The Broad Hα and Hβ emission line shapes in an AGN sample

Edi Bon

Astronomical Observatory Belgrade, Serbia

ebon@aob.bg.ac.yu

L. Č. Popović, N. Gavrilović

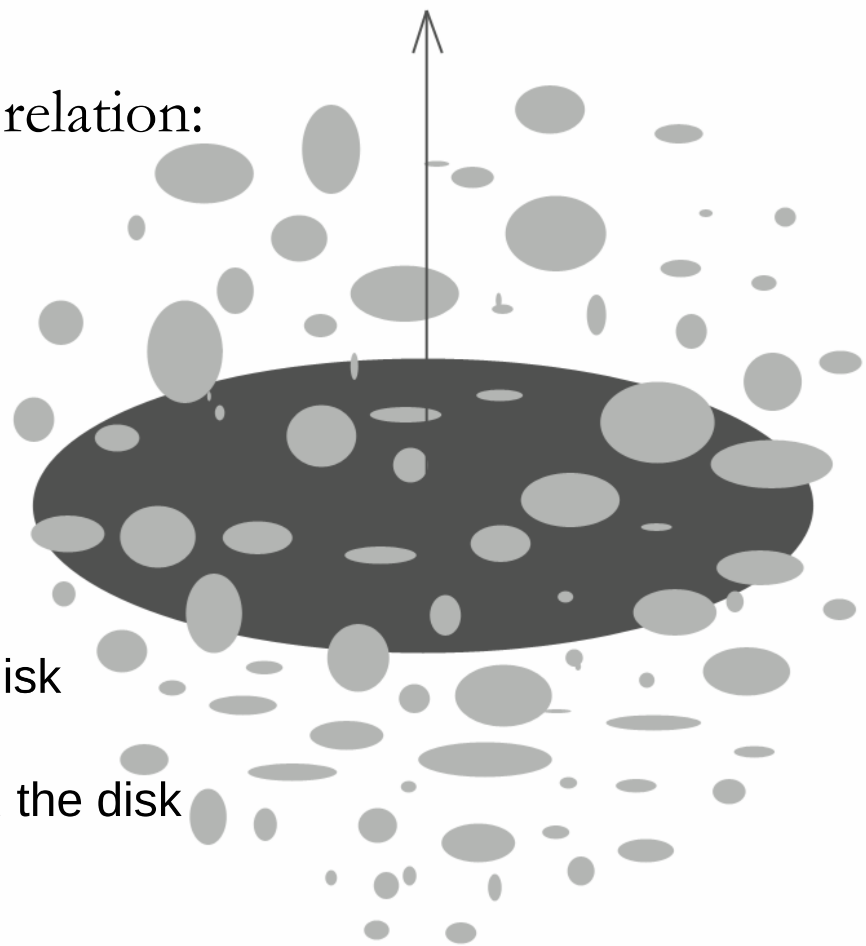
Astronomical Observatory Belgrade, Serbia

Two-component model

- The disk is contributing to the wings of the lines,
- a spherical medium arround the disk to the core of the lines.

The whole line profile can be described by the relation:

$$I(\lambda)=I_{AD}(\lambda)+I_{G}(\lambda)$$



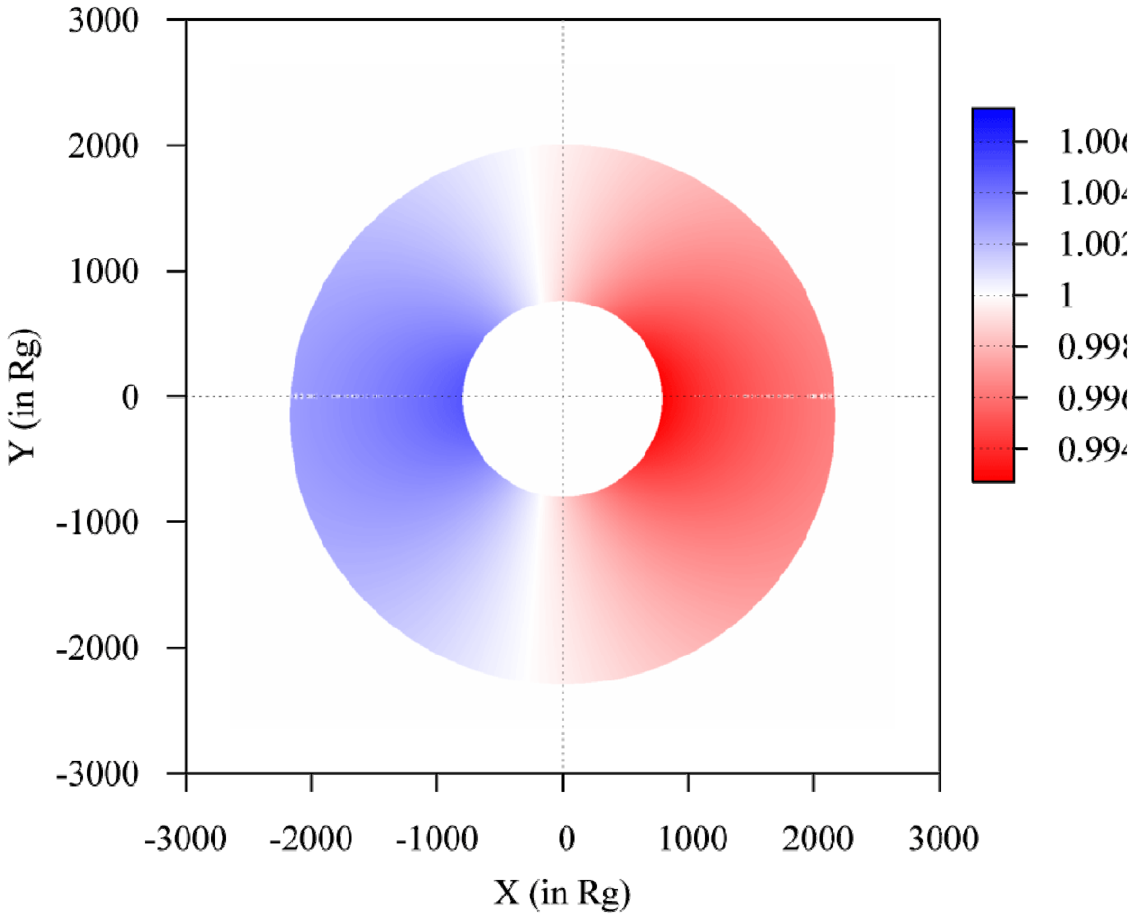
Where:

$I_{AD}(\lambda)$ the emissions of the relativistic accretion disk

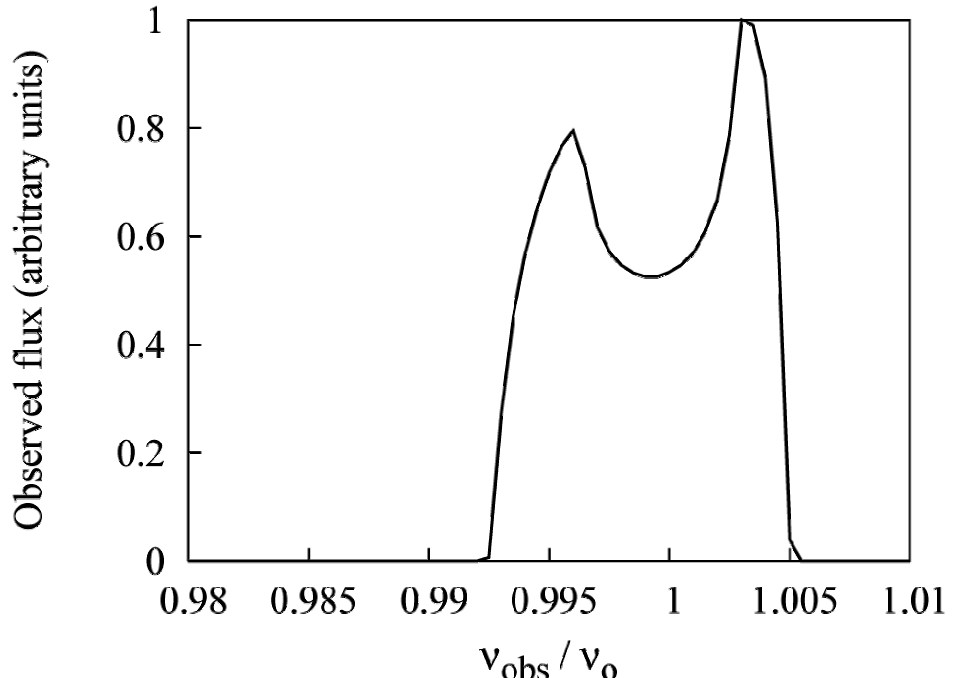
$I_{G}(\lambda)$ the emissions of the spherical region around the disk

Popović et al, 2003, 2004, Bon et al 2006

Disk model



Chen & Halpern (1989).



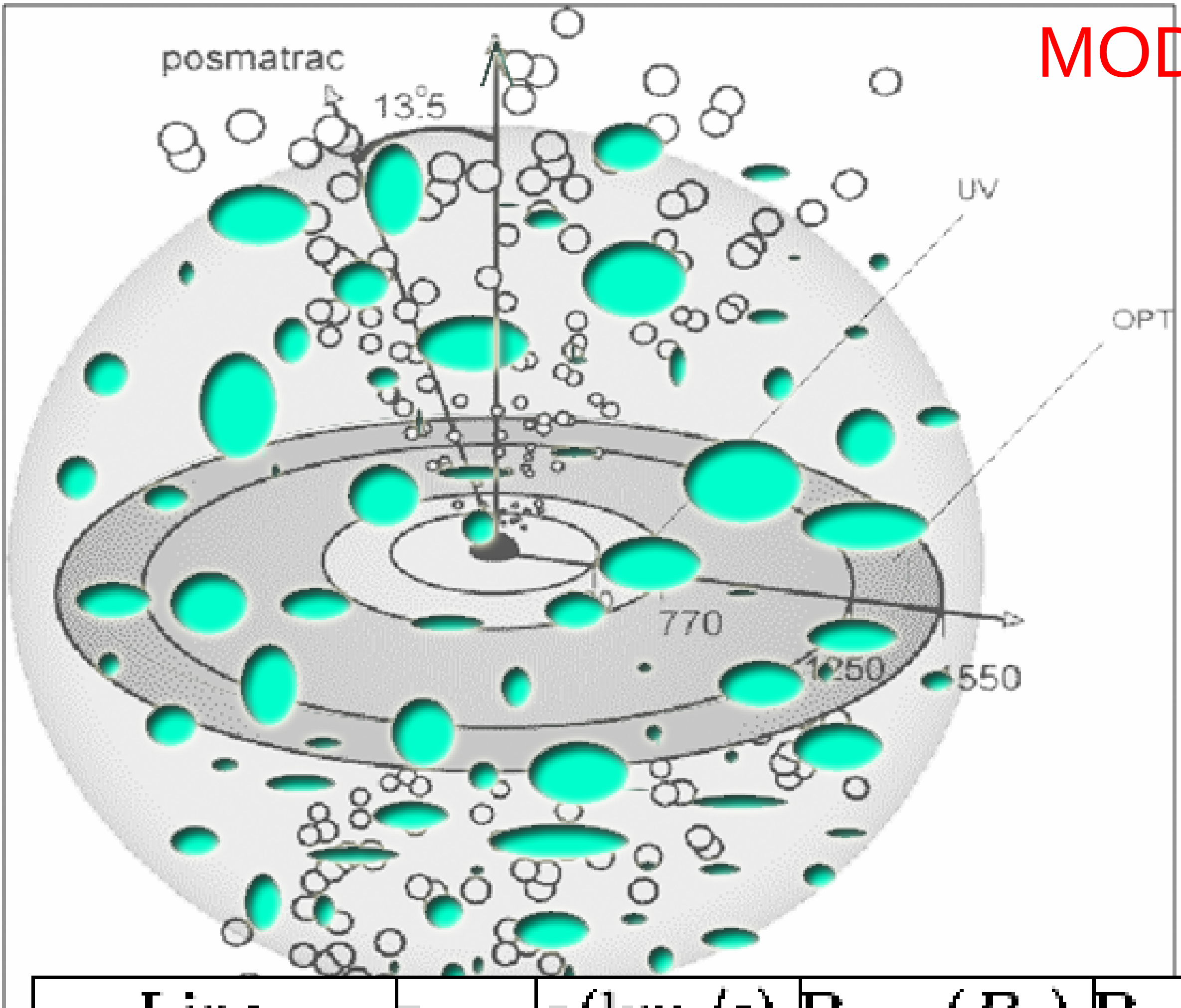
Analysis of two component model

- We modelled the single-peaked BELs with two-component model :
  accretion disk + spherical cloud region

- In this work we study the cases in which we could expect to have the disk emission in the spectra of AGN BLR with the single-peaked BELs.

- We compared the simulations with observed spectra to determine the domain of parameters

MODEL IIIZw2



- z_{disk} – shift of the disk component
- **s** – width of Gaussianian the disk
- R_{inn} inner radius
- R_{out} outer radius
- z_G shift of the Gaussian
- W_G width of the Gaussian
- < AV > averaged profile
- F_D/F_G flux ratio

