

Slit scan measurement method: Impact of the intensity (charge) cut

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CHBB-2008

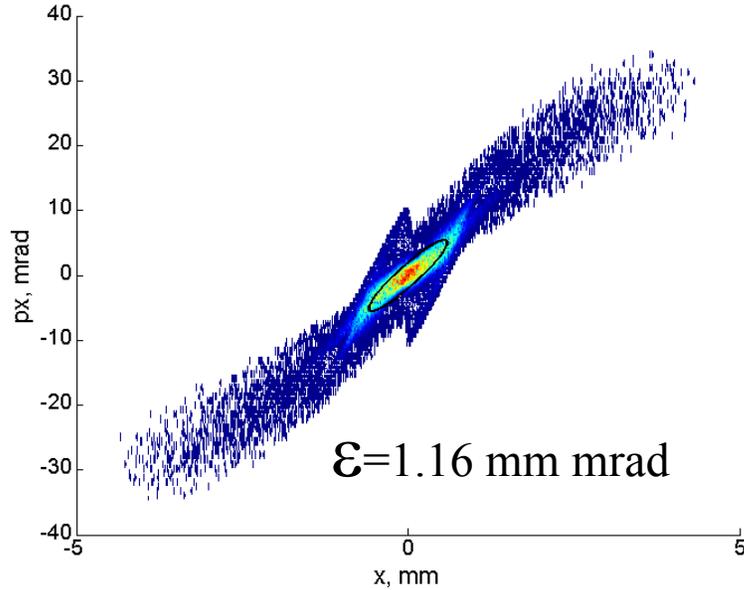
Zeuthen, Germany, 26-30.05.2008

Transverse phase space. Correlations

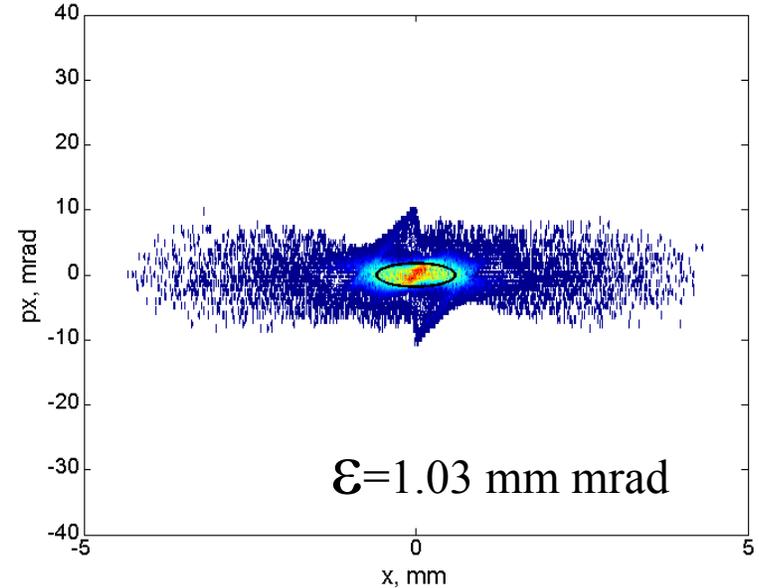
$$\varepsilon_{meas0} = \beta\gamma \cdot \sigma_X \cdot \sigma_{X'}$$

$$\sigma_{X'} = \frac{1}{L} \sqrt{\sum_{n=1}^{Nsl} w_n \cdot (\sigma_{X,n}^{BL})^2} / \sqrt{\sum_{n=1}^{Nsl} w_n}$$

$Bz_{max} = -0.2250$ T



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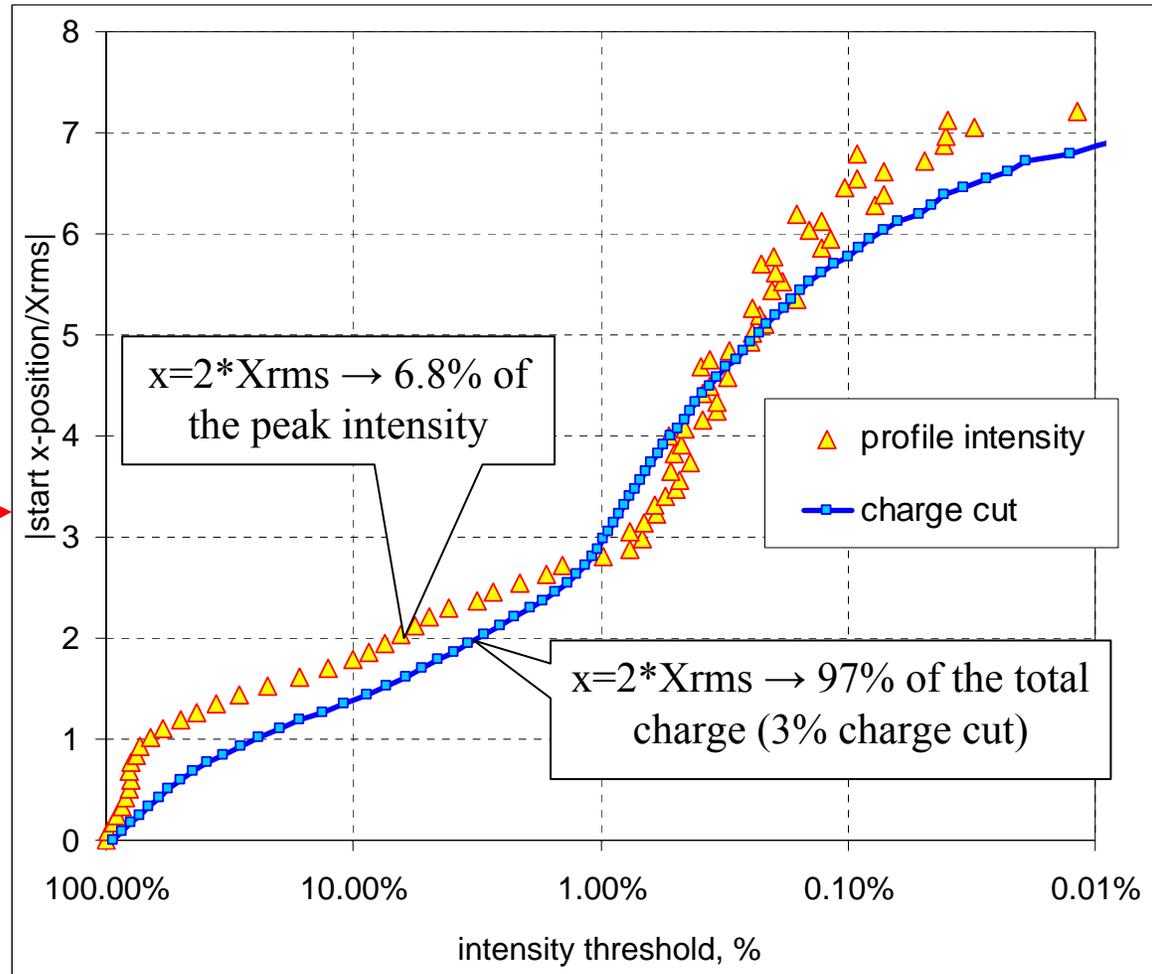
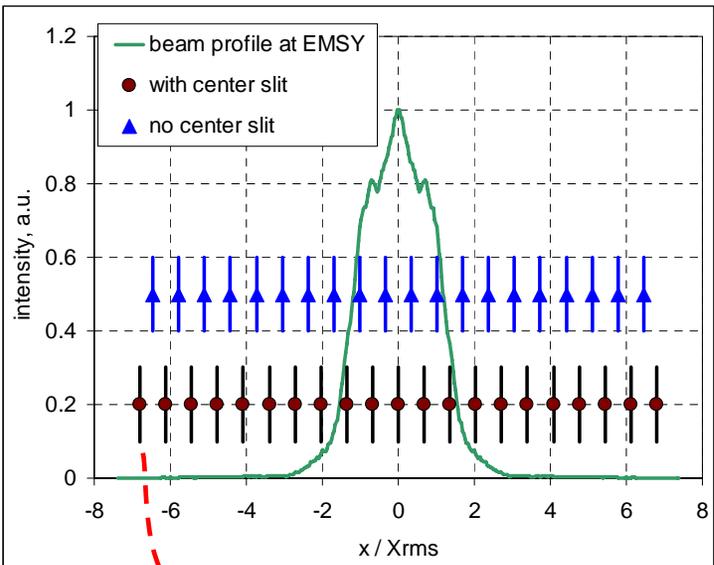


correction

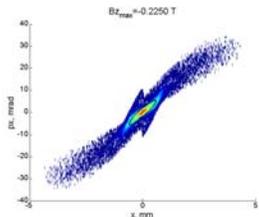
$$\varepsilon_{meas}^2 = \varepsilon_{meas0}^2 + \left(\frac{pz0}{L} \right)^2 \sigma_x^2 \cdot \sum_s w_s \cdot (\bar{b}_s - c \cdot \bar{a}_s)^2$$

