Front-End Misalignments and MEBT Trajectory

Stuart Henderson
AP Video
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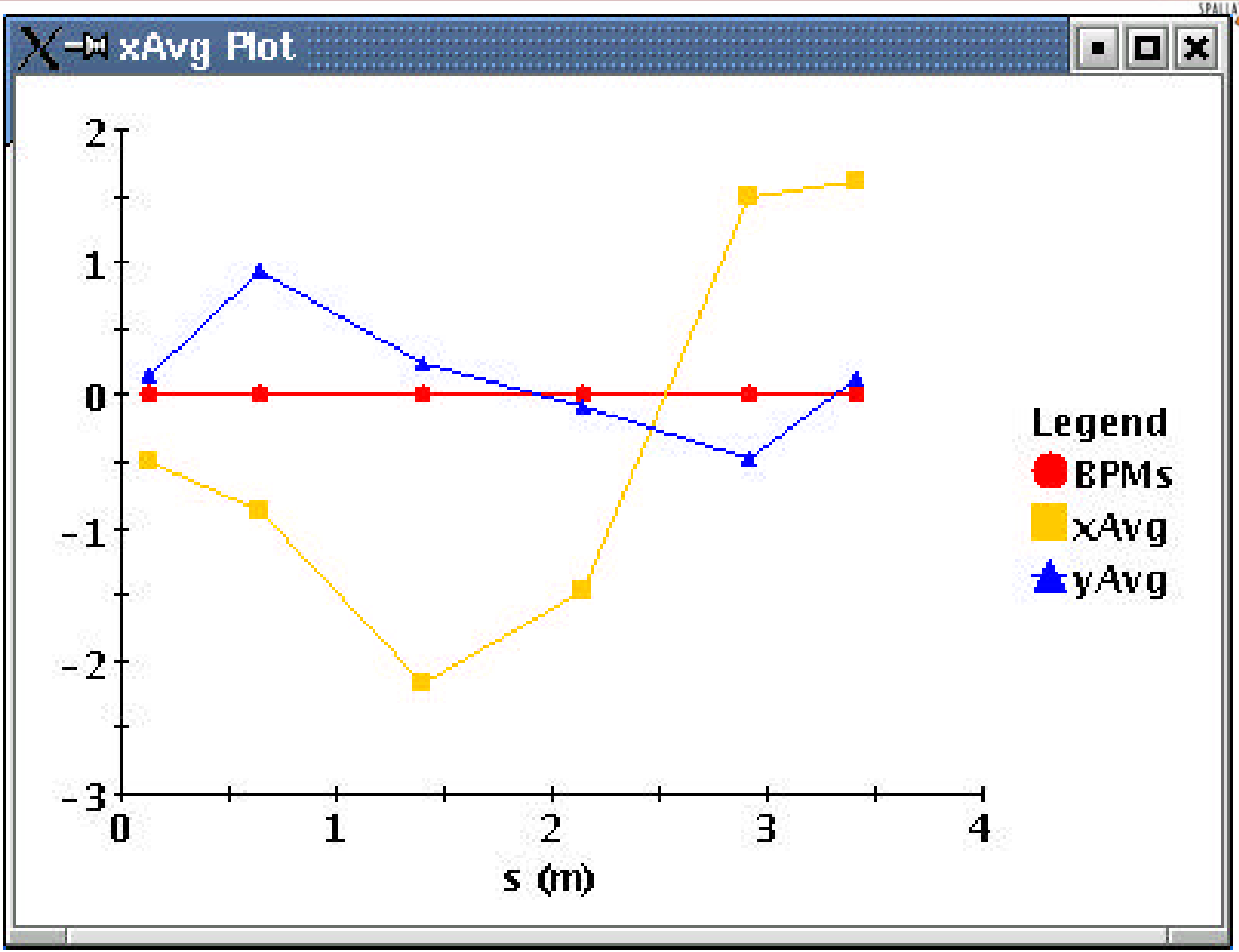
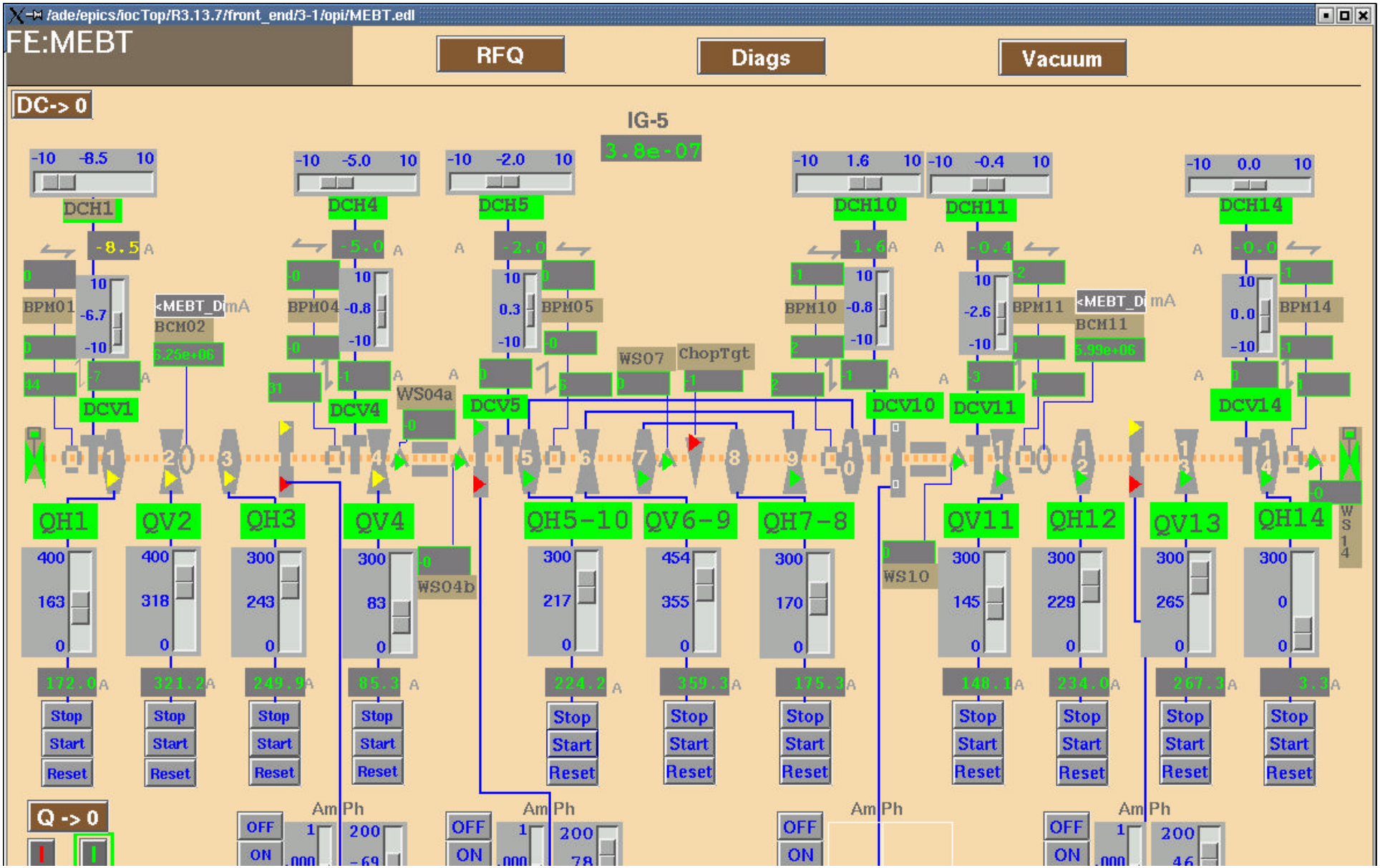
Front-End Misalignments and the MEBT Trajectory

