

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

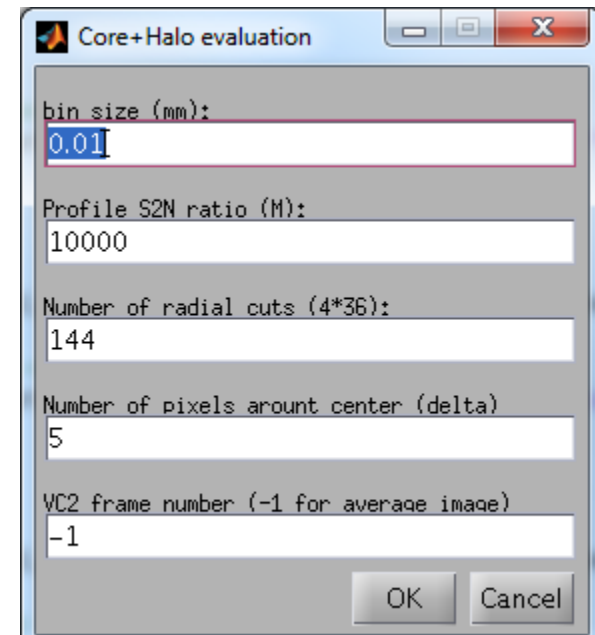
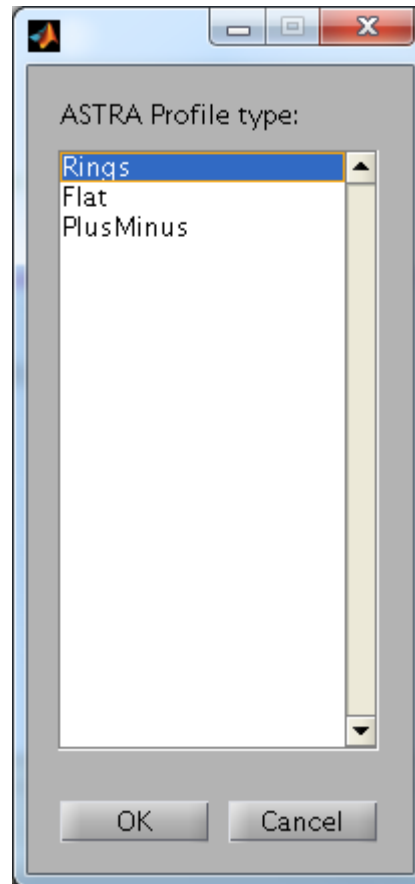
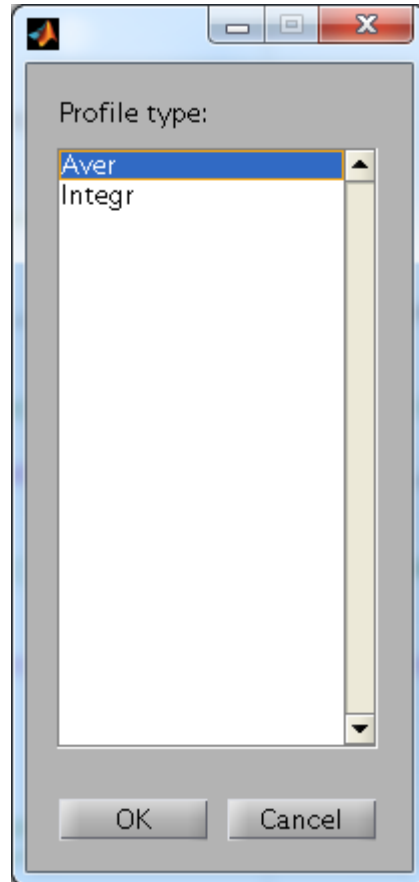
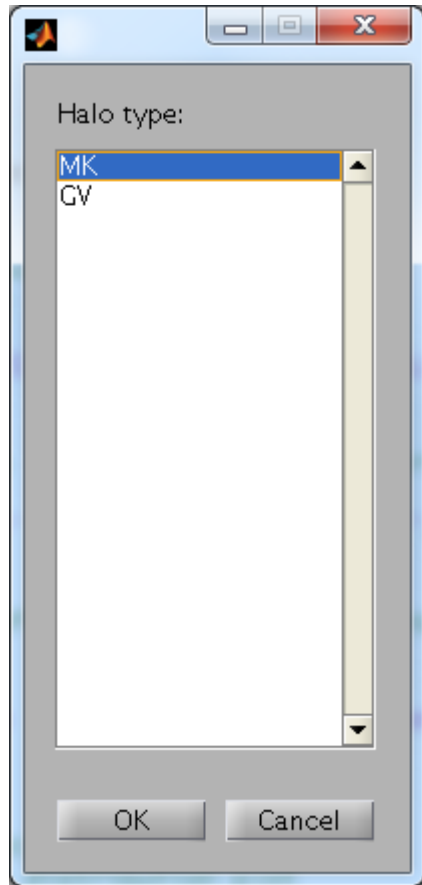
M. Krasilnikov, 04.08.2016

