Matlab script for transverse halo generation in ASTRA input file (4th update)

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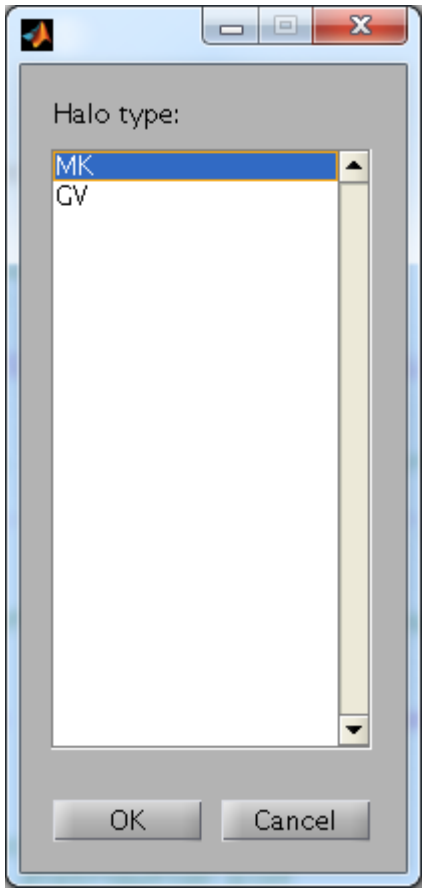
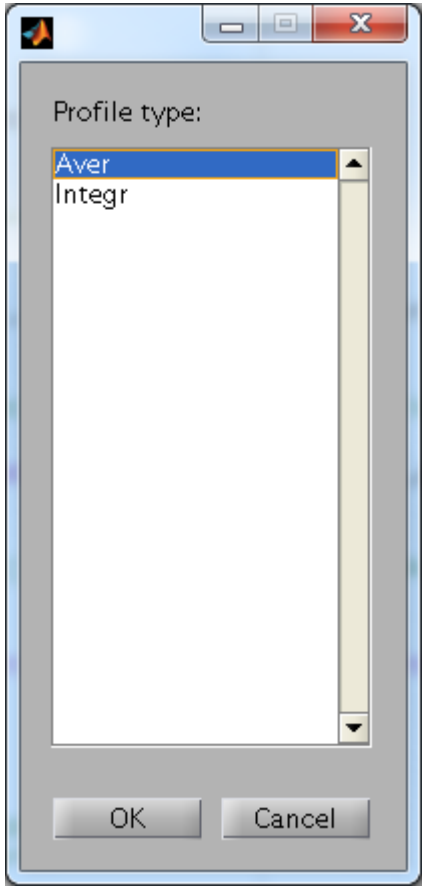
Matlab script CHD_MK4.m

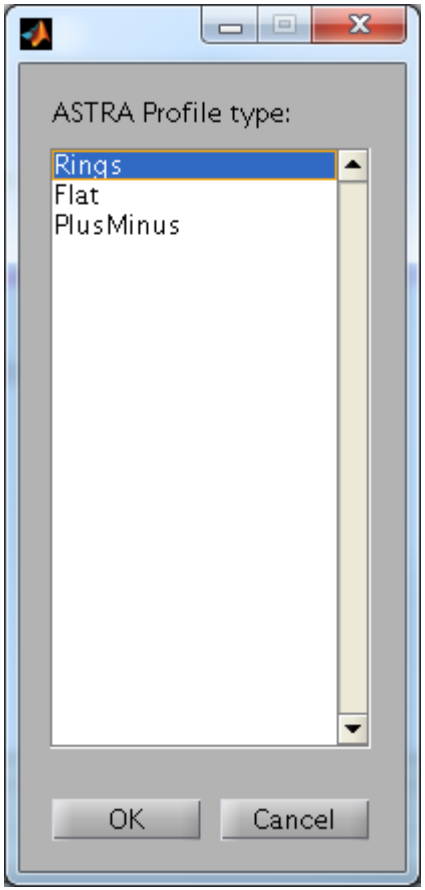
(\measure\scripts\SVN\MatlabScripts\CoreHaloGenerators\)

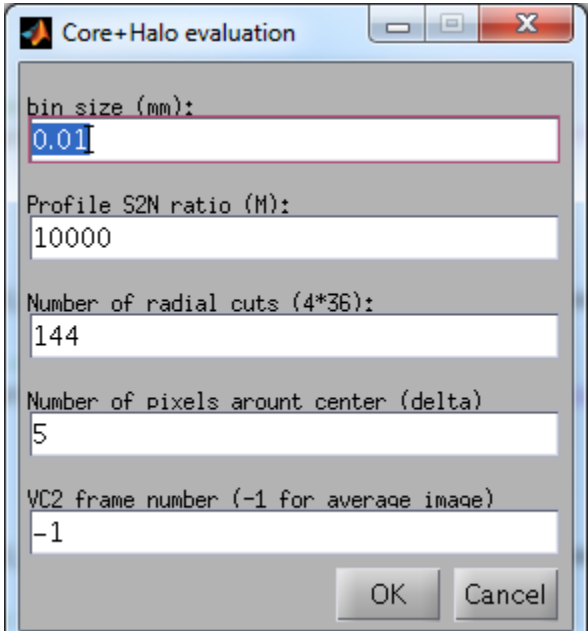
- Before start the script you should have:
  - Images from VC2 (.imc and .bkc)
  - ASTRA cathode distribution (.ini) with ideal (radial homogeneous) transverse profile
- What does the script:
  - Loading VC2-image (number of frames-> <Signal>-<Background>)
  - Interactive determination elliptic ROI (*image reducing to ROI*)
  - Creating radial profile(s) (2 options: “Average” and “Integral”)
  - Core+halo fit → radial profile of the obtained distribution (!Visual check the center position, especially for small BSAs). Output: Xrms, Yrms, Rc, sigmaH. *2 x options for the halo model (“MK” and “GV”)*
  - *Intermediate plot → “ideal” VS image (rot. symmetric)*
  - Loading ASTRA particle distribution at the cathode (.ini file), scaling the transverse span to the VC2 image, modification of macroparticle charges of the halo area, save in the new (.ini) file
  - Core+halo fit of the obtained ASTRA distribution
  - *Major distribution and fit parameters saved in a txt file*