- An outstanding issue from Front-end commissioning at ORNL relates to several MEBT trajectory observations
  - Measured trajectories with MEBT correctors “off” showed large errors
  - Strong or full-strength MEBT correctors required to straighten trajectory
  - MEBT trajectory seen to depend on RFQ power
  - MEBT output emittance shows extreme dependence on MEBT trajectory
- Very important to understand the trajectory
- A number of people have worked on aspects of this problem

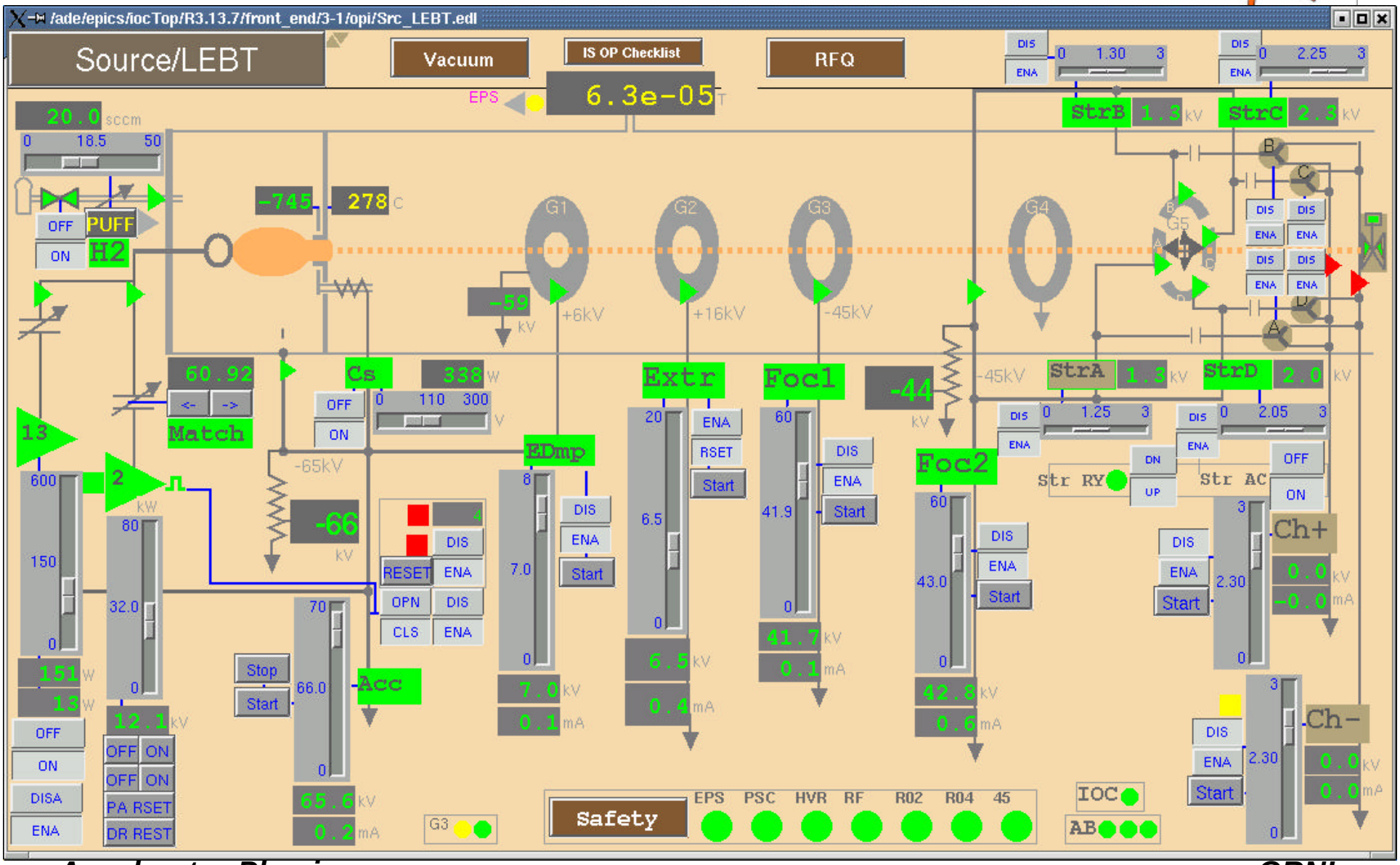
Typical MEBT Trajectory with LEBT/MEBT Correctors Off