Matlab script CHD_MK4.m

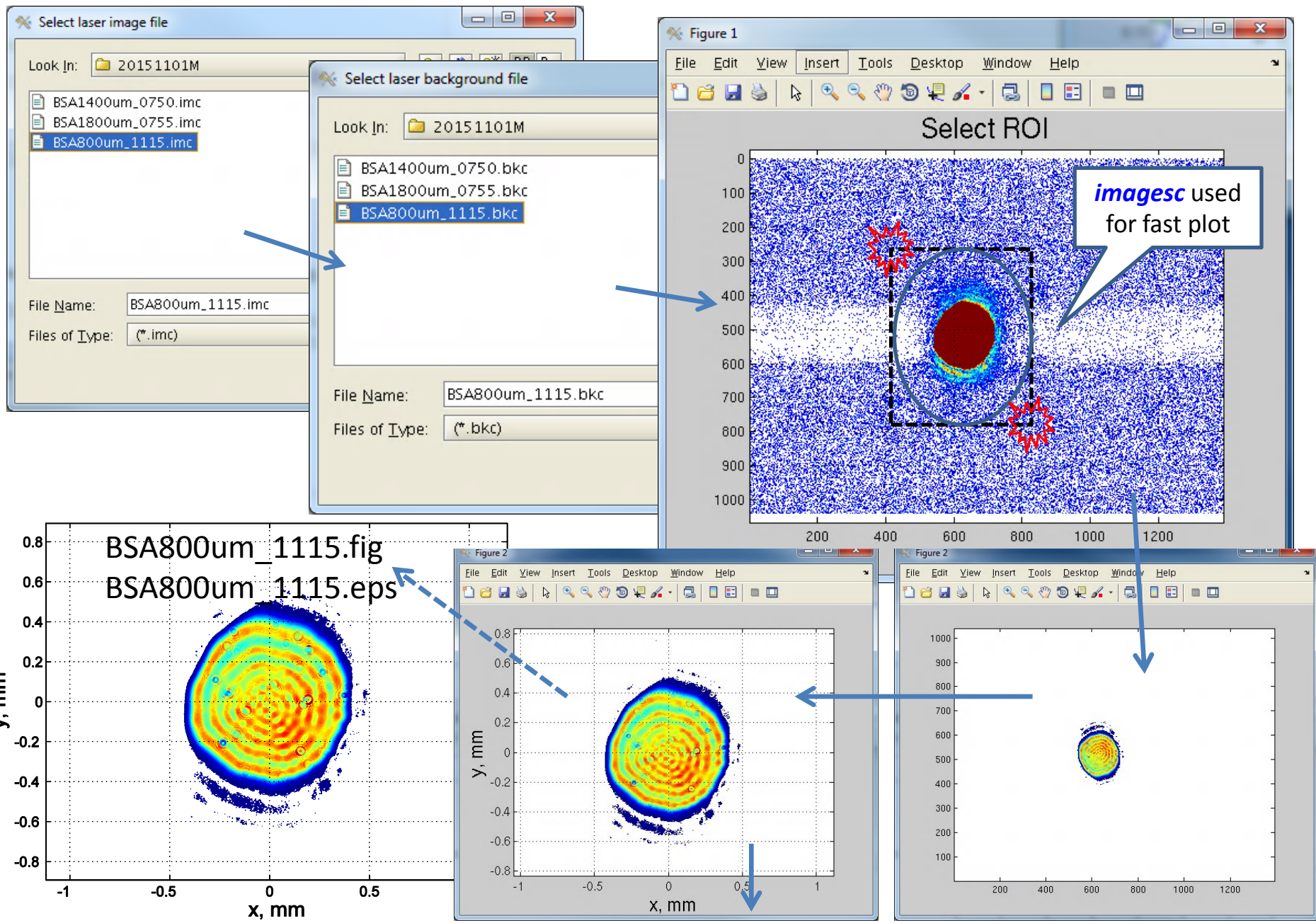
(\measure\scripts\SVN\MatlabScripts\CoreHaloGenerators\)

- 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*

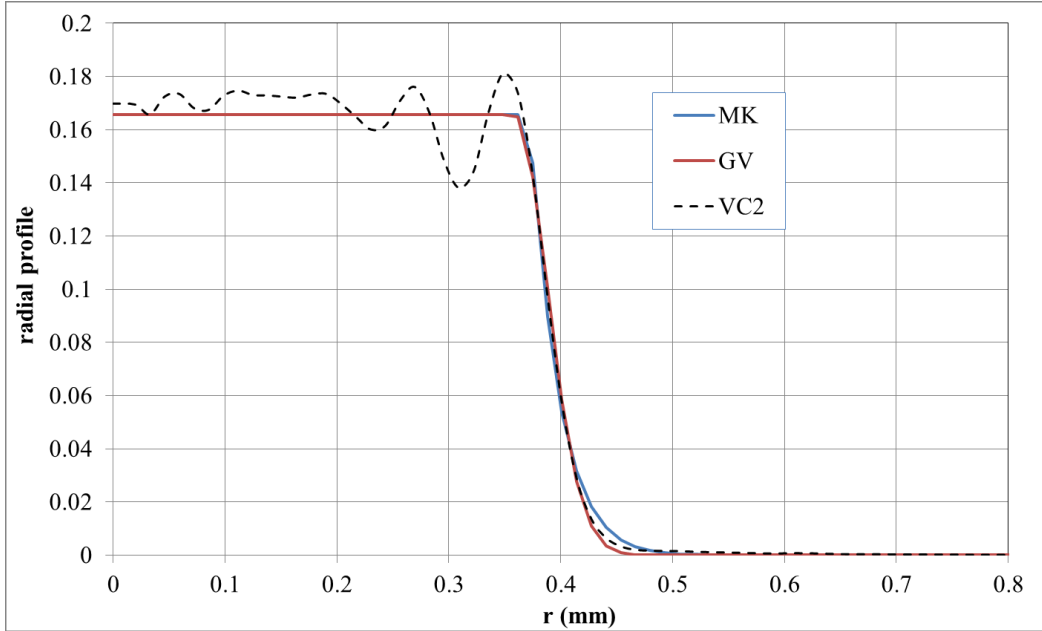
Startup dialogs



Raw image → ROI selection

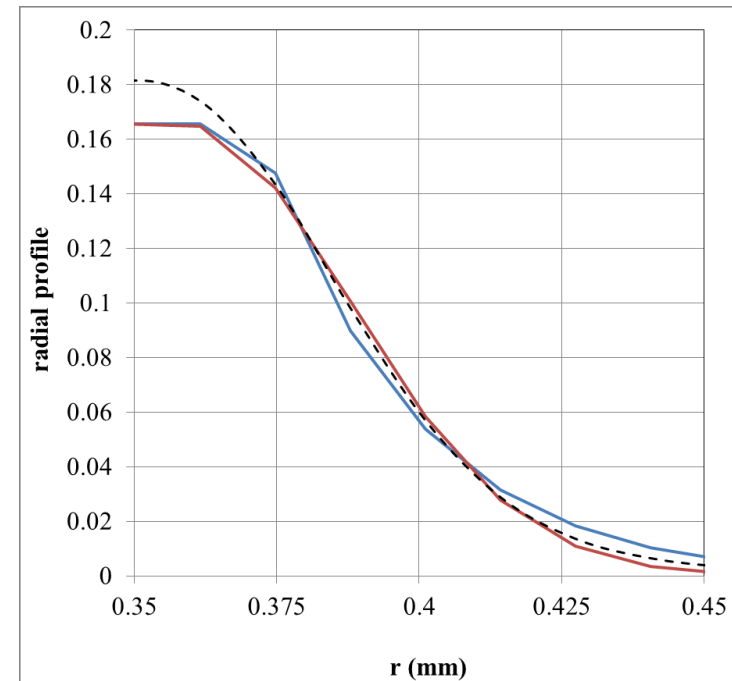
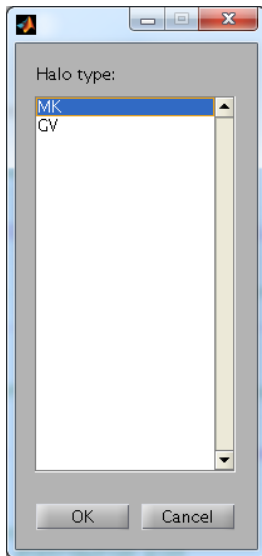


Halo modeling: 2 options – ‘MK’ and ‘GV’