Emittance measurements using slit scan technique:

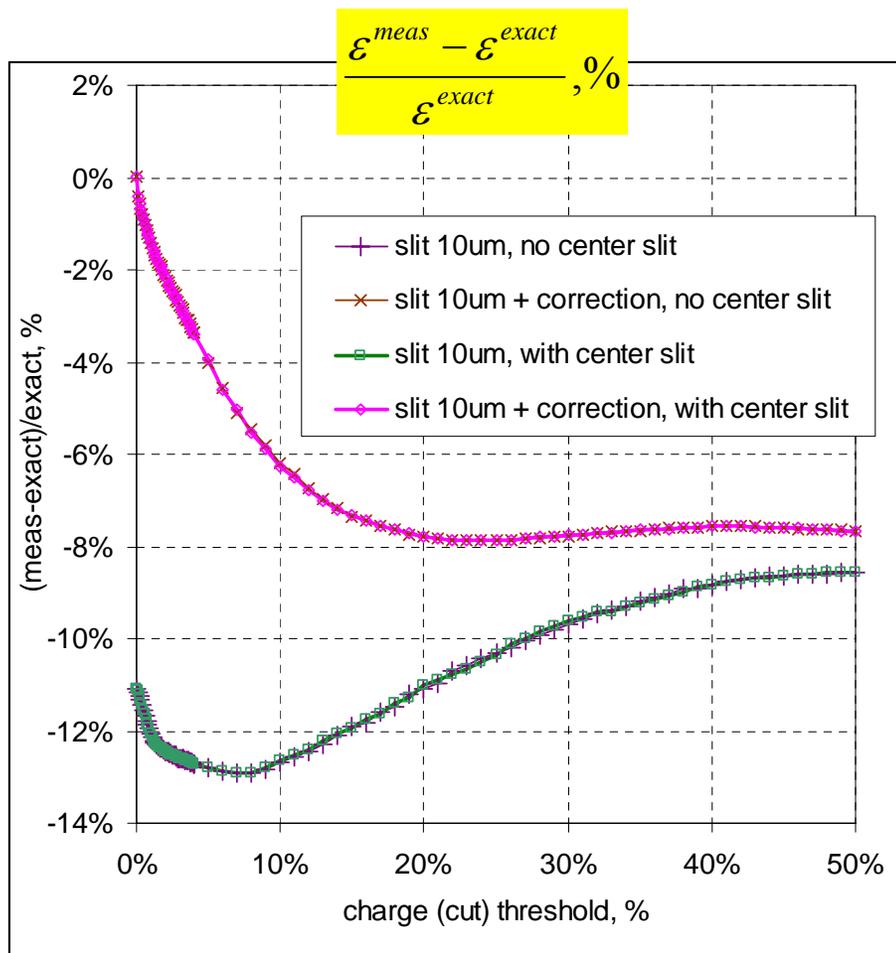
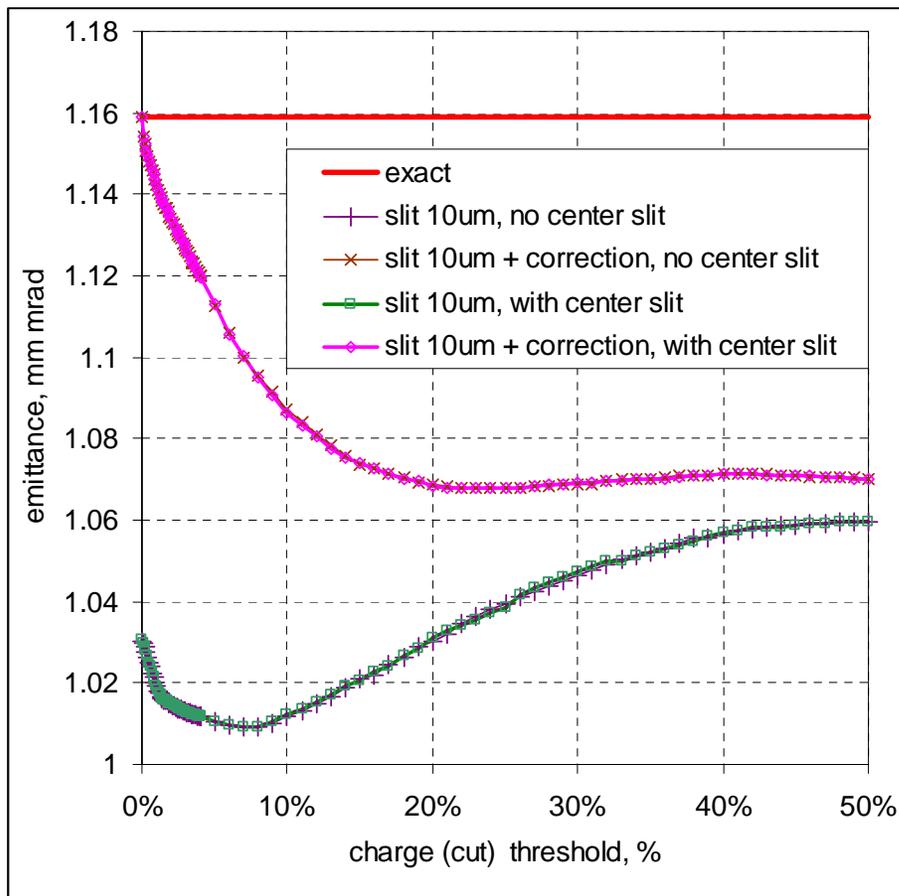
Intensity threshold for slit scan