Startup dialogs

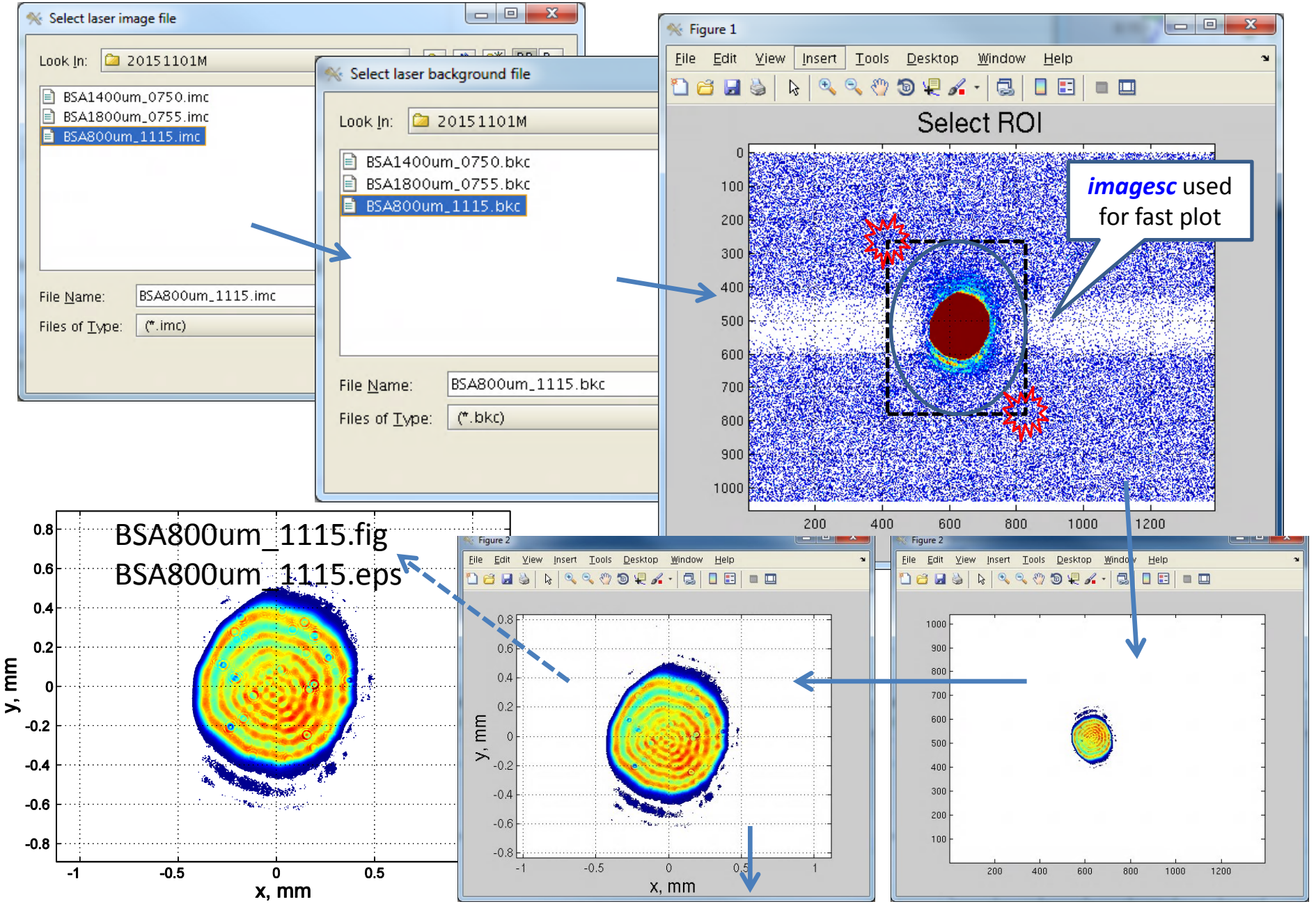




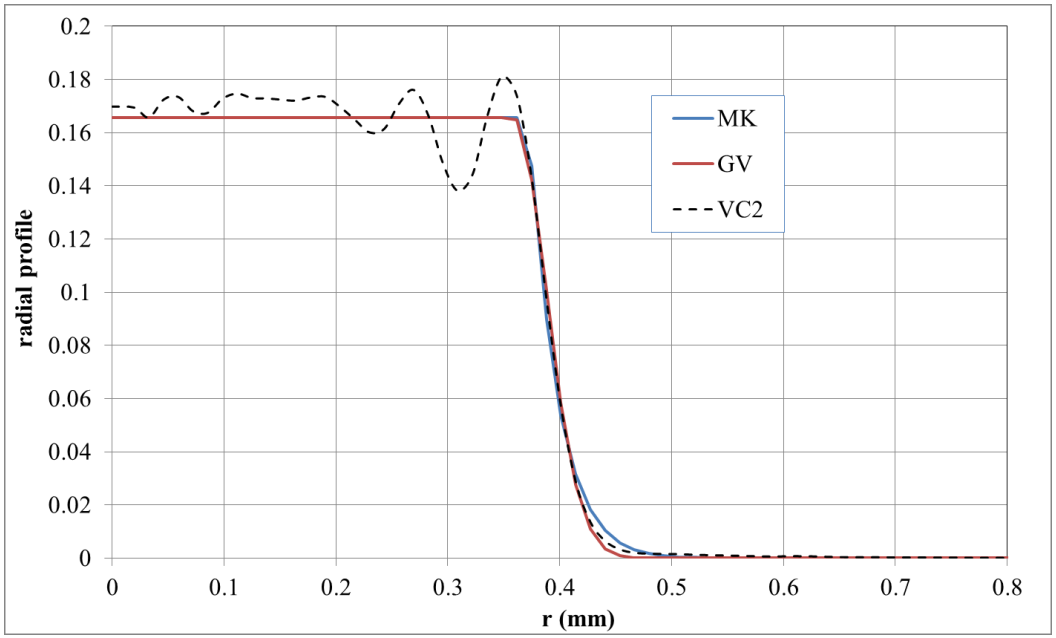




Raw image → ROI selection

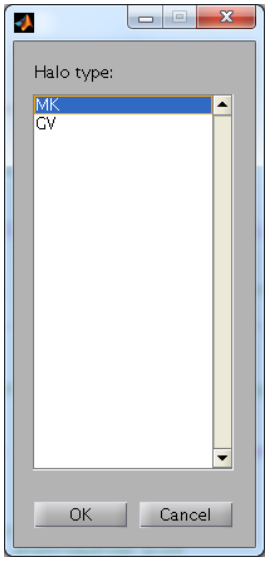


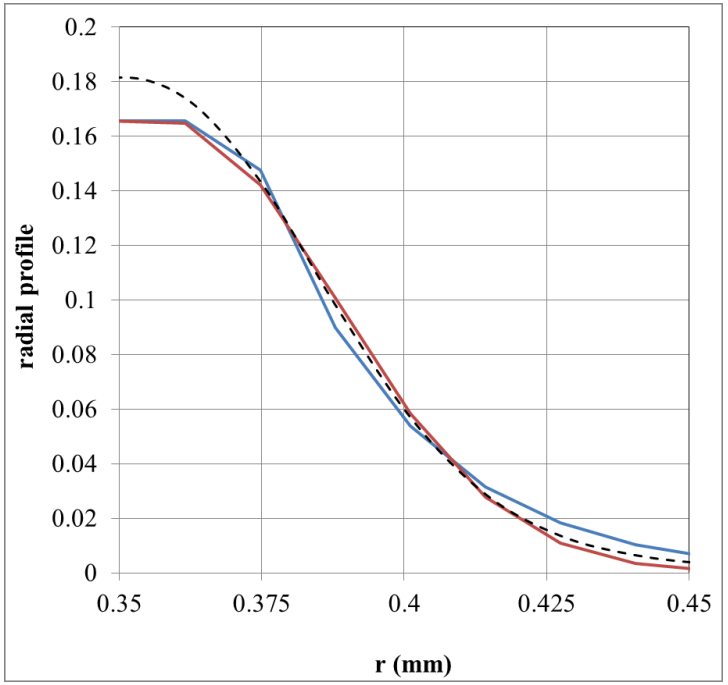
