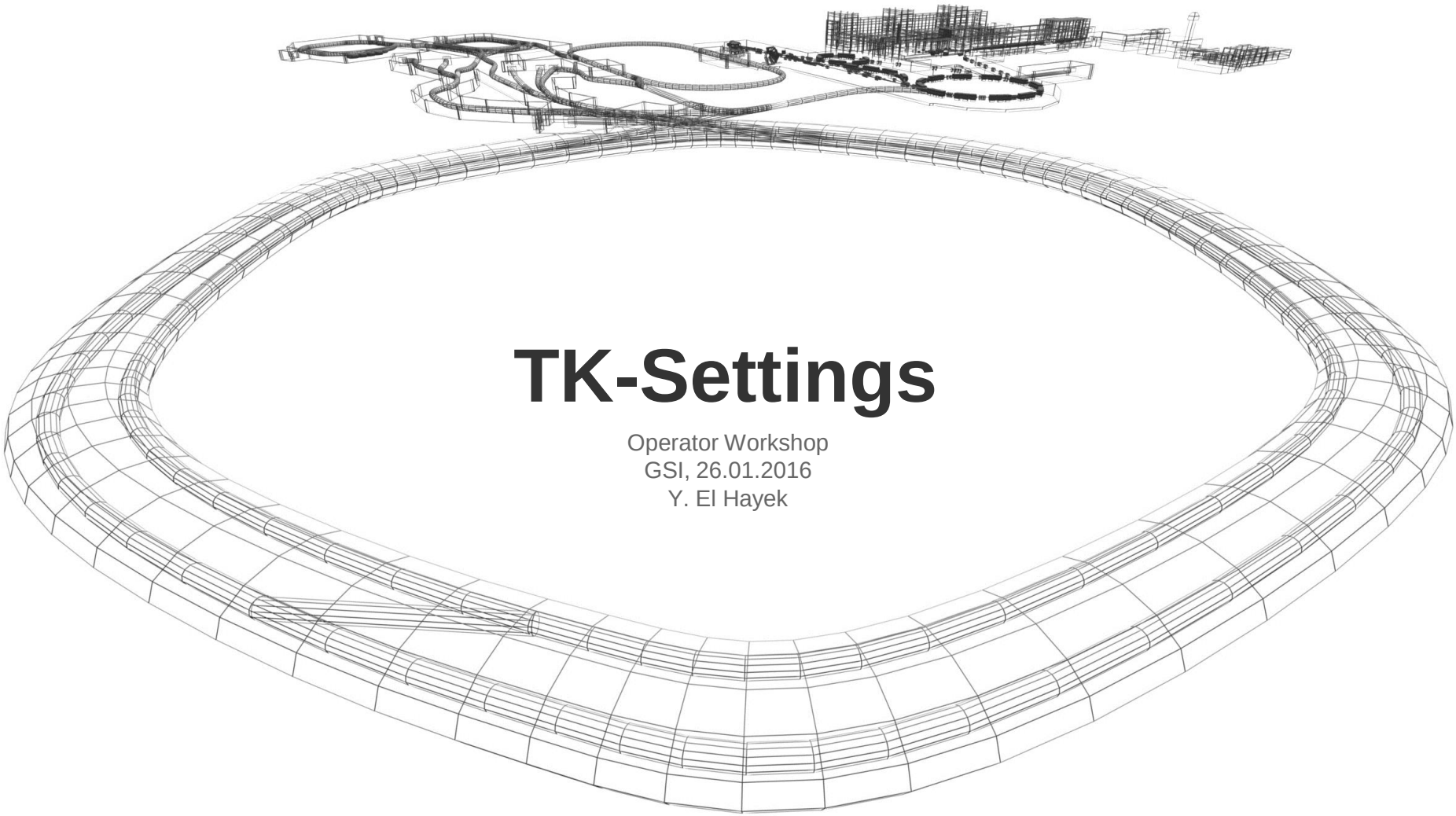
GSI Helmholtzzentrum für Schwerionenforschung GmbH



TK-Settings

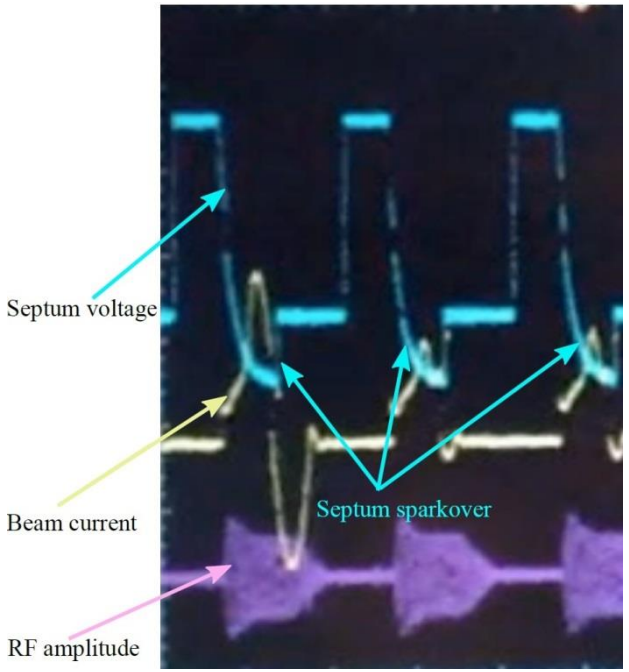
Operator Workshop
GSI, 26.01.2016
Y. El Hayek

Outline

- Motivation
- Multi-Turn Injection Basics
- TK-Collimation:
  - TK-Settings
  - Envelope and Emittance Fit
- Collimation Results
  - Septum Protection
  - Injection Efficiency & Dynamic Vaccum
- Summary

