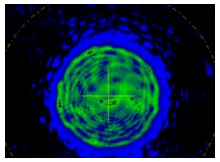
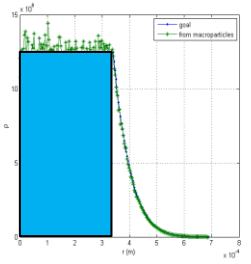
When the core+halo initial distribution is utilized, ASTRA shows good agreement with extracted charge measurements

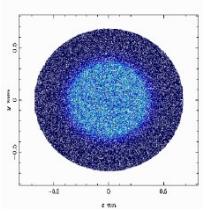
If a uniform distribution is used instead, the charge saturates

Actual laser radial distribution

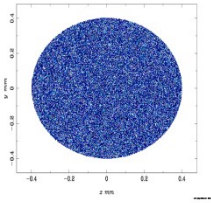




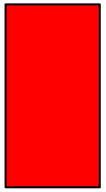
Transverse radial profile core + halo



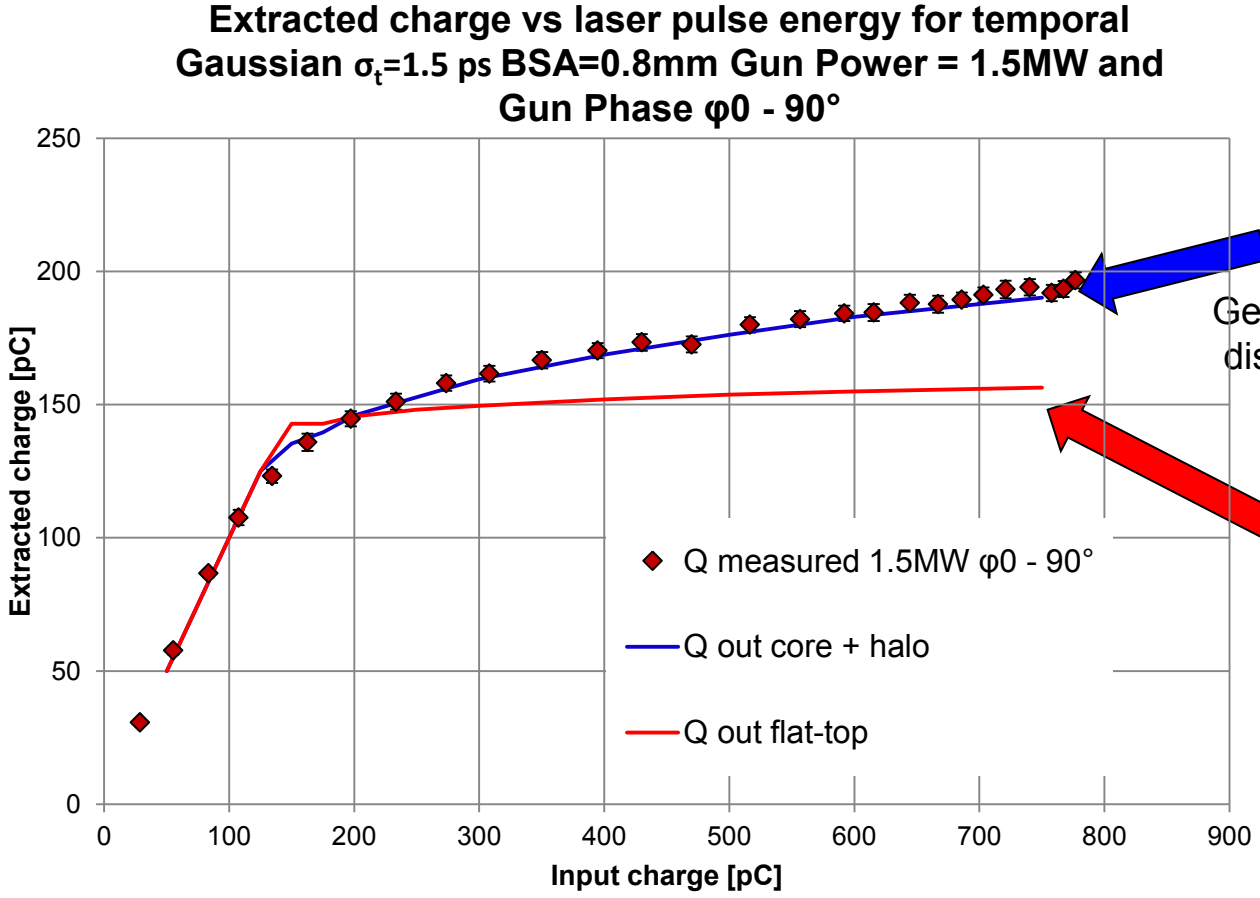
Generated ASTRA input distribution core + halo