Halo modeling: 2 options – ‘MK’ and ‘GV’



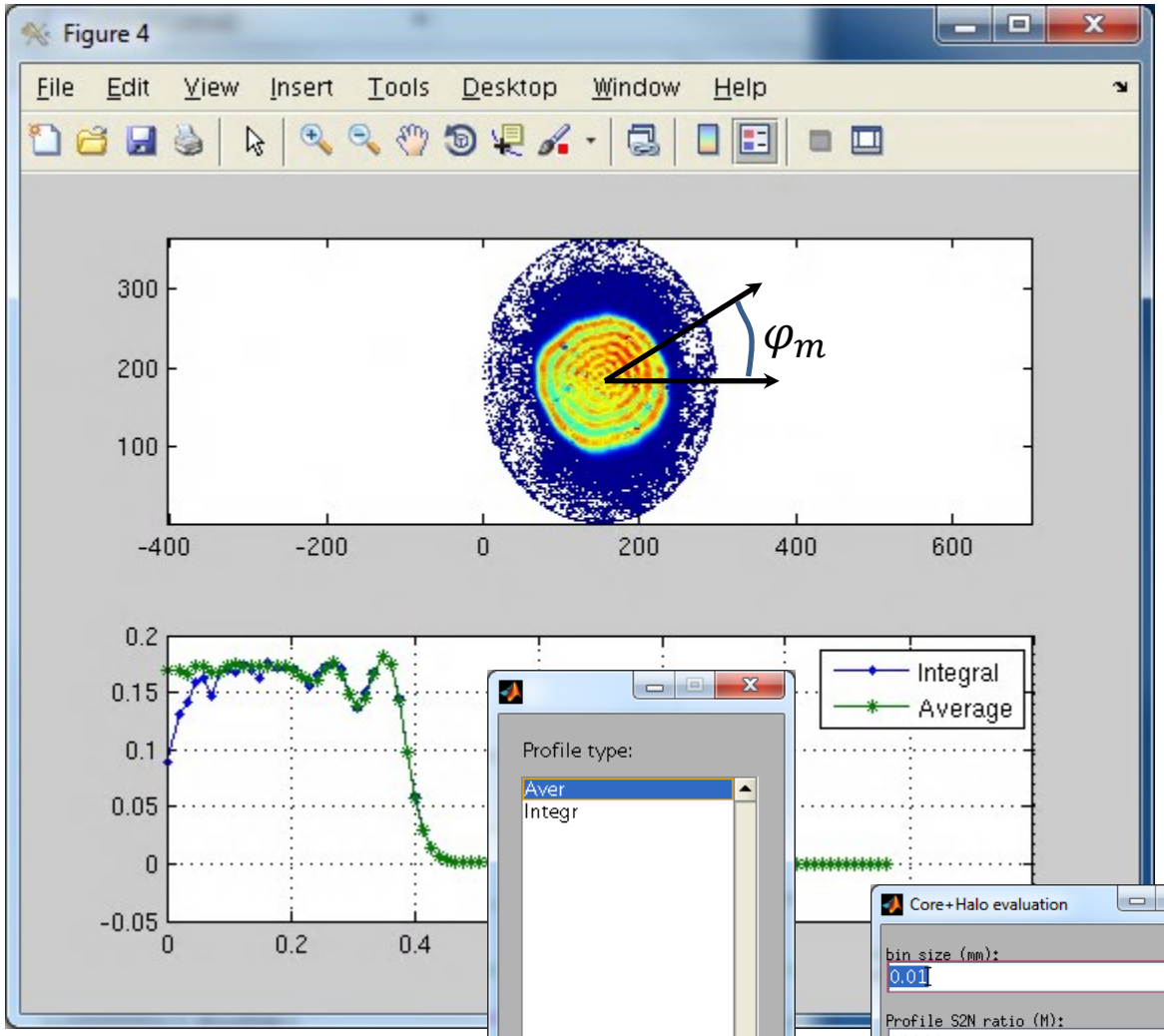
$$P(r) = \begin{cases} 1; if\ r < R_c \\ \chi \cdot Halo(r, R_c, \sigma_H); if\ r > R_c \end{cases}$$

