Galactic kinematics

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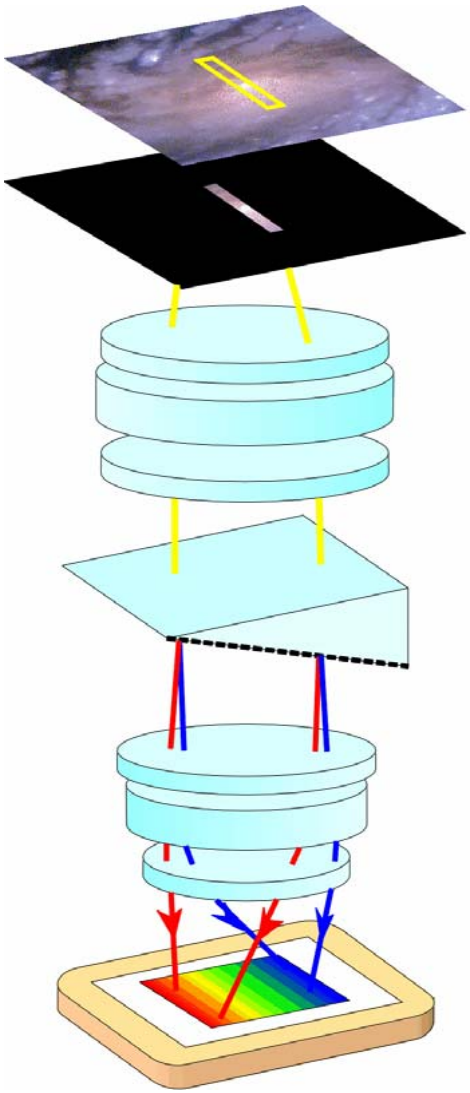
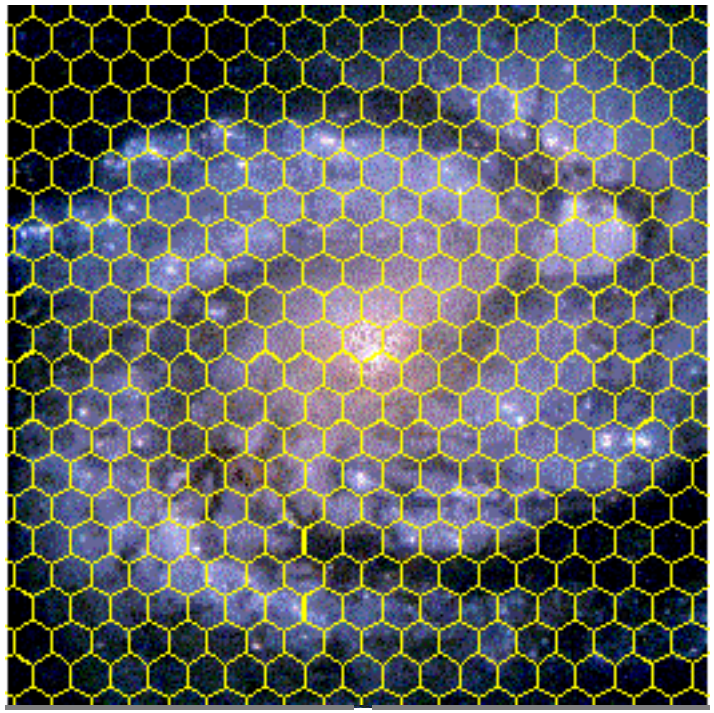
Outline

