



SIS18 Closed Orbit Feedback Project: Ion Optical Aspects

27.11.2009

David Ondreka

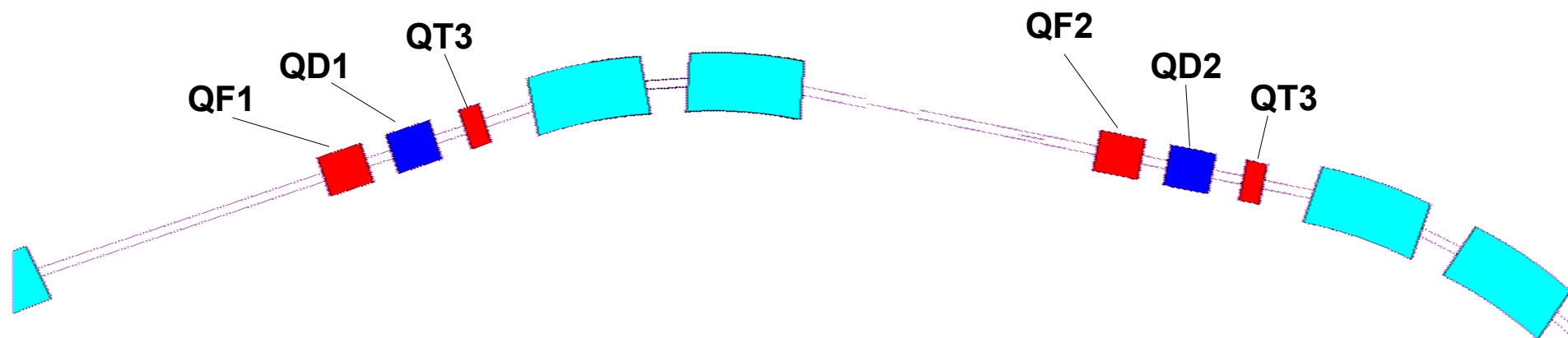
Agenda

- **SIS18 Layout**
 - Linear Lattice
 - BPMs and Correctors
- **Optics Variation in SIS18**
 - Triplet – Doublet Transition
 - Γ_t -Shift
 - Local Orbit Bumps
- **Optics in LSA**
 - Twiss Tables
 - YASP

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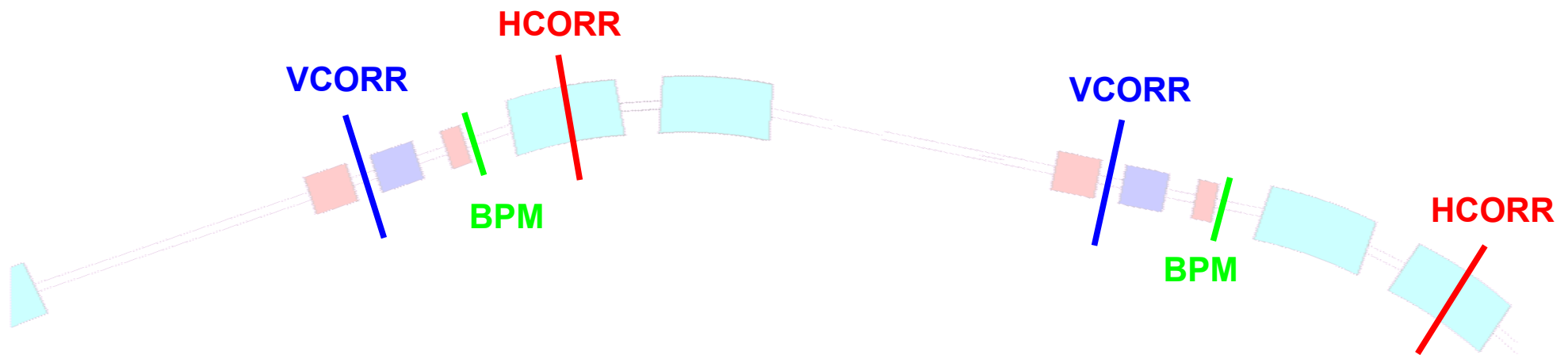
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SIS18: Linear Lattice