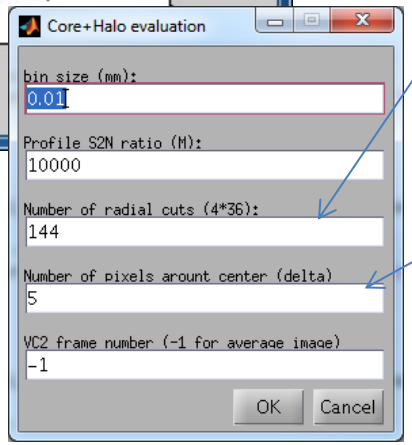
$$Halo(r, R_c, \sigma_H) = \begin{cases} \exp\left[-\frac{r^2 - {R_c}^2}{2{\sigma_H}^2}\right], MK \\ \exp\left[-\frac{(r - R_c)^2}{2{\sigma_H}^2}\right], GV \end{cases}$$





Intermediate plot: reduced image and 2 options of the radial profile





Integral (old):

$$P_{Int}(r) \propto \frac{1}{r}\int_0^{2\pi} I(r,\varphi)\, d\varphi$$

Average (new):

$$\varphi_m = 0 : d\varphi = \frac{2\pi}{M_\varphi} : 2\pi$$

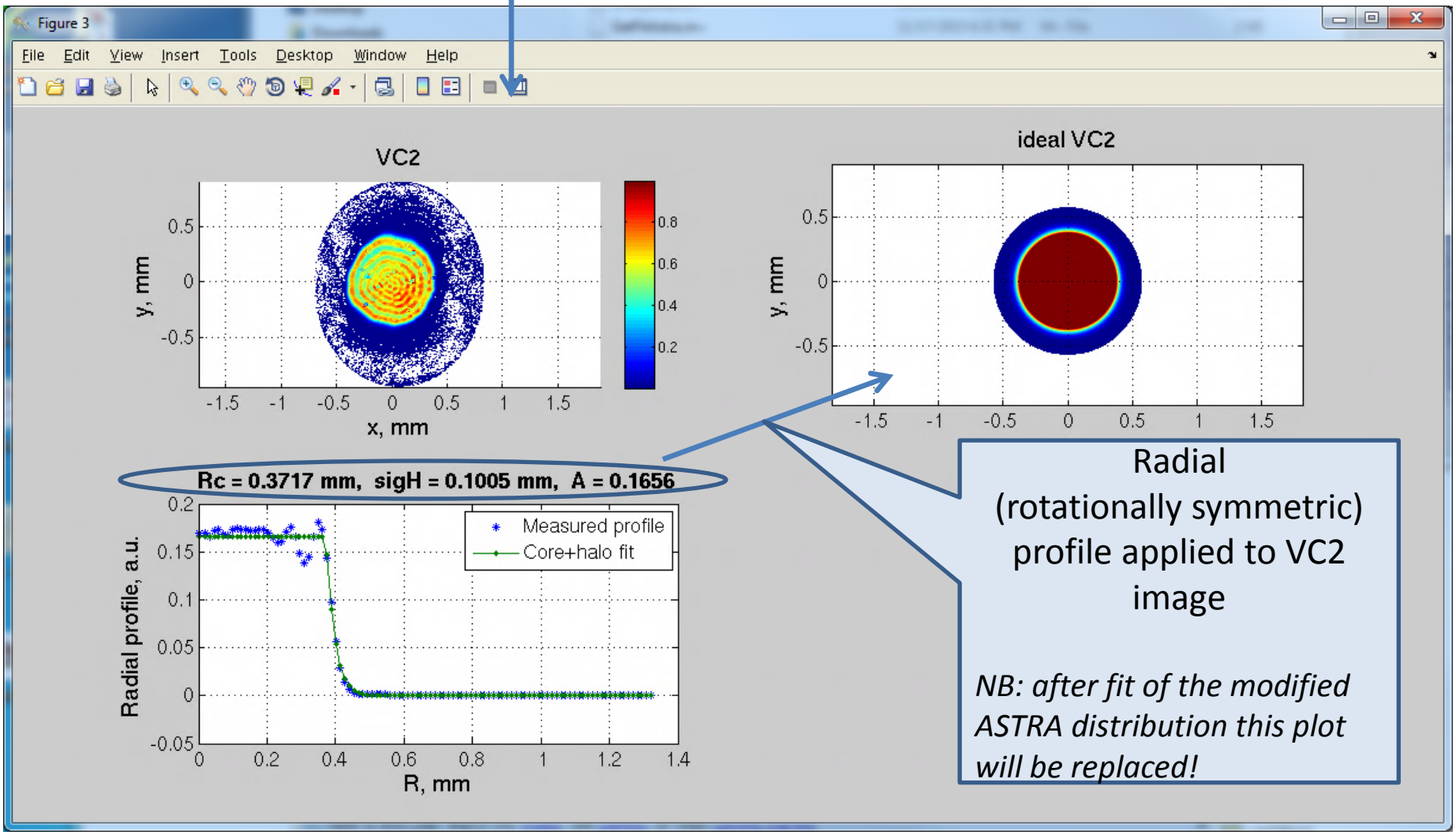
$$P_{aver}(r) \propto \frac{1}{M_\varphi}\sum_{m=1}^{M_\varphi} P_{\varphi_m}$$