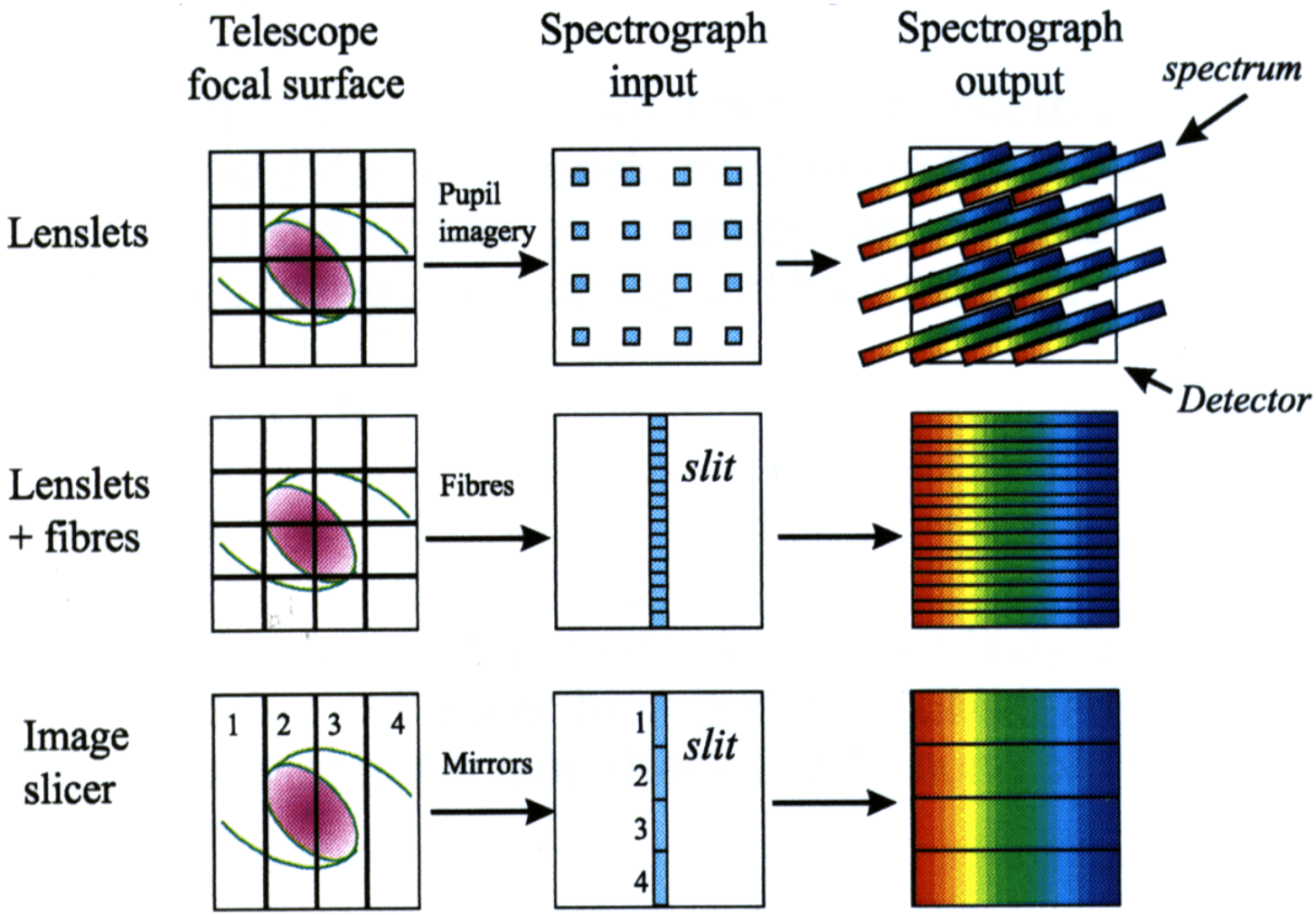
1. *Spectroscopy*
2. *Ionized-gas kinematics (Hβ, Hα)*
3. *Stellar kinematics (LOSVD)*
4. *Kinematical decouplings*