- **12 Periods**
 - 2 bends, 3 quadrupoles
- **Quadrupoles organized in 5 families**
 - 2 foc., 2 defoc. in alternating periods
 - 1 triplet family
- **Superperiodicity**
 - $S = 6$ by distribution of quadrupole families
 - $S = 12$ if $QF1 = QF2$ and $QD1 = QD2$

SIS18: BPMs and Correctors

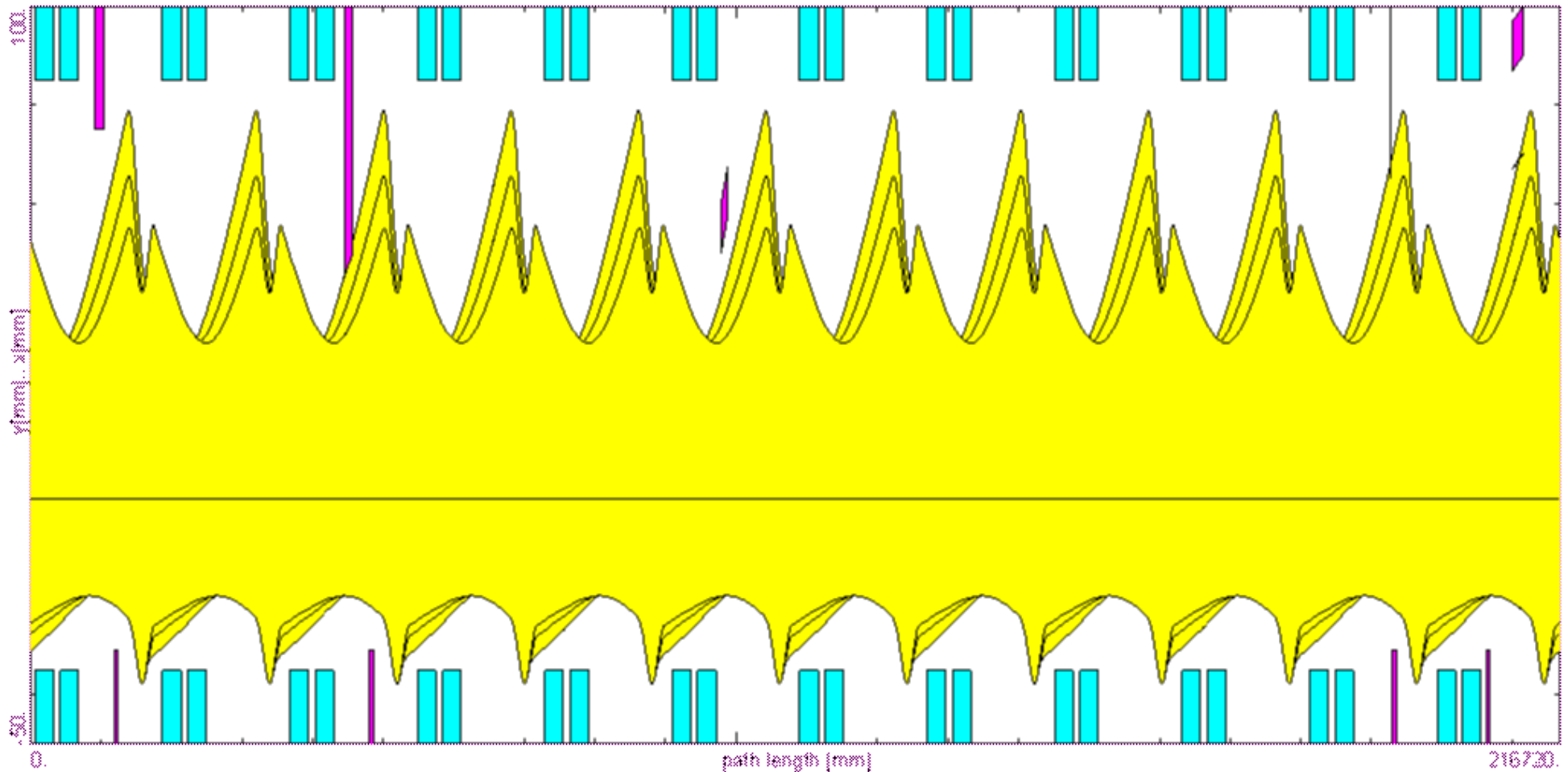


- **Distribution of BPMs and correctors**
 - BPMs: symmetric
 - Vertical correctors: symmetric
 - Horizontal correctors:
 - S##MU2A in periods 4 and 6
 - S##MU1A elsewhere