Simulated measured emittance vs. **Intensity threshold**

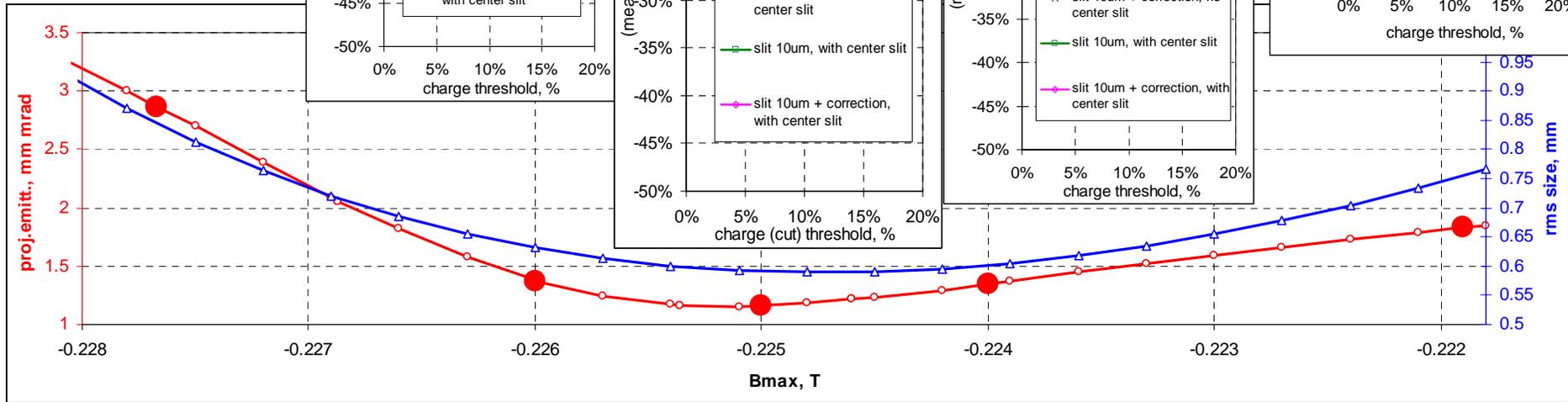
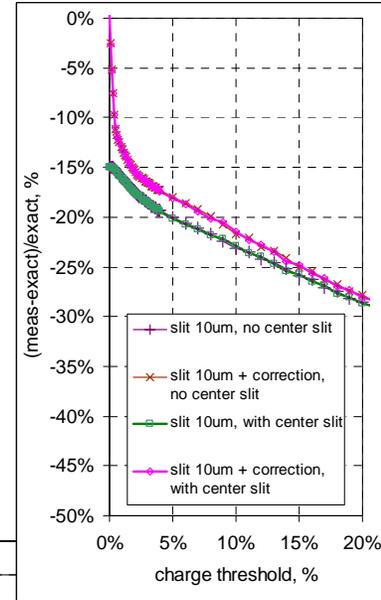
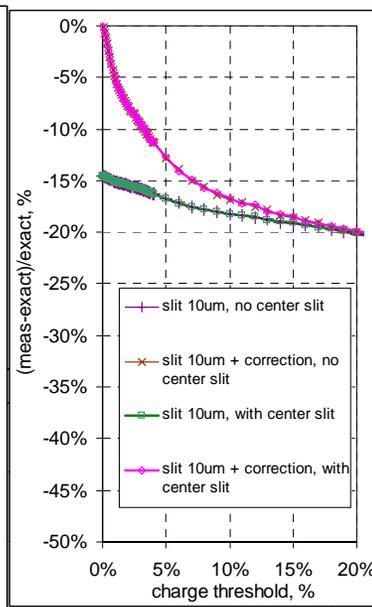
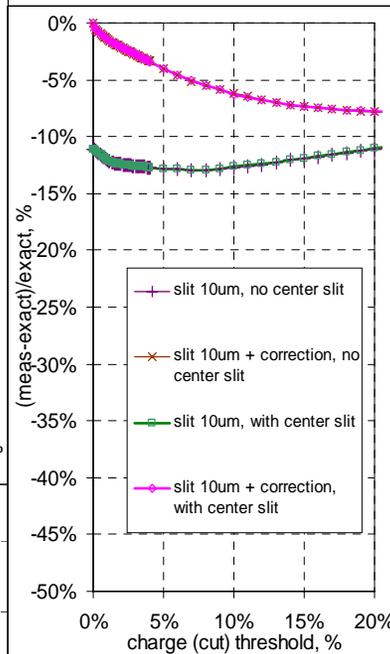
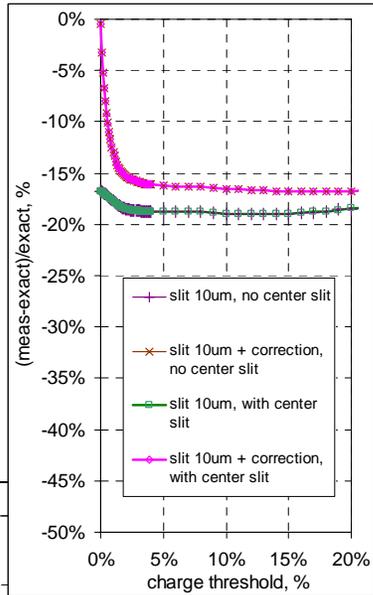
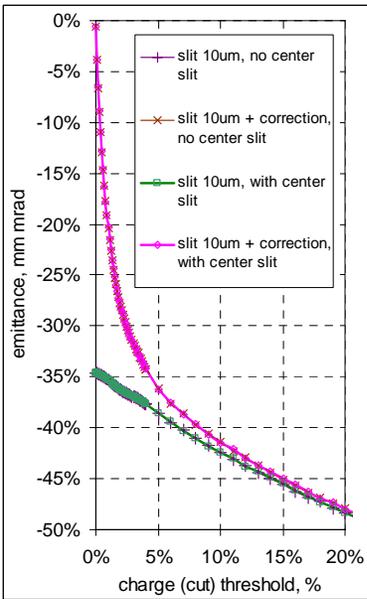


step size=slit opening=10um



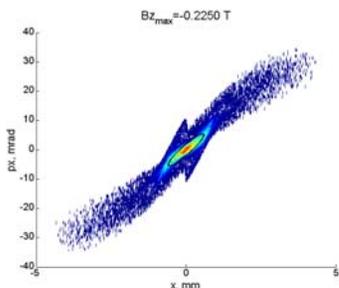
Intensity threshold influence for various solenoid peak fields

Main solenoid scan (step size=slit opening=10um)

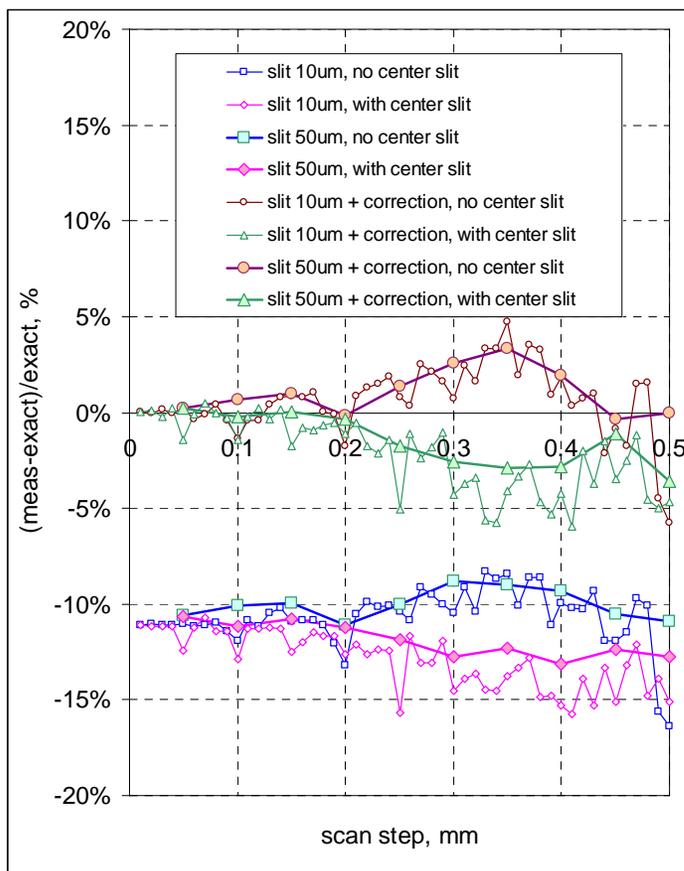


← Imain

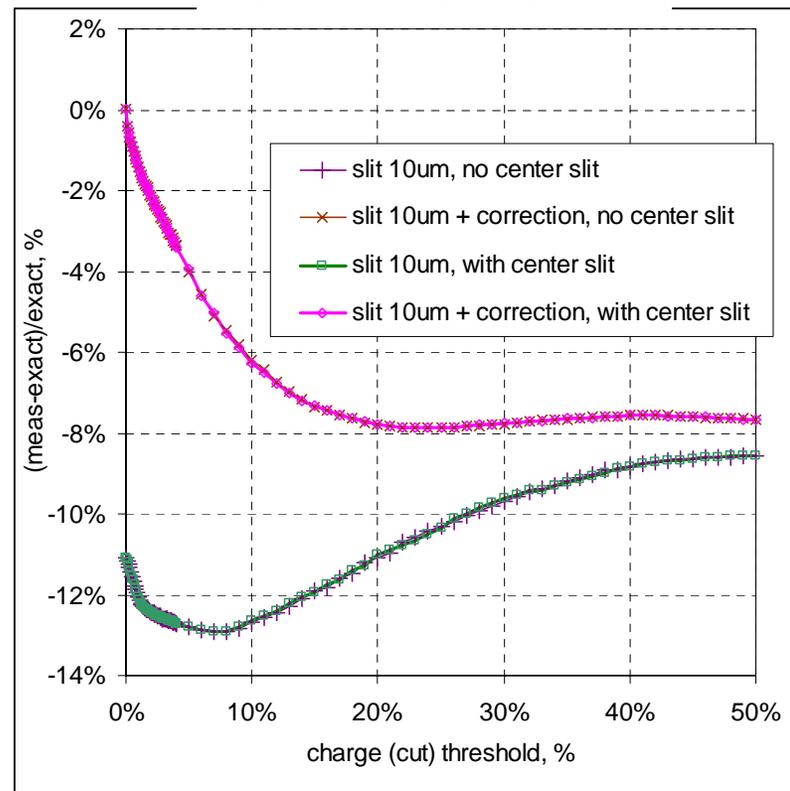
Slit scan systematic error: scan step and charge threshold



