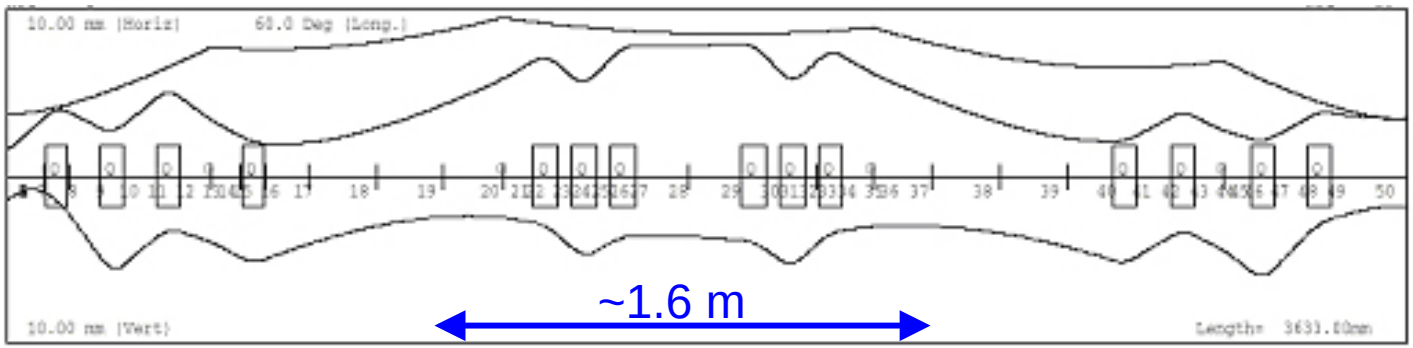
Sources of FE halo generation

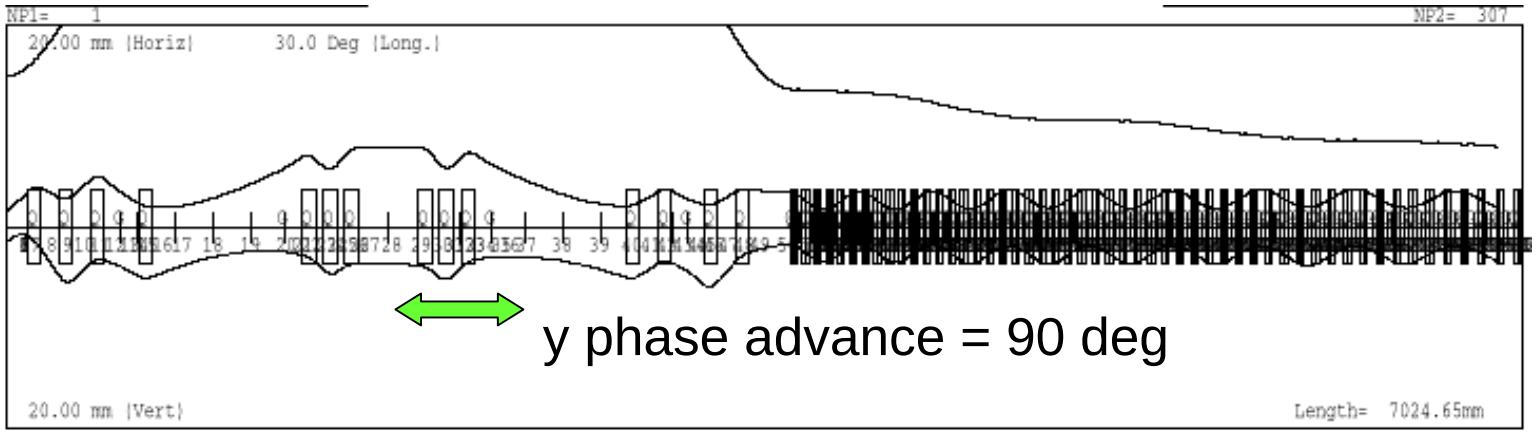
- MEBT is the largest contributor to FE halo generation
- Nonlinear space charge force stemming from a large transverse beam eccentricity generates halo in MEBT
- As minor contributors, several FE components and physical effects may contribute to the generation of beam halo