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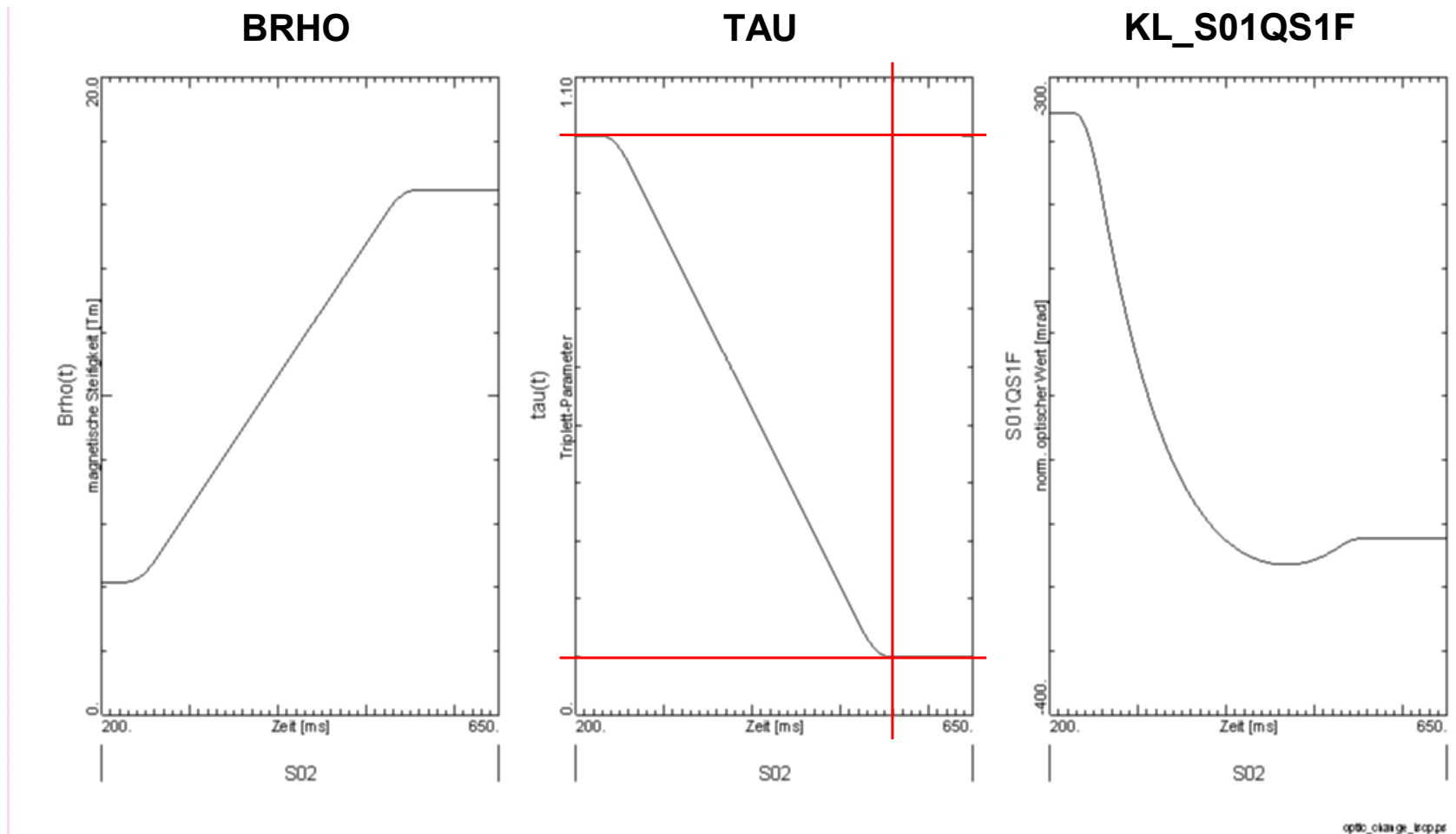
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Triplet – Doublet: Optics