Typical MEBT Corrector Settings



Typical LEBT Settings

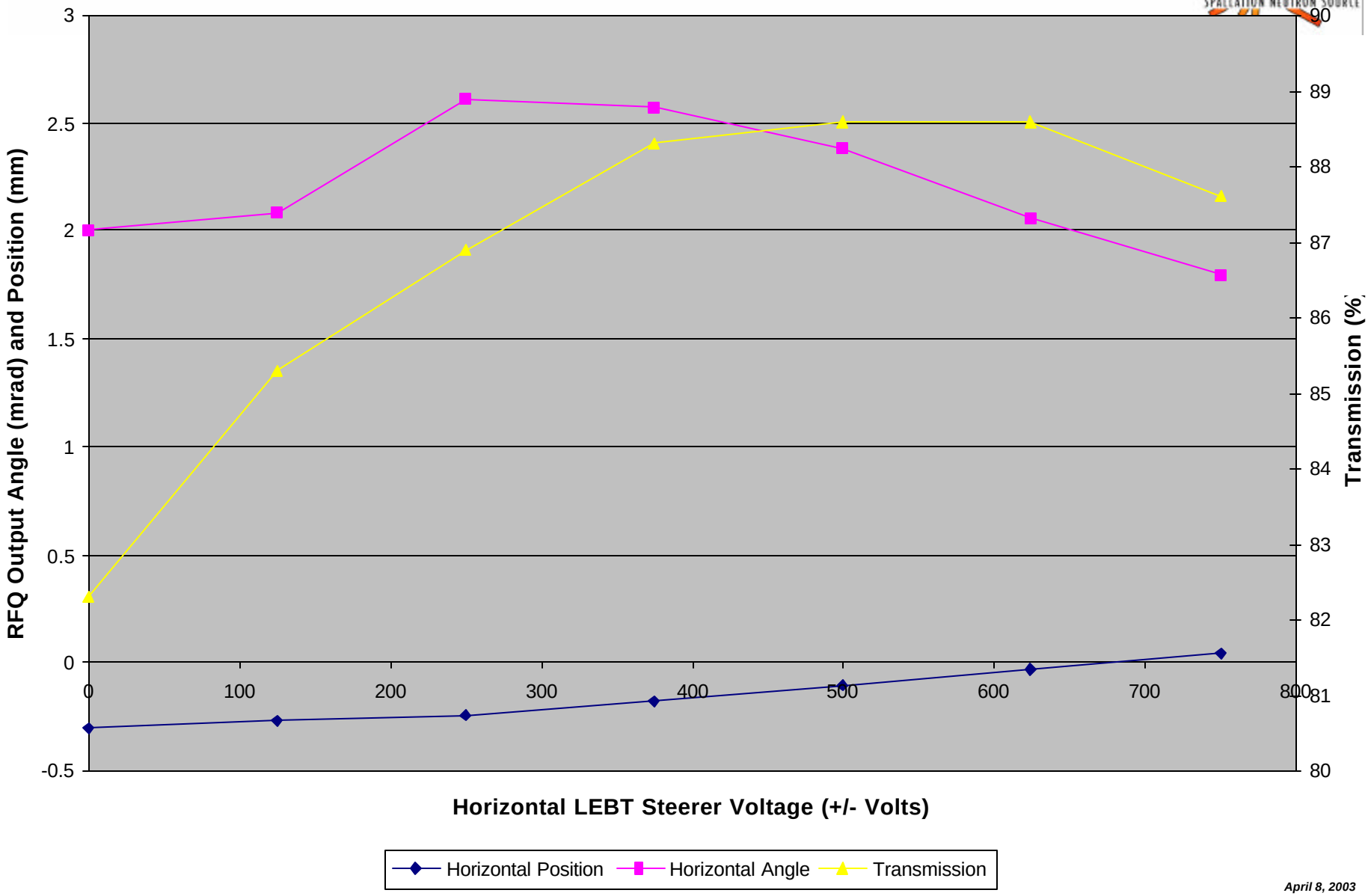


Problem #1: IS/LEBT to RFQ Relative Misalignment

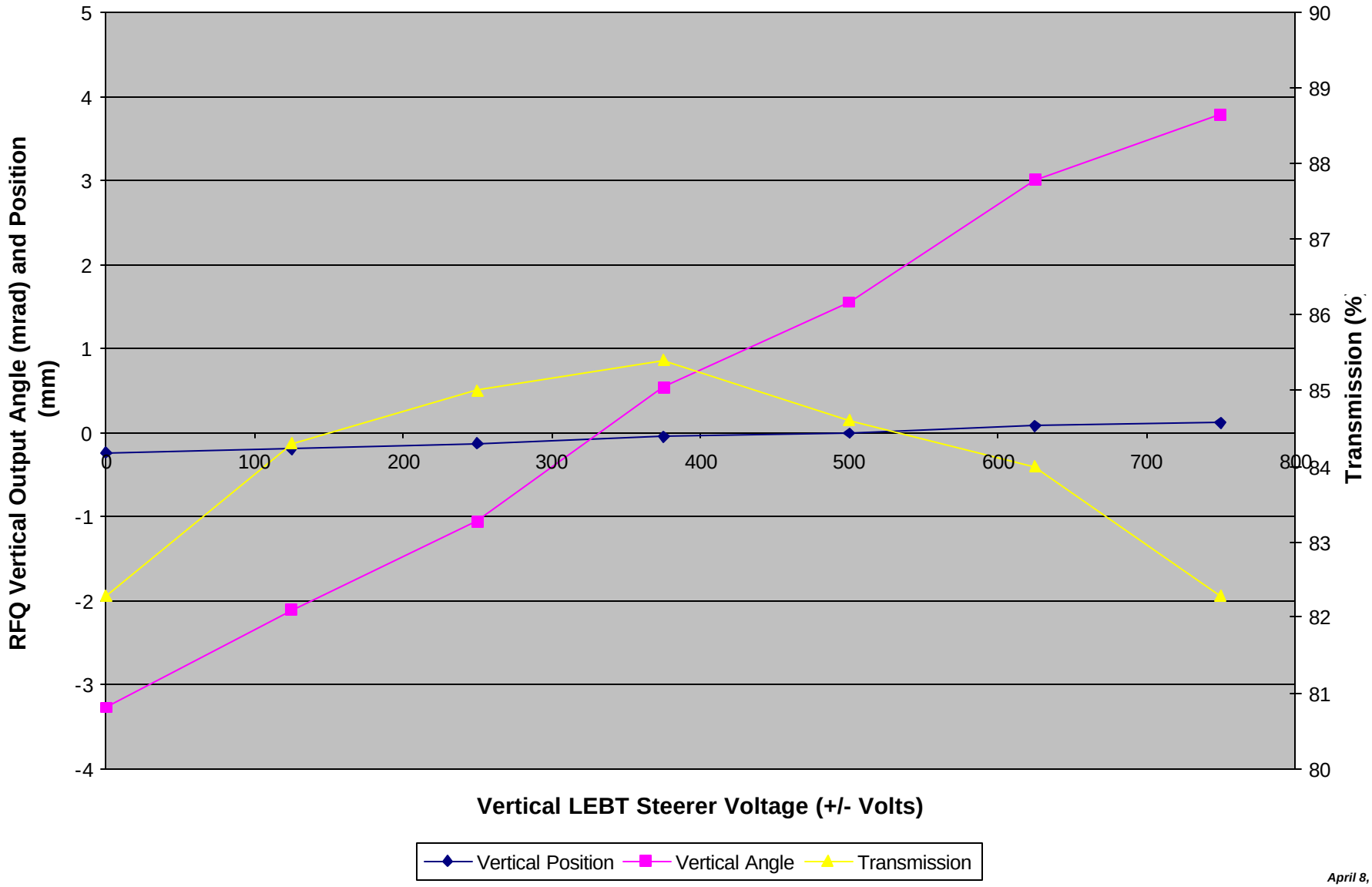
- We attempted to align IS/LEBT to RFQ with beam-based transmission and MEBT trajectory measurements
- We measured conflicting, irreproducible results
  - Observed MEBT trajectory to move on its own following LEBT flange position adjustment
  - Recent news: survey reveals LEBT flange relaxation over 20-30 minute period (Stockli, Error,…)
  - Not so recent news: Upon opening LEBT during commissioning found loosened screws, failed glue joints (Stockli, Welton, …)
- We commissioned with the IS/LEBT to RFQ "randomly" misaligned with no way for in-situ alignment.
- After shutdown, Survey group measured following LEBT to RFQ position:

$$\Delta x = -1.12 \text{ mm} \quad \Delta y = -0.81 \text{ mm}$$

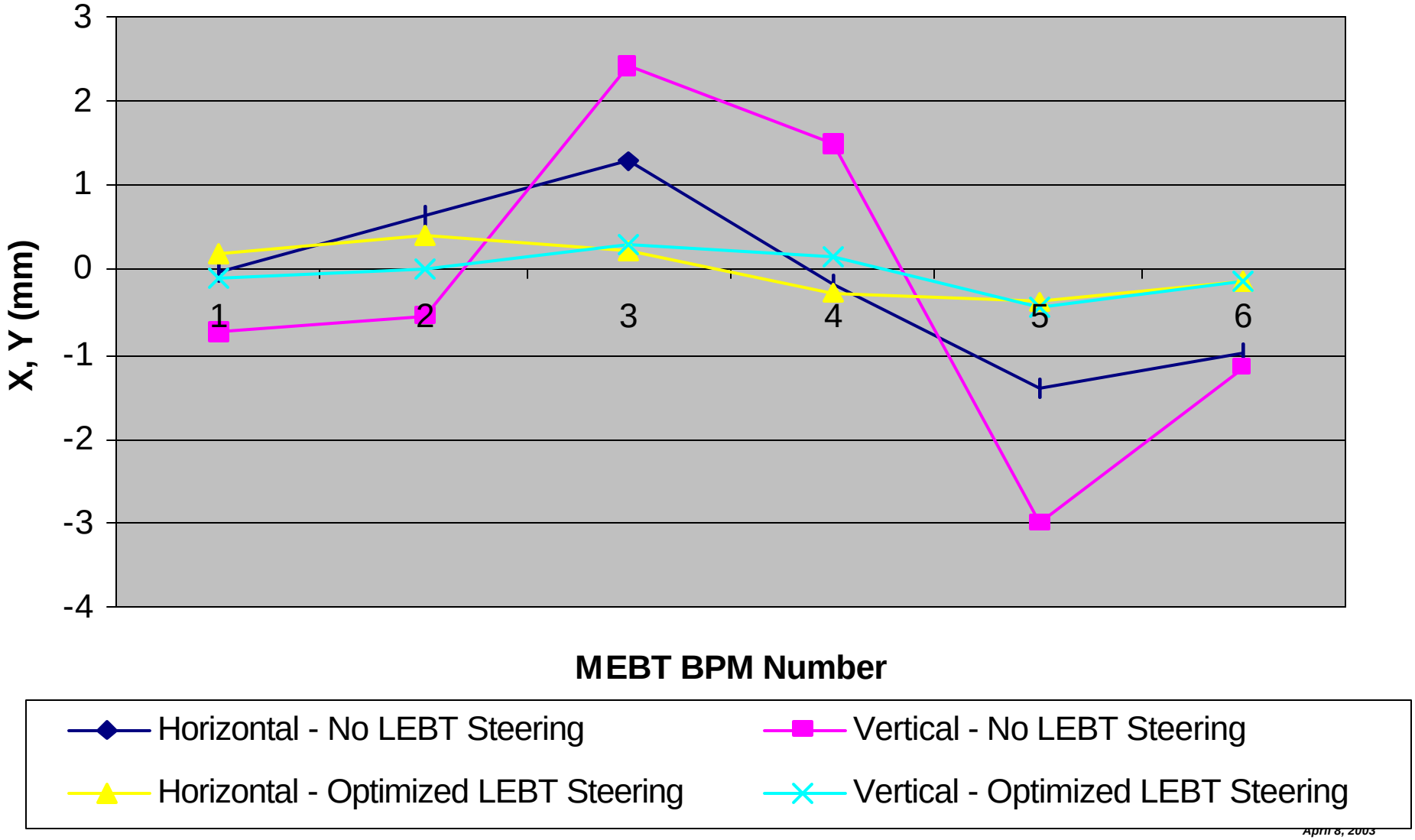
RFQ Output for Measured LEBT/RFQ Misalignment vs. Horizontal LEBT Steering