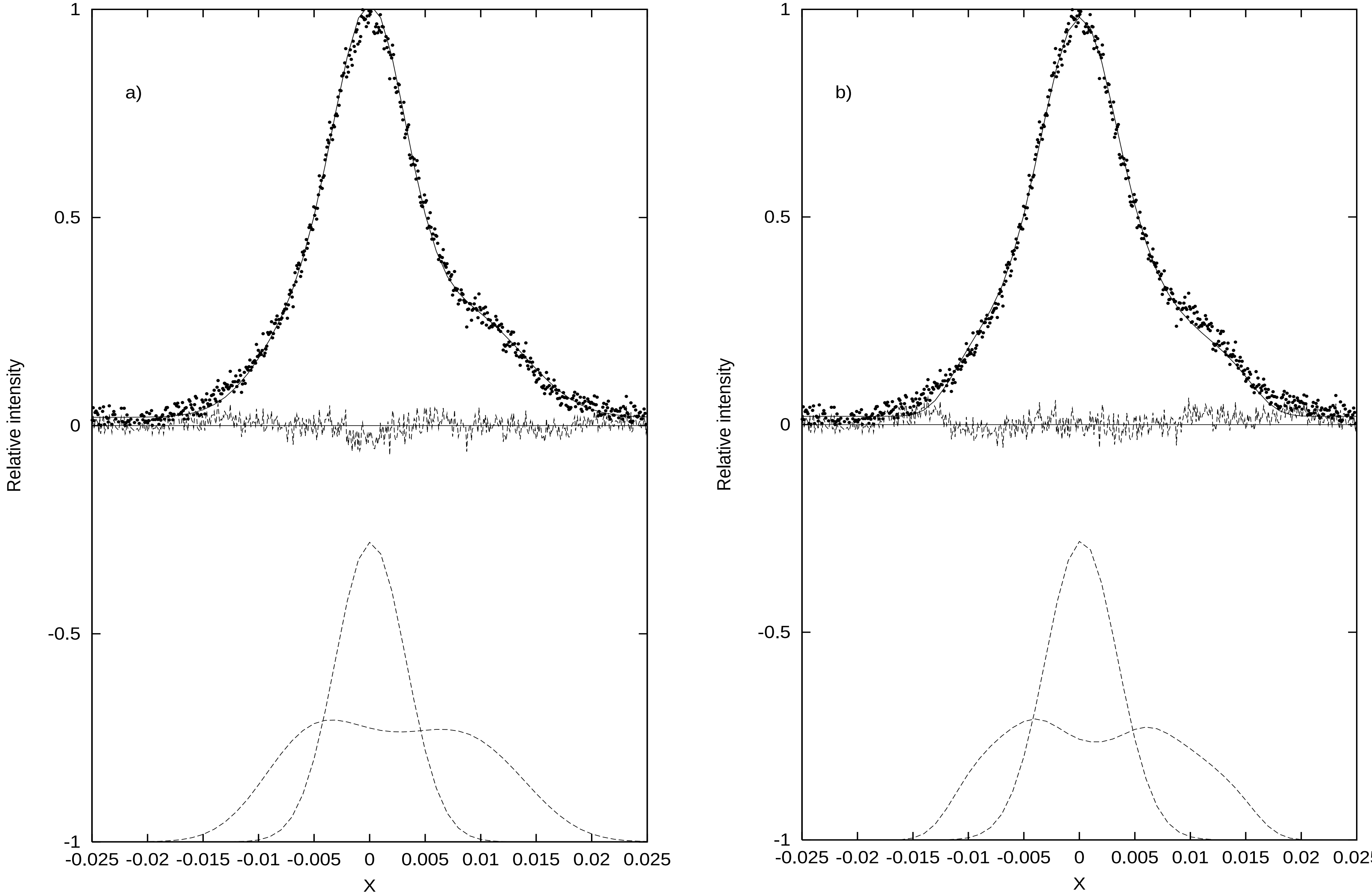
Line	z_{disk}	σ(km/s)	R_{inn} (R_g)	R_{out} (R_g)	z_G	W_G (km/s)	F_D/F_G
Lyα	-800	850	200	900	-20	1280	1.11
Mg IIλ2789	-350	920	300	1000	-30	1100	1.86
Hβ	-600	920	400	1300	-130	1100	3.14
Hα	-600	850	450	1300	-120	1170	1.52
$< AV >$	-600	890	400	1200	-120	1170	1.72

Popovic et al. 2003, ApJ, 599, 185

Previously showen to have an indication of a disk emission in the X domain of spectra

Object	i	$z_1^{min,max}$	$W_1^{min,max}$ (km/s)	$R_{inn,min}$ (Rg)	$R_{out,max}$ (Rg)	$z_g^{min,max}$	W_g (km/s)	p^{min}
3C 120	8–30	–300, +300	1050, 1500	350	20 000	+30, +300	900 ±150	2.0
3C 273	12–30<	–30, +300	690, 1760	400	15 400	+30, +60	1380 ±150	2.3
MRK 1040	5–27<	–250, +300	800, 1400	100	18 000	0 ±30	500 ±200	1.3
MRK 110	7–50	–320, +300	450, 1250	400	49 000	+150 ±30	960 ±50	1.7
MRK 141	12–33	–630, –450	700, 1500	300	10 000	+200, +300	1620 ±100	2.1
MRK 493	5–30<	–480, +60	360, 560	600	124 000	+60 ±30	360 ±50	1.8
MRK 817	12–35	–450, +300	850, 1200	140	14 000	0, +130	1550 ±100	1.8
MRK 841	15–50	–750, –150	1070, 1800	450	27 400	–300 ±30	1500 ±100	2.1
NGC 3227	12–34	–780, –300	900, 1550	350	12 000	–300, 300	1500 ±100	2.1
NGC 4253	5–25<	–630, –90	280, 850	500	69 500	–90, –30	550 ±50	2.0
PG 1116	8–30<	–450, 0	1100, 1800	500	15 800	0, +90	1400 ±250	2.2
PG 1211	8–30	–660, 0	540, 1100	600	67 400	+90 ±30	600 ±300	1.9
III Zw2	7-17	-600	1400,1550	400	1300	120 ±10	1200±100	3
NGC 3516	6-16	-760 ±120	600,840	400	1550	150±200	1500±200	3
⟨...⟩	9–31	–515, –5	770, 1330	390	32700	110	1110	2.1

Popović, L. C., Mediavllilla, E.G., Bon, E., Ilić, D., 2004, ***ApJ***, 423, 909.

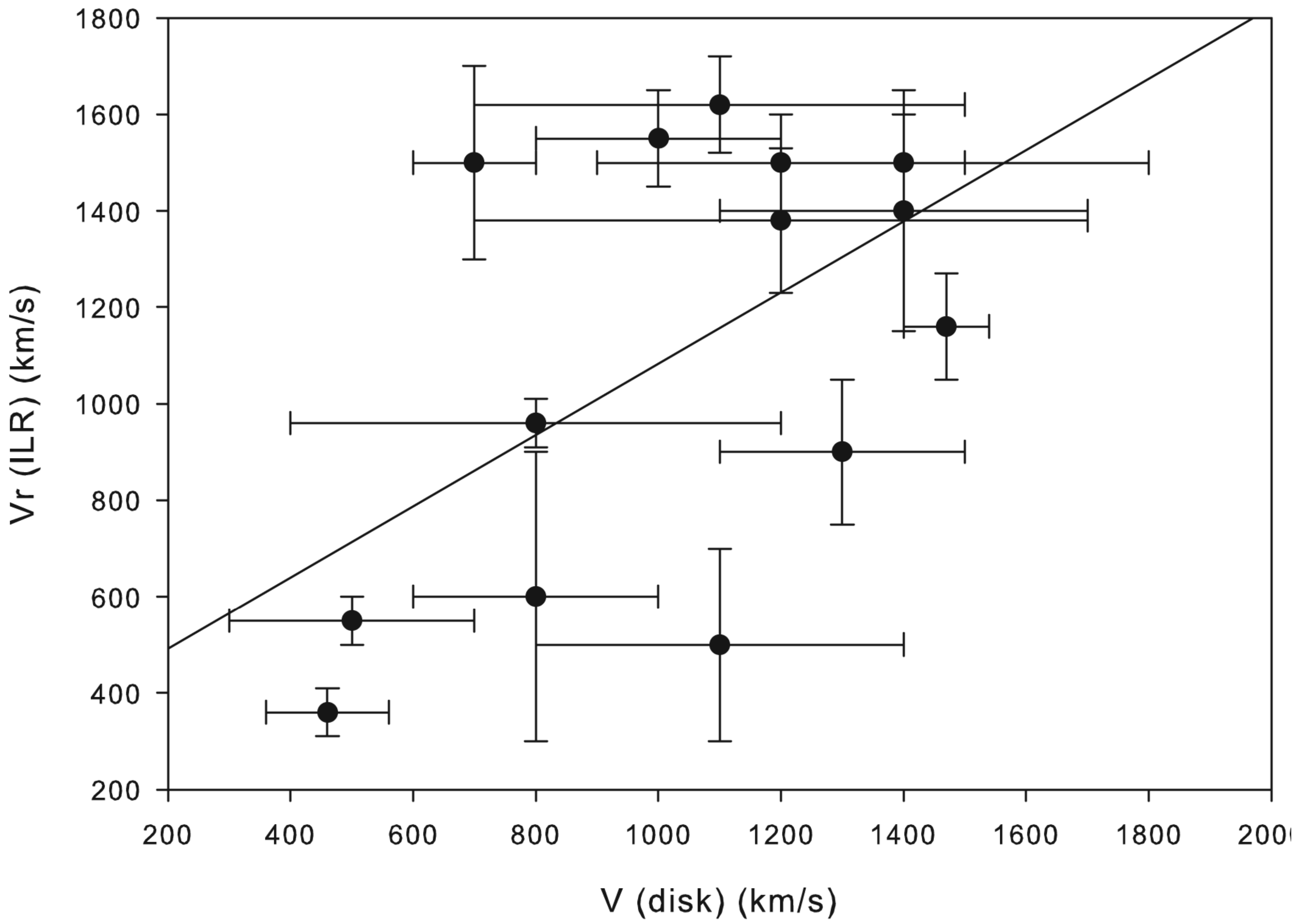


Two fits of 3C 273 with the two-component model the disk parameters are:

a) i=14°, Rinn=400 Rg, Rout=1420 Rg, Wd=1620 km/s, p=3.0 (WG=1350 km/s);

b) i=29°, Rinn=1250 Rg, Rout=15000 Rg, Wd=700 km/s, p=2.8 (WG=1380 km/s)