Long-slit spectroscopy

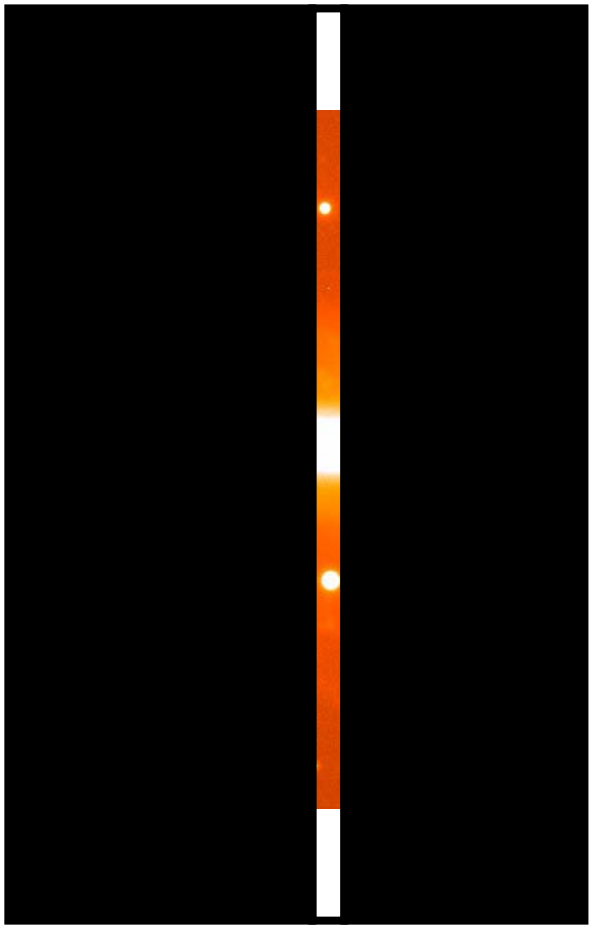


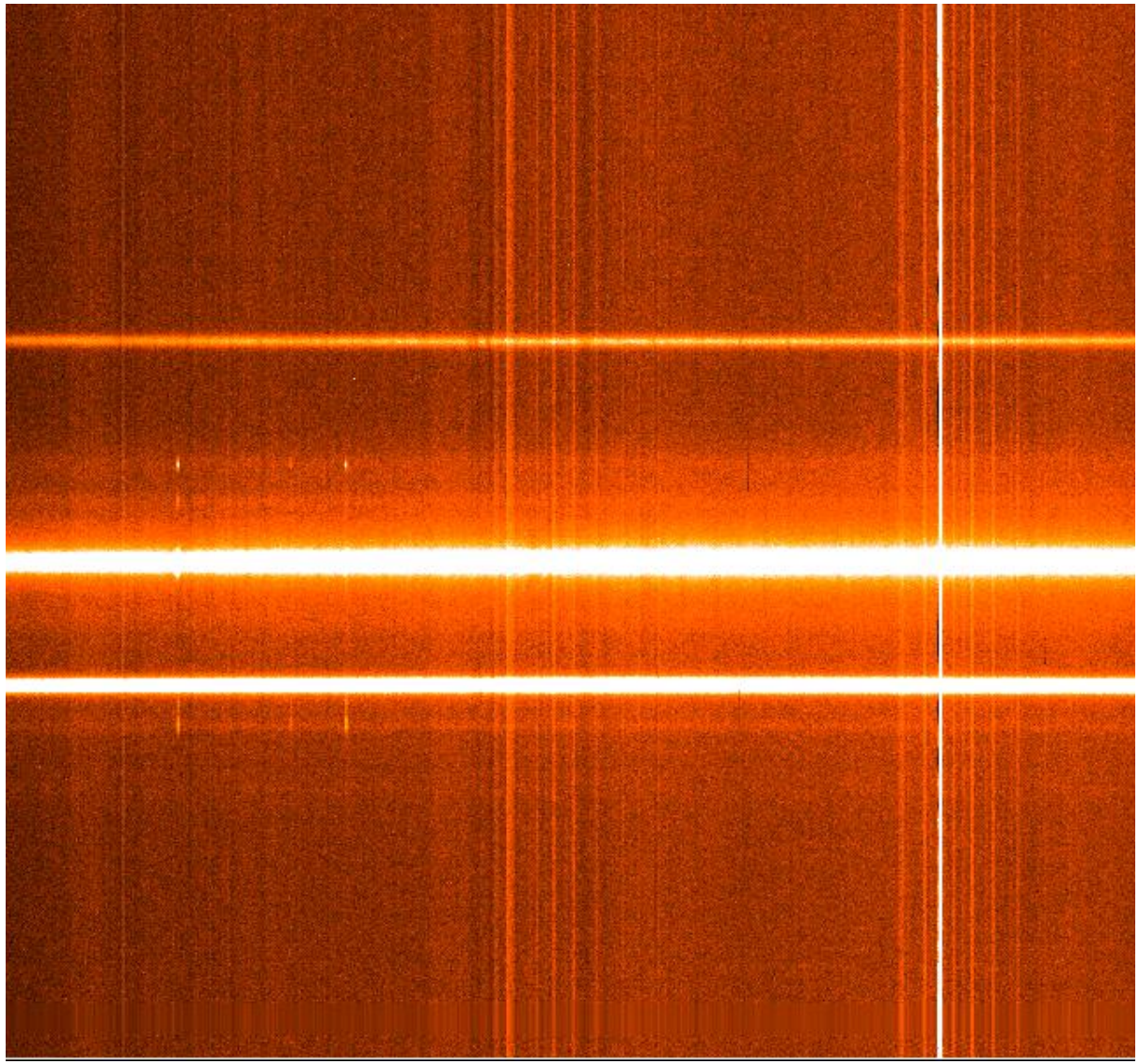