MEBT optics

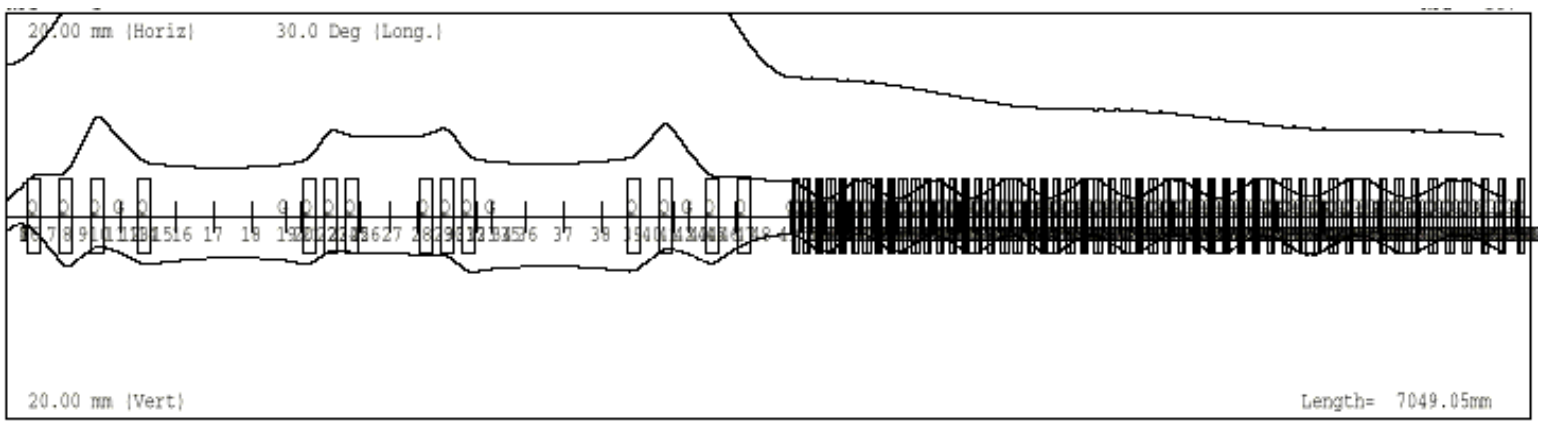


Region with a large transverse beam eccentricity ~2:1

Emittance measurements for two