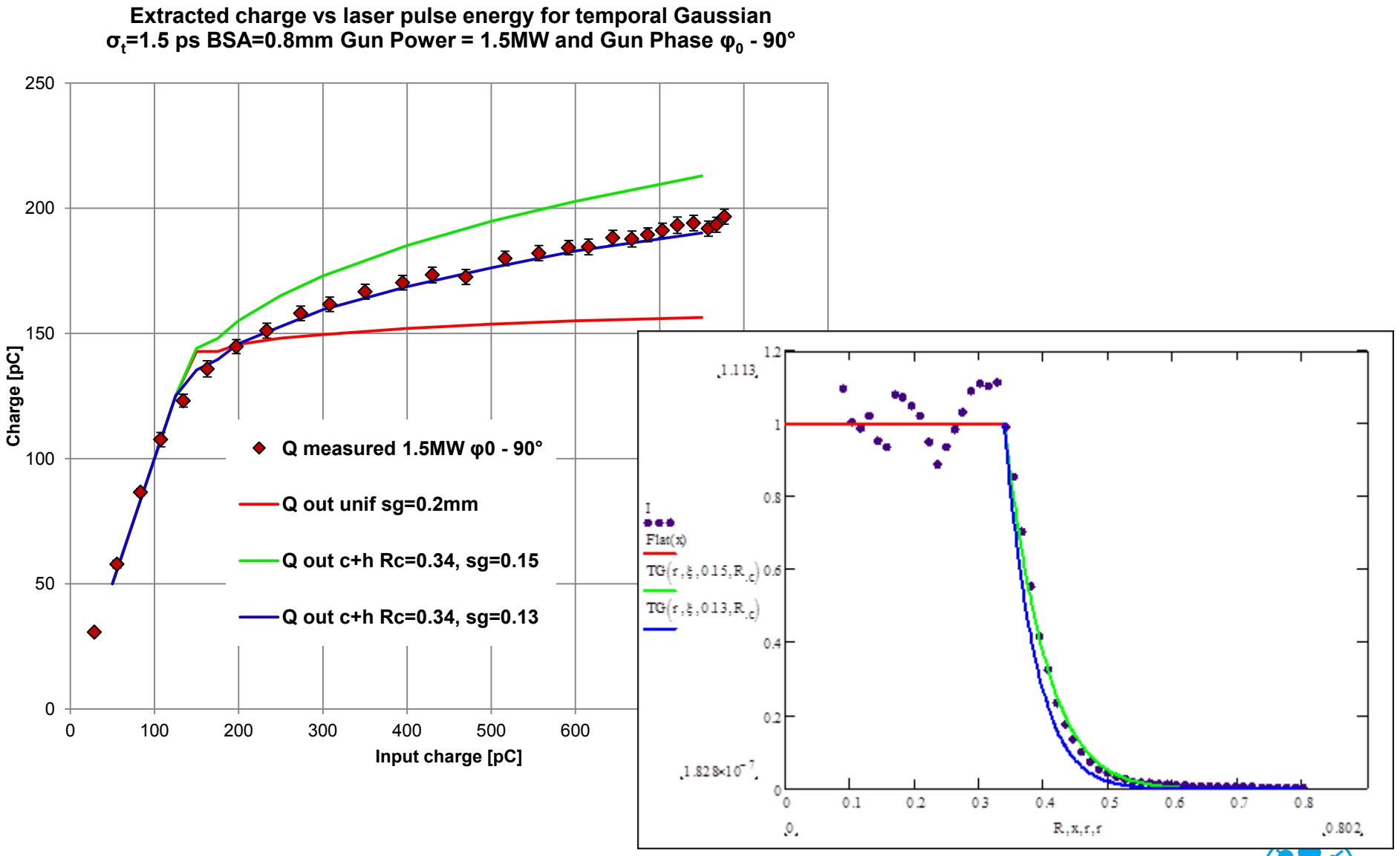
Nominal ASTRA input distribution flat-top