Integral-field spectroscopy

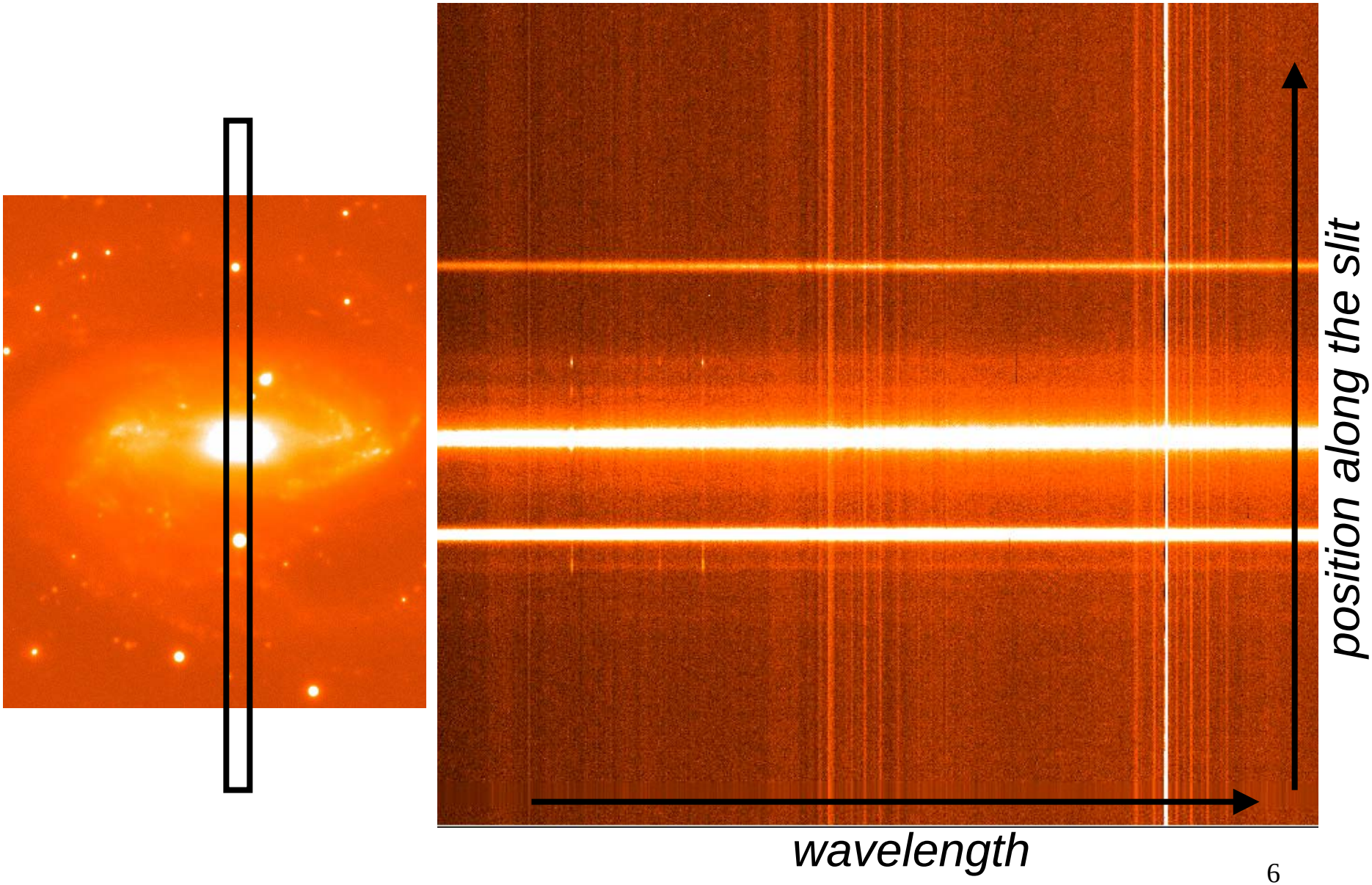