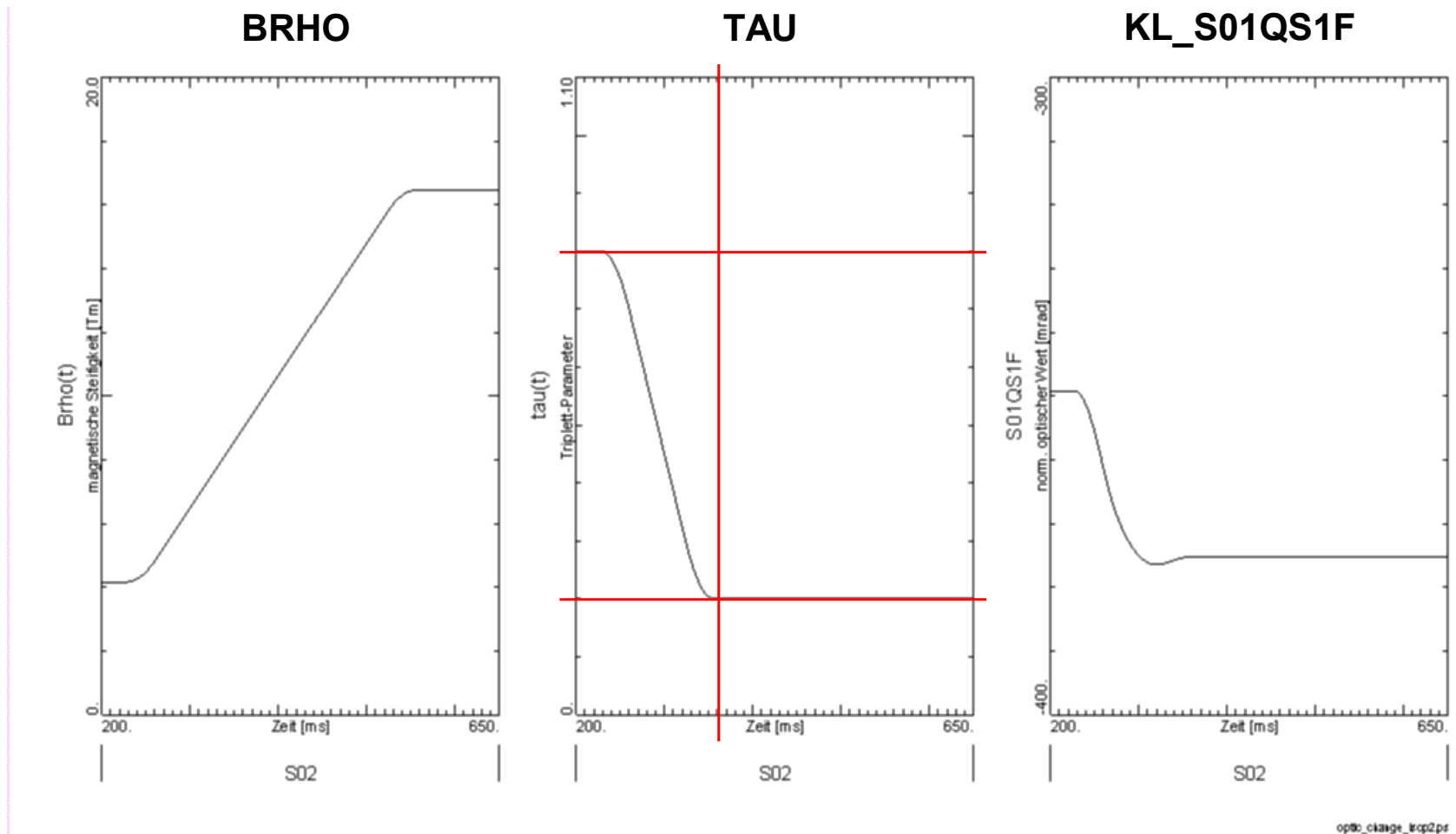
- Maximization of horizontal acceptance at injection
- Superperiodicity 12
- Parameterization by **triplet parameter TAU**