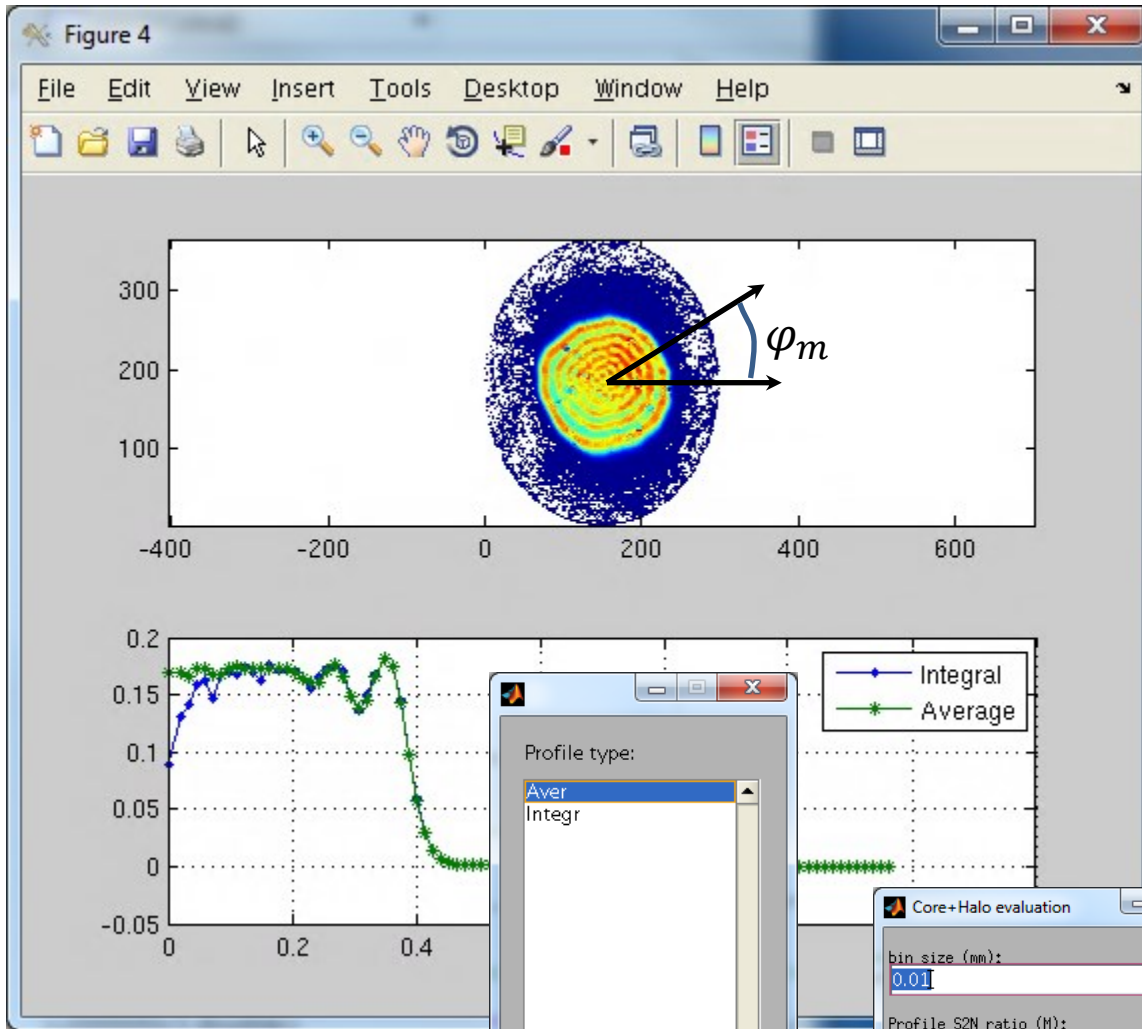


$$P(r) = \begin{cases} 1; & \text{if } r < R_c \\ \chi \cdot \text{Halo}(r, R_c, \sigma_H); & \text{if } r > R_c \end{cases}$$

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



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



Integral (old):

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

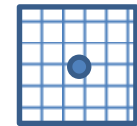
Average (new):

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

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

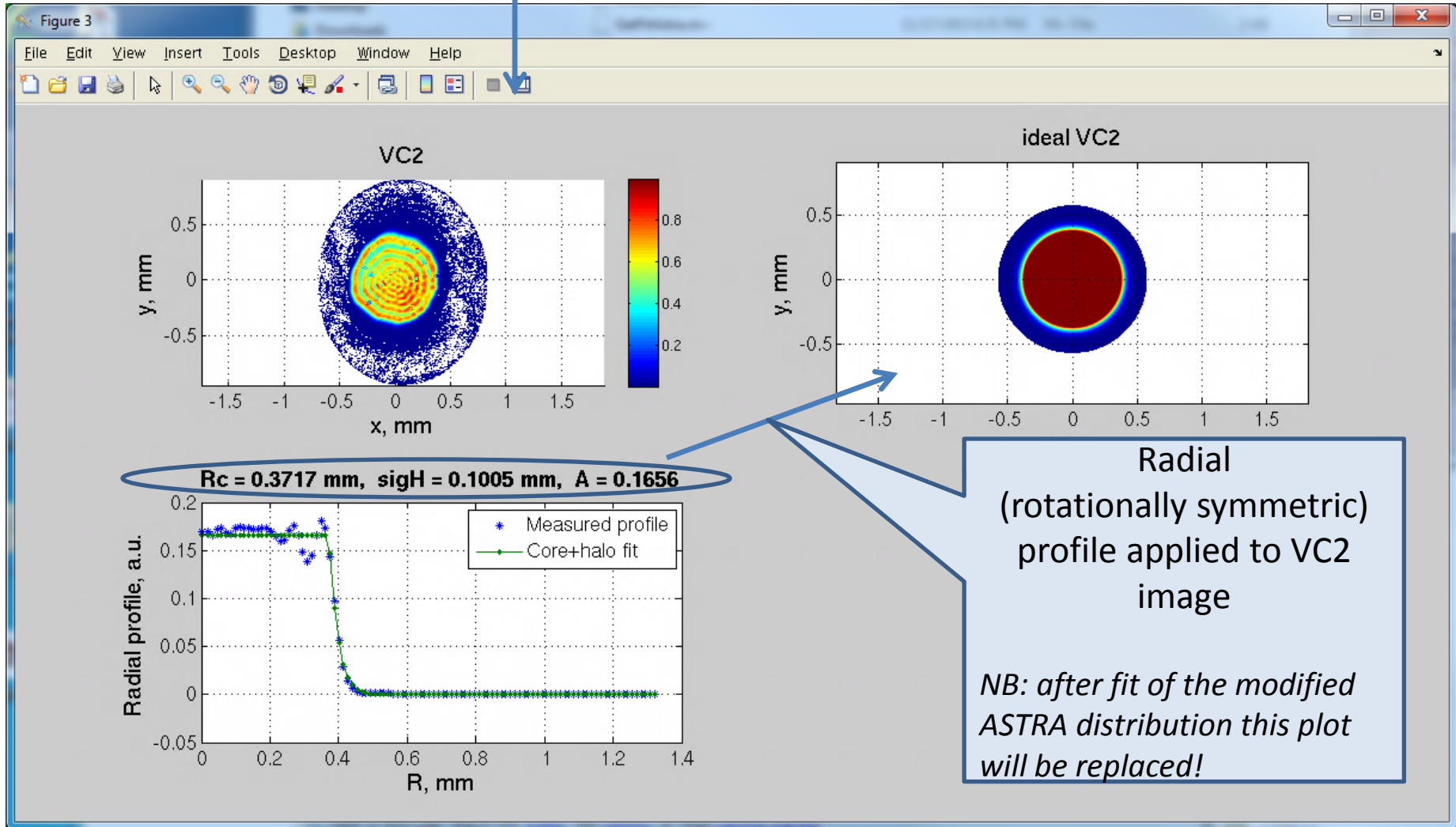
$$P_\varphi = \text{interp2}[I(x, y), \\ x = r \cos\varphi, y = r \sin\varphi]$$