$$P_\varphi = interp2[I(x,y),\ x = r\,cos\varphi, y = rsin\varphi]$$

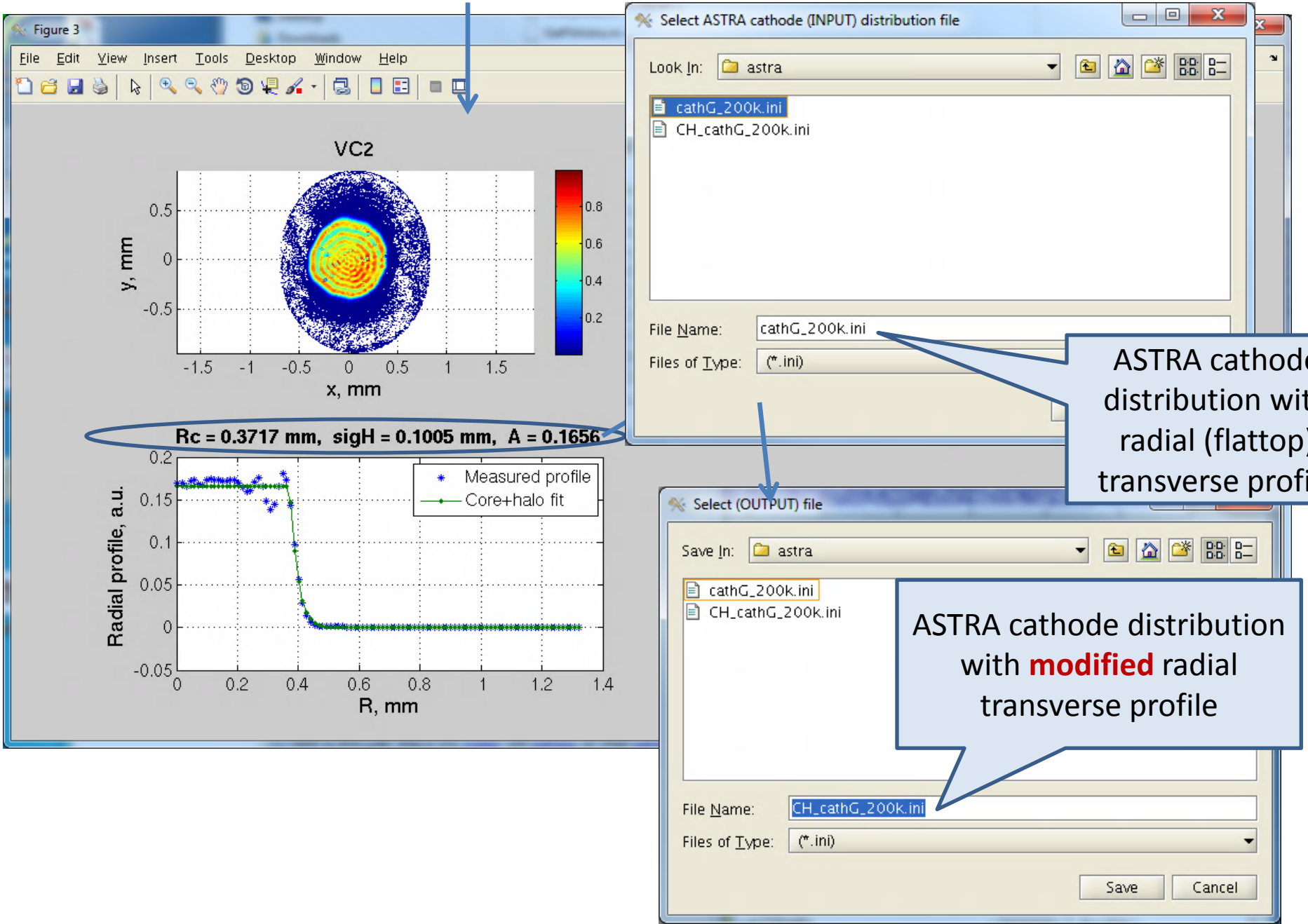
$$P_{Int}(0) = \langle I(x,y)\rangle_{delta}$$

$(2 \cdot delta + 1) \times (2 \cdot delta + 1)$

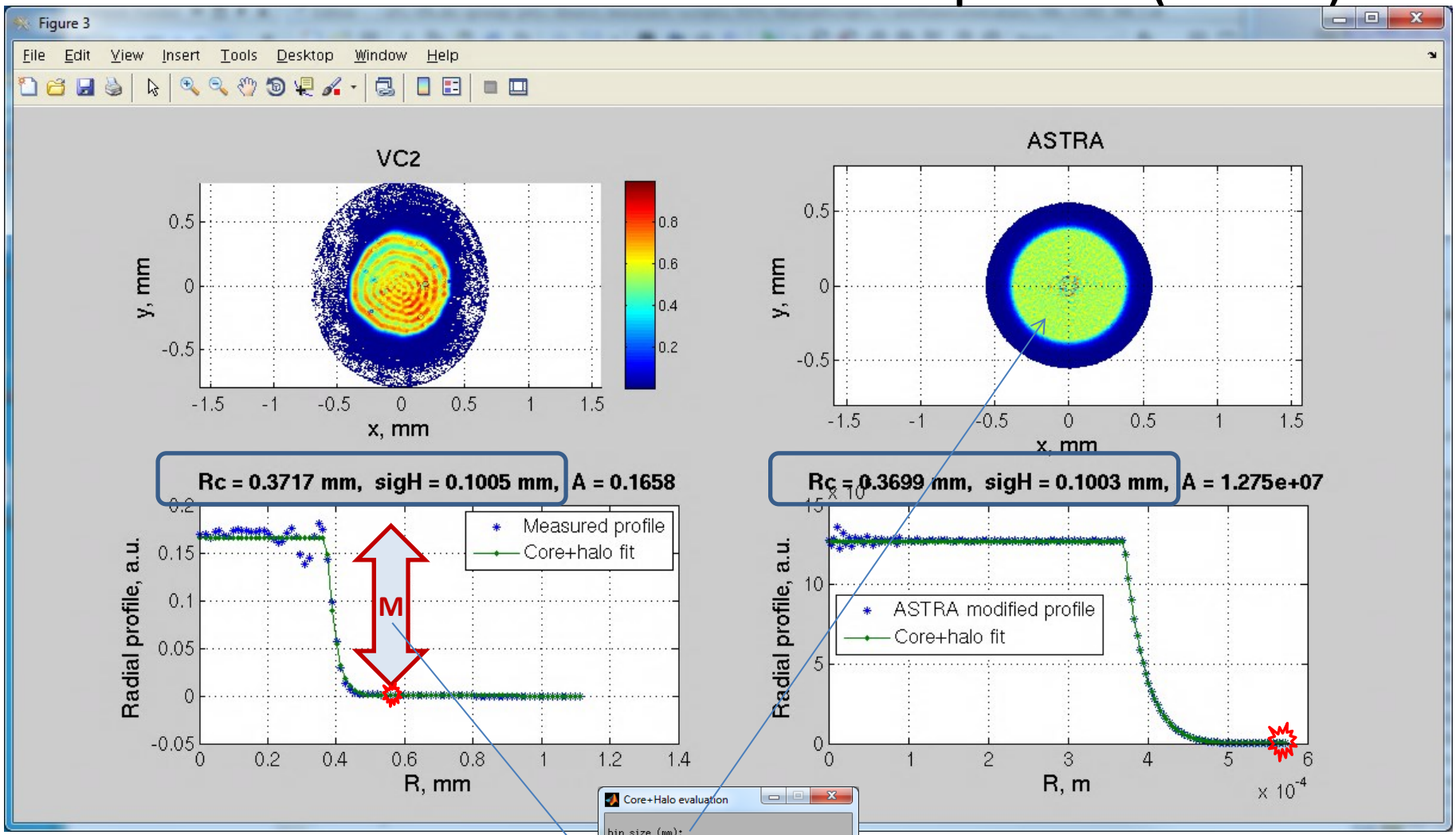
Core+halo fit of the VC2 profile: “ideal” VC2