Threshold=0%

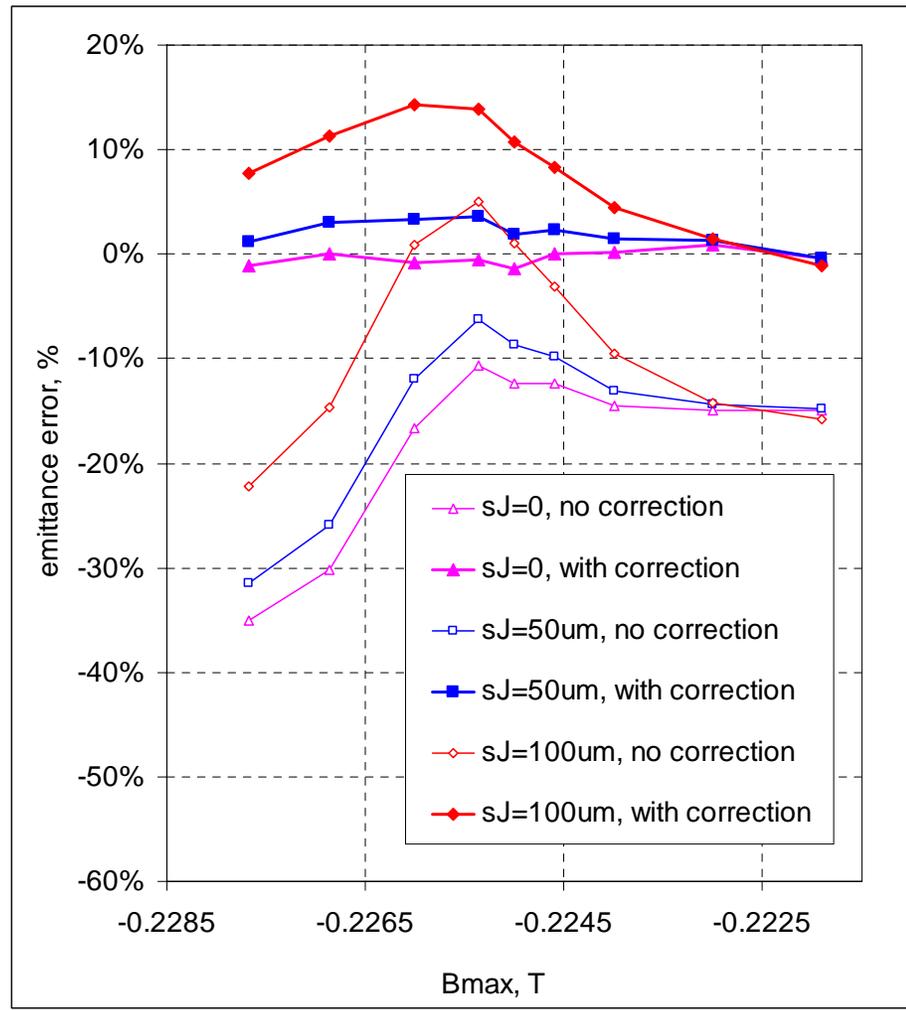
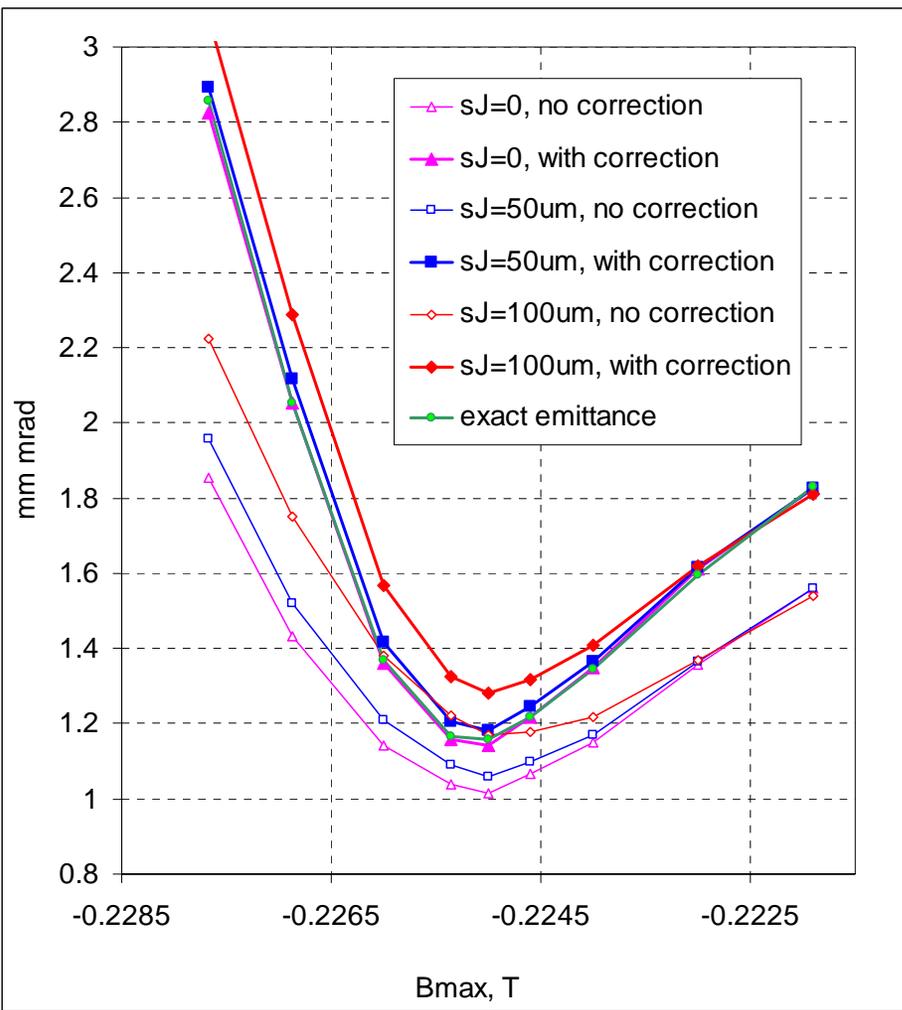