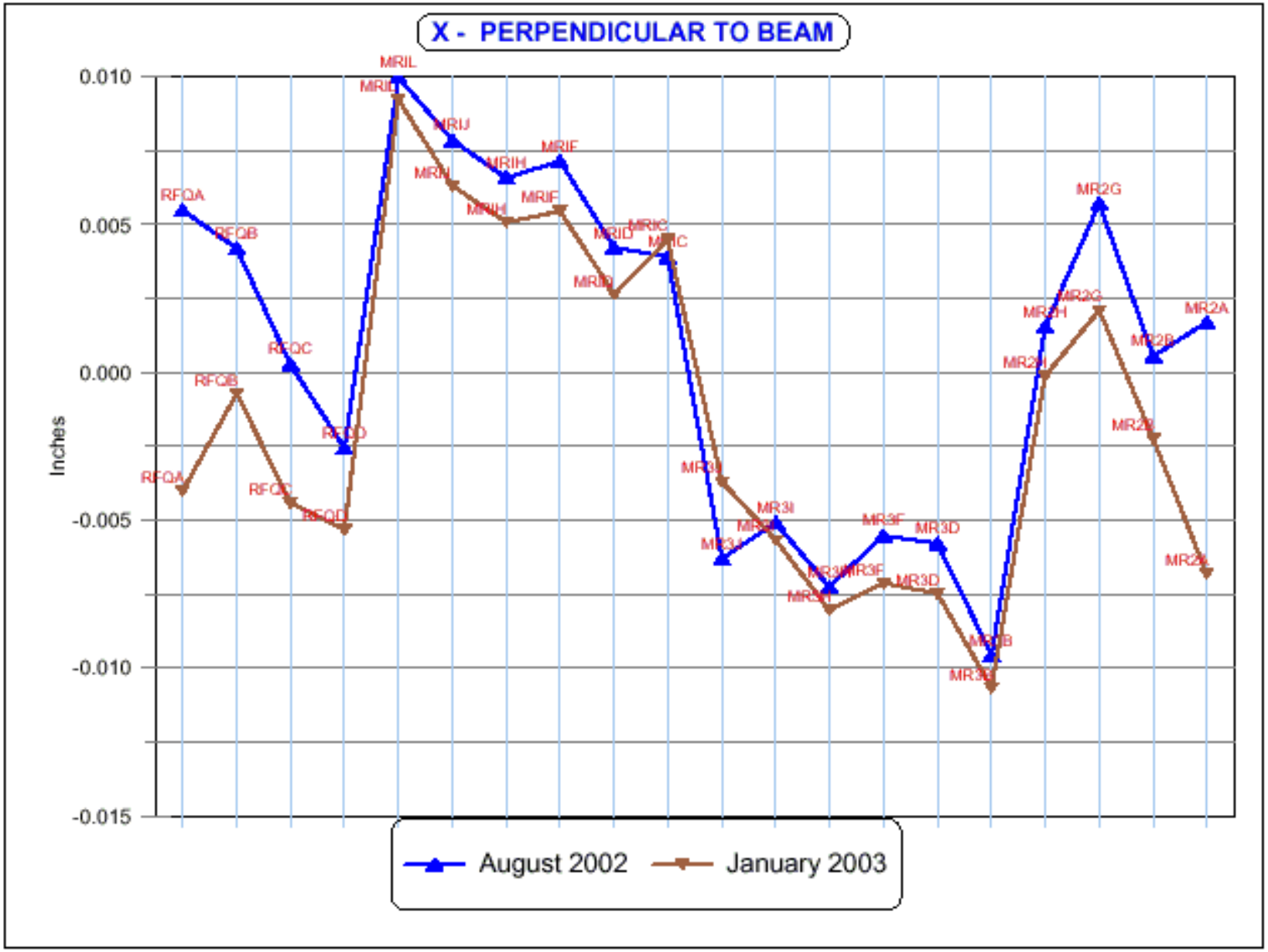
RFQ Output for Measured LEBT/RFQ Misalignment vs. Vertical LEBT Steering



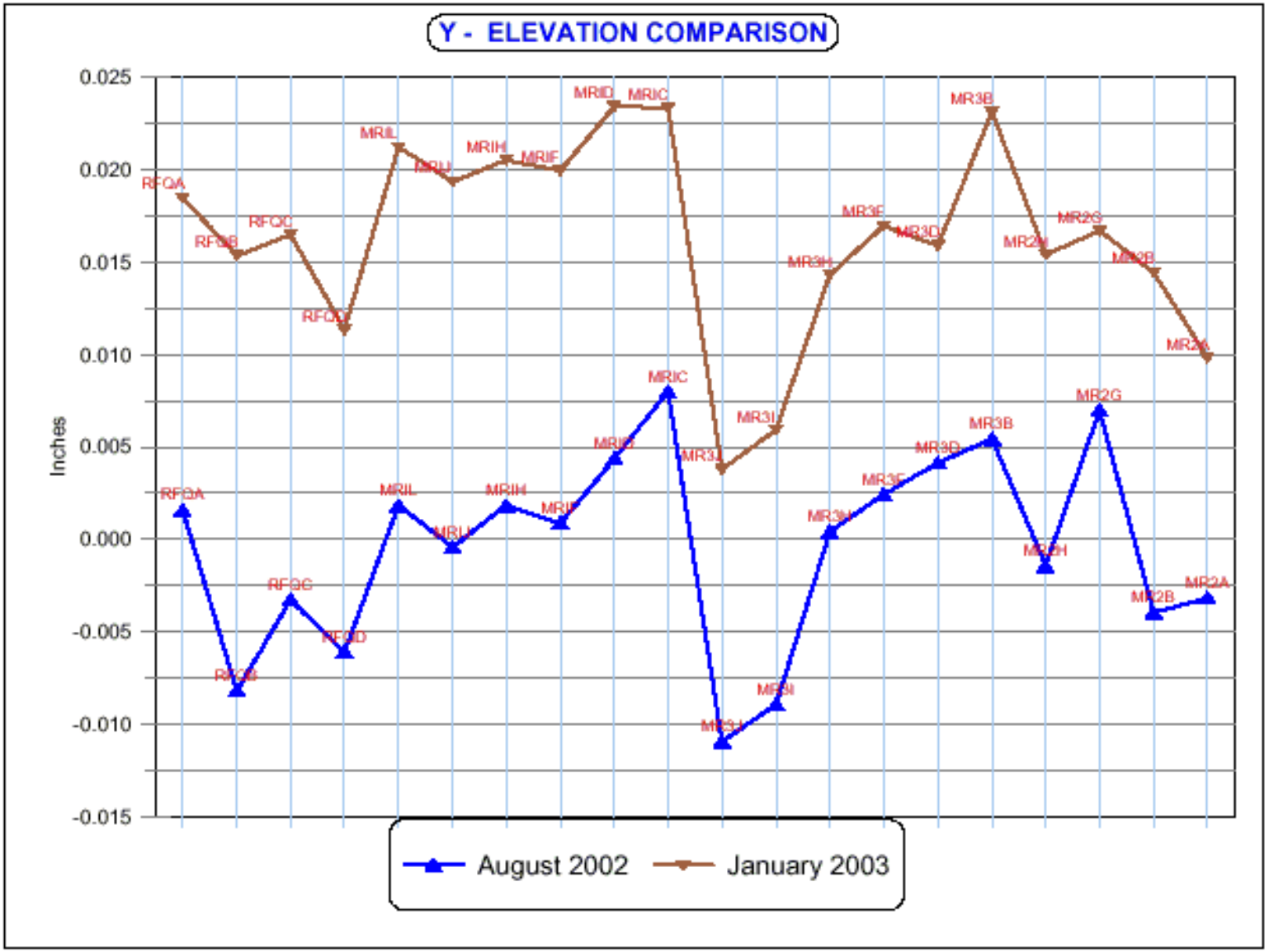
Predicted MEBT Trajectories with IS/LEBT Misalignment