Motivation

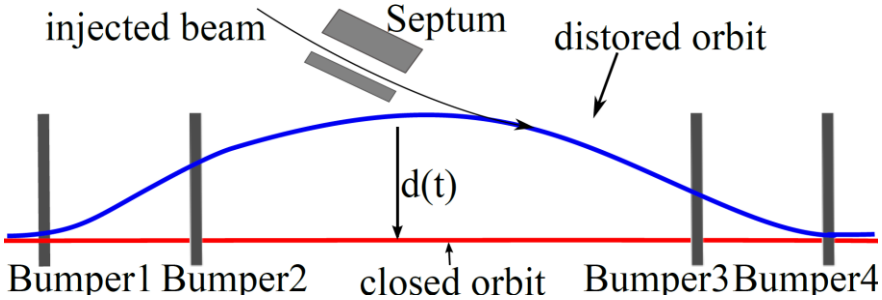
- Problems with low charge state operation
  - Beam loss provokes sparkover in septum
  - Erosion of septum electrodes
  - Strong pressure increase in septum tank
    - Break down of dynamic vaccum
    - High losses during cycle
- Solution: collimation in transfer channel (TK)
  - Shift losses from SIS18 to transfer channel → Collimation
  - Reduce the beam emittance by cutting out hot core → High brillance



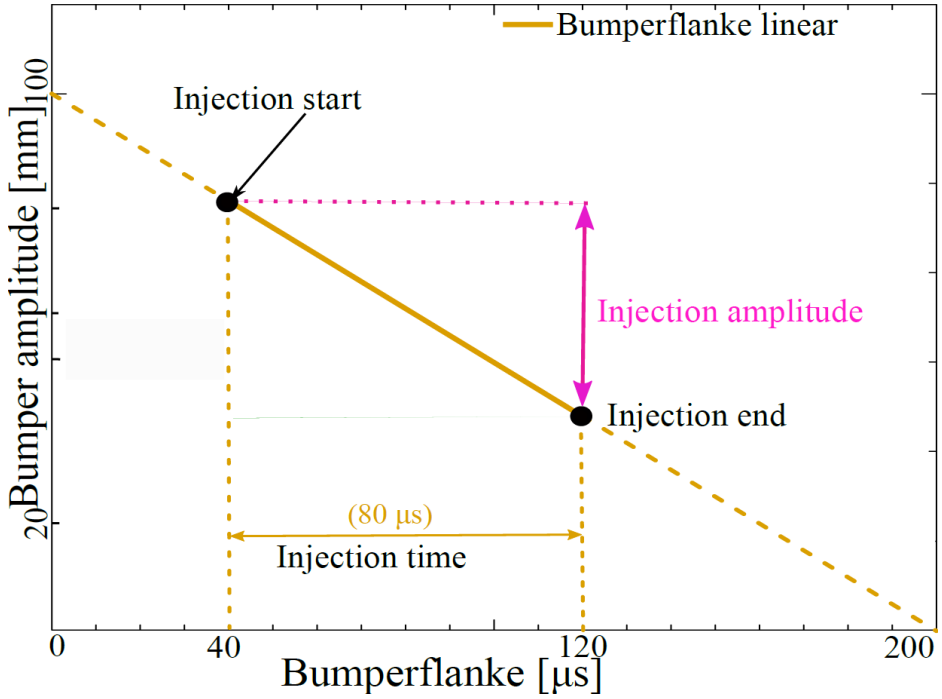
Multi-Turn Injection (MTI) Principle

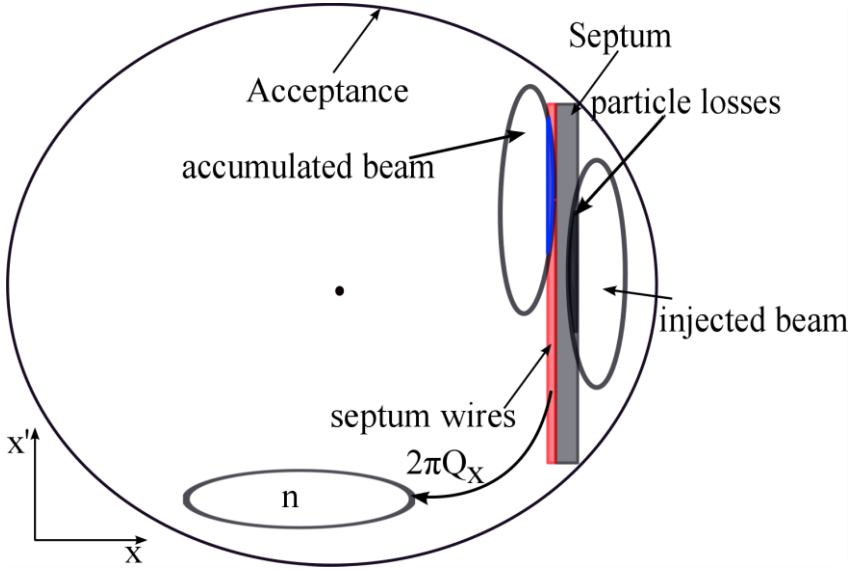
- Basics for the injection:
  - In the local region of a paticle, the particle density in phase spase is constant
  - in an occupied phase space volume cannot be injected a second time whitout losing particles
  - The injected beam should match as well to the phase space characteristics of SSI18
  - The phase space adjustment is done by using the Beam transport system before injection, it is essential for the transmission optimization
  - High packing density → higher losses
  - Lower packing density → lower intensity