Nominal transverse radial profile flat-top

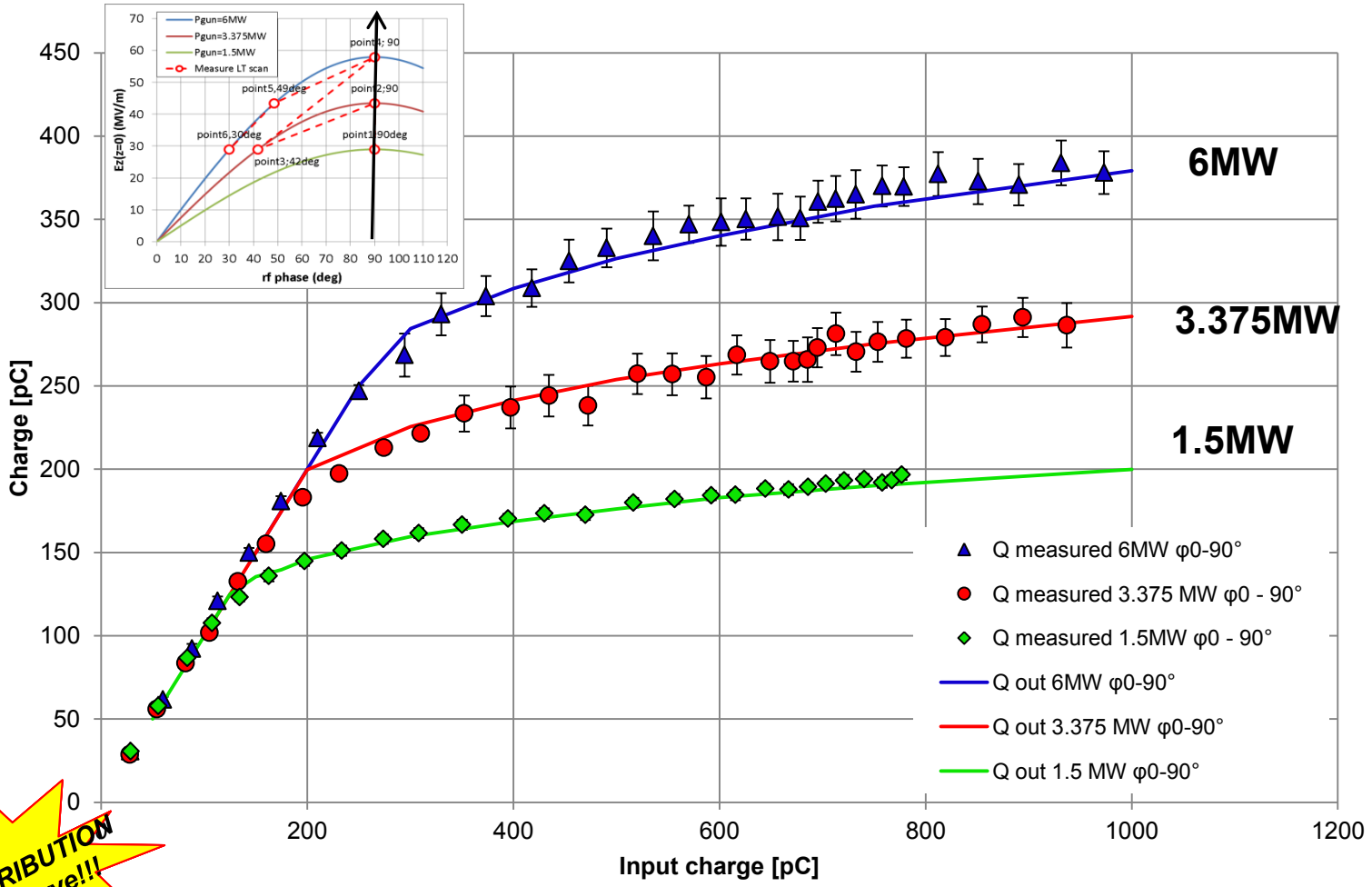


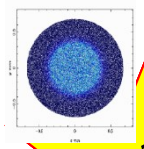
Slight changes in the curve fit used to generate the distribution have significant impact on the output charge…



…but once the fit is found, the core + halo input distribution fits the experimental data…

Extracted charge with core + halo for BSA 0.8 mm with 1.5 ps rms Gaussian temporal at φ_0-90° for each Pgun