Triplet – Doublet: Timing



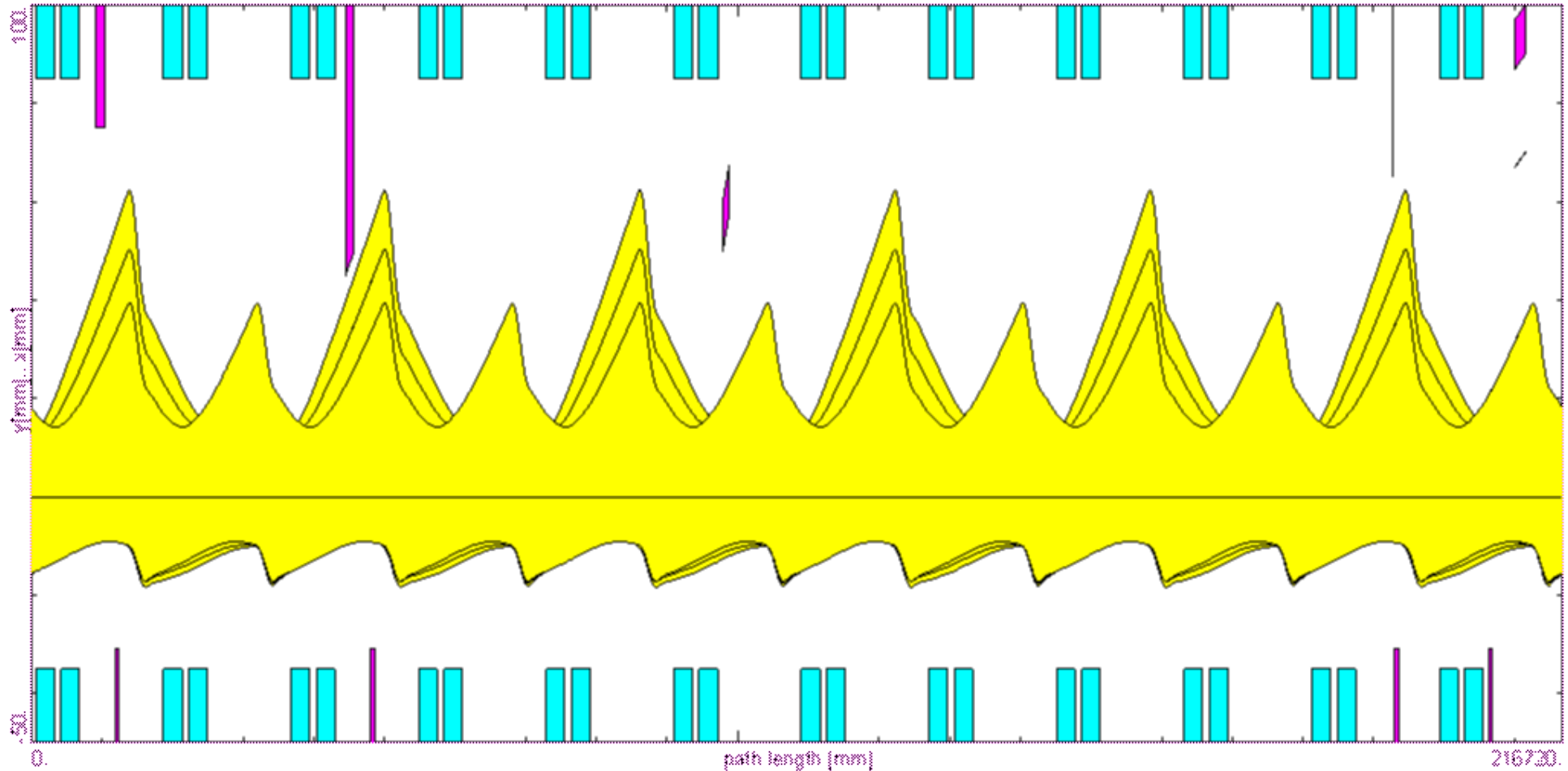
- Optic change usually proportional to field ramp
- Time dependence generally varies between cycles