Popović, L. Č., Mediavlilla, E.G., Bon, E., Ilić, D., 2004, ***ApJ***

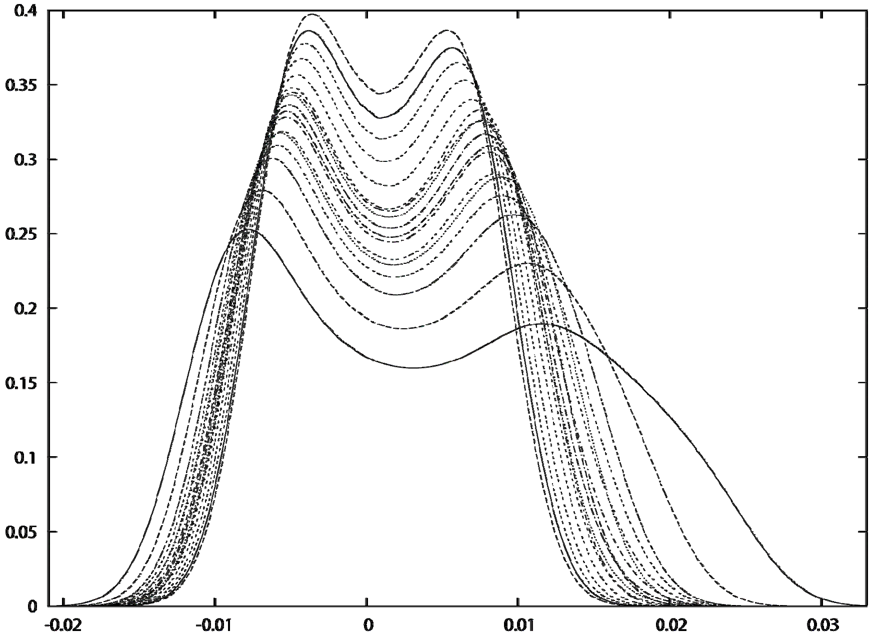


The random velocities of a spherical region (ILR) as a function of the local random disk velocities. The dashed line represents the function *V*ILR = *V*Disk [km s−1].

Popović, L. Č., Mediavlilla, E.G., Bon, E., Ilić, D., 2004, ***ApJ***, 423, 909.

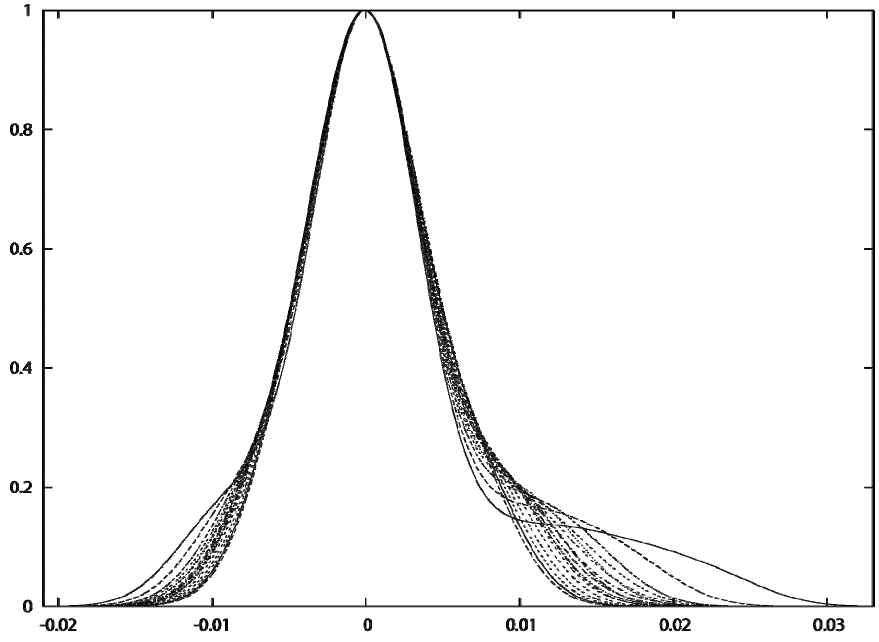
Disk profile for i=16°, fixed ring Rinn-Rout =800 Rg and emissivity p=3