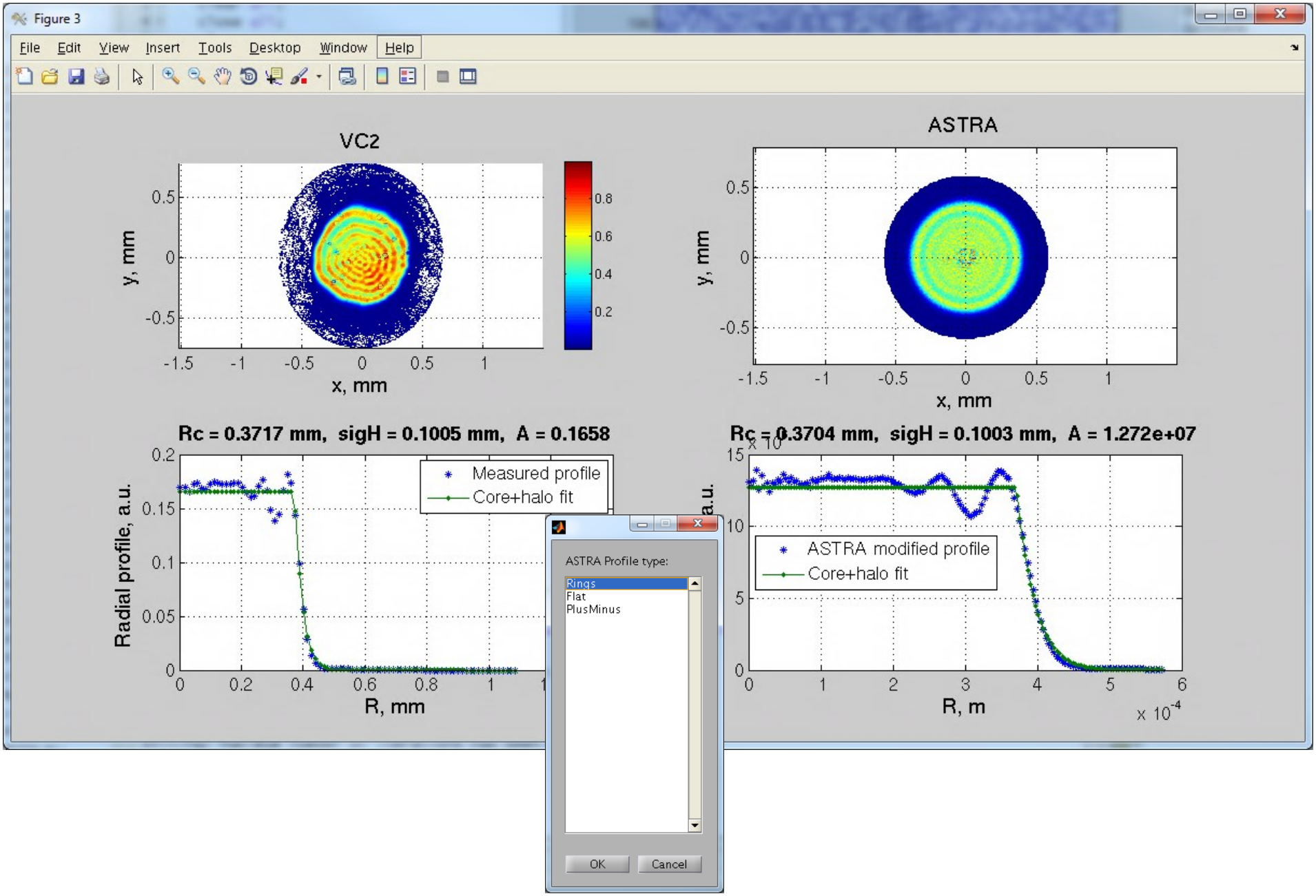
Core+halo fit of the VC2 profile



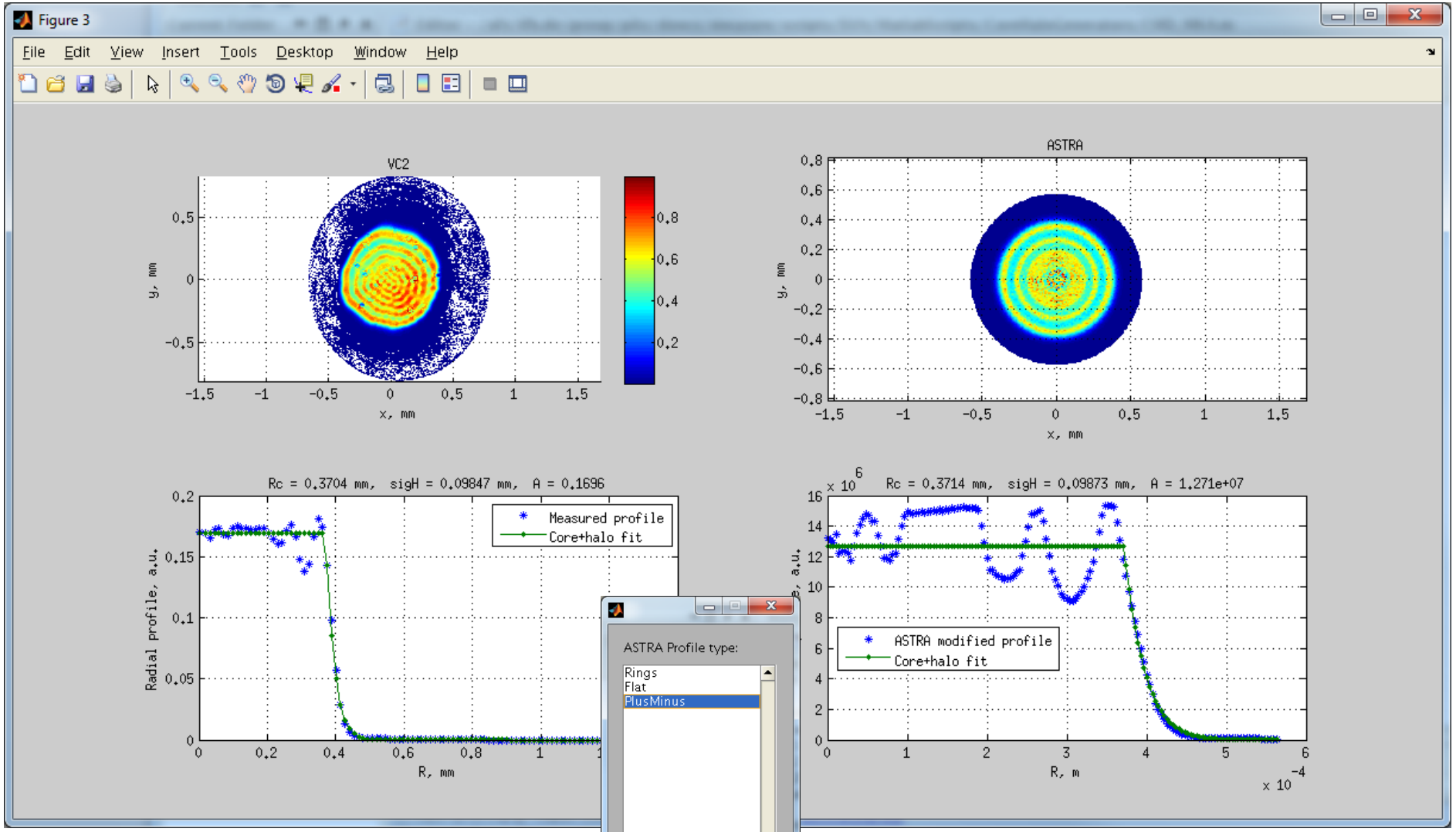
Core+halo fit of the new ASTRA profile (check)