MTI in SIS18



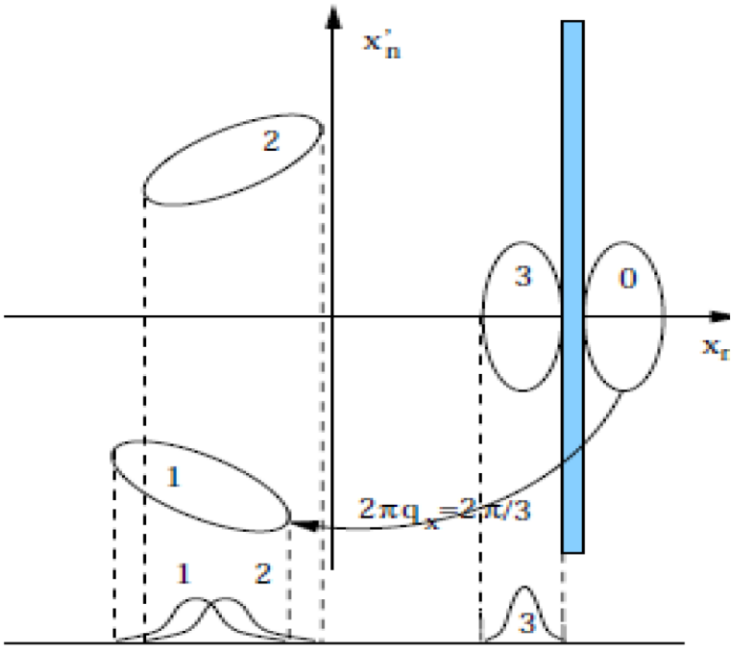
Multiturn injection losses



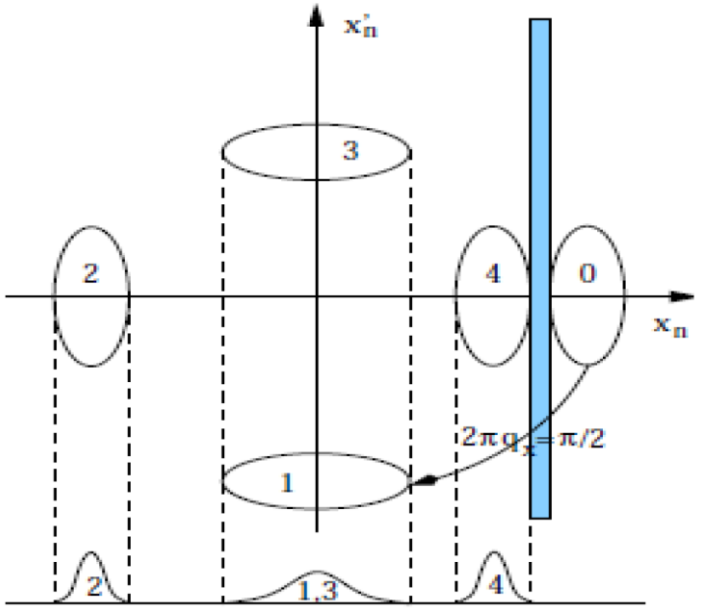


MTI: Transversal Accumulation

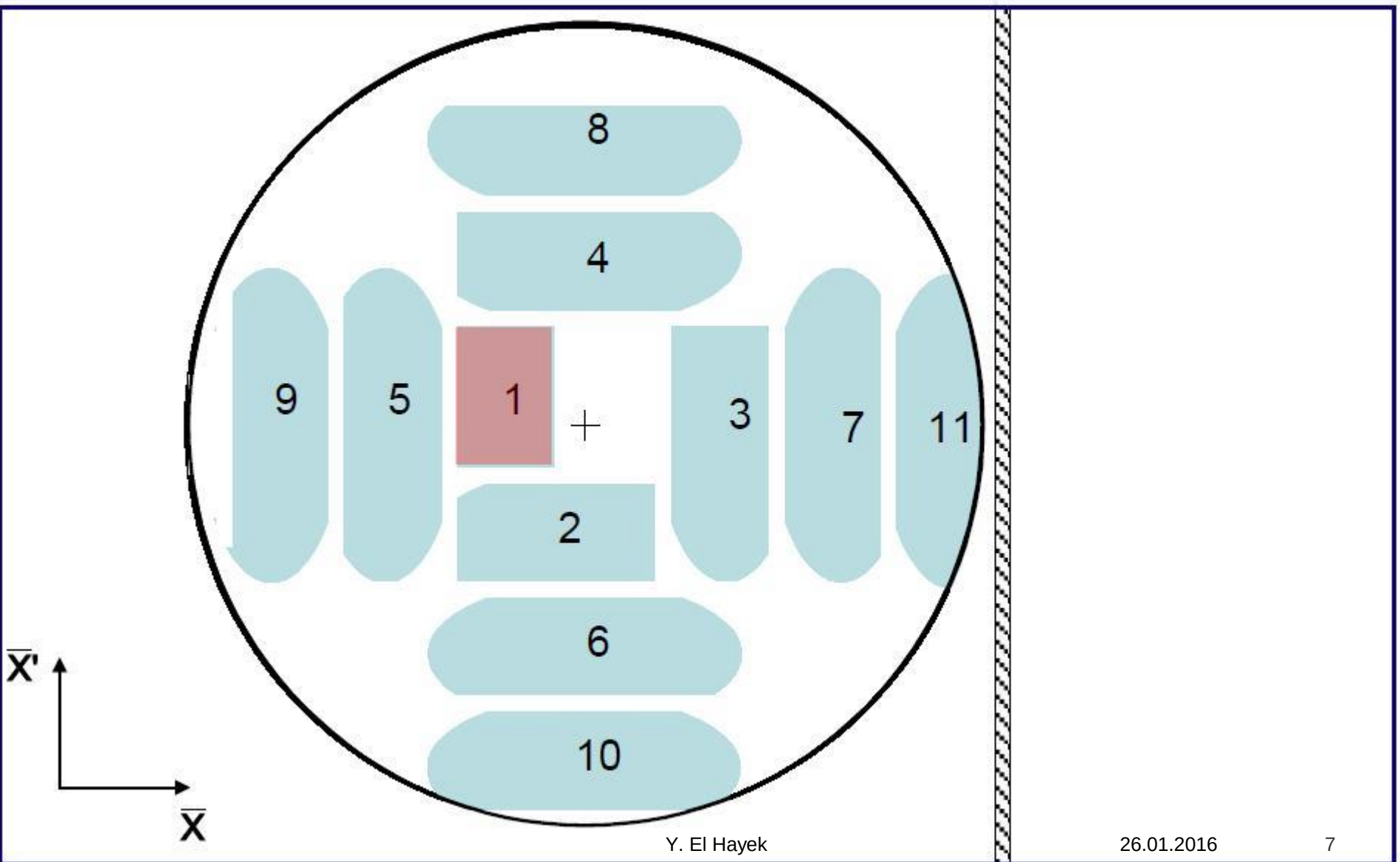
- Accumulation with 1/3 Tune
- Tune $Q_h = 3\frac{1}{3}$