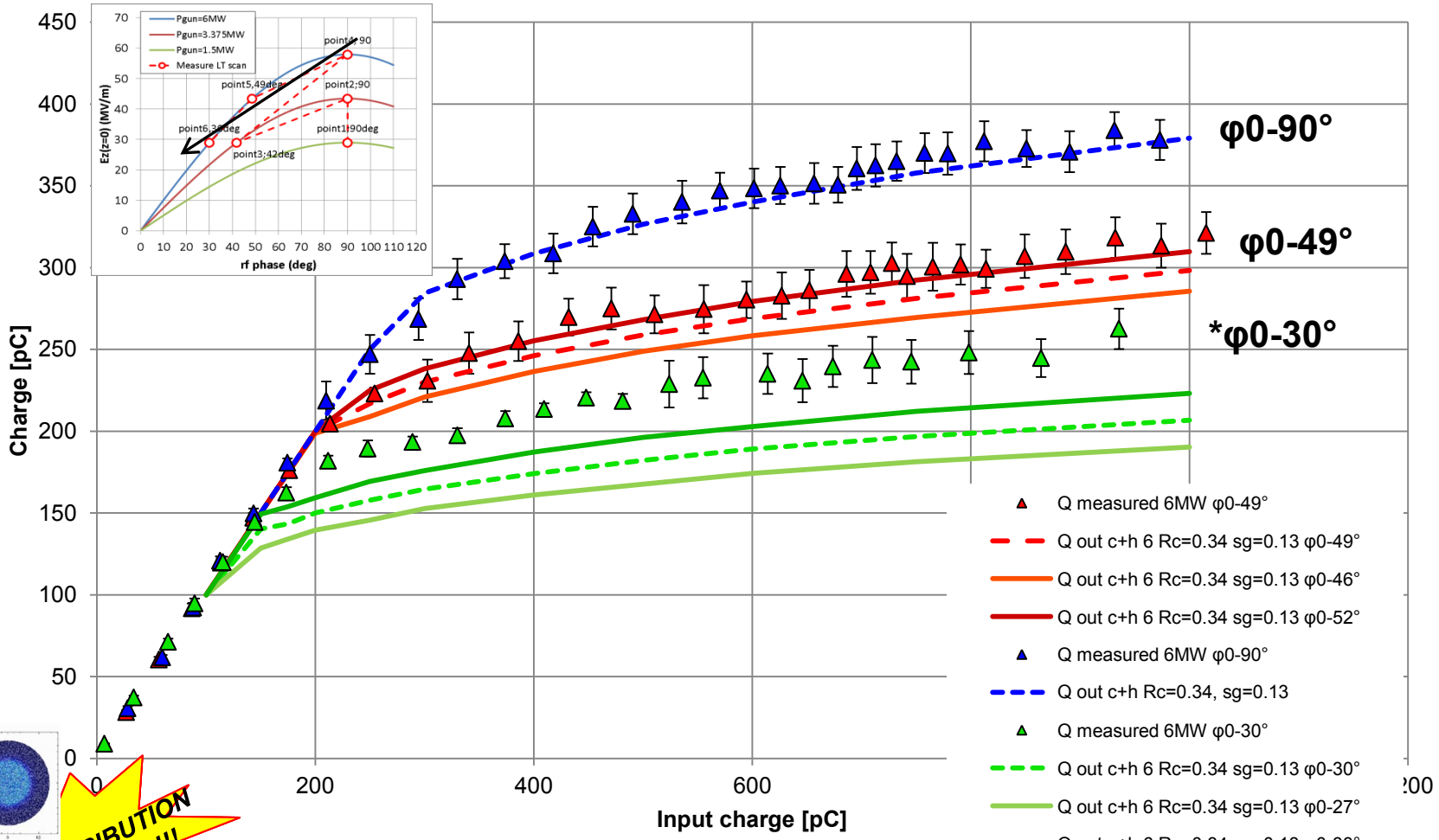




SAME DISTRIBUTION For each curve!!!

…for most cases anyway.

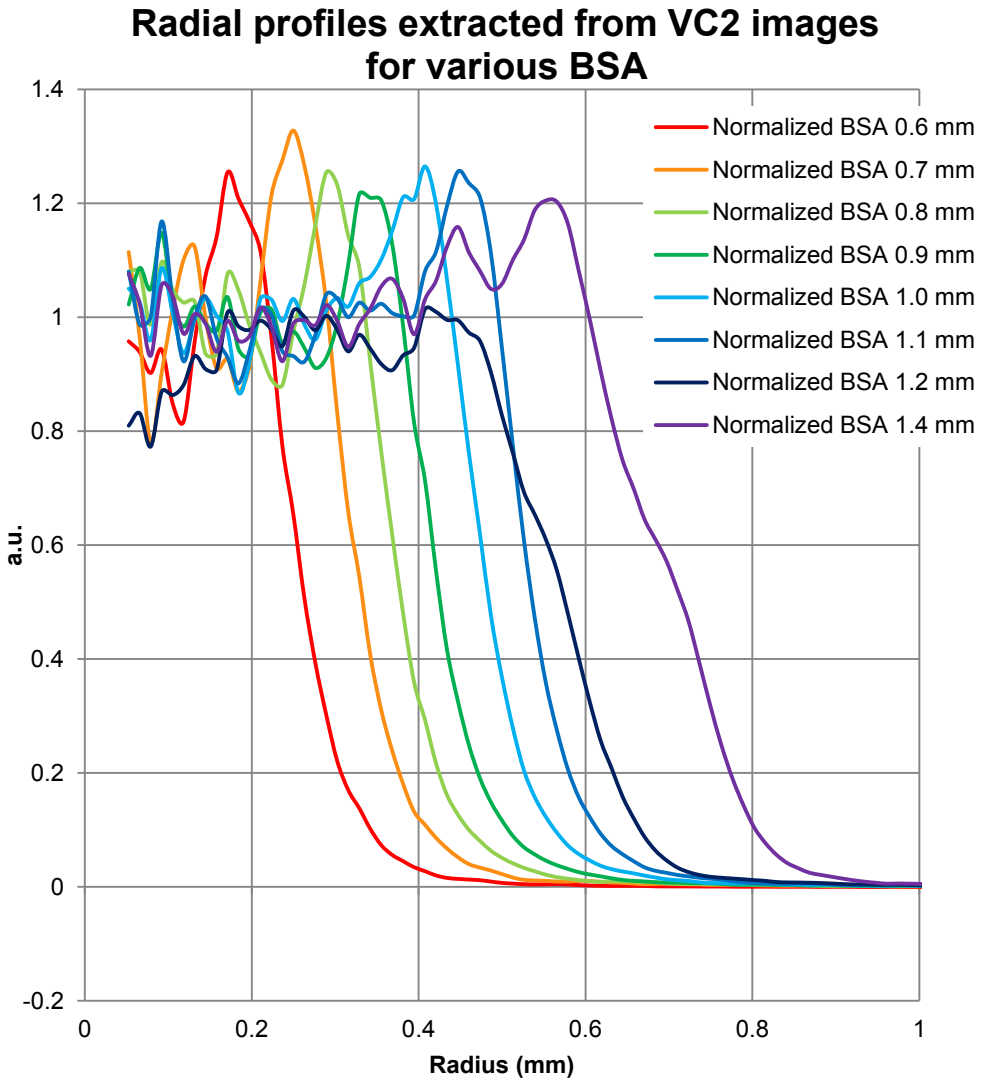
Extracted charge with core + halo for BSA 0.8 mm with 1.5 ps rms Gaussian temporal at Pgun=6MW for each phase