different MEBT optics

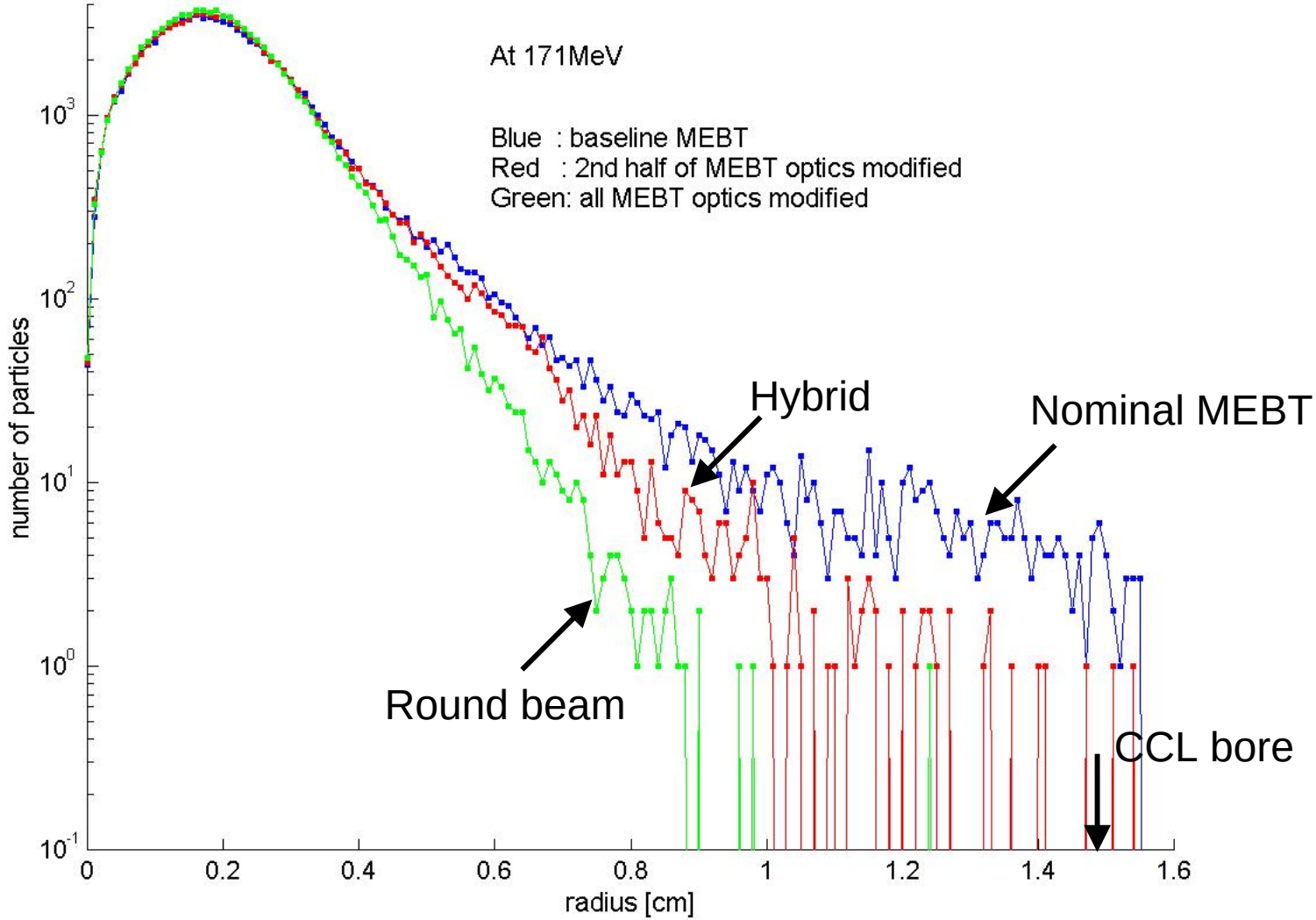


Nominal MEBT optics

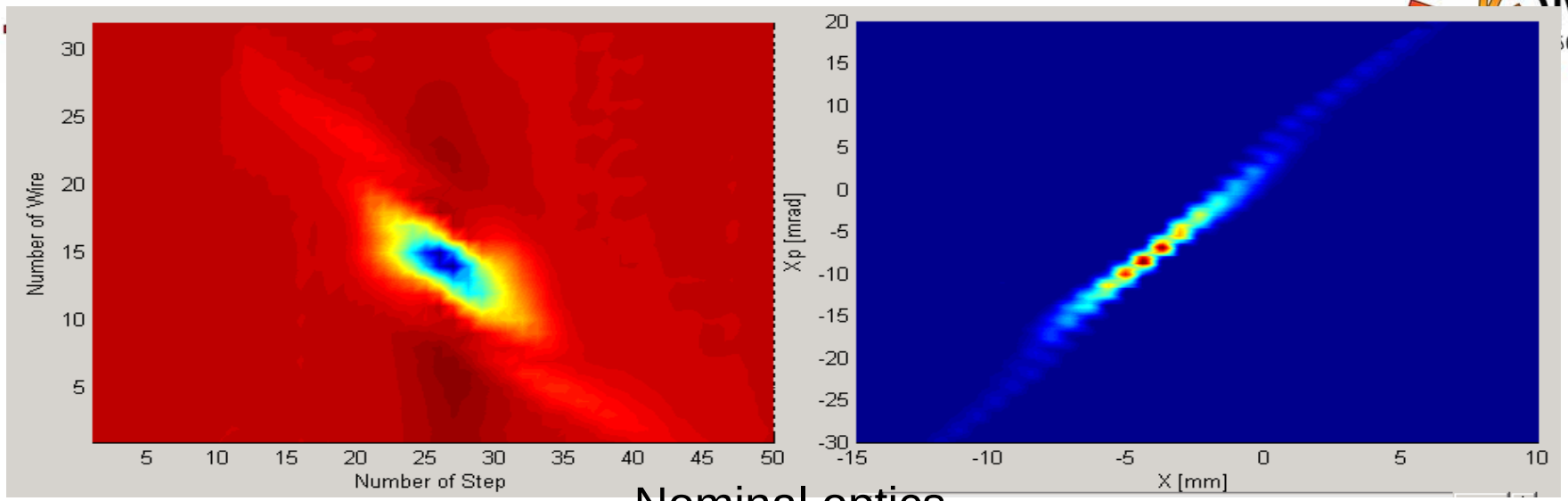


Round beam optics