- Accumulation with $\frac{1}{4}$ Tune
- Tune $Q_h = 3\frac{1}{4}$

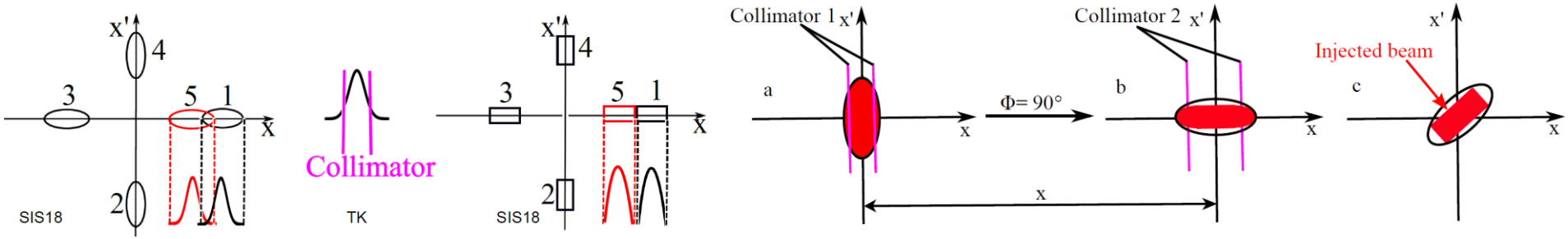


MTI: Example with fractional Tune Q_h=0.25

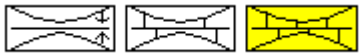


TK Collimation

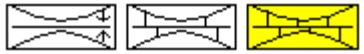
- Overlap of two beams by four turns
- To shift the particle losses from SIS18 to TK
- Protection of injection Septum
- Improvement of dynamic vacuum in SIS18
- Reduce the injected emittance and increase the beam brillance

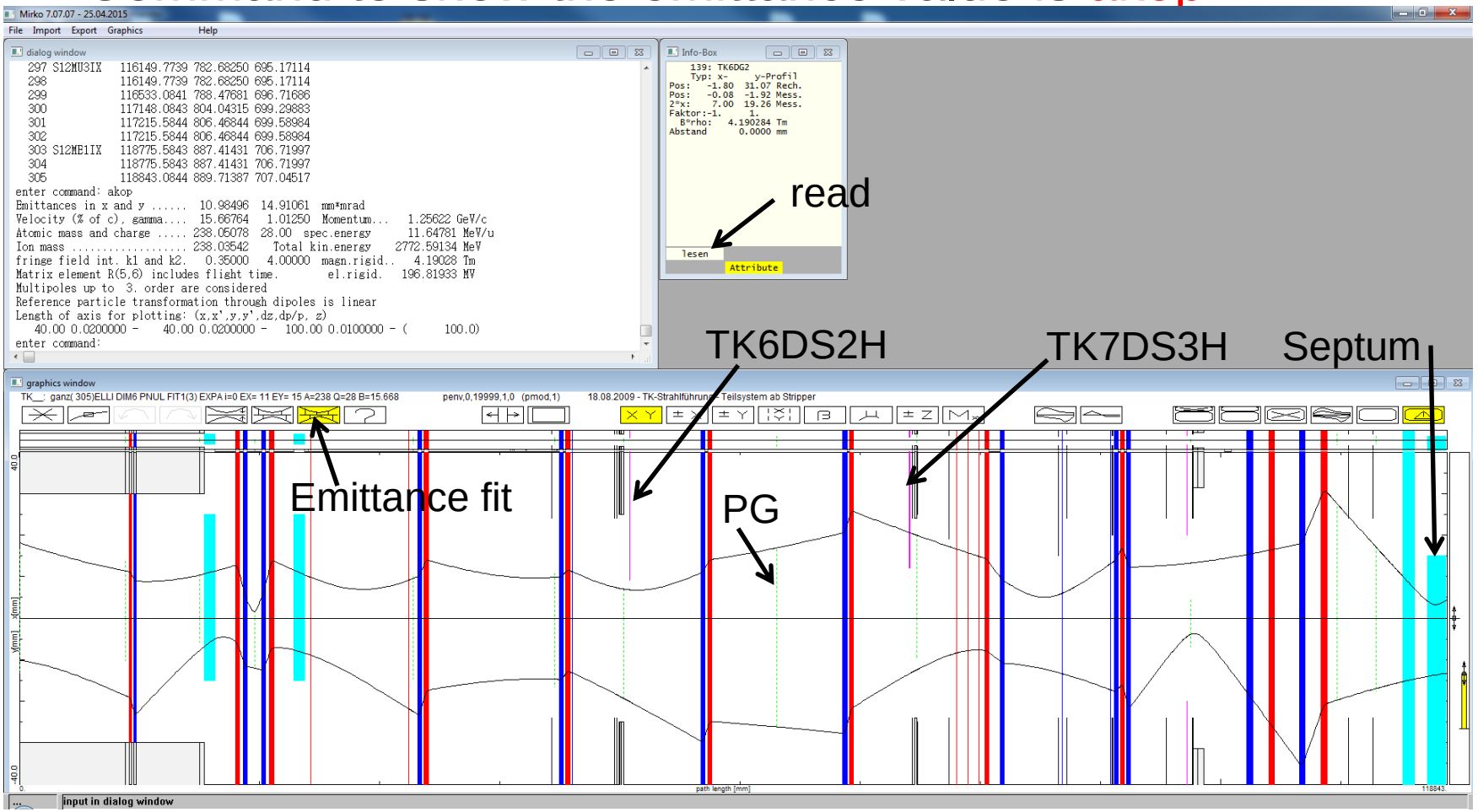


TK Collimation: TK-Settings

- Prepare the beam for the collimation in TK:
  - Calculate the beam envelope and emittance (MIRKO)
    - Green lines are the Profile Grids
    - Switch MIRKO for the Emittance fit 
    - Try to find three combination of PGs that fit the envelope over all PG
    - The fitted envelope should be almost cover all profile grids
    - Calculate the beam emittance: MIRKO command akop
  - To check the phase advance between the collimators:
    - Switch MIRKO to calculate the phase advanc 
    - To check the phase advance between the collimators:
      - Load the makro schlitze.mak MIRKO command @schlitze
    - Set the phase advance between two collimators to 90°
    - Set the phase advance between the second collimator and the injection septum to 360°
    - Increase the beam width at the collimators