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

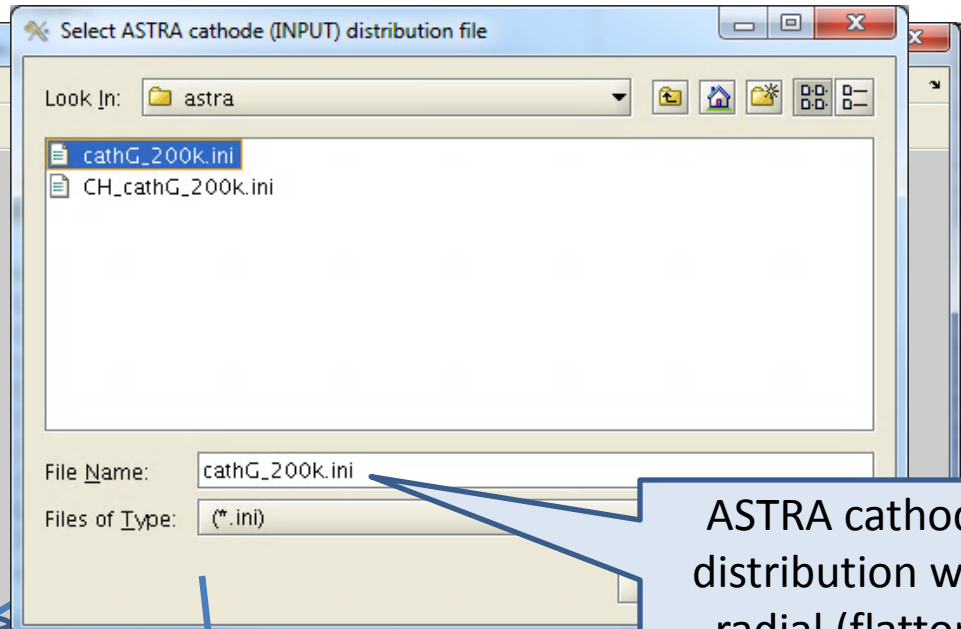
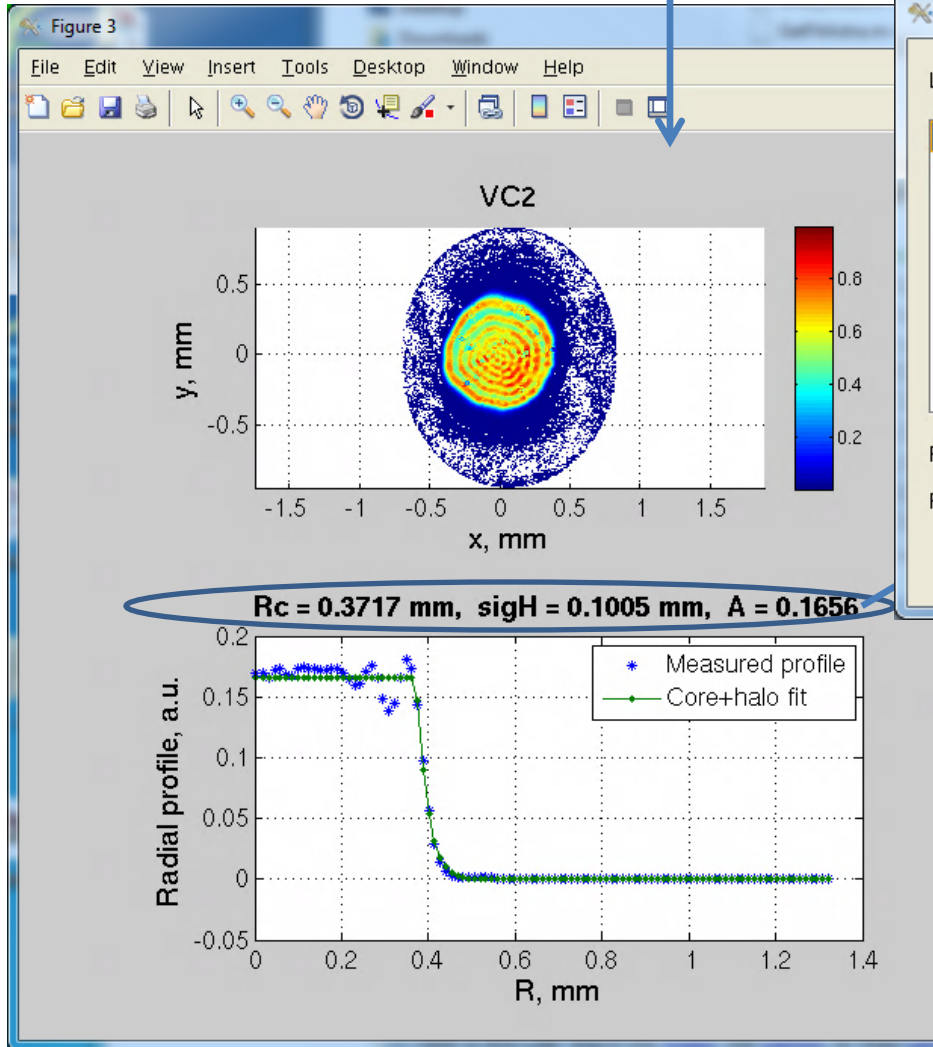