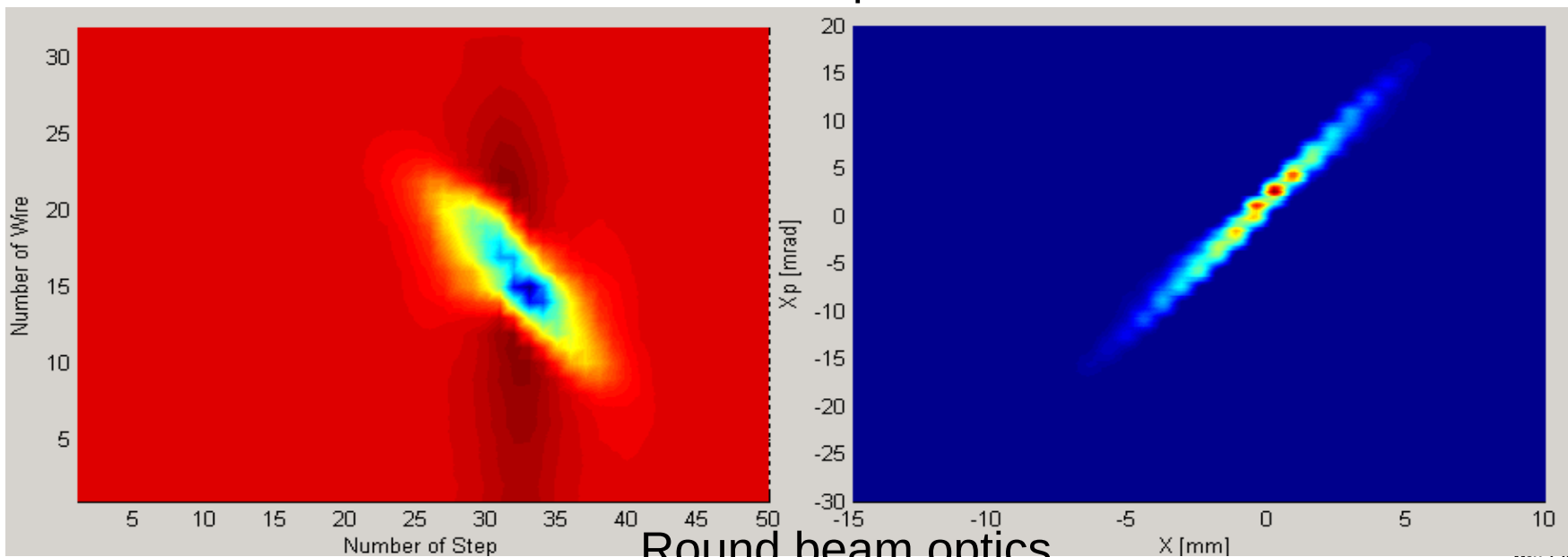
Optics modification (chopper to anti-chopper) alone reduces halo at 171MeV significantly