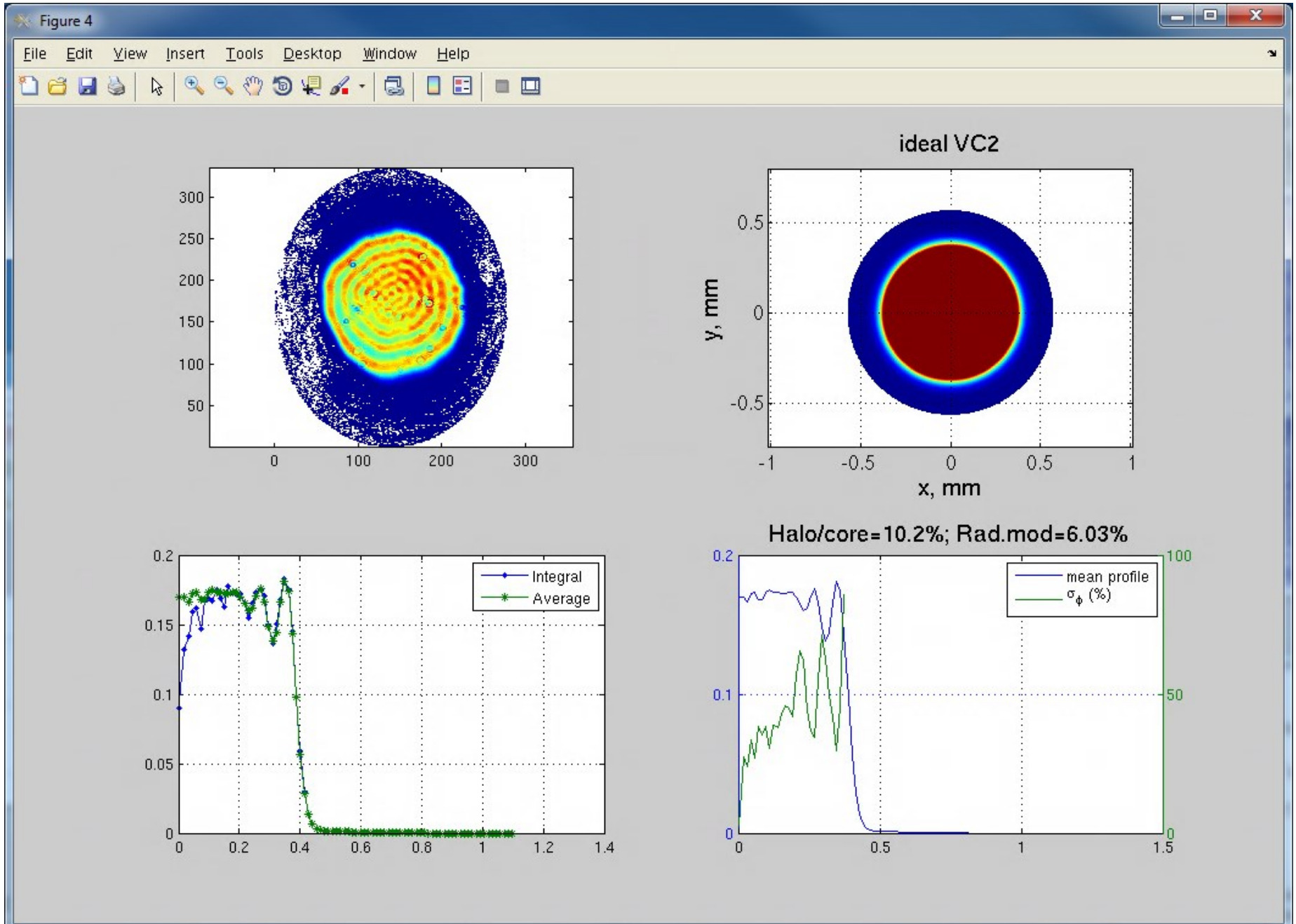
New option: real radial profile →ASTRA profile