Step size=slit opening=10um



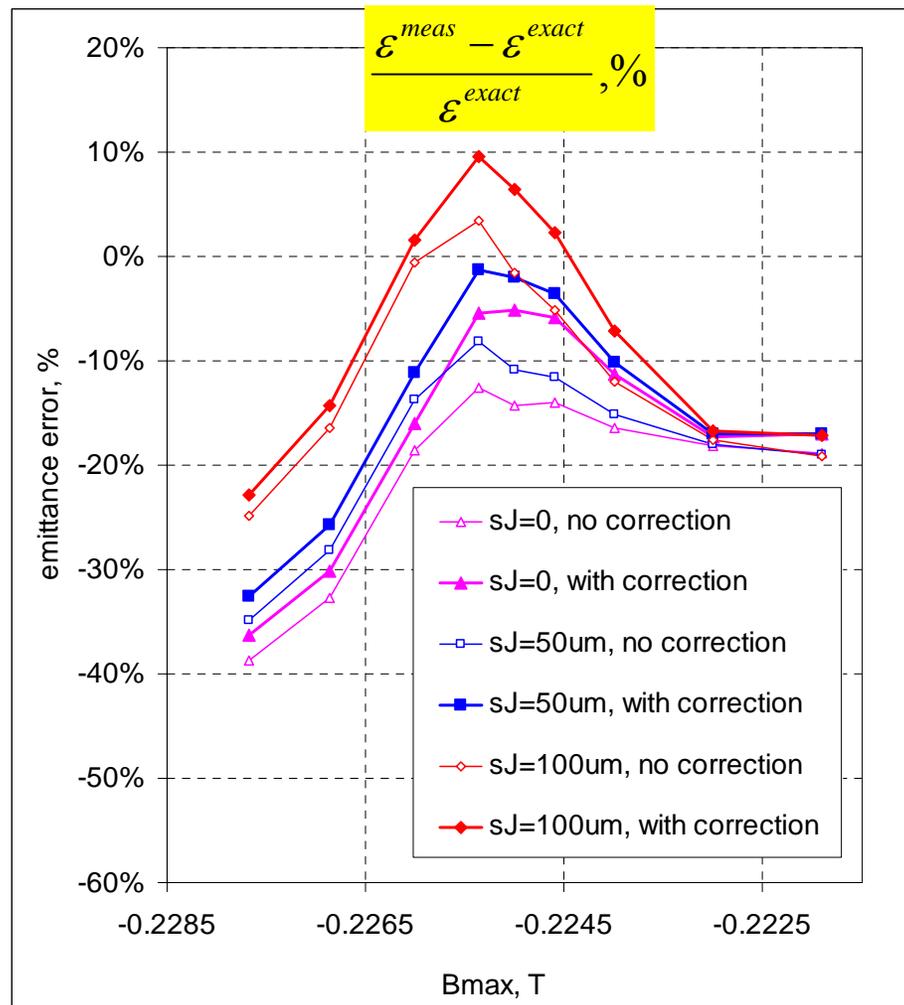
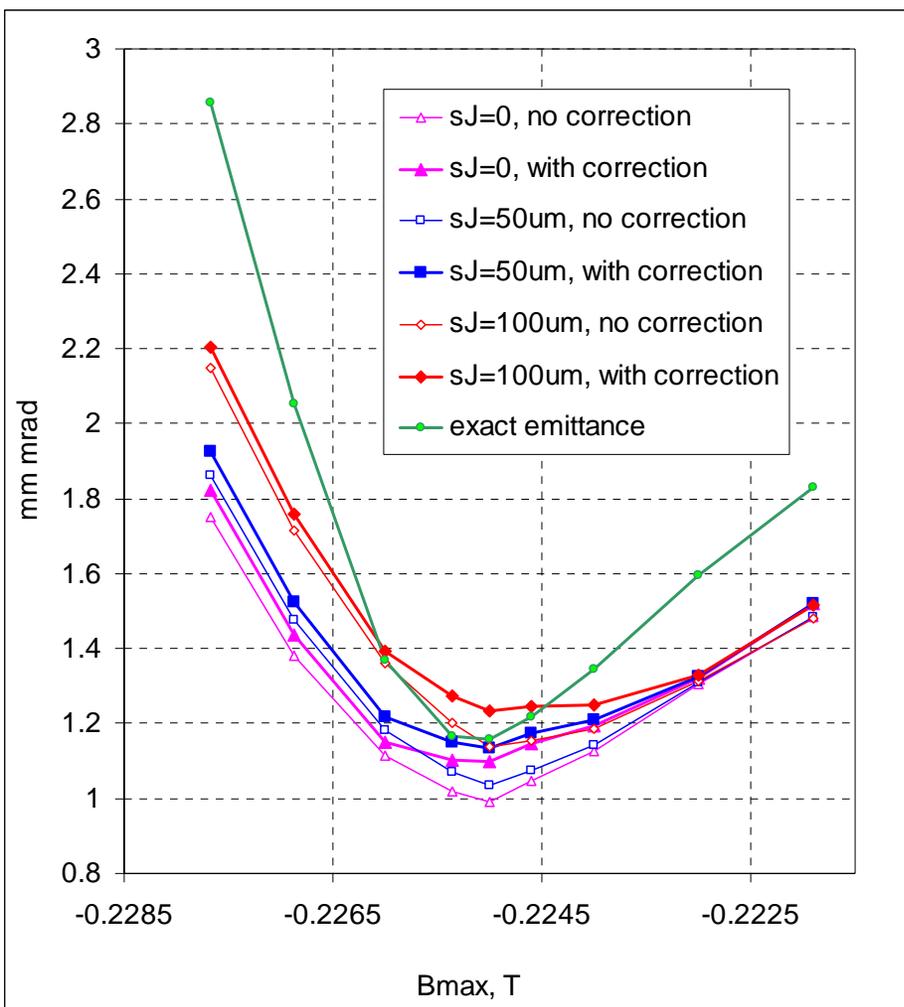
Slit scan X Beam position jitter=Measured emittance

Scan step=100 μ m, charge cut threshold=0%



Slit scan X Beam position jitter=Measured emittance

Scan step=100um, charge cut threshold=5%



Conclusions

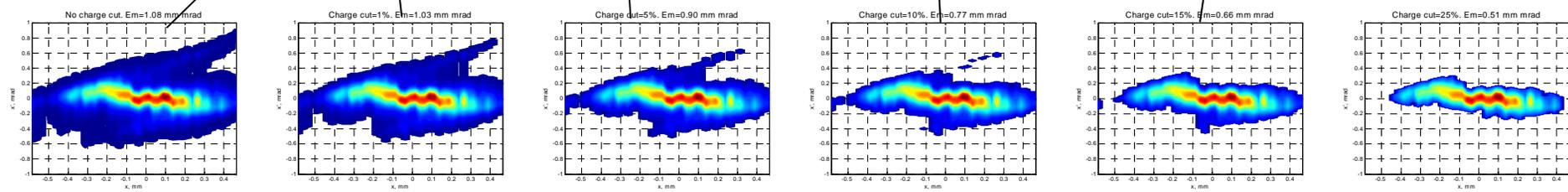
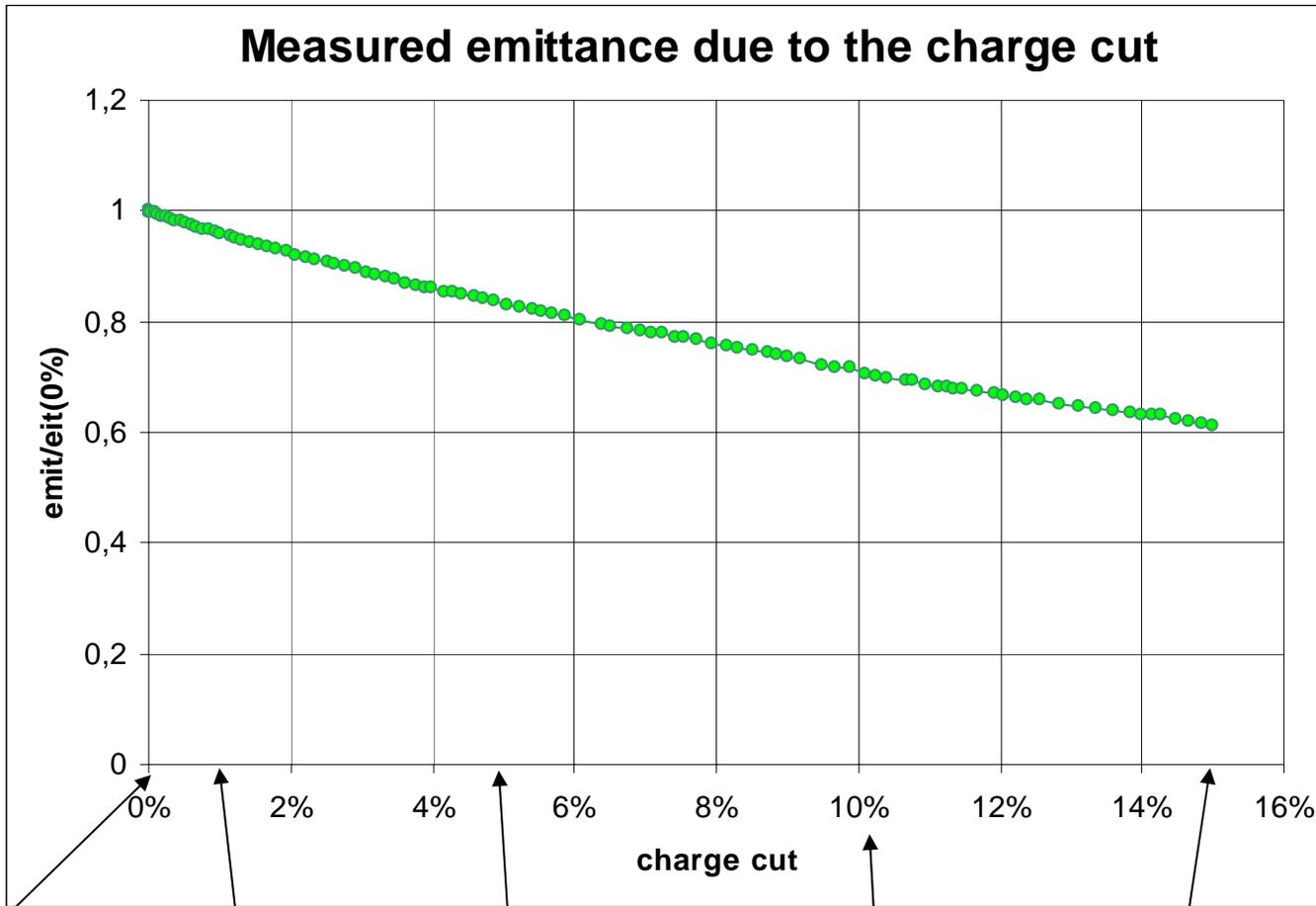
- Factors affecting slit scan measurements:

| Factor | Effect on measured emittance | Solution/remark |
|----------------------------------|------------------------------|---|
| Phase space nonlinearity | -10..-30% | correction term experimentally ~-10% |
| Scan step dx | ~1% if dx<200um | dx~100um |
| Intensity threshold (charge cut) | -5..-30% @ 5% charge cut | ???real charge cut??? |
| Beam position jitter | +5% @ 50 um rms jitter | <ul style="list-style-type: none">improve stability?measurement with synchronized BPM? |