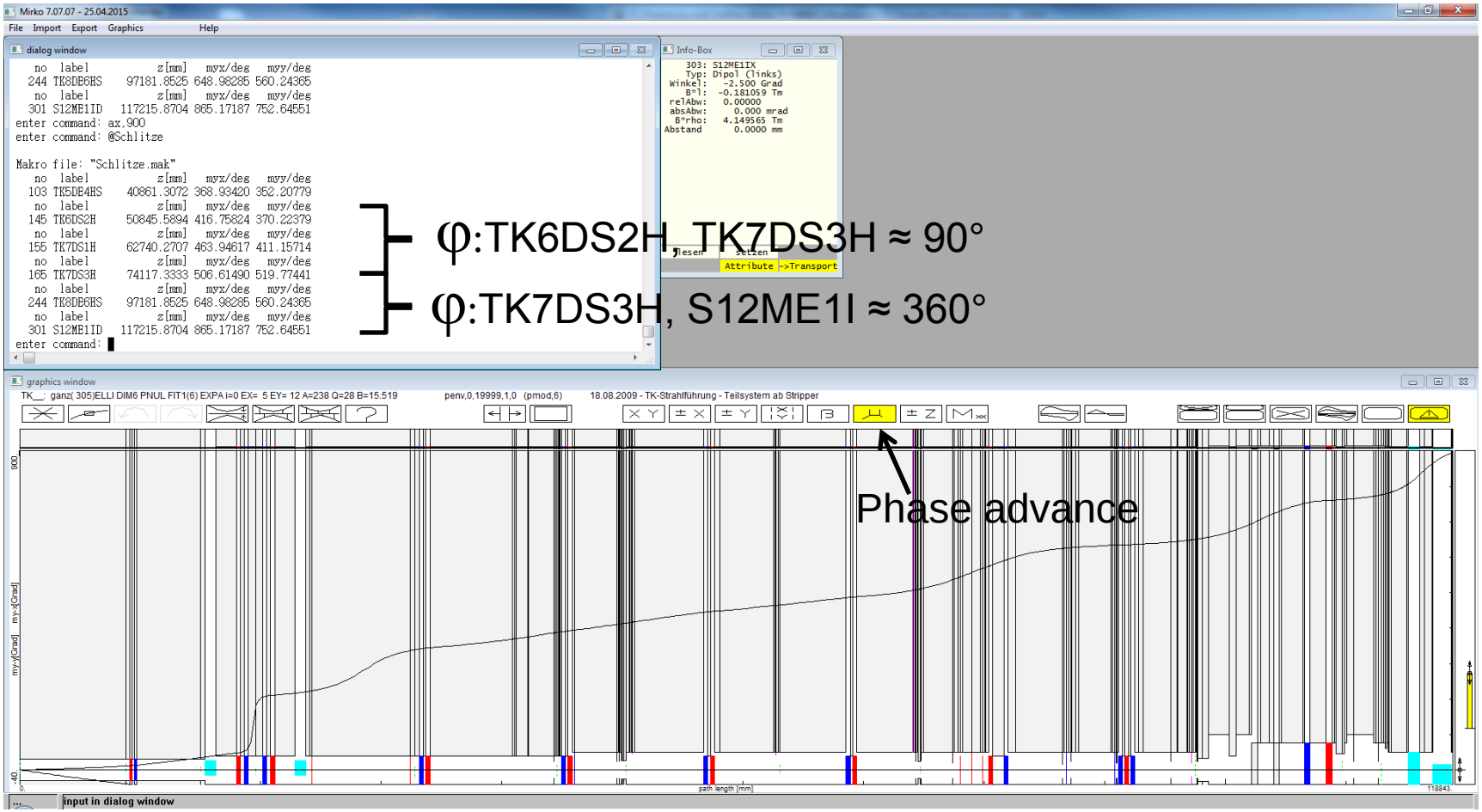
TK Collimation:Envelope and Emittance Fit