$$(2 \cdot \text{delta} + 1) \times (2 \cdot \text{delta} + 1)$$

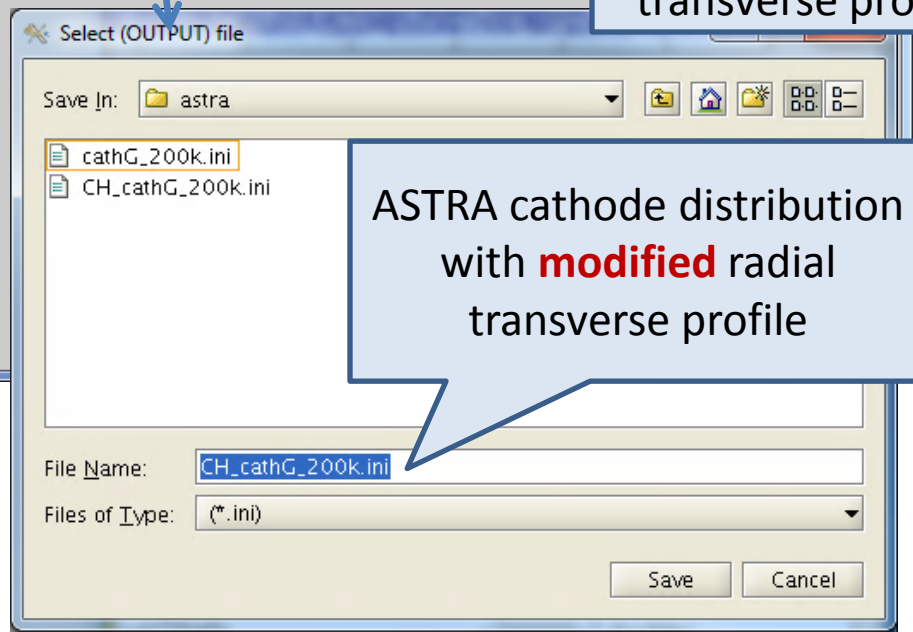
Core+halo fit of the VC2 profile: "ideal" VC2