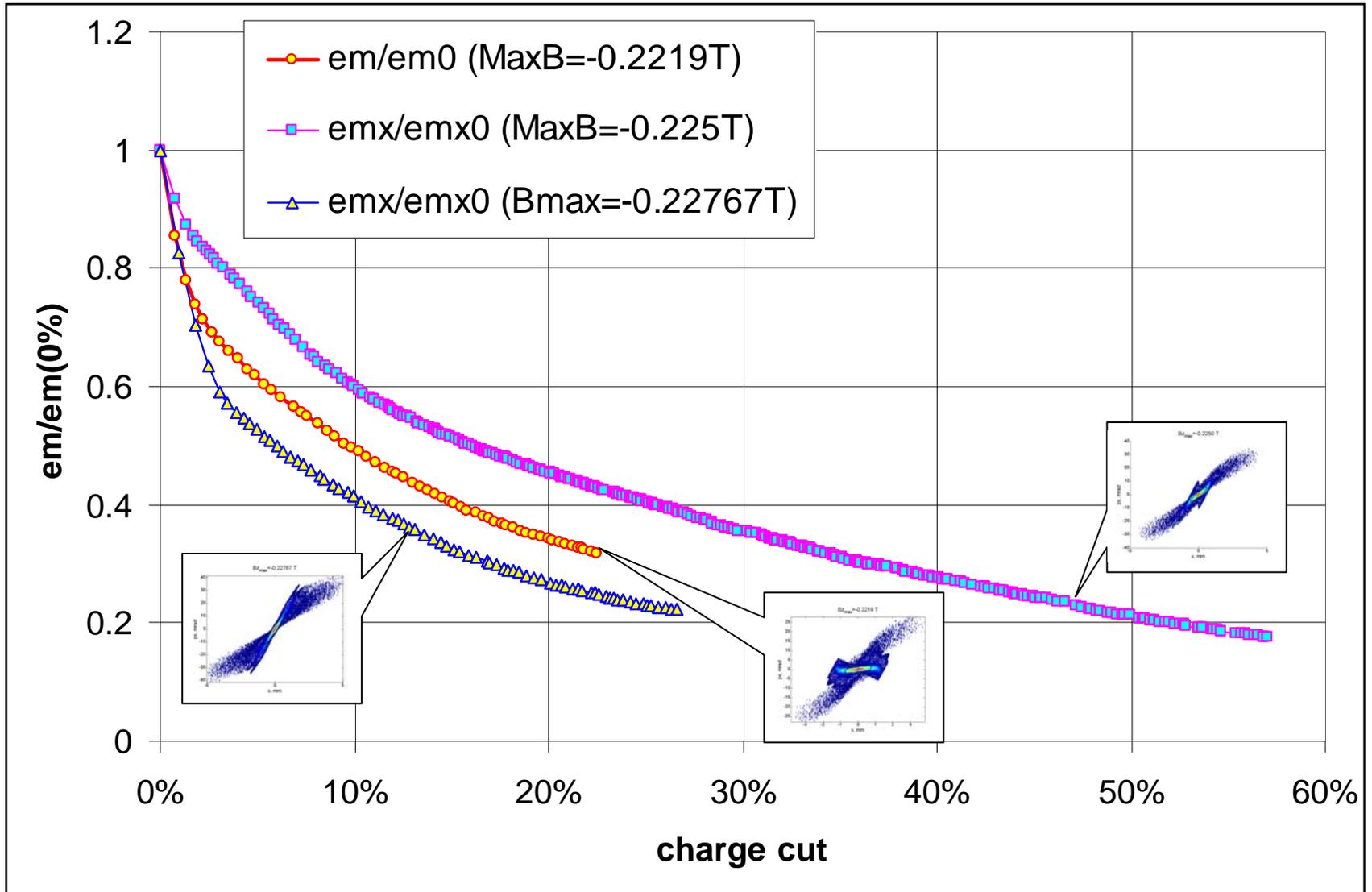
- Combined** factors (dx=100um X 5% charge cut X 50um position jitter) resulted in **-30...0...-20%** measured emittance underestimations

Influence of the charge cut on to the phase space

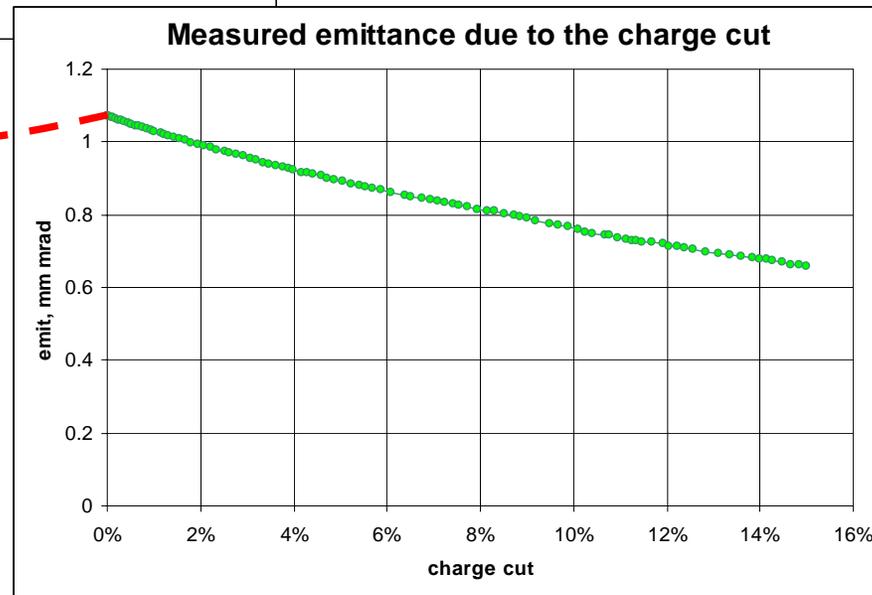
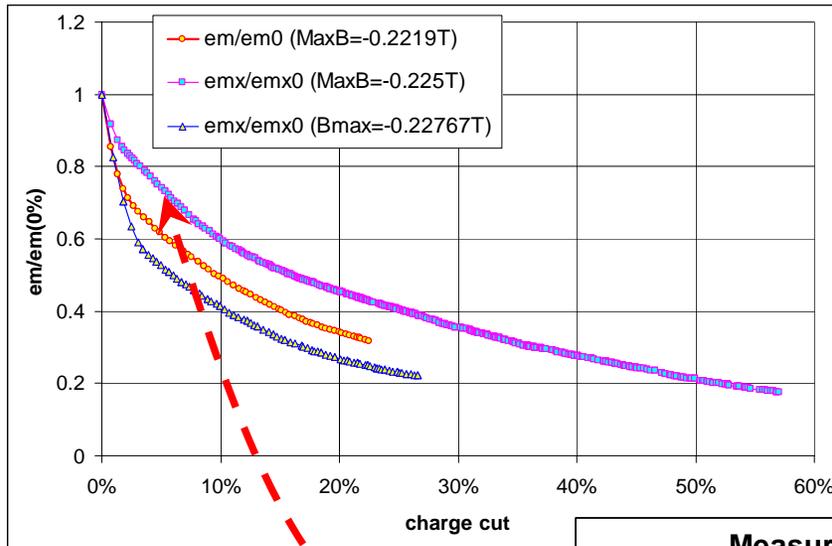
“Intentional” charge cut. Measured emittance