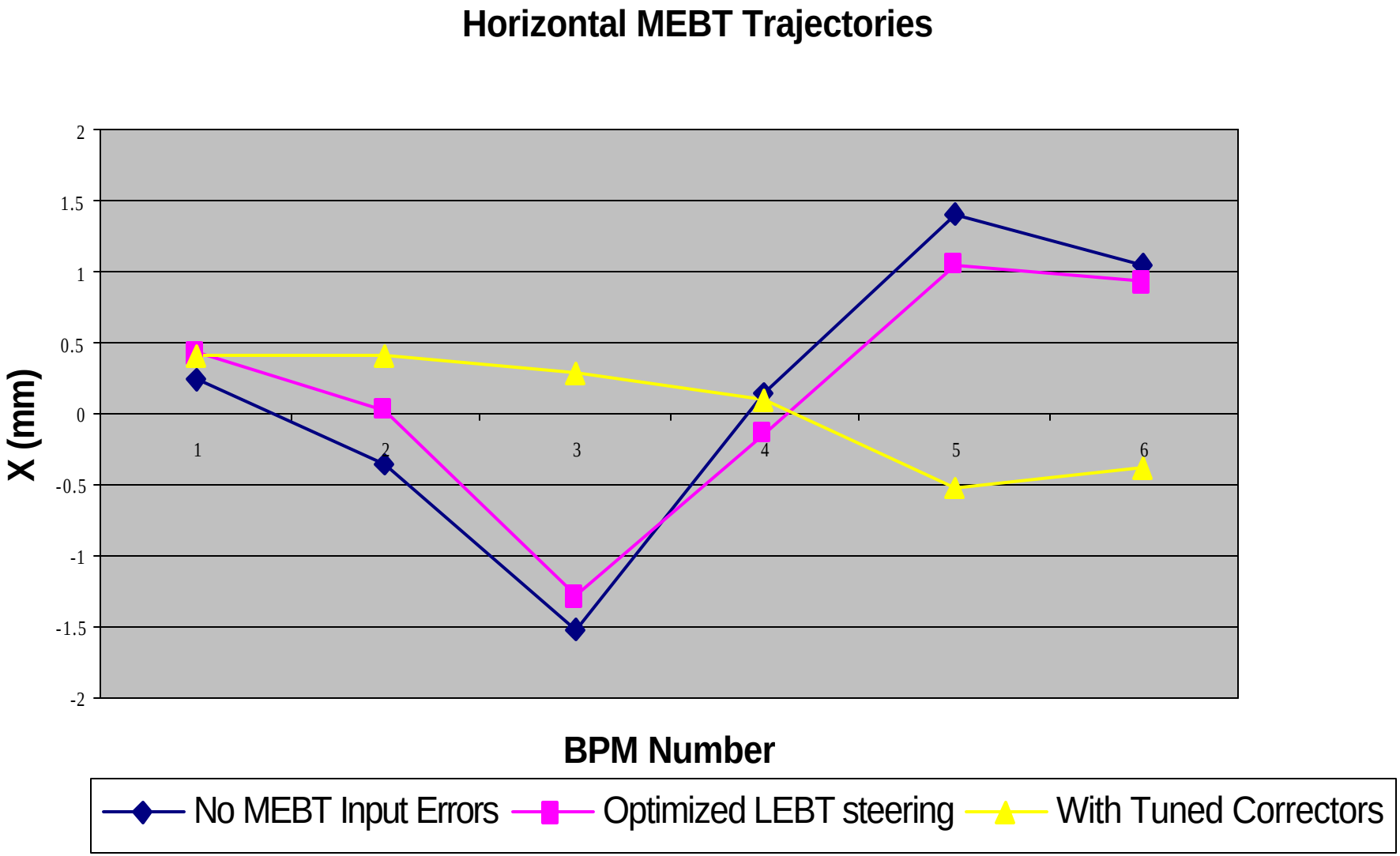
Problem #2: MEBT was misaligned
Horizontal Front-End Survey