Core+halo fit of the VC2 profile

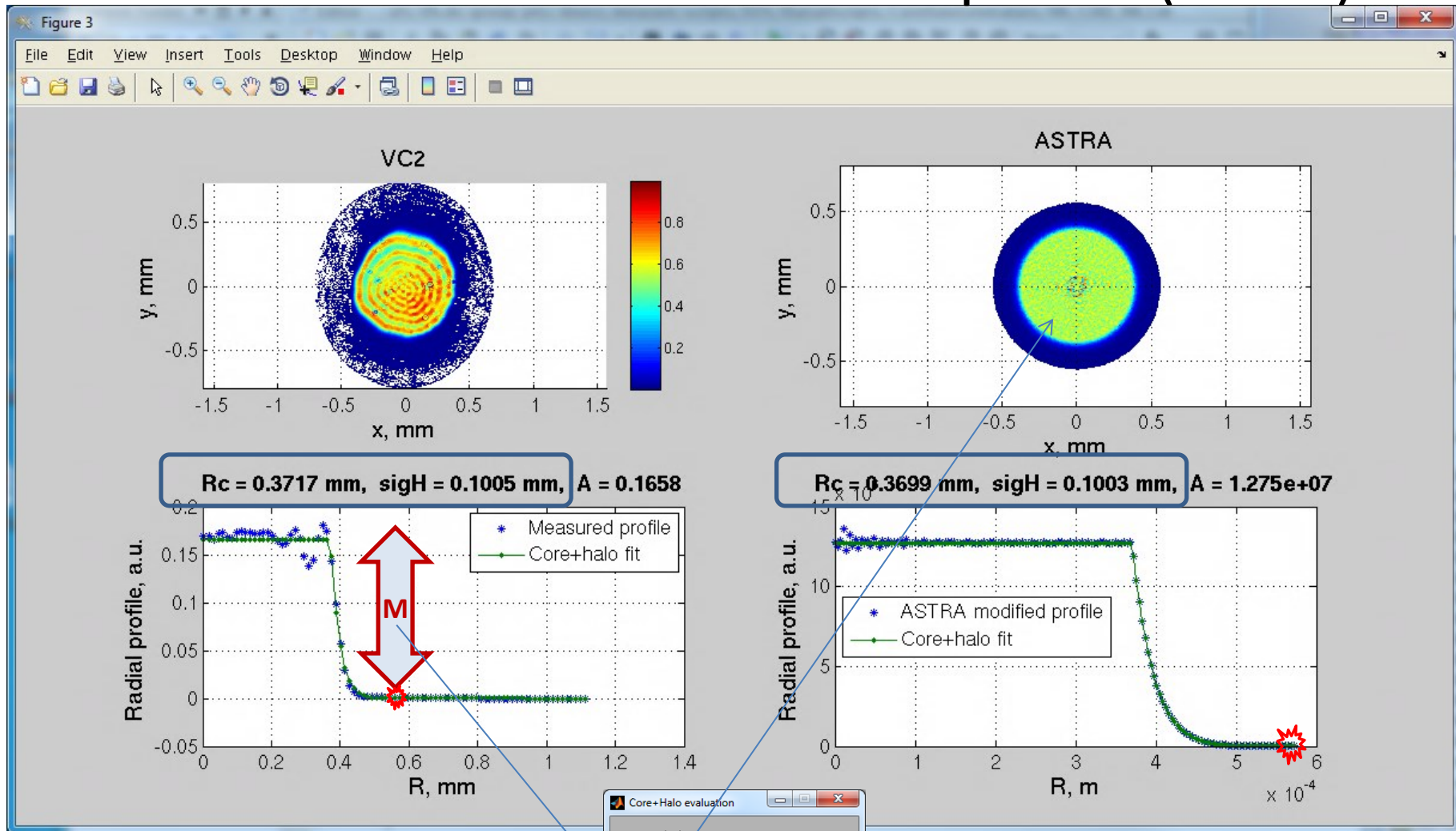


ASTRA cathode distribution with radial (flattop) transverse profile



ASTRA cathode distribution with **modified** radial transverse profile

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



Rc = 0.3717 mm, sigH = 0.1005 mm, A = 0.1658

Rc = 0.3699 mm, sigH = 0.1003 mm, A = 1.275e+07

Core+Halo evaluation

bin size (mm):
0.01

Profile S2N ratio (M):
10000

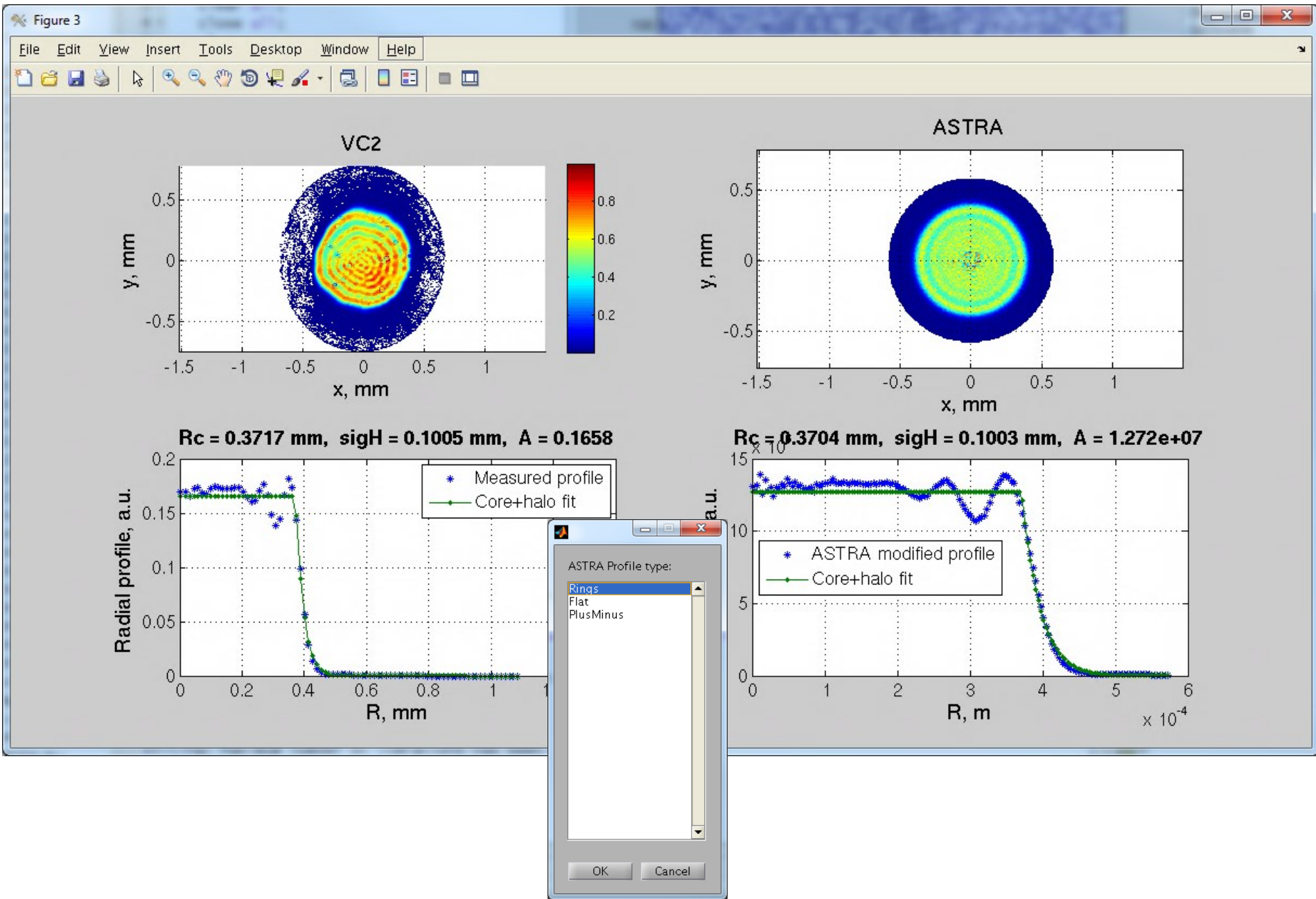
Number of radial cuts (4*36):
144

Number of pixels around center (delta)
5

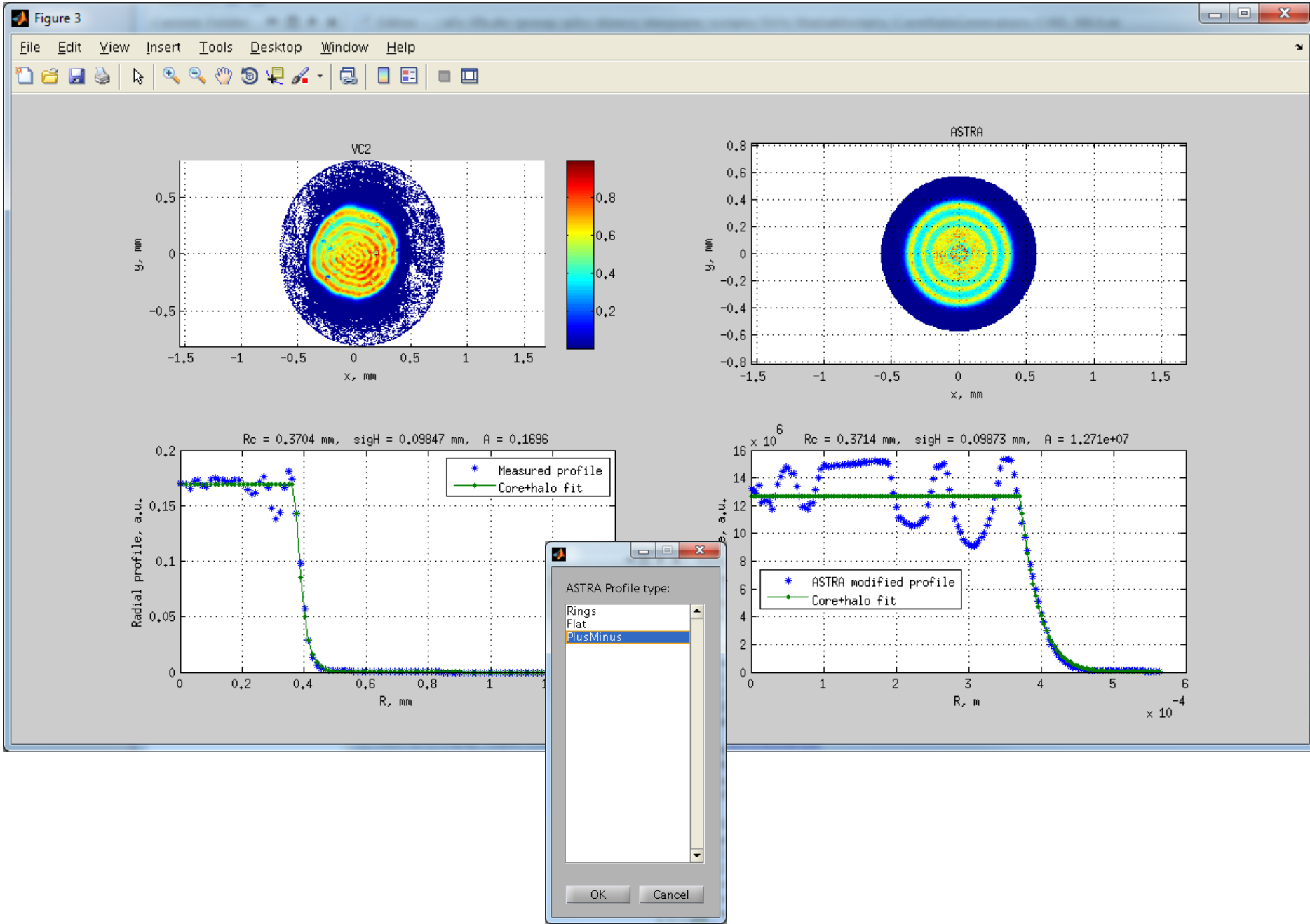
VC2 frame number (-1 for average image)
-1