Triplet – Doublet: Timing



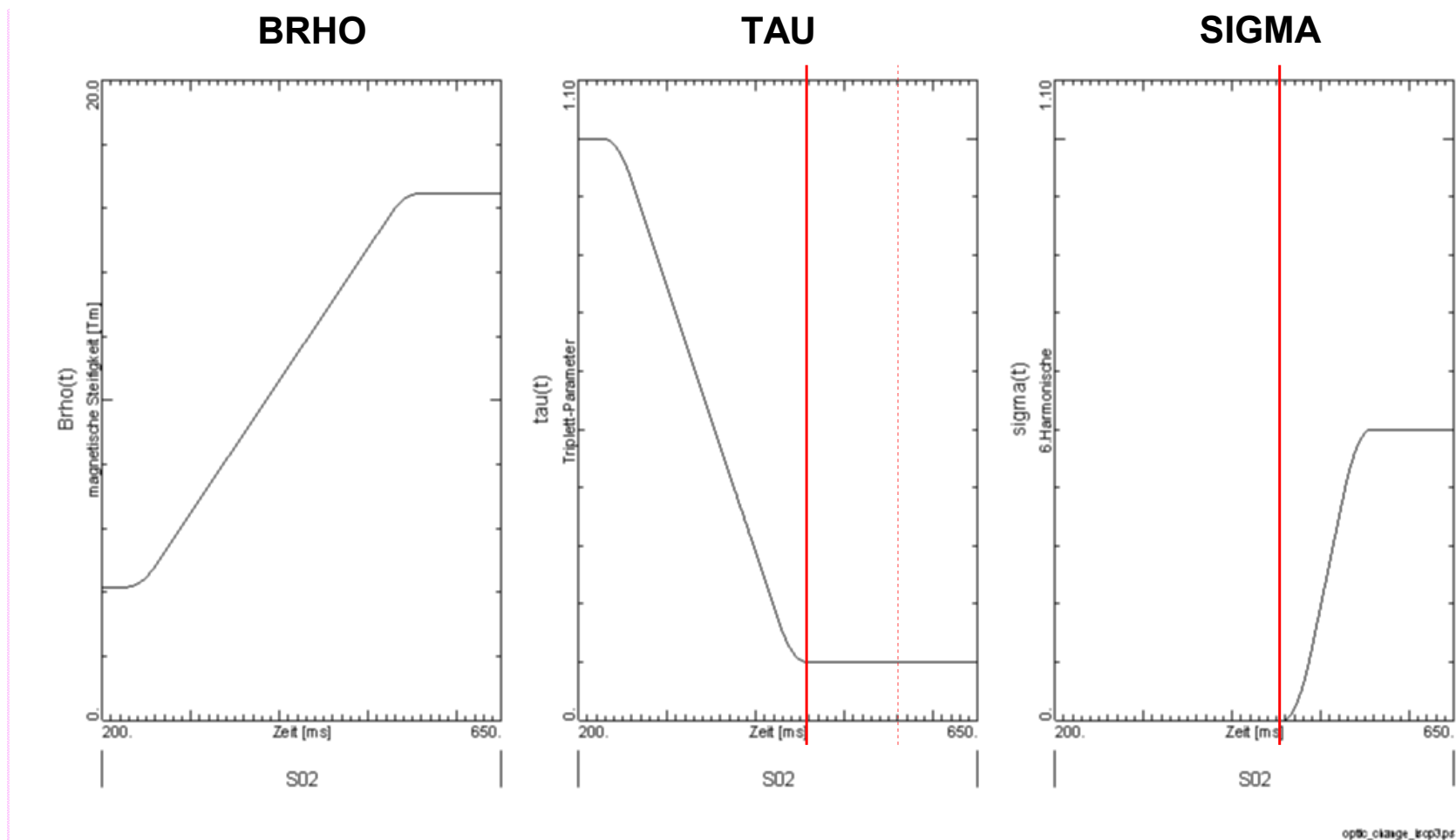
- **Adjusted optic change:**
 - TAU_INJ \rightarrow 0.8, TAU_EXT \rightarrow 0.2, TAU_OFFSET \rightarrow 0.2 s