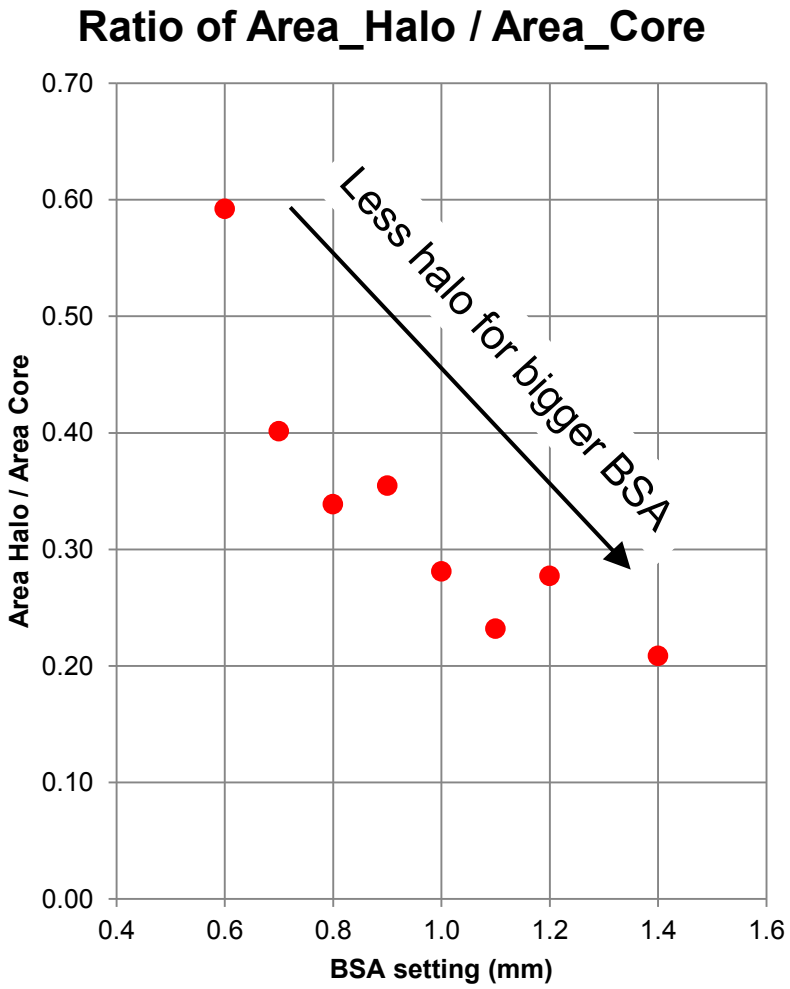


SAME DISTRIBUTION For each curve!!!