OK Cancel

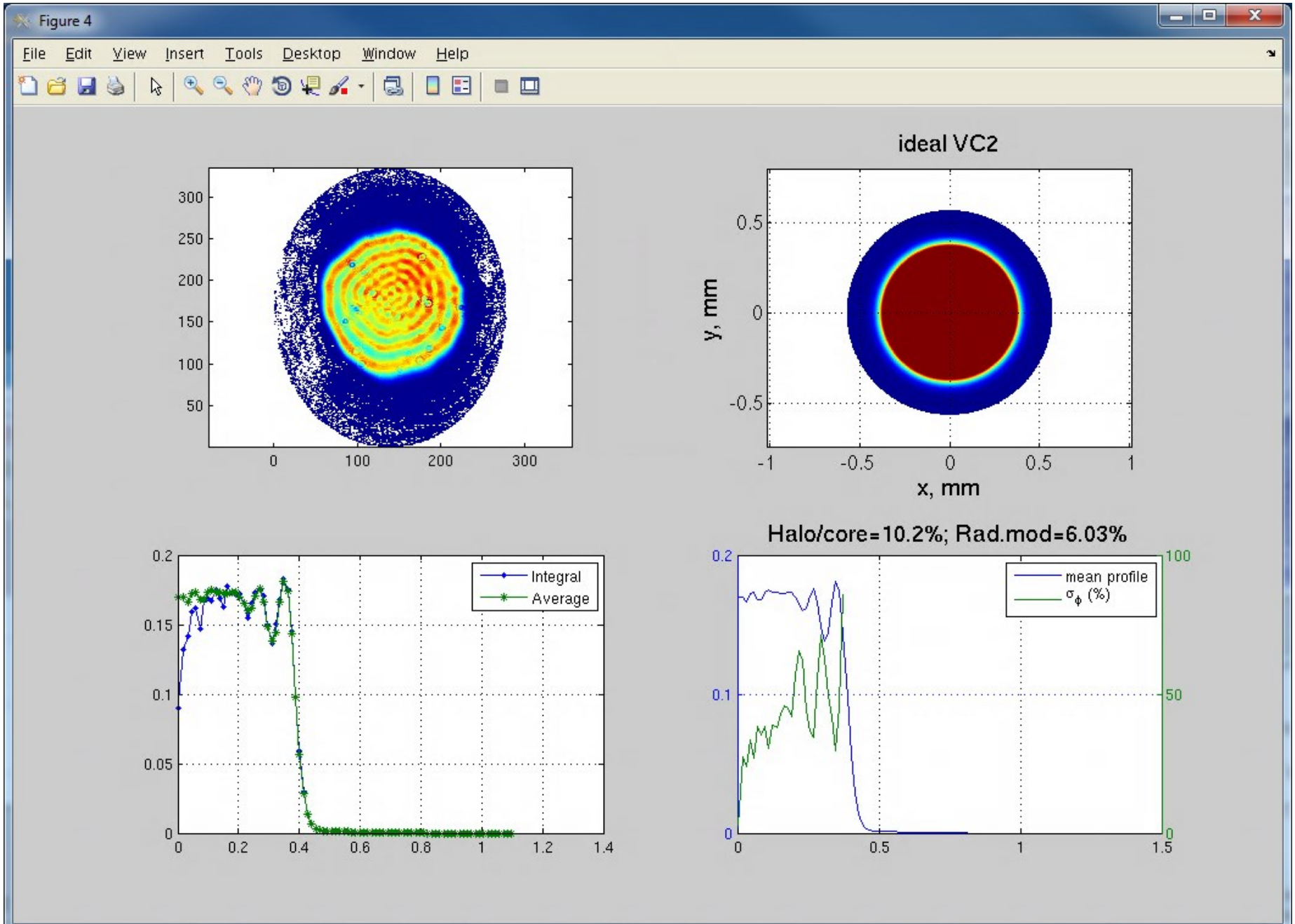
New option: real radial profile → ASTRA profile