γ_t -Shift: Optics



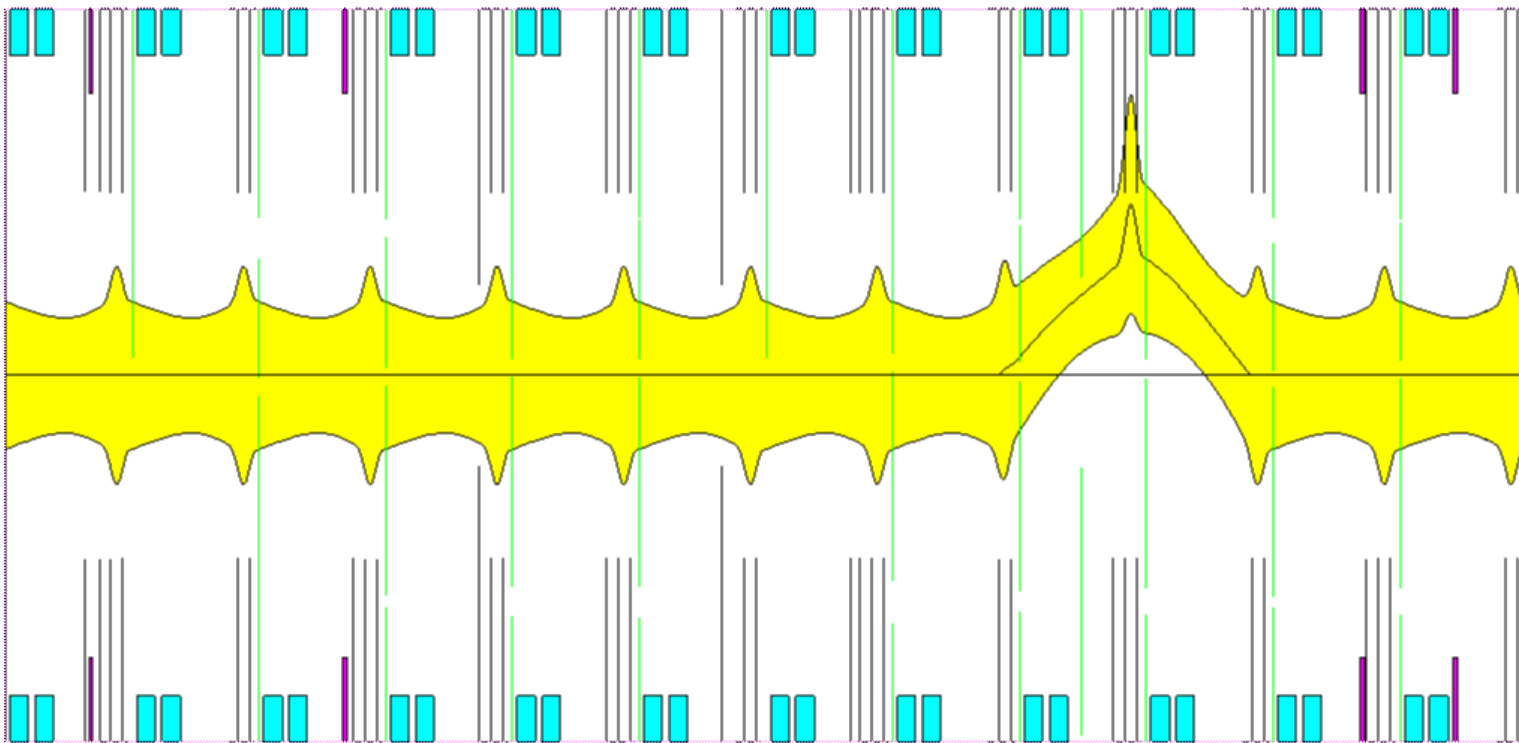
- Necessary for high energy proton operation (≥ 3.5 GeV)
- Superperiodicity 6
- Parameterization by **asymmetry parameter SIGMA**

γ_t -Shift: Timing



Local Orbit Bumps

Vertical orbit bump



- **Corrector angles optics dependent**
- **Beam position at BPM optics dependent**
- **Position target value** for orbit feedback required