- Emittance fit through three PG 
- Command to show the emittance value is akop

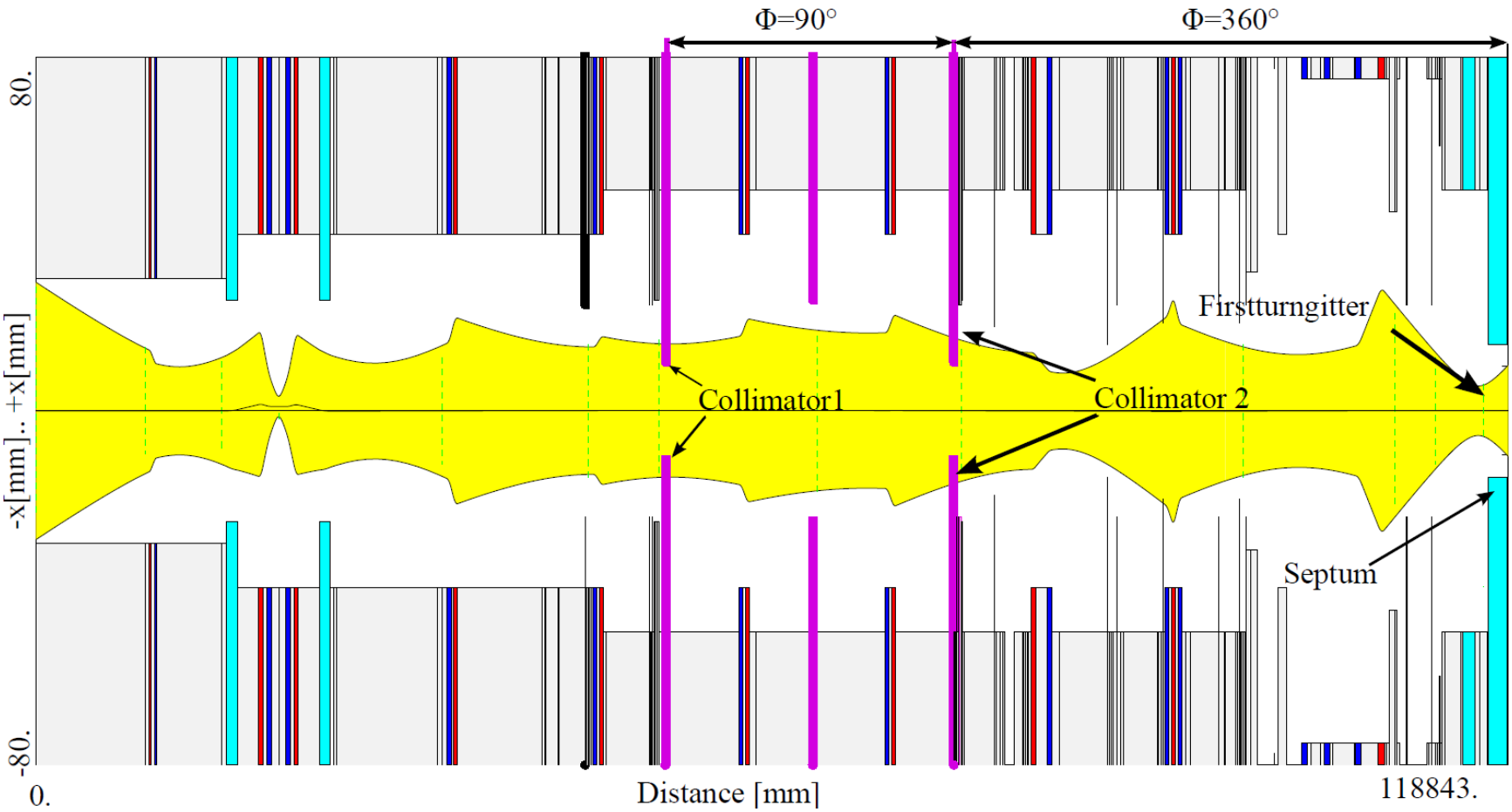


TK-Collimation: Phase Advance

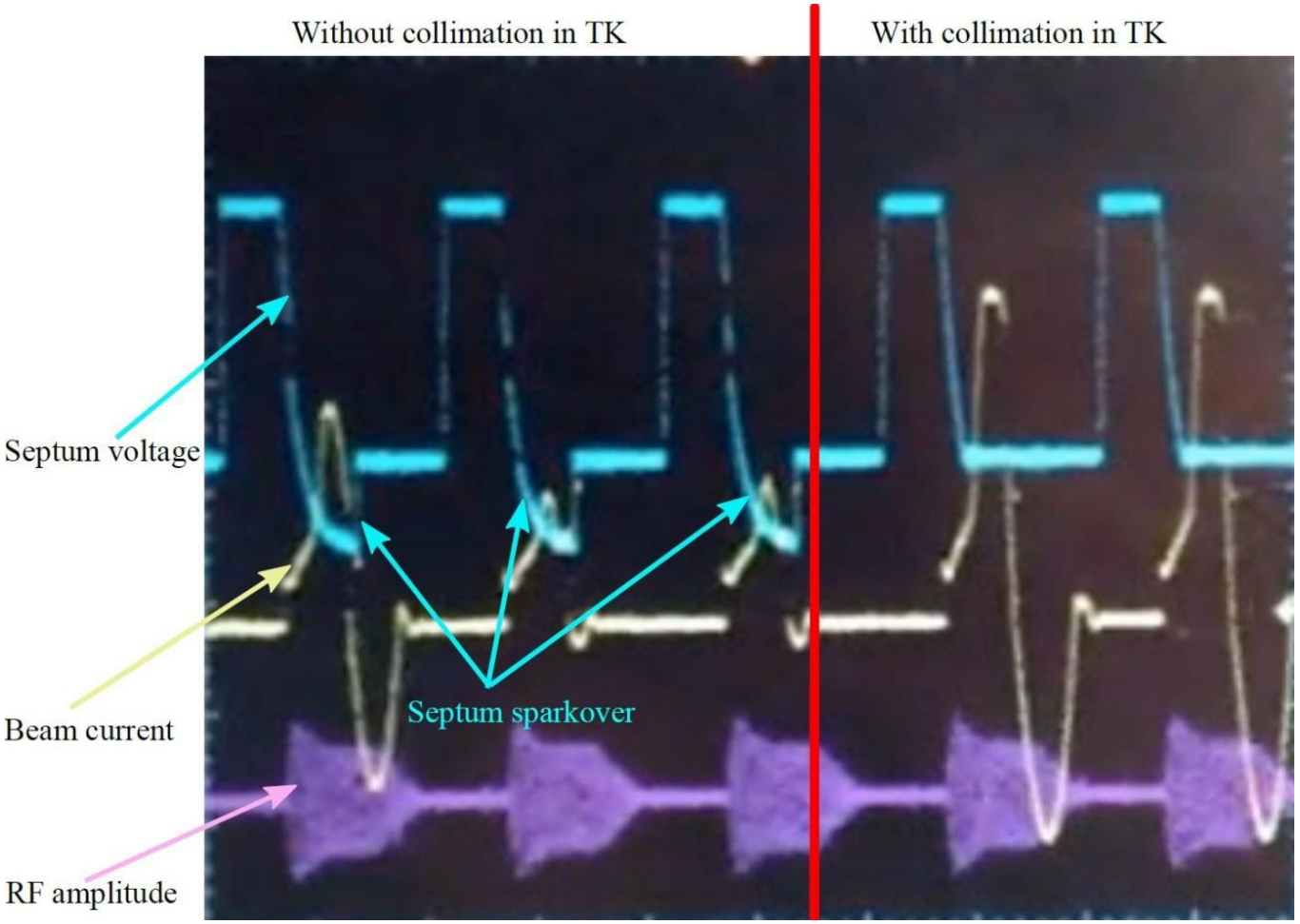
- Switch MIRKO to calculate the phase advance
- Phase advance between Collimators and septum: MIRKO command @SCHLITZE
- Phase advance between PGs: MIRKO command @PROFILGITTER