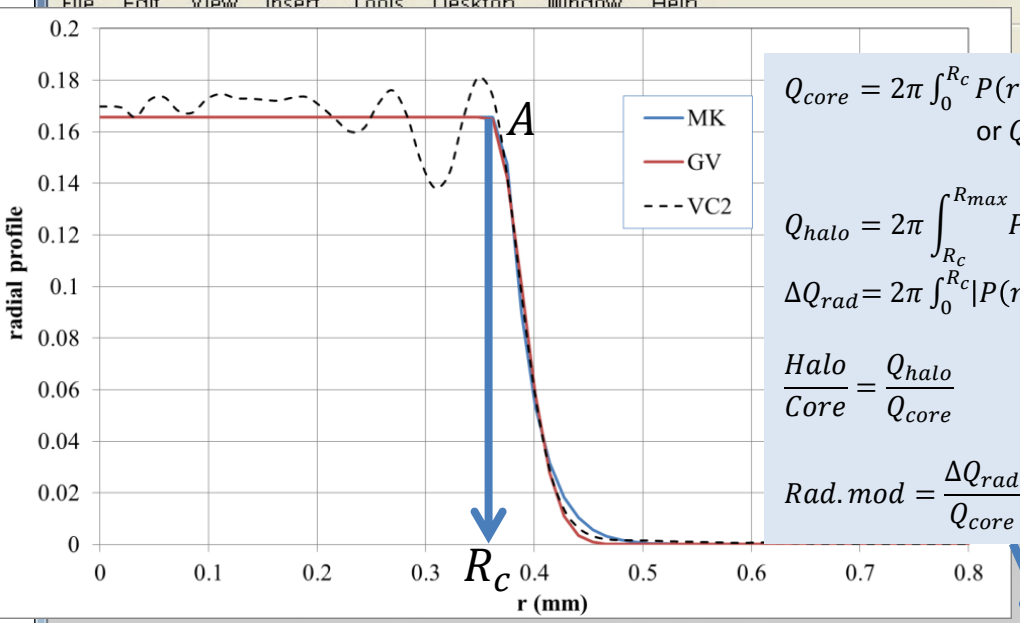
Another new option: real radial profile →ASTRA profile



Laser distribution evaluation



Laser distribution evaluation



$$Q_{core} = 2\pi \int_0^{R_c} P(r)\, r dr$$

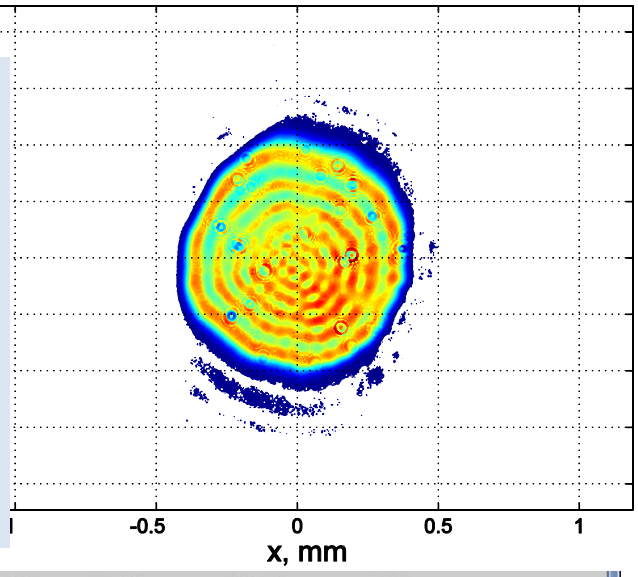
or $Q_{core} = \pi {R_c}^2$?

$$Q_{halo} = 2\pi \int_{R_c}^{R_{max}} P(r)\, r dr$$

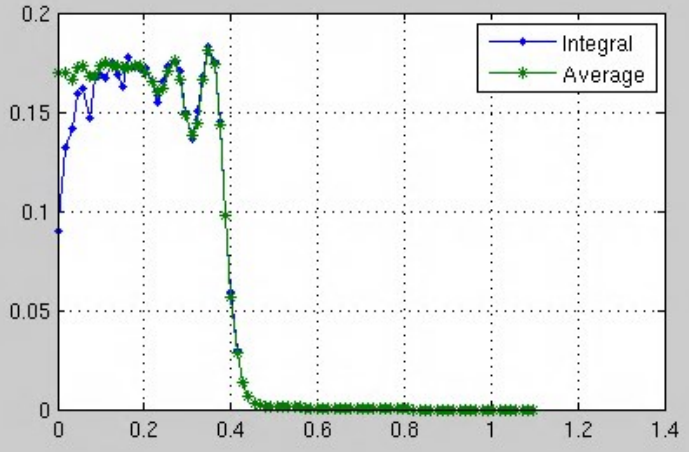
$$\Delta Q_{rad} = 2\pi \int_0^{R_c} |P(r) - A|\, r dr$$

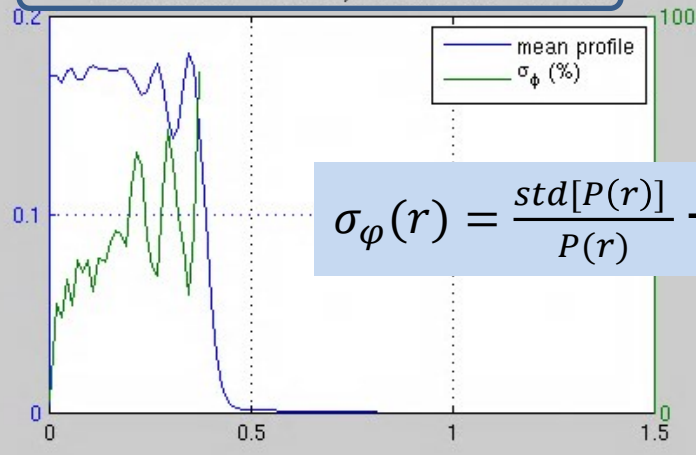
$$\frac{Halo}{Core} = \frac{Q_{halo}}{Q_{core}}$$

$$Rad.mod = \frac{\Delta Q_{rad}}{Q_{core}}$$



Halo/core=10.2%; Rad.mod=6.03%





$$\sigma_\varphi(r) = \frac{std[P(r)]}{P(r)} \rightarrow ???$$

Summary and outlook

- Matlab script **CHD_MK4.m** (also you need GetFit.m; GetHalo.m, GetFitAstra.m; PlotTransvDistr.m) can be used now (running under Linux) → currently located at
  …group\pitz\doocs\measure\scripts\SVN\MatlabScripts\CoreHaloGenerators\
- 'Not flat' core (radial modulations: "Rings" and "PlusMinus" have been implemented)
- Laser spot evaluation procedure
- All suggestions are welcomed

text output → FigureFileName.txt
(e.g. BSA800um_1115.txt)
Xmean, Ymean, Xrms, Yrms, Rc, sigH,…