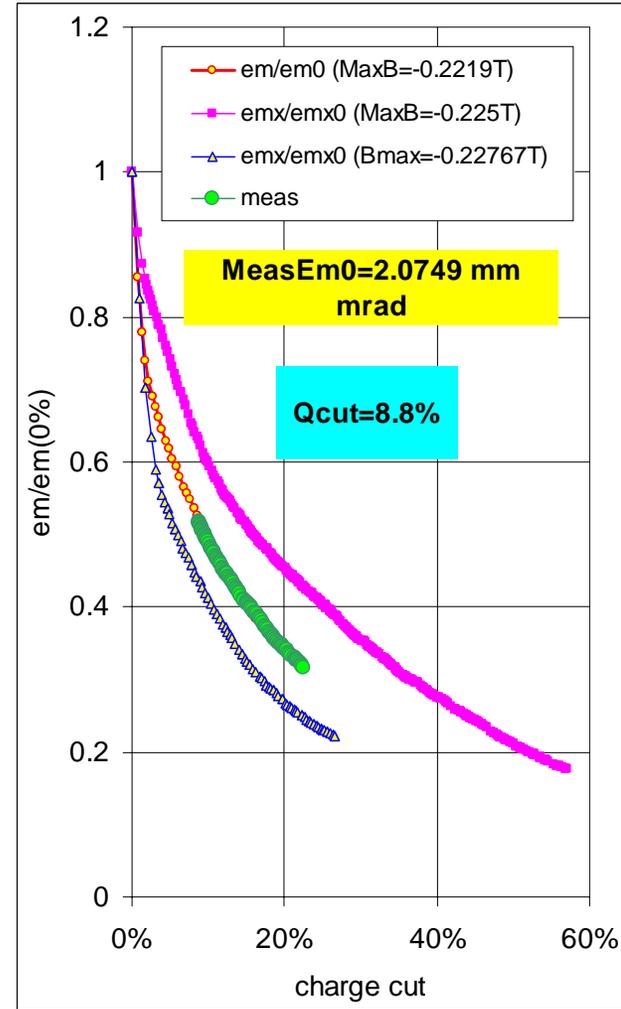
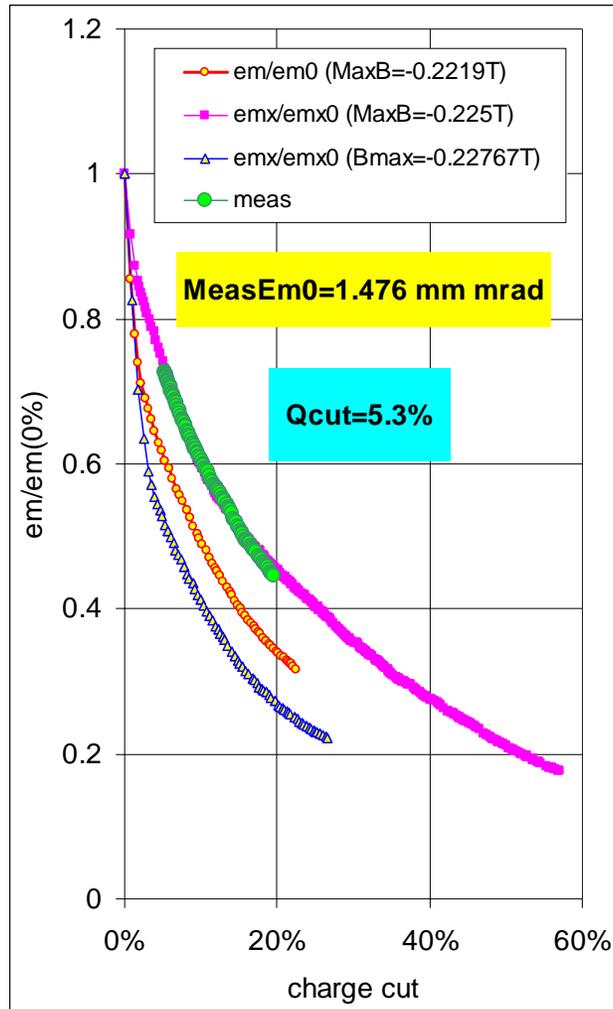
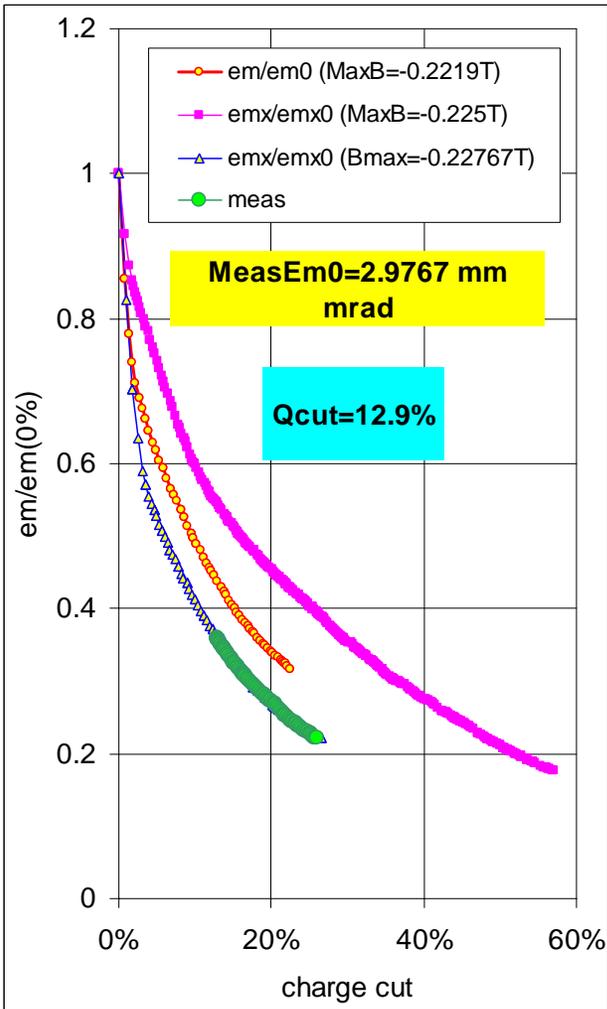
“Intentional” charge cut. Simulated emittance



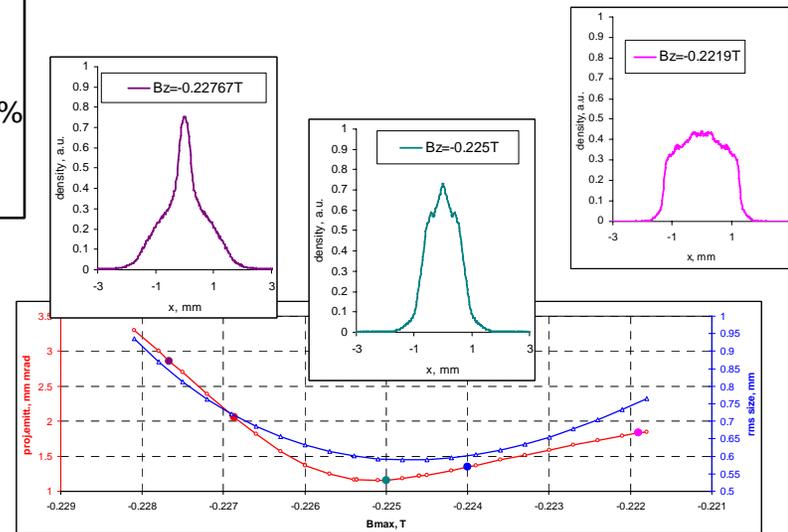
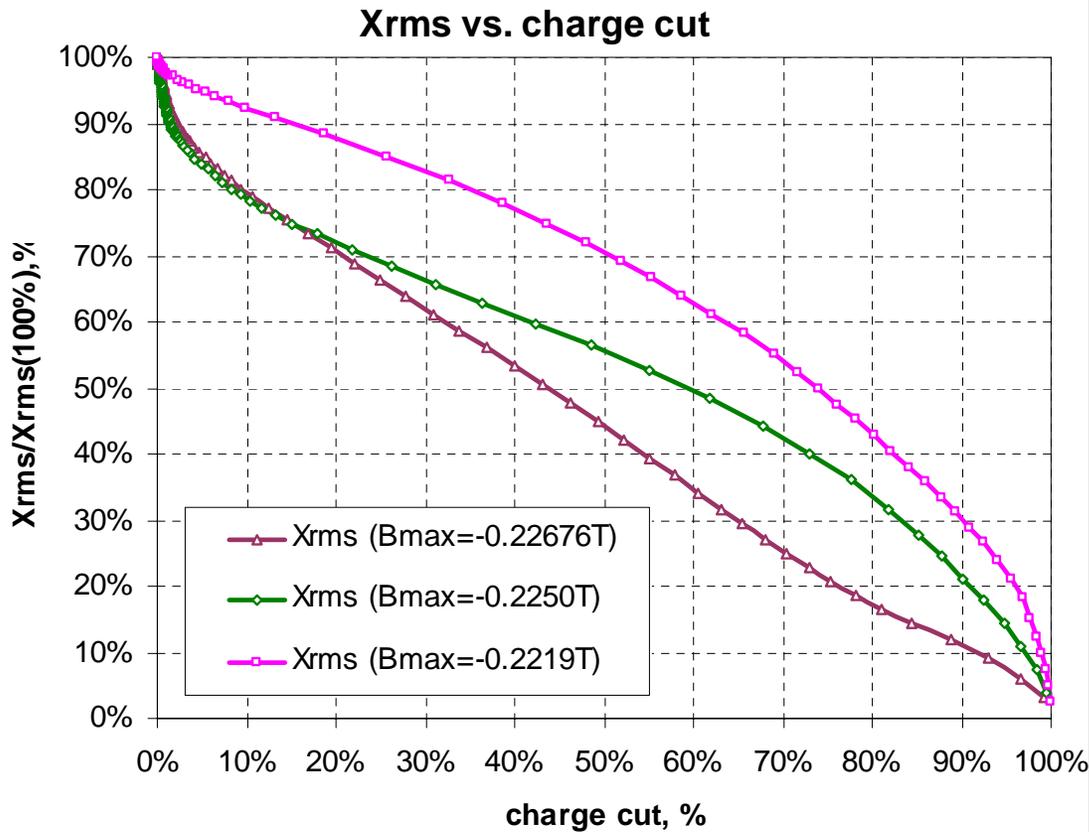
Charge cut: fit measured to simulated