*data taken on different shift

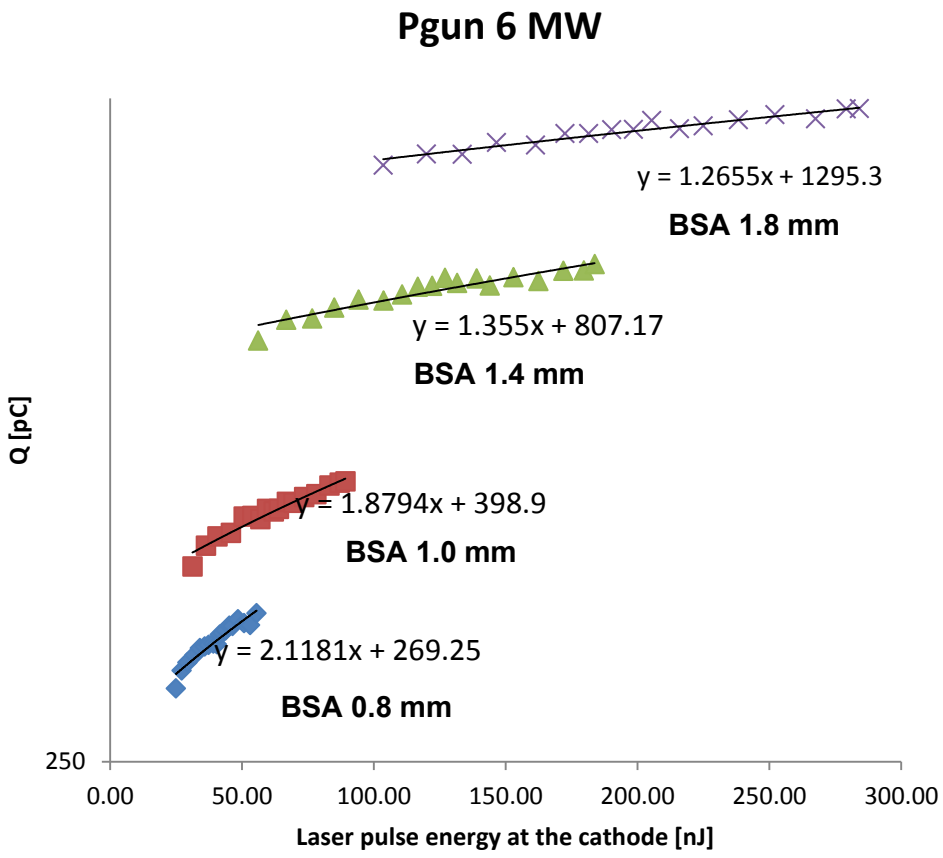
Our hypothesis about Halo decreasing as the BSA is increased is confirmed from VC2 data…

