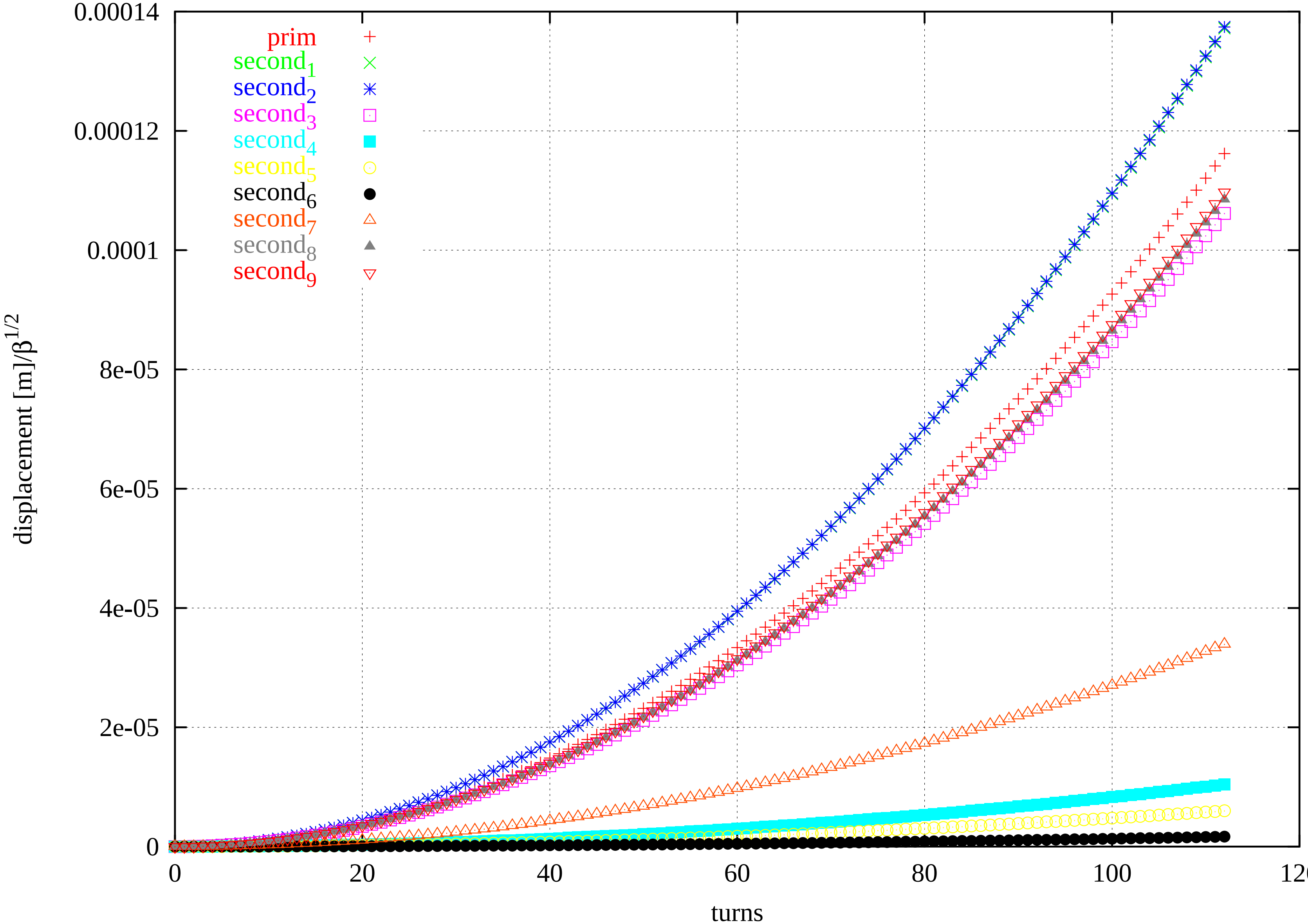
energy	7 TeV
emittance	0.503 nm
Q	64.31
τ	100 s
σ	200 ms
Θ_{max}	5.11 mrad

$$\Theta_{quench}(t) = \Theta_{max} - \Theta_{max} \cdot e^{-\frac{t^2}{2\sigma^2}}$$

Quench at MBs between IP2 and IP3, collimators in IR7: Total number of particles at the collimator relativ to initial number of particles in the ring



Quench at MBs between IP2 and IP3, collimators in IR7: closed orbit displacement



PLANS...

- Completing the studies on the MBs in one arc
- Studying an ansatz for the halo (superposition of two gaussian distributions with different σ)
- multi-turn or single-turn secondary collimation?
- quadrupole failure szenarios

Warm D1 magnets at IP5, core of the bunch not tracked: total number of particles relative to the initial number of particles in the ring in the course of time