E_x for nominal optics vs round beam optics



Nominal optics



Round beam optics

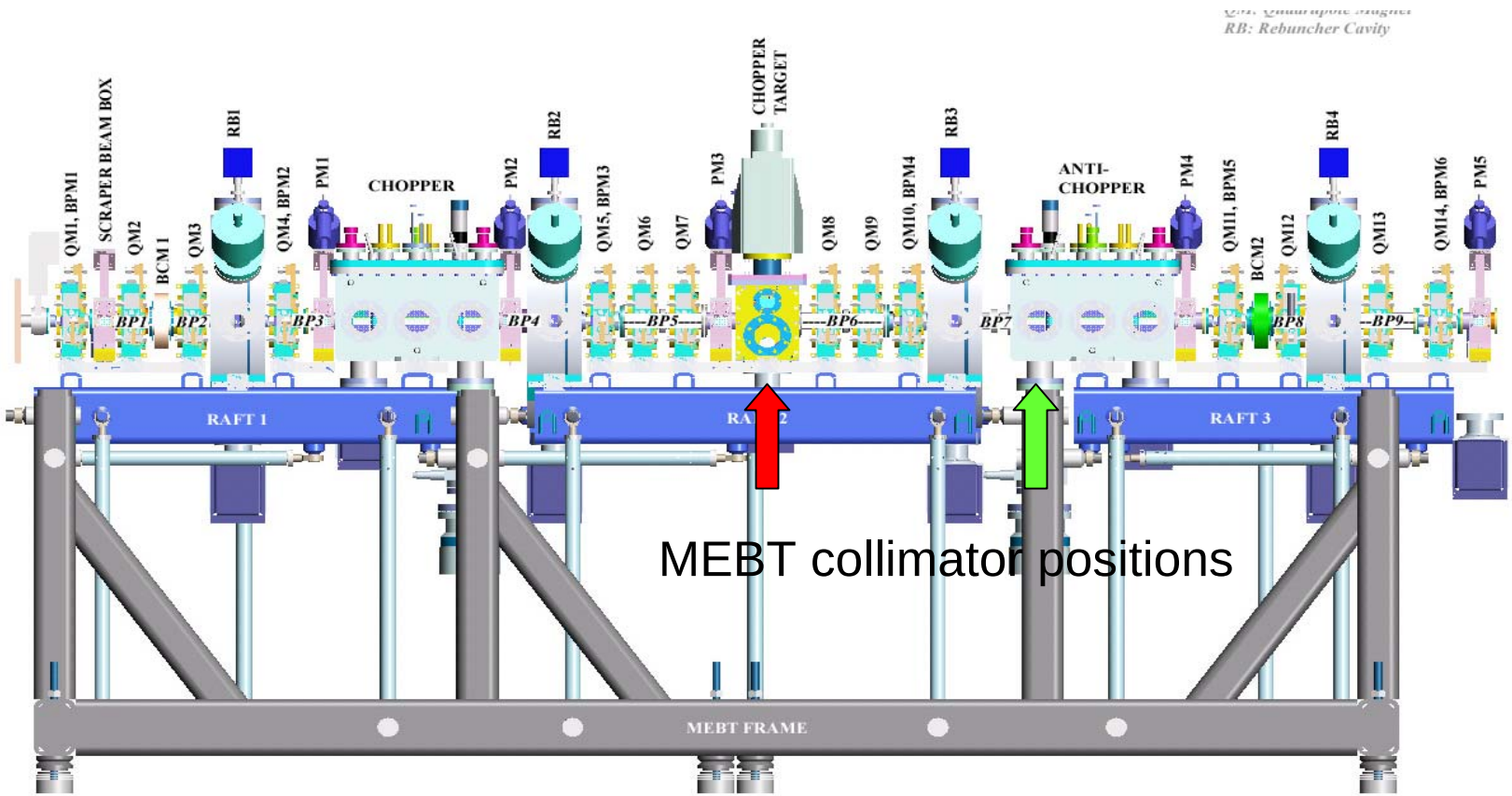
Measurements consistent with model predictions

- Significant reduction of halo
- Significant reduction of rms emittance in both planes