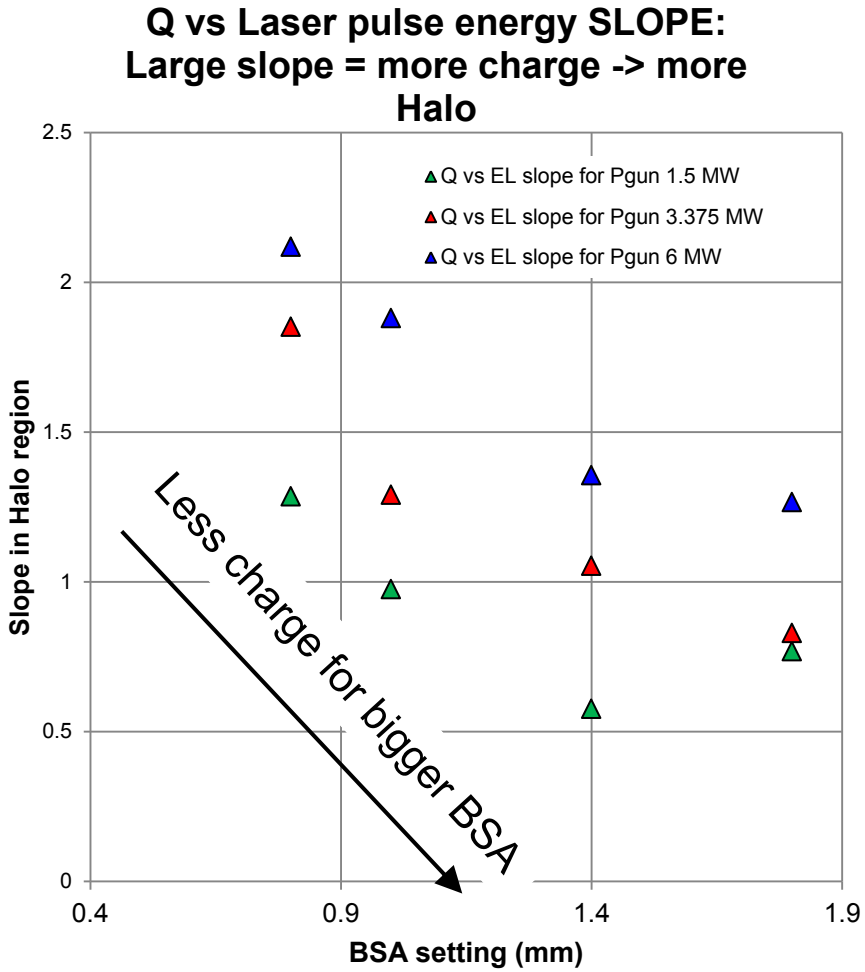




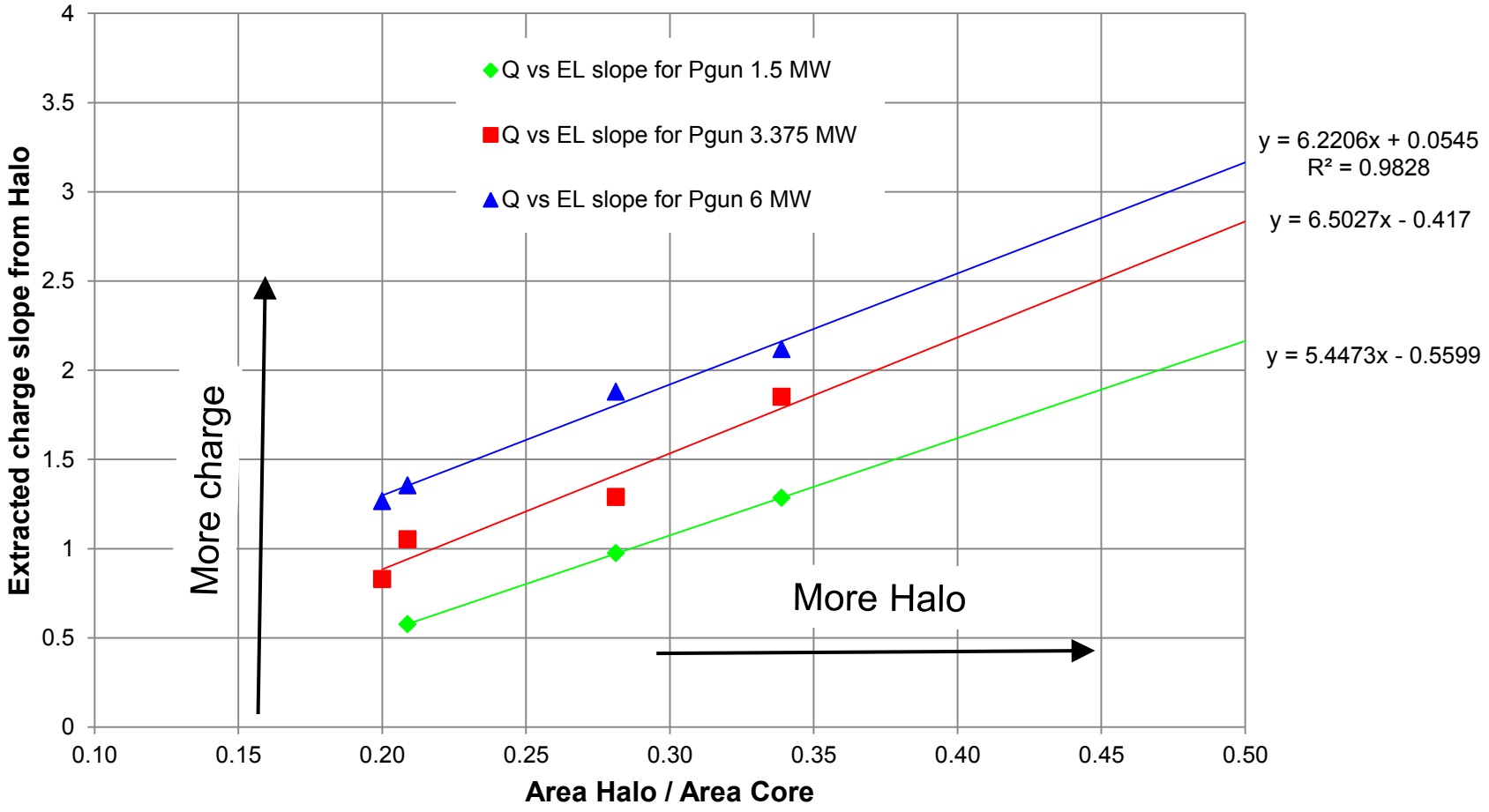
…and also from the electron beam data, where less charge is extracted from Halo for larger BSA settings

- The slope indicates that charge continues to be extracted from halo regions even though charge from core has saturated