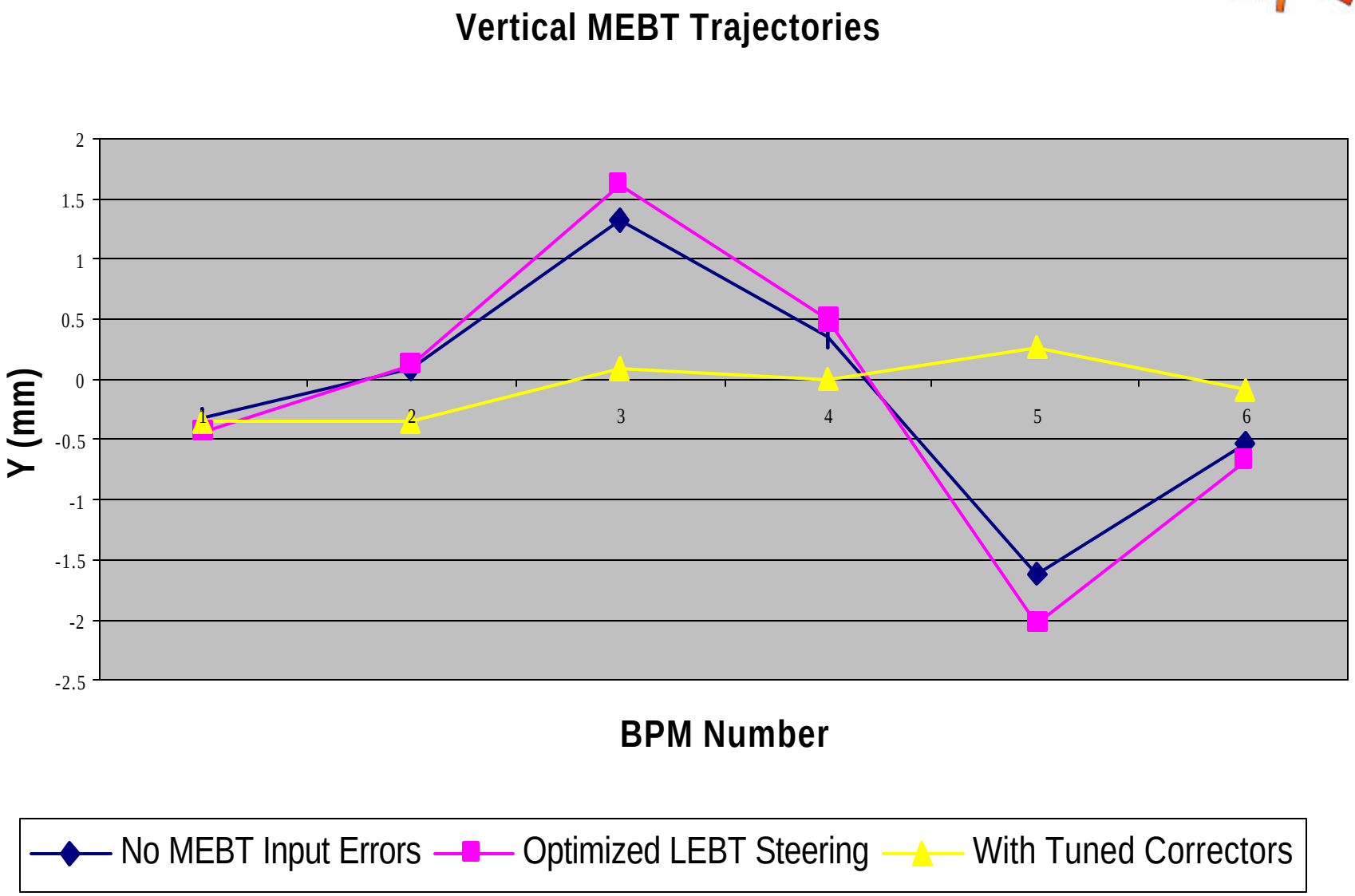
Vertical Front-End Survey



MEBT Trajectories with misaligned rafts



MEBT Trajectories with misaligned rafts



Conclusions

- Two misalignments at work:
  - IS/LEBT to RFQ misalignment
  - MEBT Raft misalignments nearly an order of magnitude greater than parameter list
- Solution:
  - IS/LEBT, RFQ, MEBT, DTL1 will be re-aligned (Error et. al.)
  - LEBT Flange adjustment with set-screws (Stockli et. al.)
  - Fixed MEBT corrector controls problem that lead to PS oscillation (Elec, Controls groups)
- Qualitative agreement between simulation and measurements using measured misalignments