Disk



Disk + Spherical region

For flux ratio F_d/F_g=1

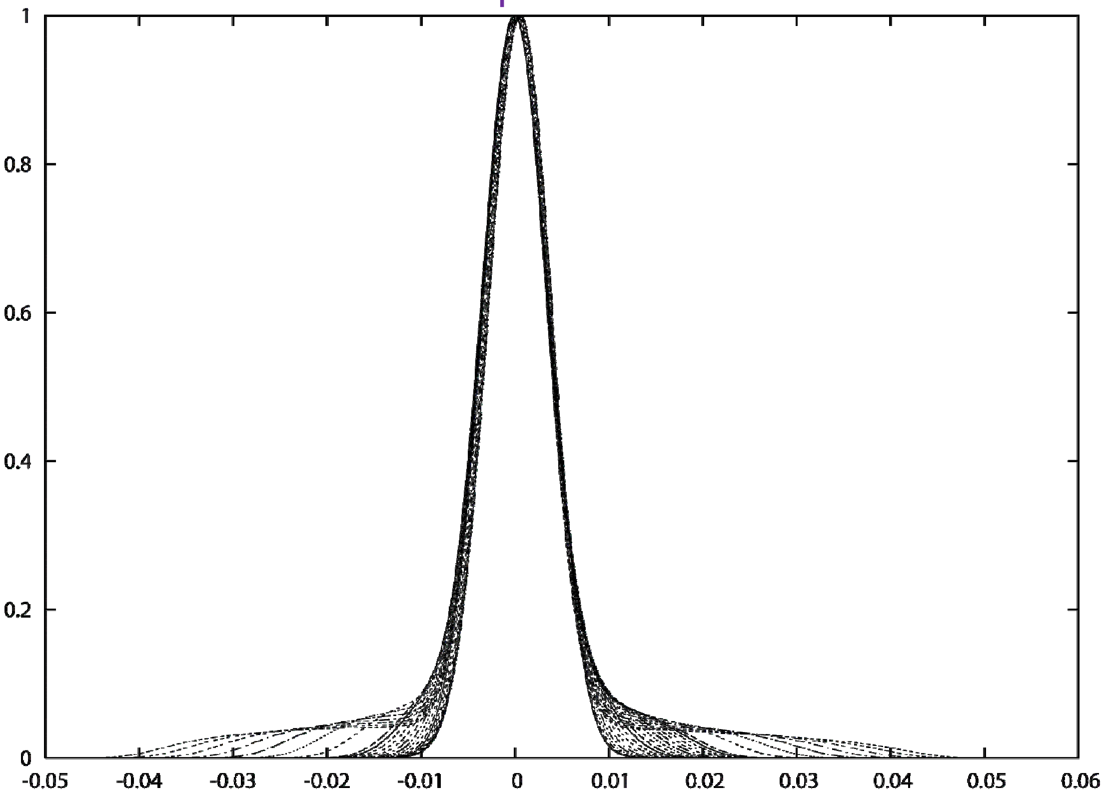


Disk + spherical region

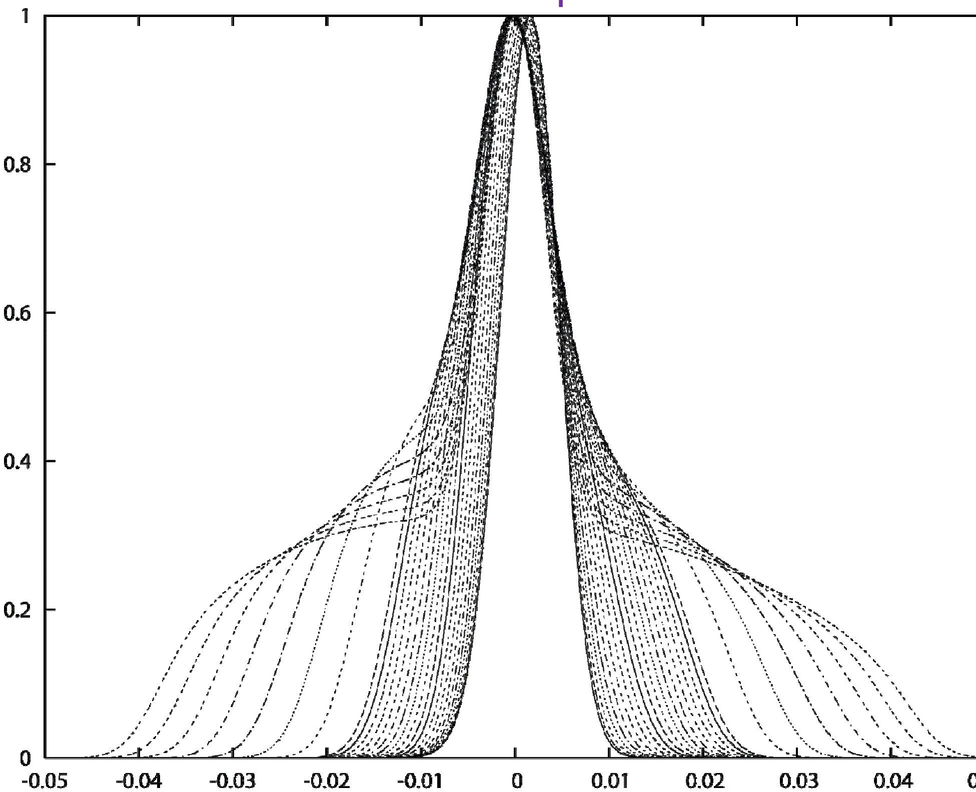
profiles for the inclinations from 1° to 60°

and flux ratios of these regions corresponding to:

$F_{disk}/F_{sph}=0.3$

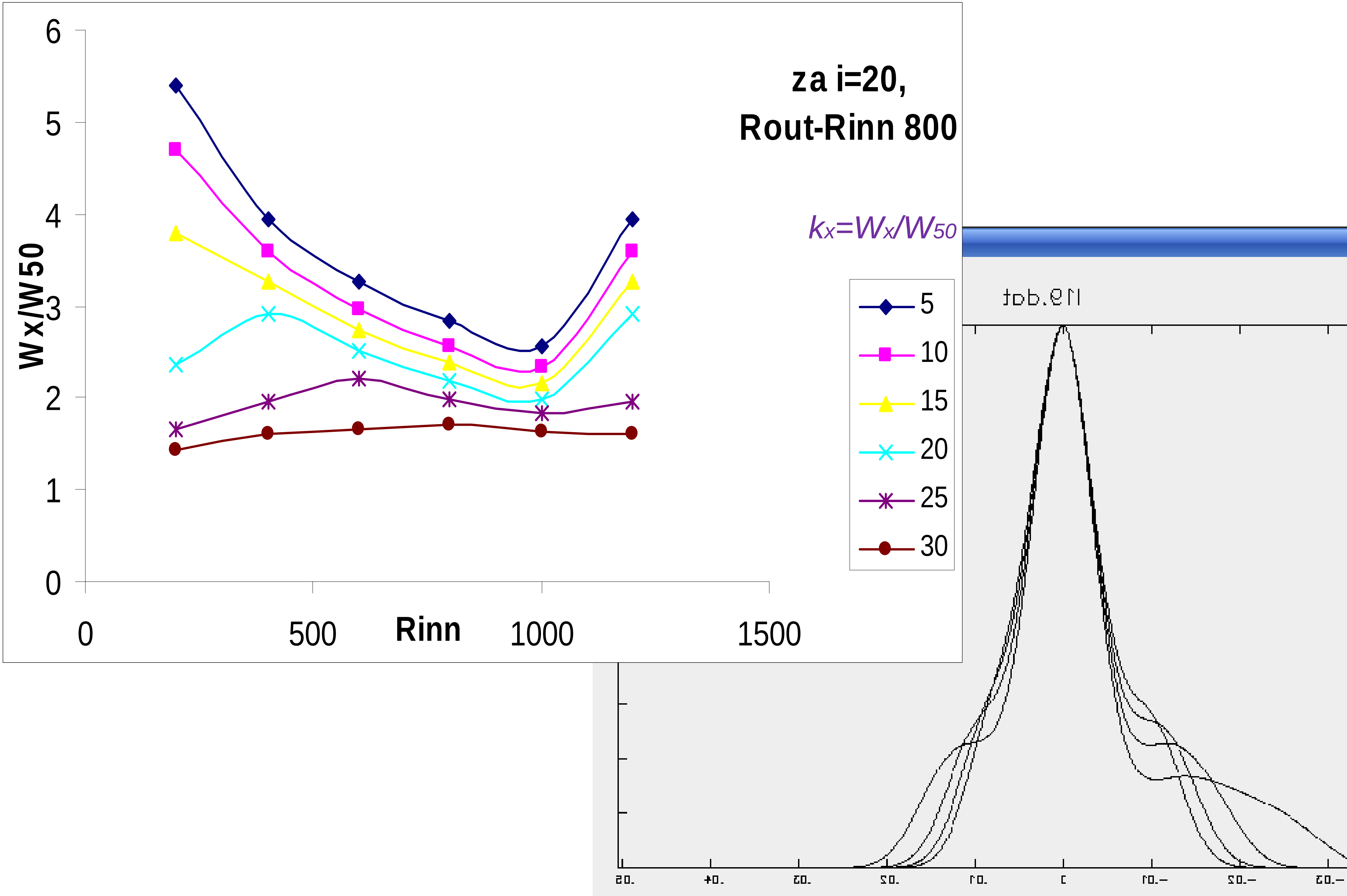


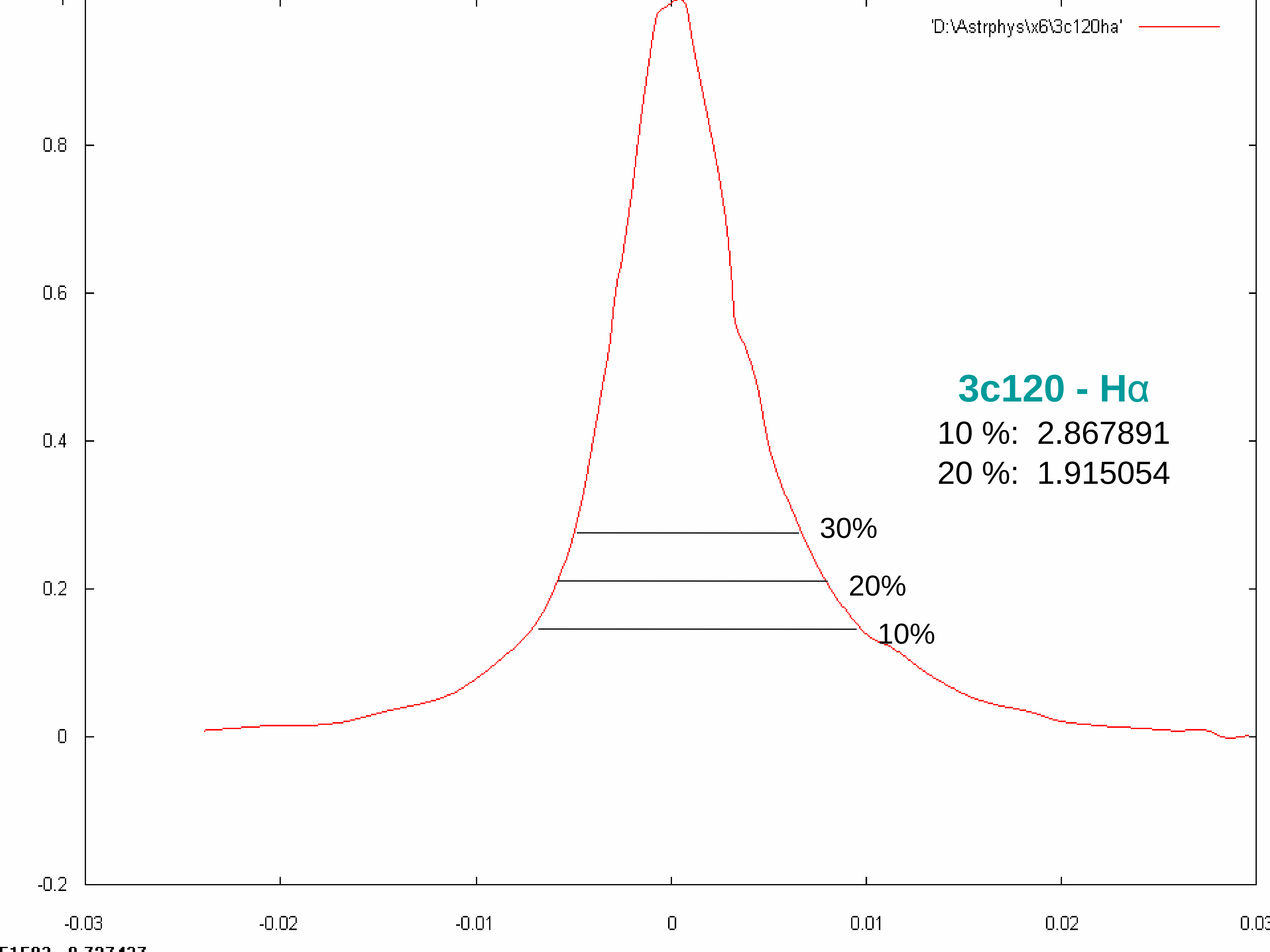
$F_{disk}/F_{sph}=3$



$F_G=F_D$, for i=20,

For ring width of 800 R_G, with R_{inn} from 200 to 1200





'D:\Astrphys\x6\3c120ha'
3c120 - Hα
10 %: 2.867891
20 %: 1.915054
30%
20%
10%
0.8
0.6
0.4
0.2
0
-0.2
-0.03
-0.02
-0.01
0
0.01
0.02
0.03

The sample

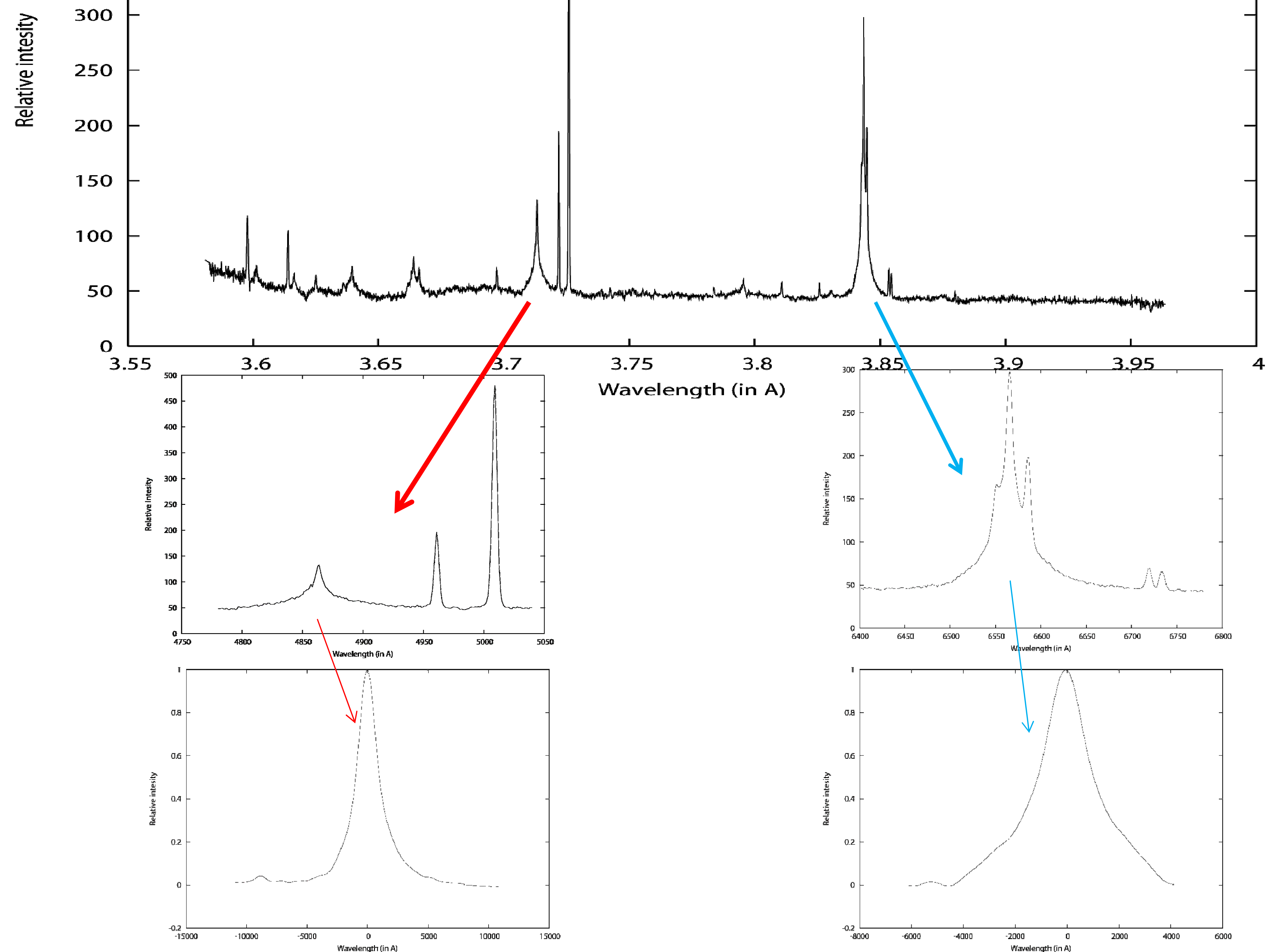
of Sy1 spectra taken from SDSS:

i) The Ha and Hb are present in the spectra, i.e. objects are located at redshift *z < 0:5*