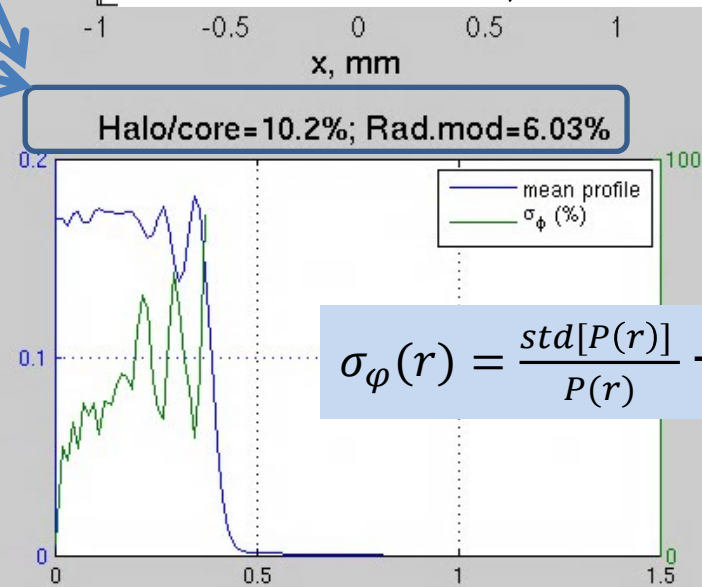
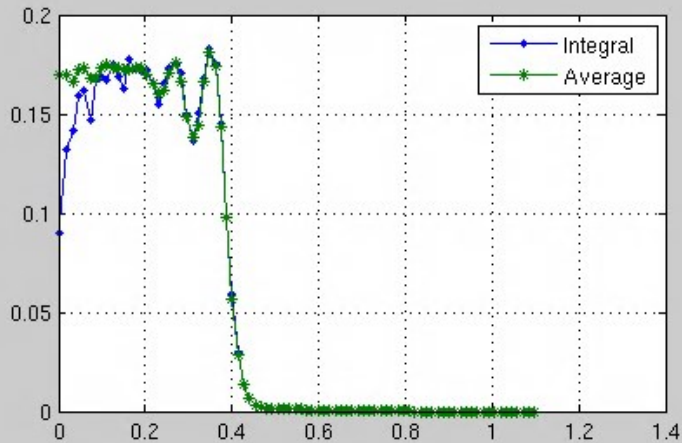
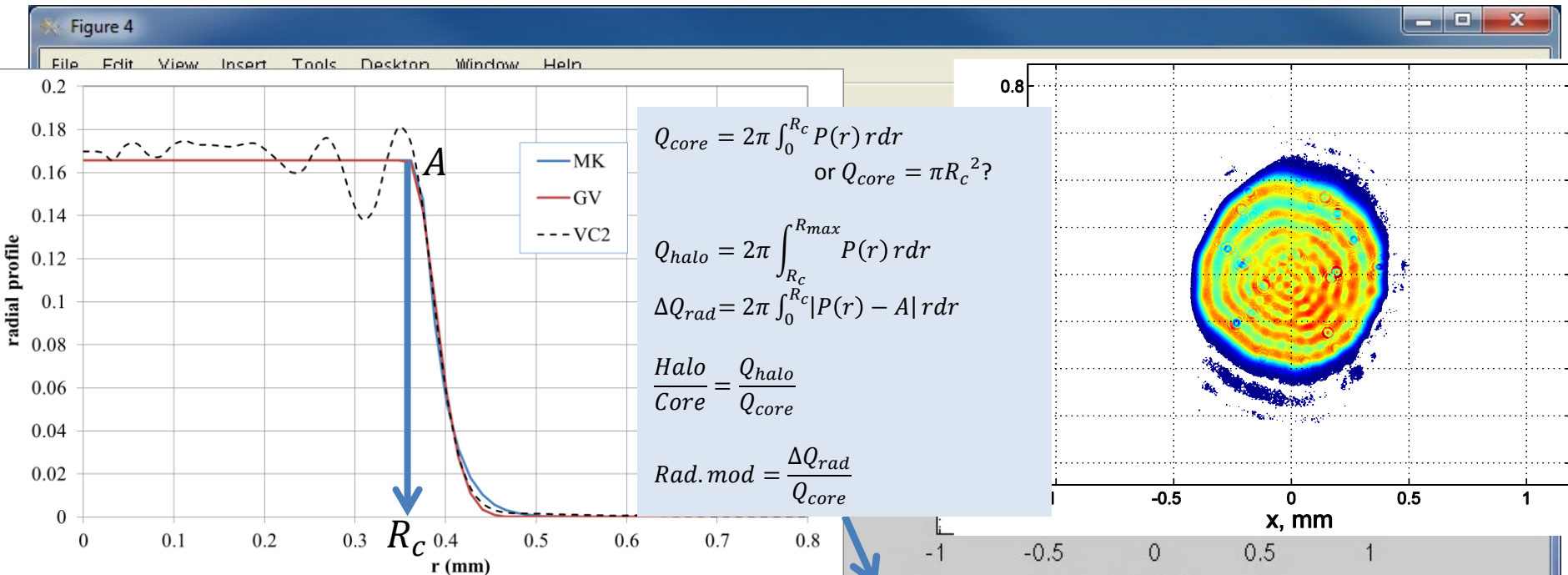
Another new option: real radial profile → ASTRA profile



Laser distribution evaluation



Laser distribution evaluation

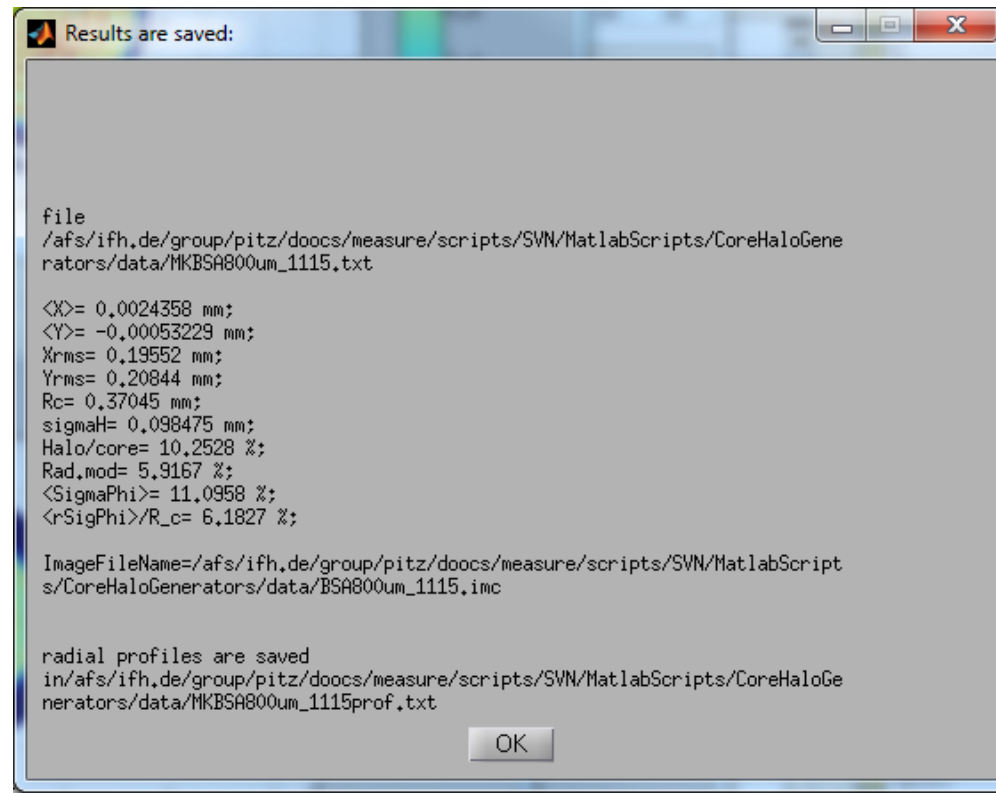


$$\sigma_\phi(r) = \frac{std[P(r)]}{P(r)} \rightarrow ???$$

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,...



```
Results are saved:

file
/afs/afh.de/group/pitz/doocs/measure/scripts/SVN/MatlabScripts/CoreHaloGenerators/data/MKBSA800um_1115.txt

<X>= 0,0024358 mm;
<Y>= -0,00053229 mm;
Xrms= 0,19552 mm;
Yrms= 0,20844 mm;
Rc= 0,37045 mm;
sigmaH= 0,098475 mm;
Halo/core= 10,2528 %;
Rad.mod= 5,9167 %;
<SigmaPhi>= 11,0958 %;
<rSigPhi>/R_c= 6,1827 %;

ImageFileName=/afs/afh.de/group/pitz/doocs/measure/scripts/SVN/MatlabScripts/CoreHaloGenerators/data/BSA800um_1115.imc

radial profiles are saved
in/afs/afh.de/group/pitz/doocs/measure/scripts/SVN/MatlabScripts/CoreHaloGenerators/data/MKBSA800um_1115prof.txt

OK
```