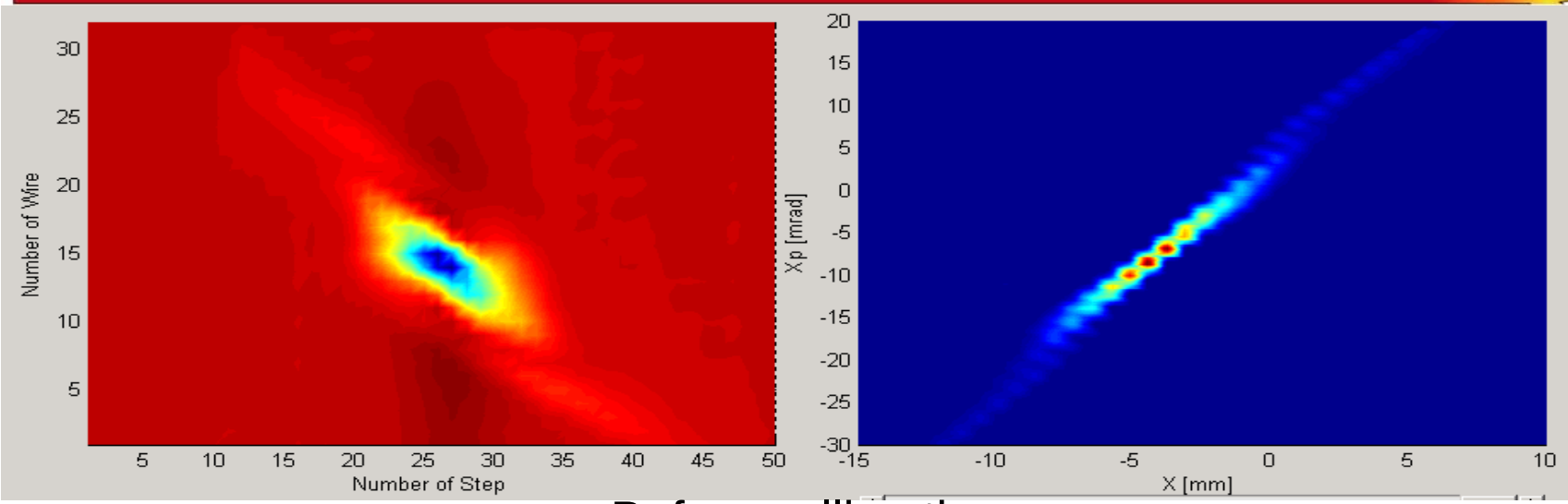
  ε_x= 0.593 mm-mrad → 0.376 mm-mrad

  ε_y= 0.353 mm-mrad → 0.264 mm-mrad

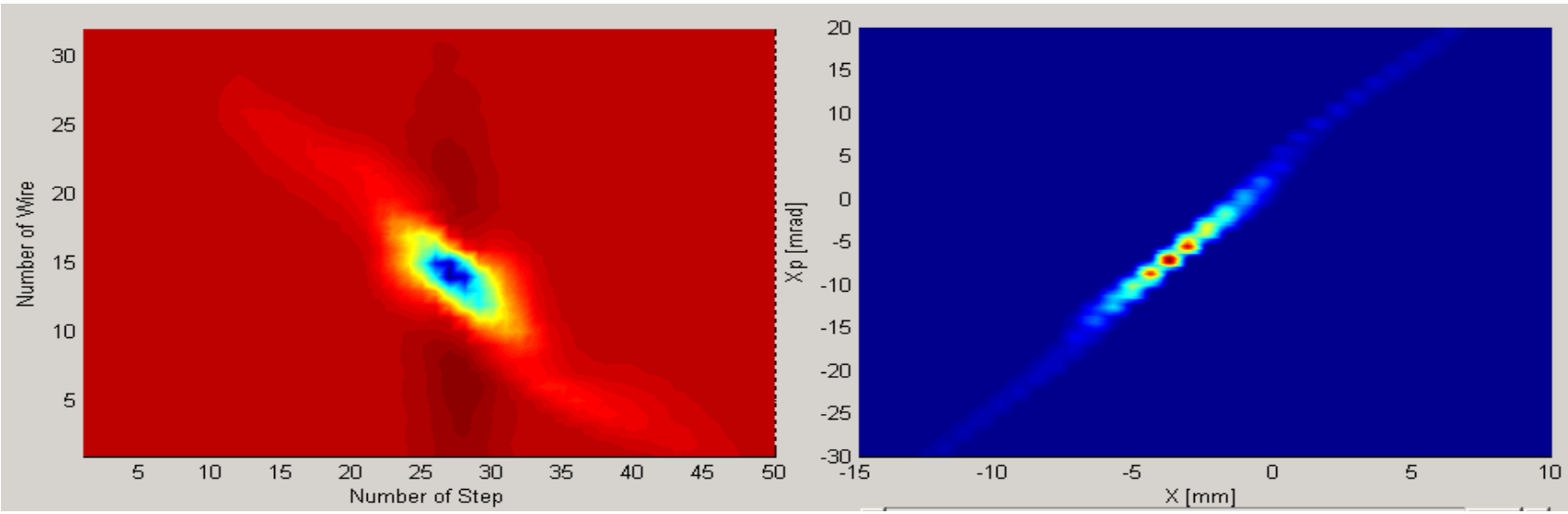
Saeed et al installed horizontal collimators at the anti-chopper box



Little difference in x-plane before and after collimation (10mA is collimated out of 32 mA)