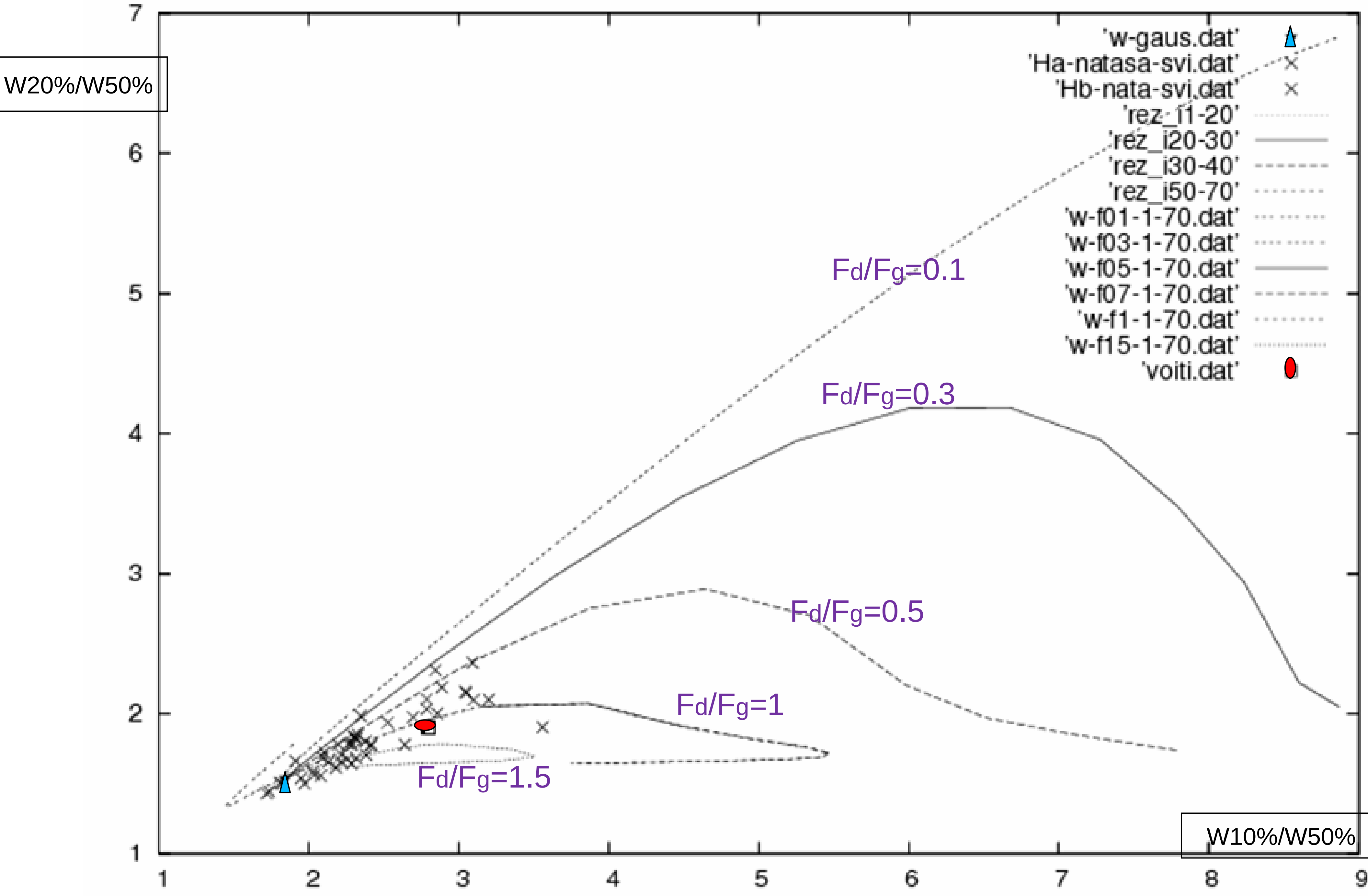
ii) only those with high S/N ratio, *S/N > 30*

iii) the profiles of broad lines have not been affected by distortion, due to e.g. bad pixels.

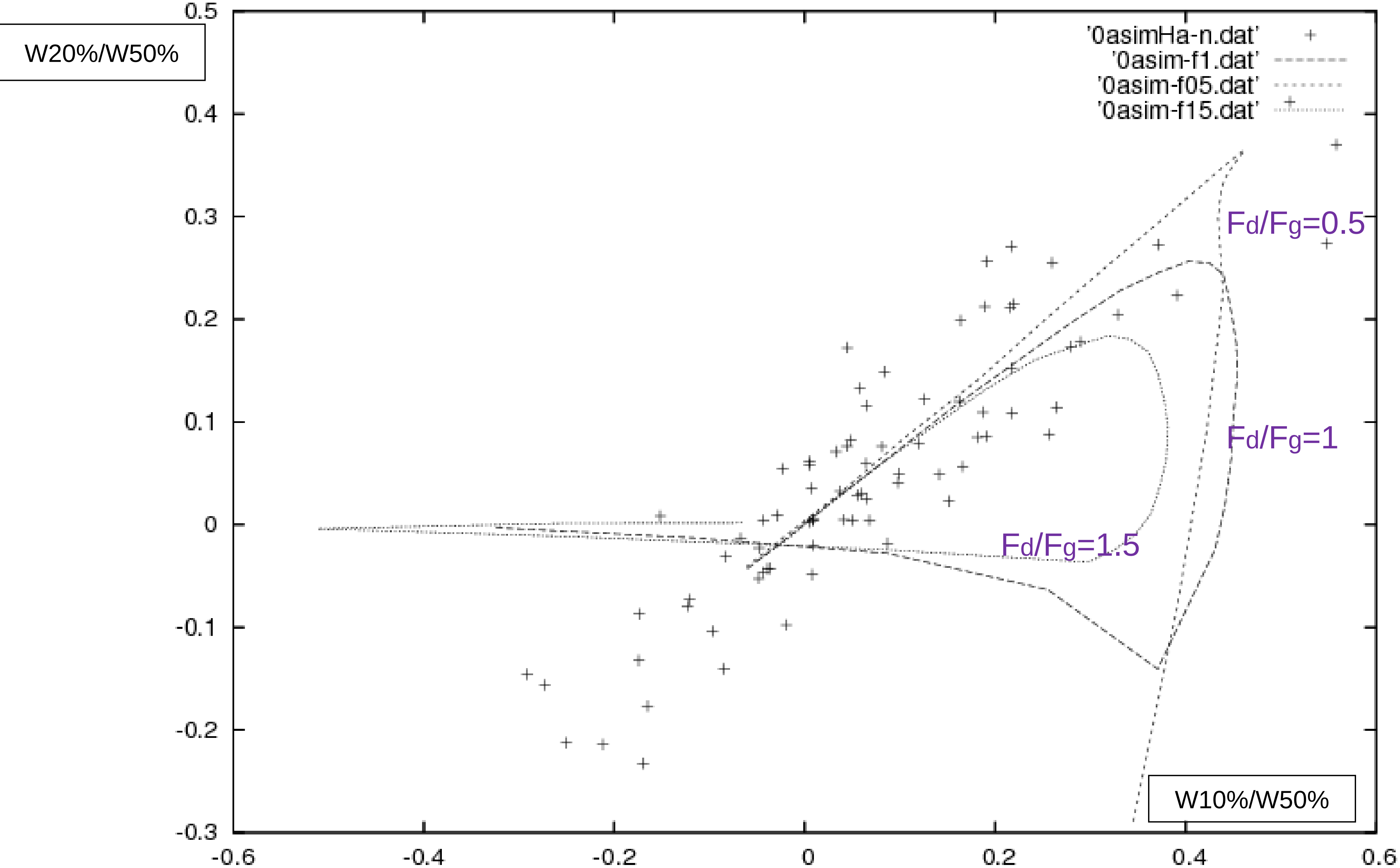
iv) The OIII lines were strong (the Fe influence under Hβ is small)