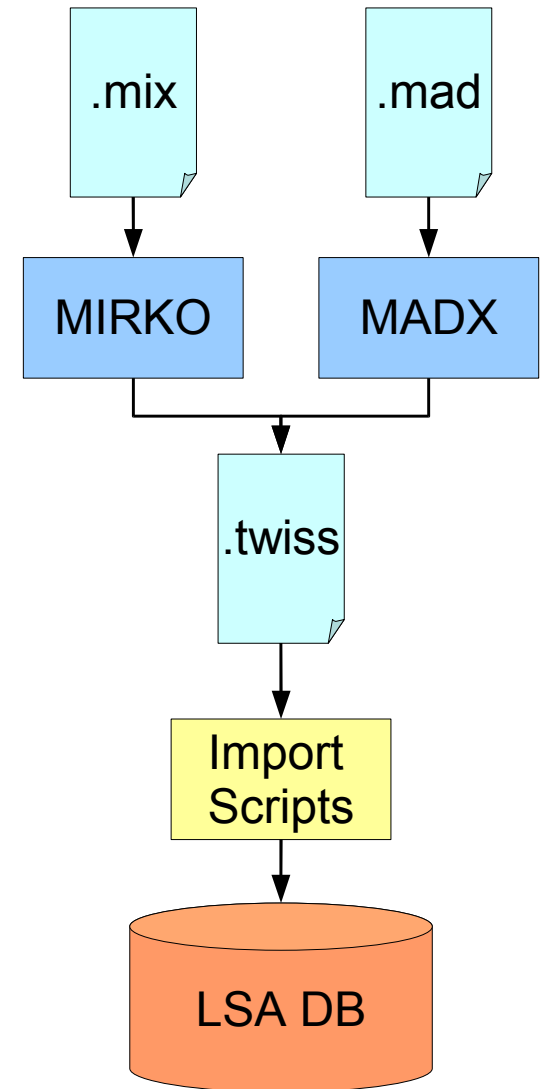
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Optics in LSA: Twiss Tables

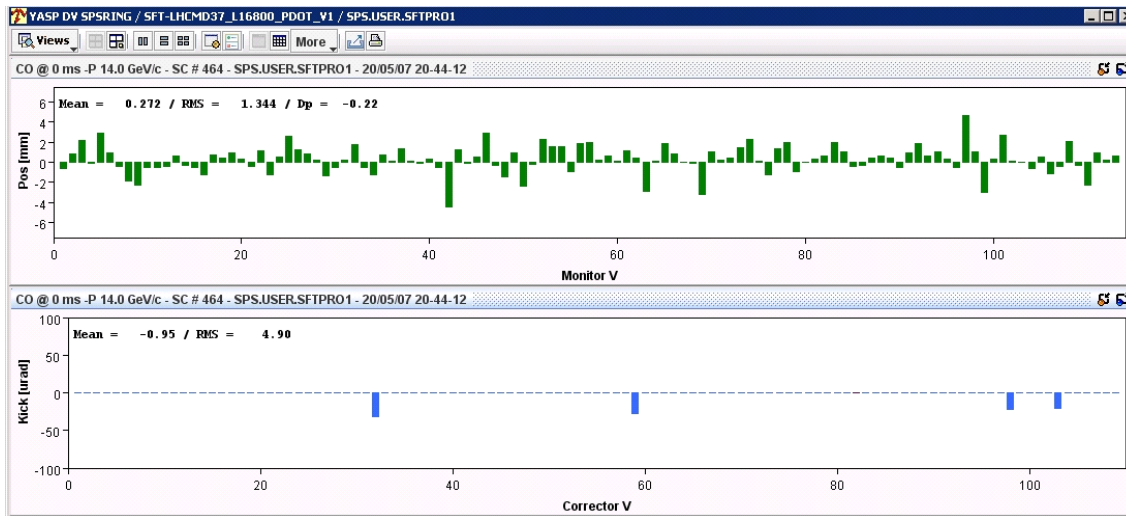
- **Optics information per element in LSA DB**
 - Theory values for strengths
 - Twiss parameters ($\beta_{x,y}$, $\alpha_{x,y}$)
 - Phase advance ($\mu_{x,y}$)
 - Dispersion ($D_{x,y}$, $D'_{x,y}$)
- **Automated Import**
 - Import from Twiss file via scripts
 - Generation of Twiss using MIRKO or MADX
 - Standard MIRKO/MAD lattice files
- **Users of optics information**
 - LSA Core: theory strengths, orbit bumps
 - Applications, e.g. YASP for orbit correction
 - Orbit Feedback: Calculation of response matrix

$$M_{ij} = \frac{\sqrt{\beta_i \beta_j}}{\sin(\pi Q)} \cos(\pi Q - |\mu_i - \mu_j|)$$



Optics in LSA: YASP

- **Generic application for correction of beam position @CERN**
 - Circular accelerators: Closed orbit correction (ramp!), local orbit bumps
 - Beam transport lines: centering of beam
- **Software feedback of position data into correction parameters**
- **Usage at SIS18 is foreseen → prerequisites:**
 - Setting generation via LSA
 - BPMs read out via FESA



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