TK Collimation: TK Envelope



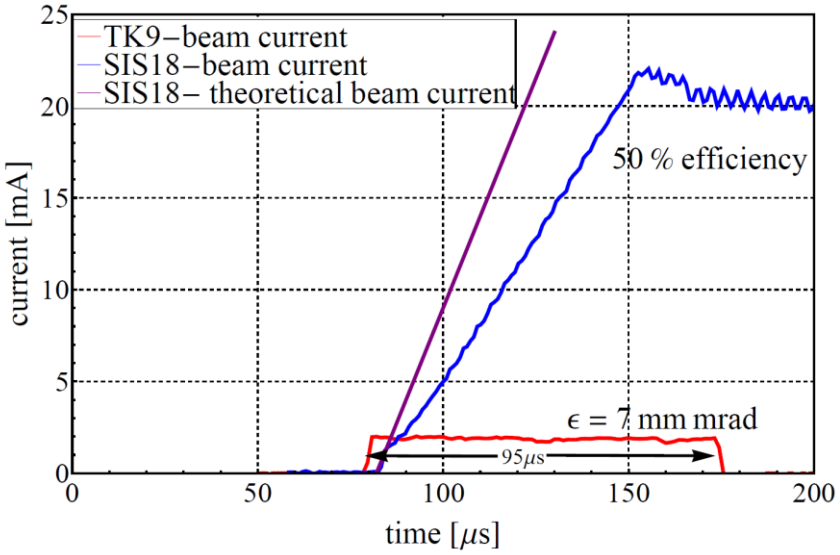
Collimation Results: Septum Protection

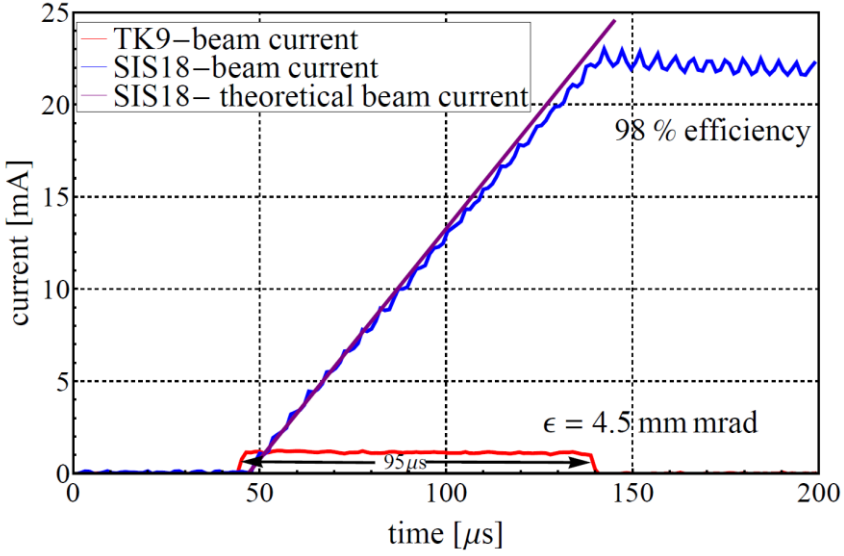


Without collimation:
- Sparkover and vacuum breakdown
- High losses during ramp

With collimation:
- Stable septum voltage (no sparkover)
- Stable beam current

Collimation Results: Injection Efficiency





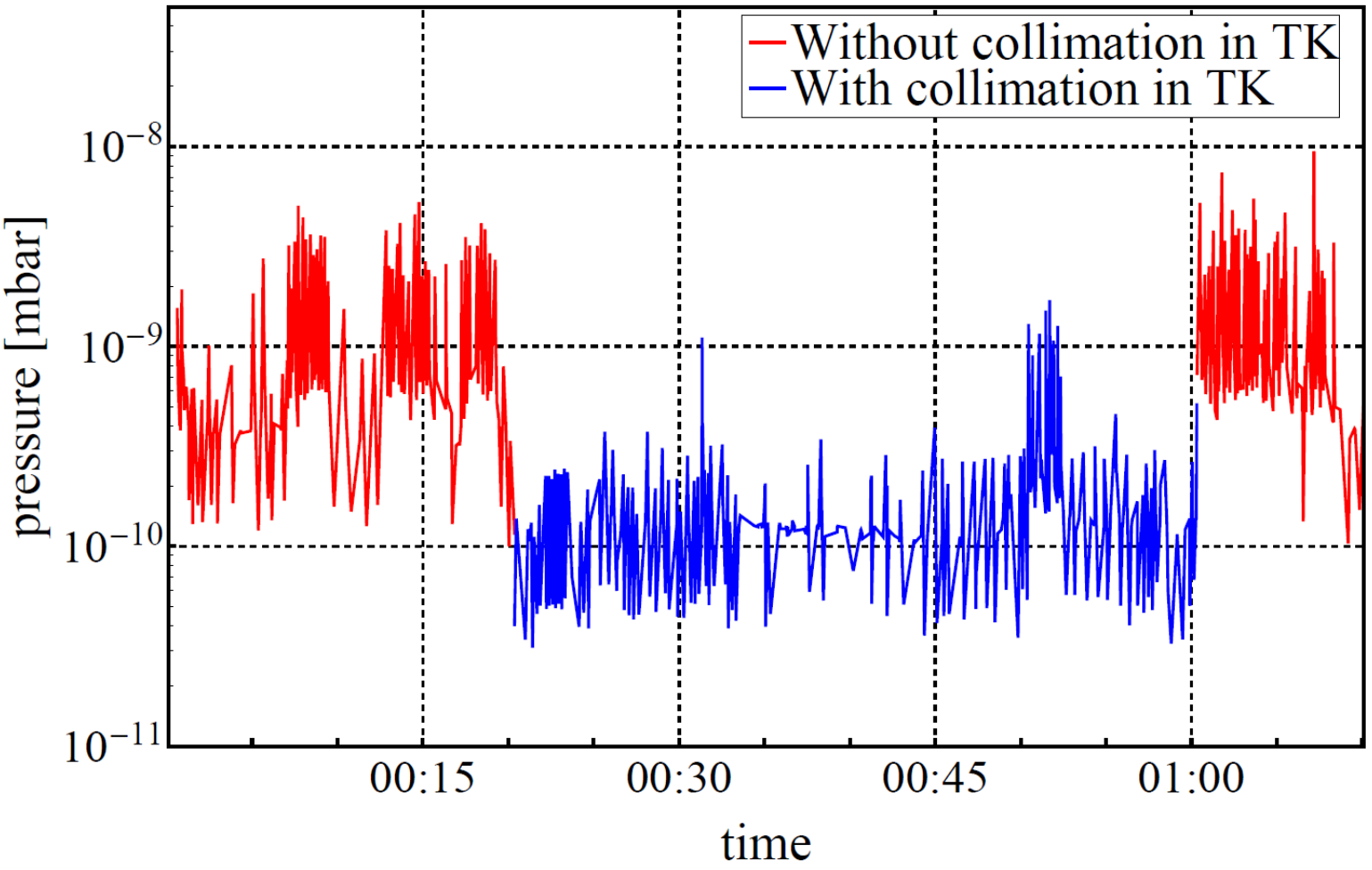
Without collimation

- Injection efficiency only ~ 50 %
- High losses at injection septum

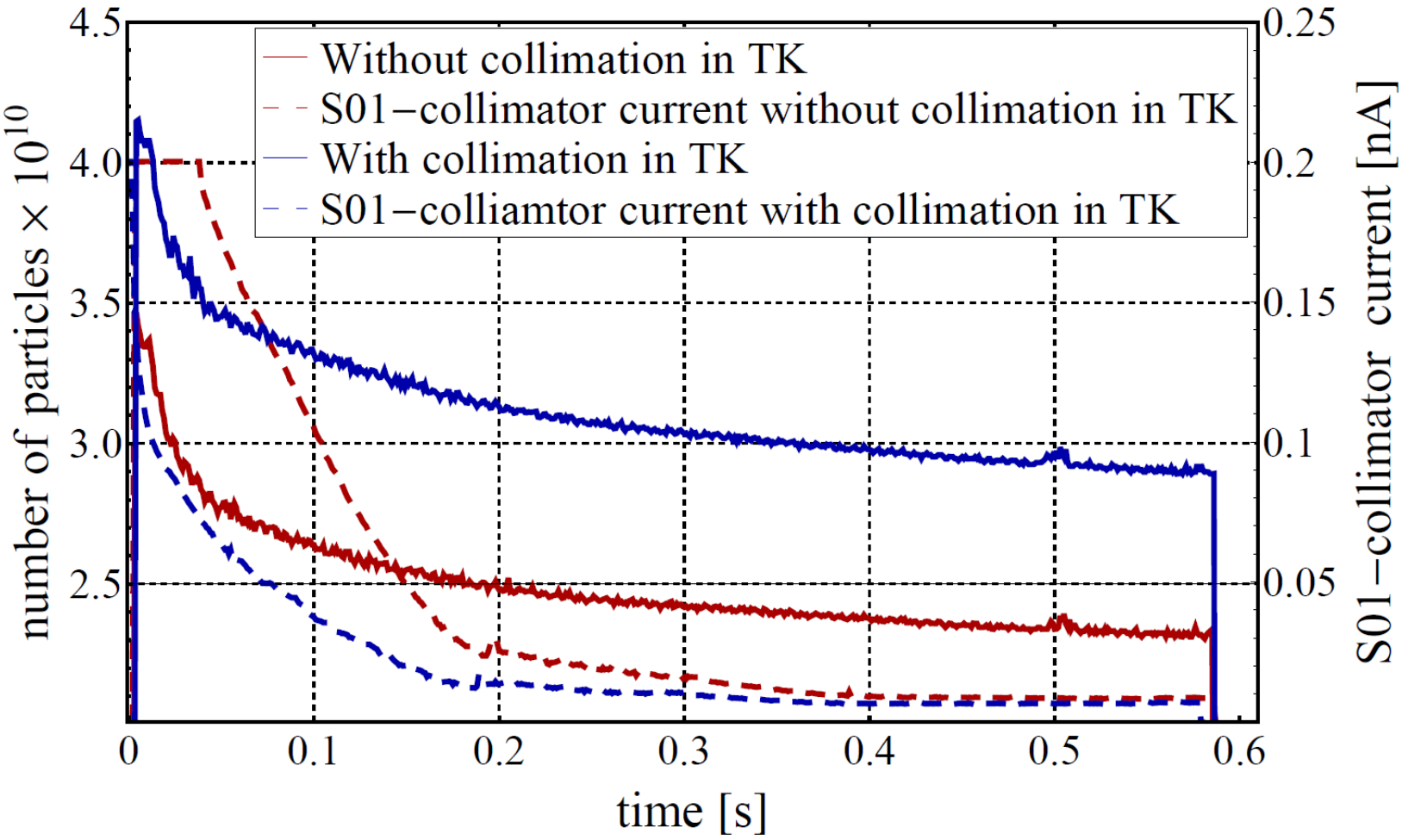
With collimation

- Injection efficiency ~ 95 %
- Few losses at injection septum
- Higher accumulated intensity

Collimation Results: Dynamic Vaccum



Collimation Results: SIS18 Intensity



Summary

- Prepare an optic in TK for the collimation:
  - Read all profile grids with MIRKO
  - Emittance fit through three profile grids
  - Set the right phase advance between collimators and septum
- Collimation in TK:
  - Stable operation through protection of septum
  - Increased intensity and transmission
  - Better dynamic vacuum due to fewer losses in ring