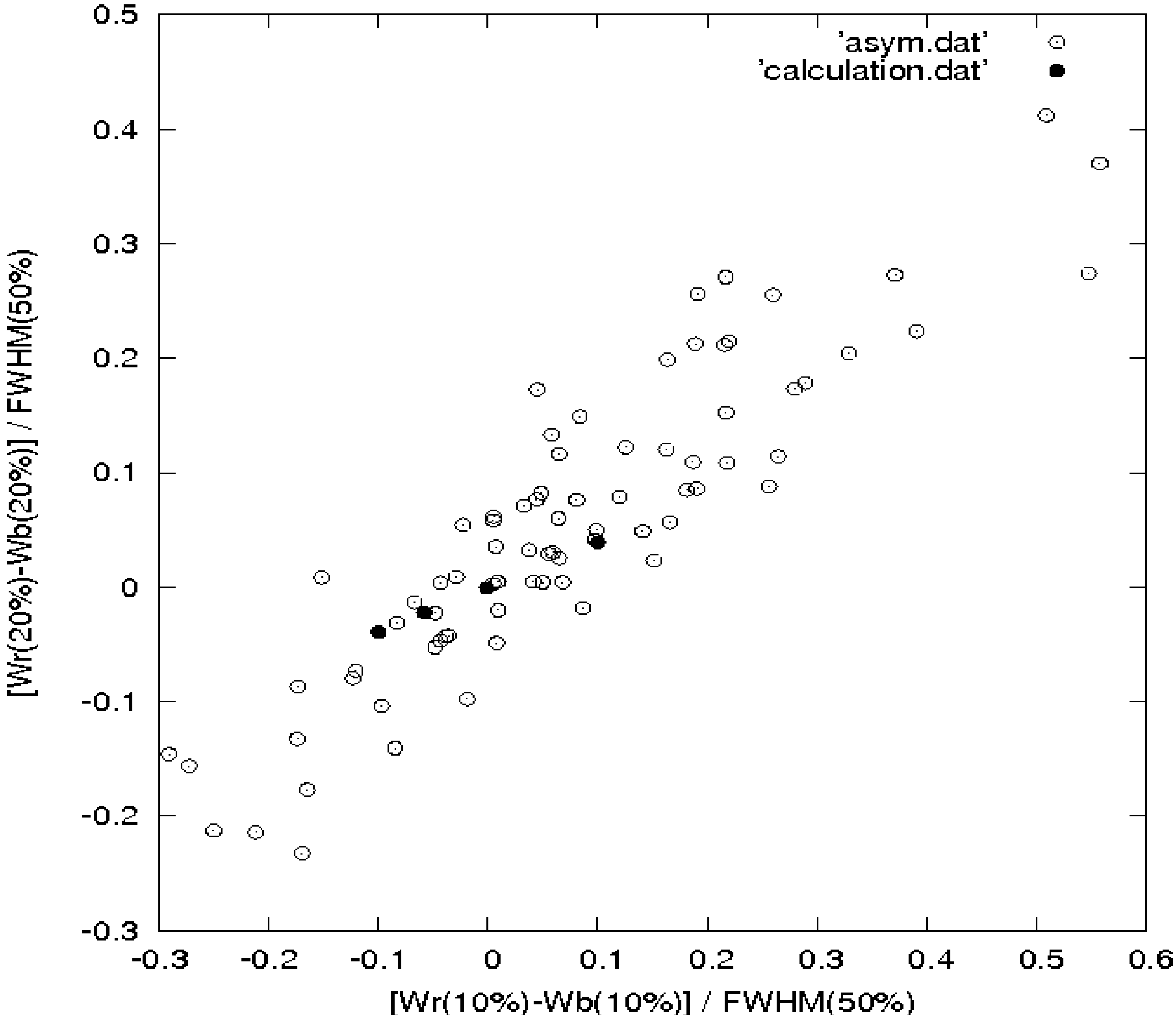

Relative intesity
300
250
200
150
100
50
0
3.55
3.6
3.65
3.7
3.75
3.8
3.85
3.9
3.95
4
Wavelength (in A)
Relative intesity
500
450
400
350
300
250
200
150
100
50
0
4750
4800
4850
4900
4950
5000
5050
Wavelength (in A)
Relative intesity
300
250
200
150
100
50
0
6400
6450
6500
6550
6600
6650
6700
6750
6800
Wavelength (in A)
Relative intesity
1
0.8
0.6
0.4
0.2
0
-0.2
-15000
-10000
-5000
0
5000
10000
15000
Wavelength (in A)
Relative intesity
1
0.8
0.6
0.4
0.2
0
-0.2
-8000
-6000
-4000
-2000
0
2000
4000
6000
Wavelength (in A)

Measured parameters vs. simulated parameters



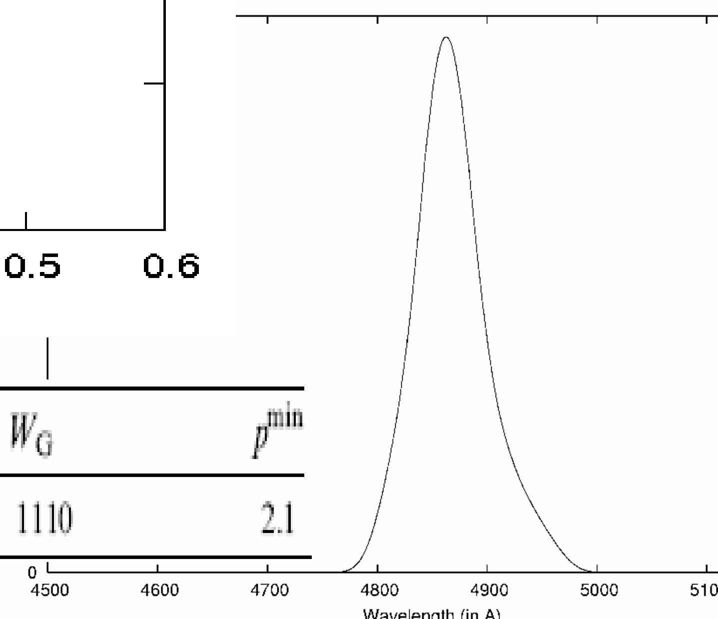
Asymmetry of the simulated profiles compared to the observed





Asymmetry of

H-alpha



i	$z_l^{\min,\max}$	$W_l^{\min,\max}$	$R_{\rm inn}^{\min}$	$R_{\rm out}^{\max}$	$z_G^{\min,\max}$	W_G	$p^{\min}$
9–31	−515, −5	770, 1330	390	32700	110	1110	2.1

Conclusions

- Contribution to the line wings
- Fd/Fs>1/3, but if Fd/Fs>3, two peak should appear
- It is likely that Fd/Fs~1 in the most of the considered AGN
- Width ratios => inclination should be small mainly i<20°,
    - and that the ring inner radius should be from ranges between 300 - 1200 Rg
- Asymmetry – disk inclination should be small, manly i<15
- q~2-3

Future work

- To test for larger sample of spectra
- To simulate grid of profiles
- …