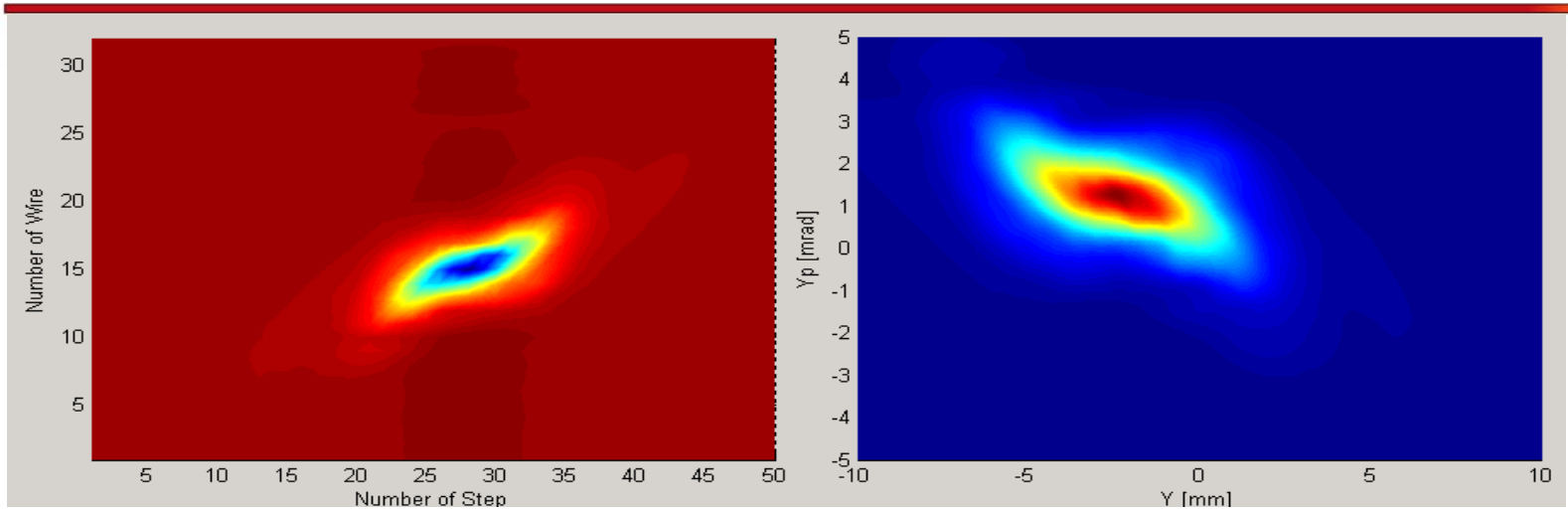


Before collimation

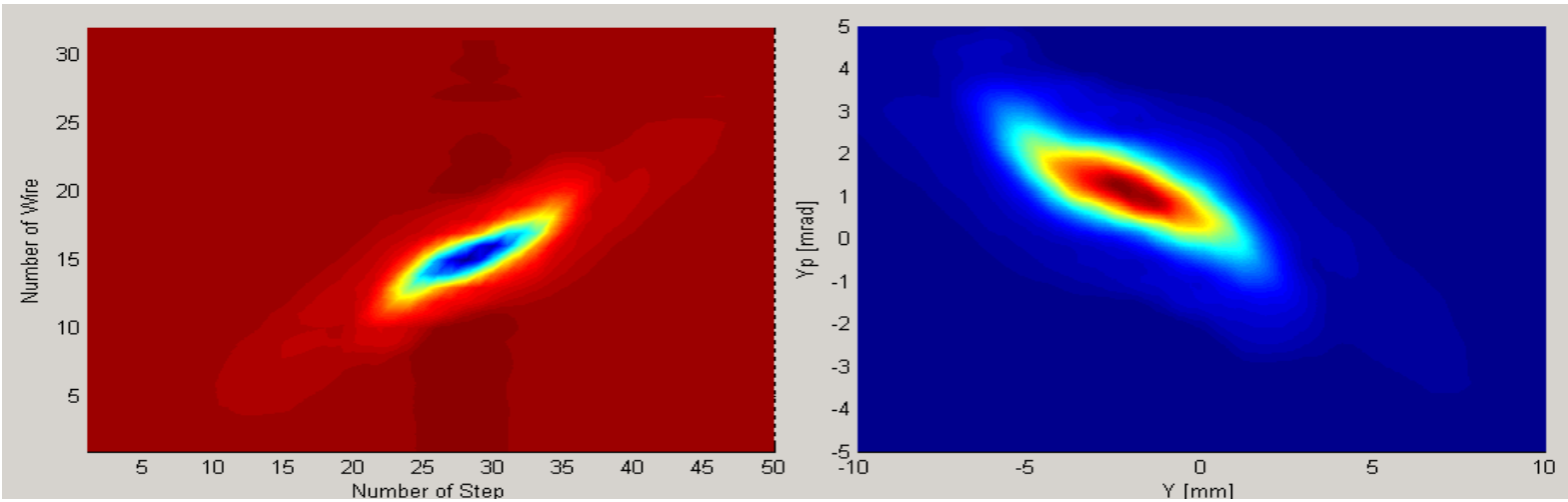


After collimation

Little difference in y-plane before and after collimation

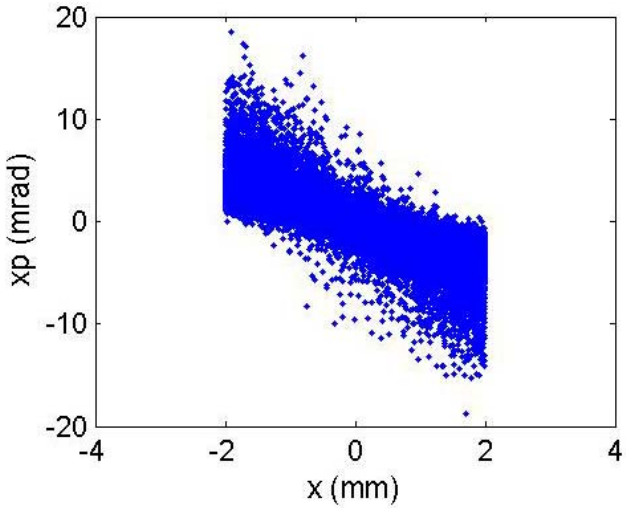


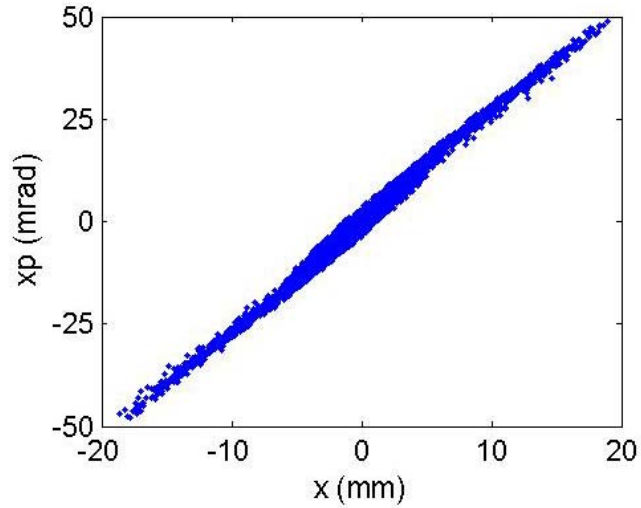
Before collimation

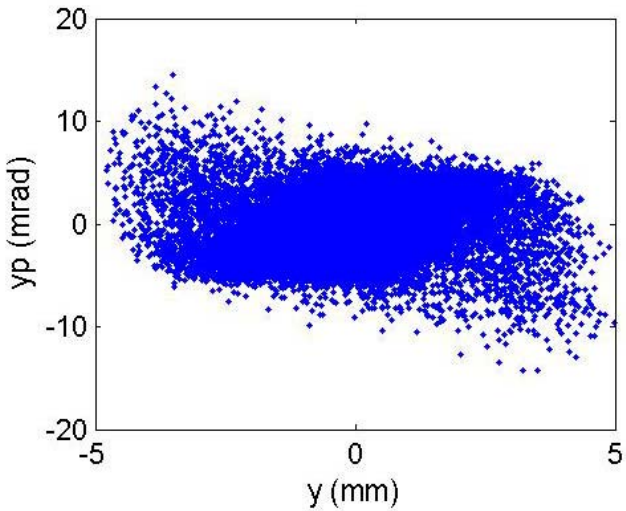


After collimation

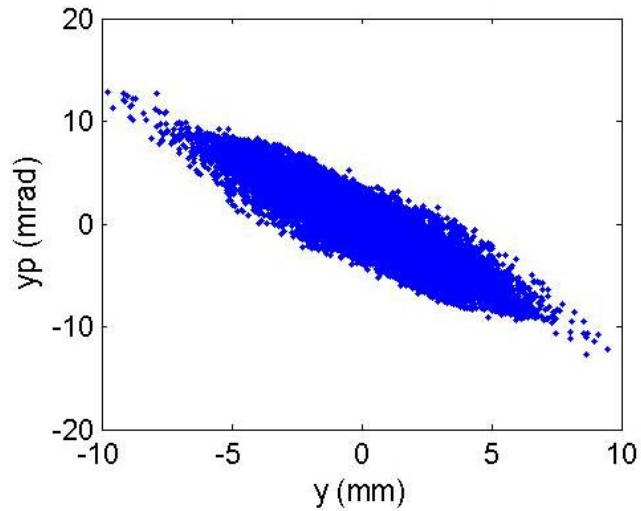
Measurements consistent with simulation







collimator



slit position

Significance of the measurements

- Benchmarking of codes with measurements
- Experimentally validated the effectiveness of the proposed round beam optics
- Implicitly validated the effectiveness of the halo collimation at the chopper target position the previous study proposed