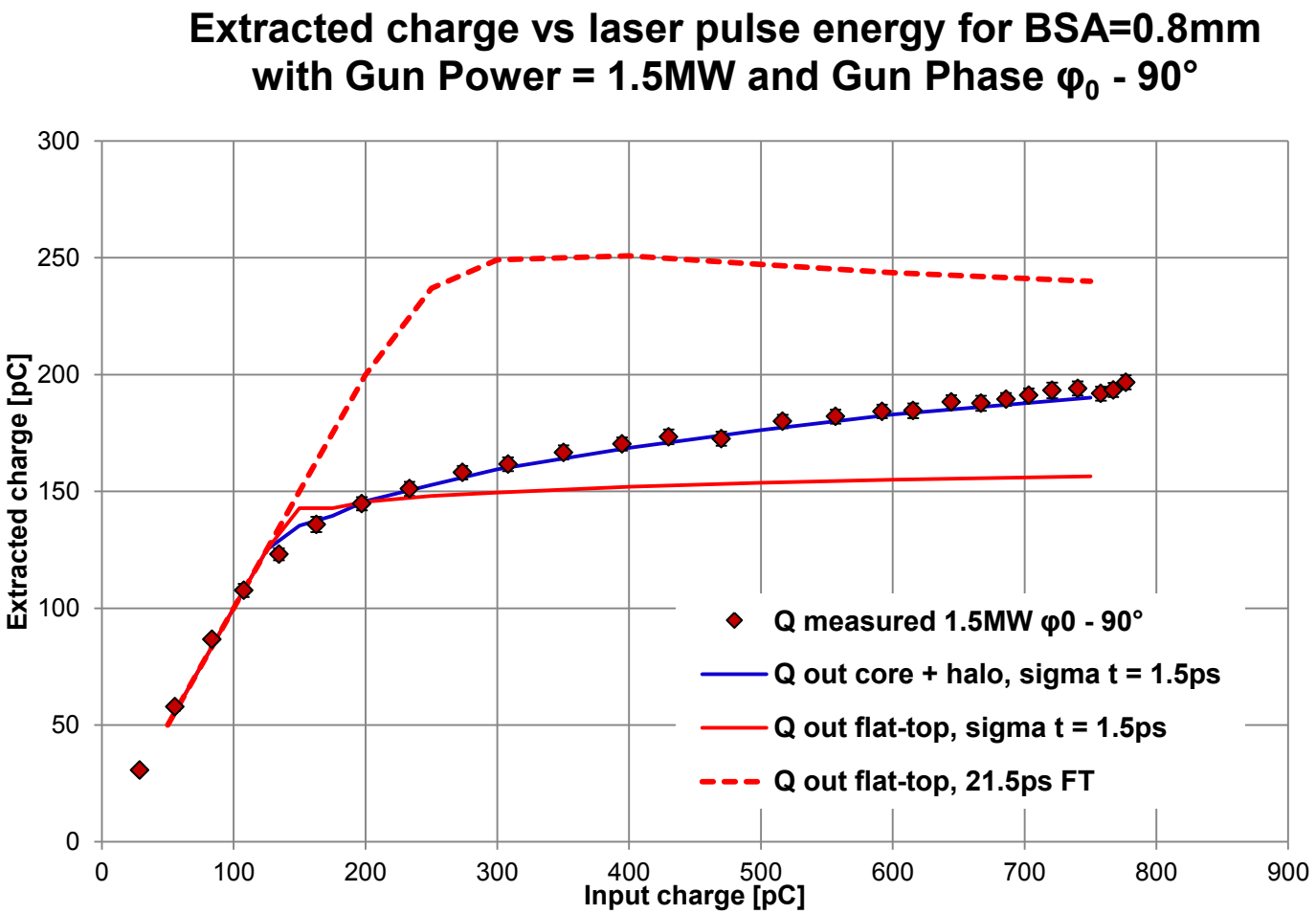
CONCLUSION: The relationship between the amount of halo in the laser distribution seems to be directly proportional to the extracted charge.



Extra stuff

For discussion: Why ASTRA shows the output charge increasing for temporal Gaussian, and decreasing for temporal flat top?

- Is it physics, or simulation settings?



- Is it physics, or simulation settings?

Photoemission studies at PITZ: Analysis of recent and past data on extracted charge vs laser pulse energy

- For a uniform (flat-top) transverse laser profile, the extracted charge should saturate beyond certain laser pulse energy, corresponding to specific beam parameters and gun operating settings.
- However, we have consistently observed that the extracted charge as a function of laser pulse energy is higher than that predicted by simulations for a variety of gun settings and laser parameters.
- Our hypothesis is that although the extracted charge saturates in the core of the uniform laser transverse distribution, halo contributes to additional charge being extracted.
- To test our hypothesis, we have generated initial (input) distributions reproducing the measured laser transverse profile, which in fact is composed of a flat-top core with halo.
- Using these distributions, we obtain now very good agreement between ASTRA simulations and measured extracted charge vs laser pulse energy.
- This result indicates that indeed, halo is contributing to excess extracted charge compared to an ideal flat-top uniform transverse laser distribution.

CONCLUSION: Behavior of Halo as a function of BSA is consistent for both, laser radial profile measurements and beam extracted charge