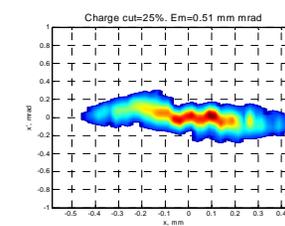
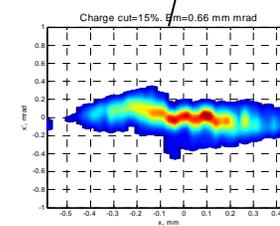
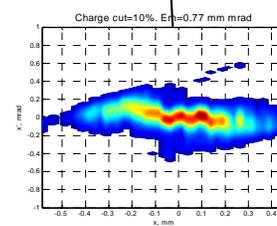
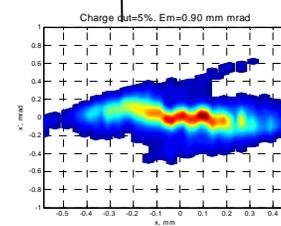
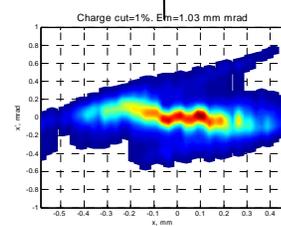
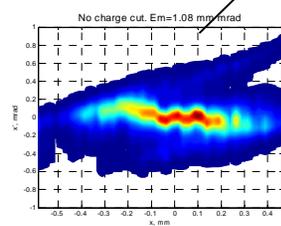
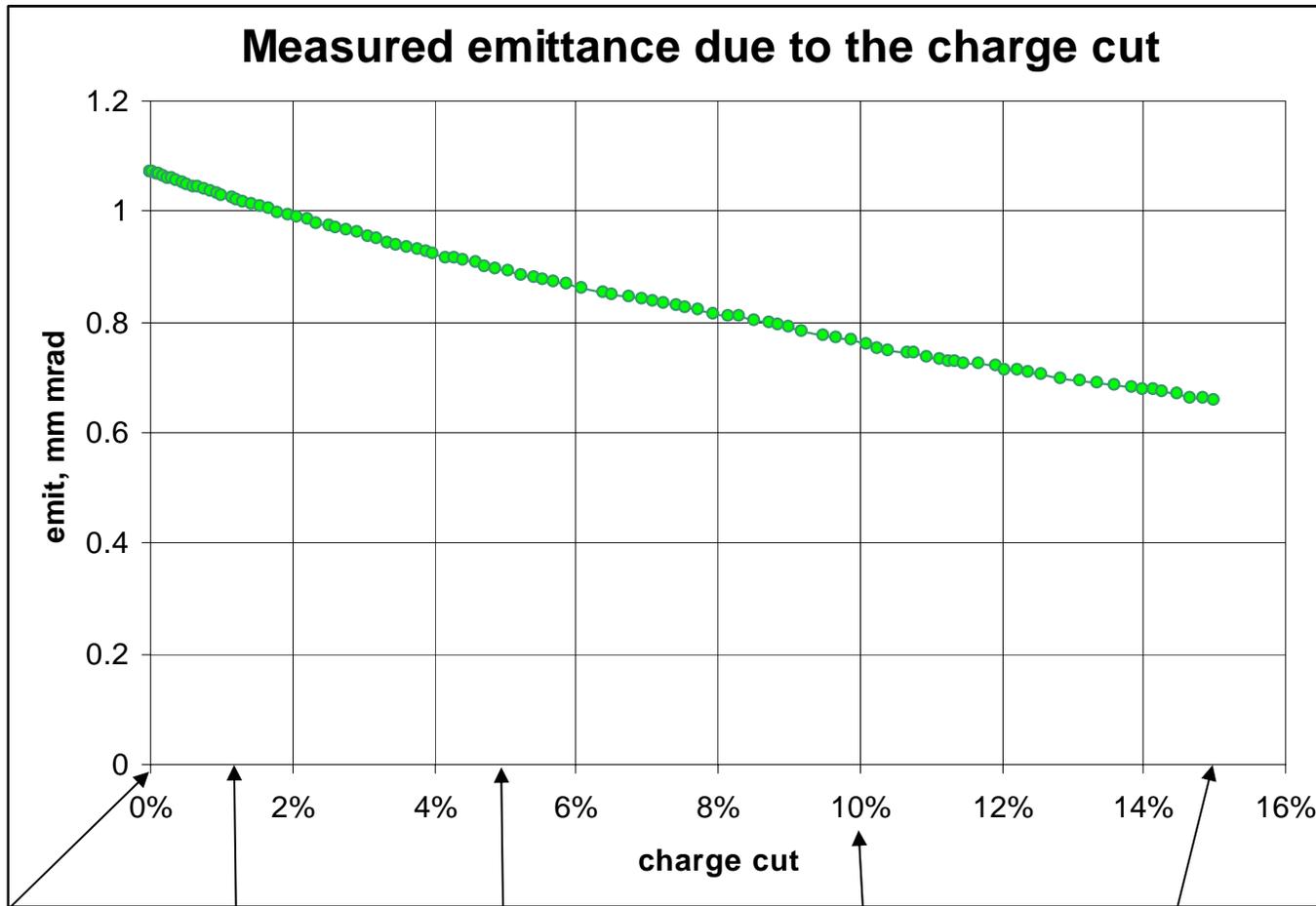
Charge cut: fit measured to simulated



RMS size reduction due to the charge cut

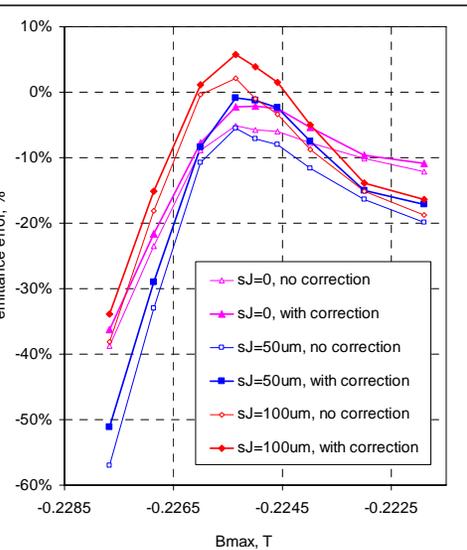
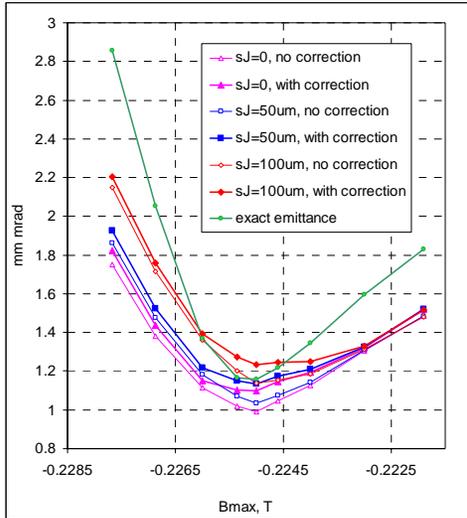


“Intentional” charge cut. Measured emittance



Slit scan X Beam position jitter=Measured emittance

Scan step=100 μ m, Charge threshold=5%



Systematic error due to 50 μ m position jitter