Ionized-gas kinematics: ESO 186-07

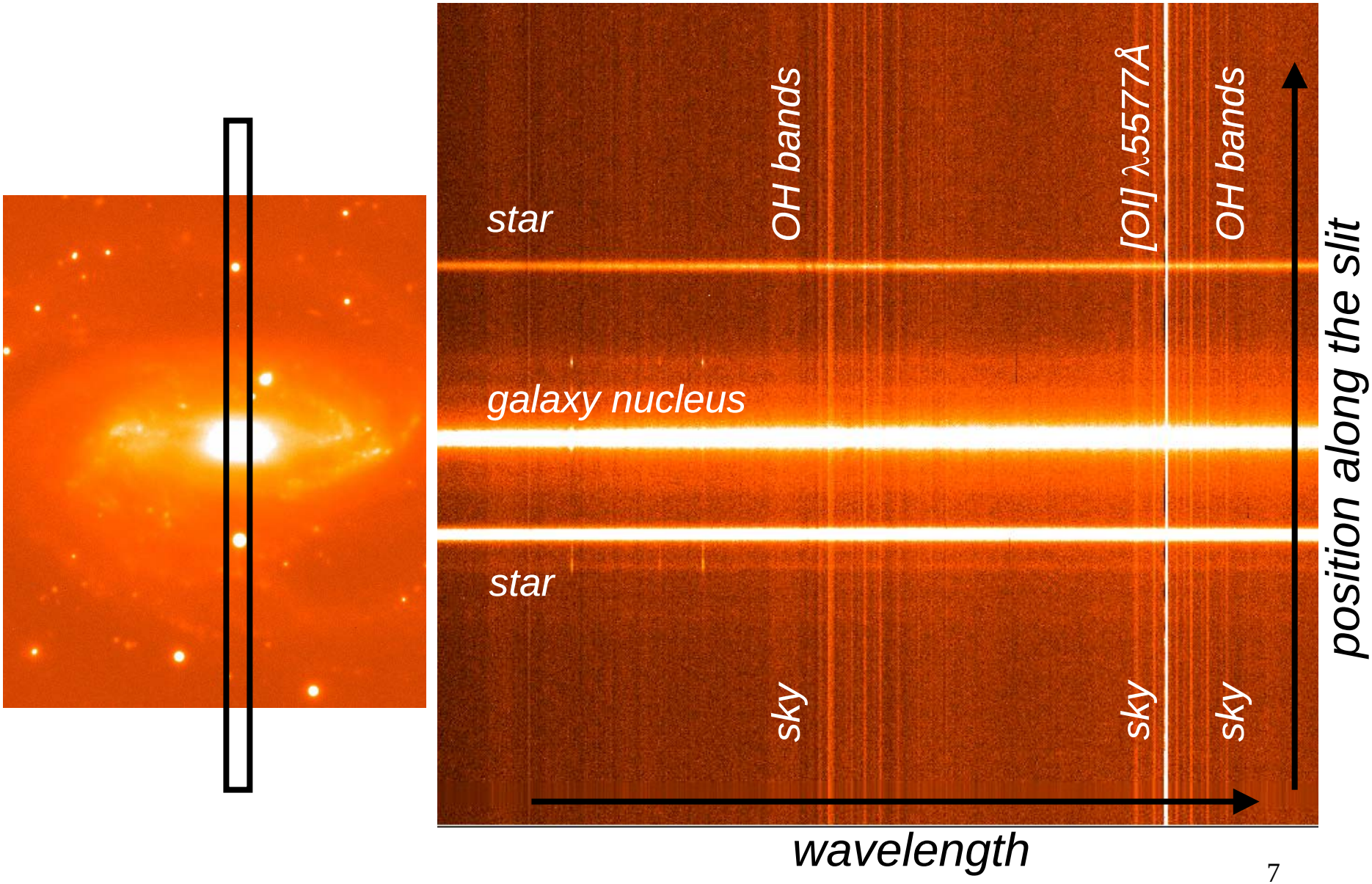




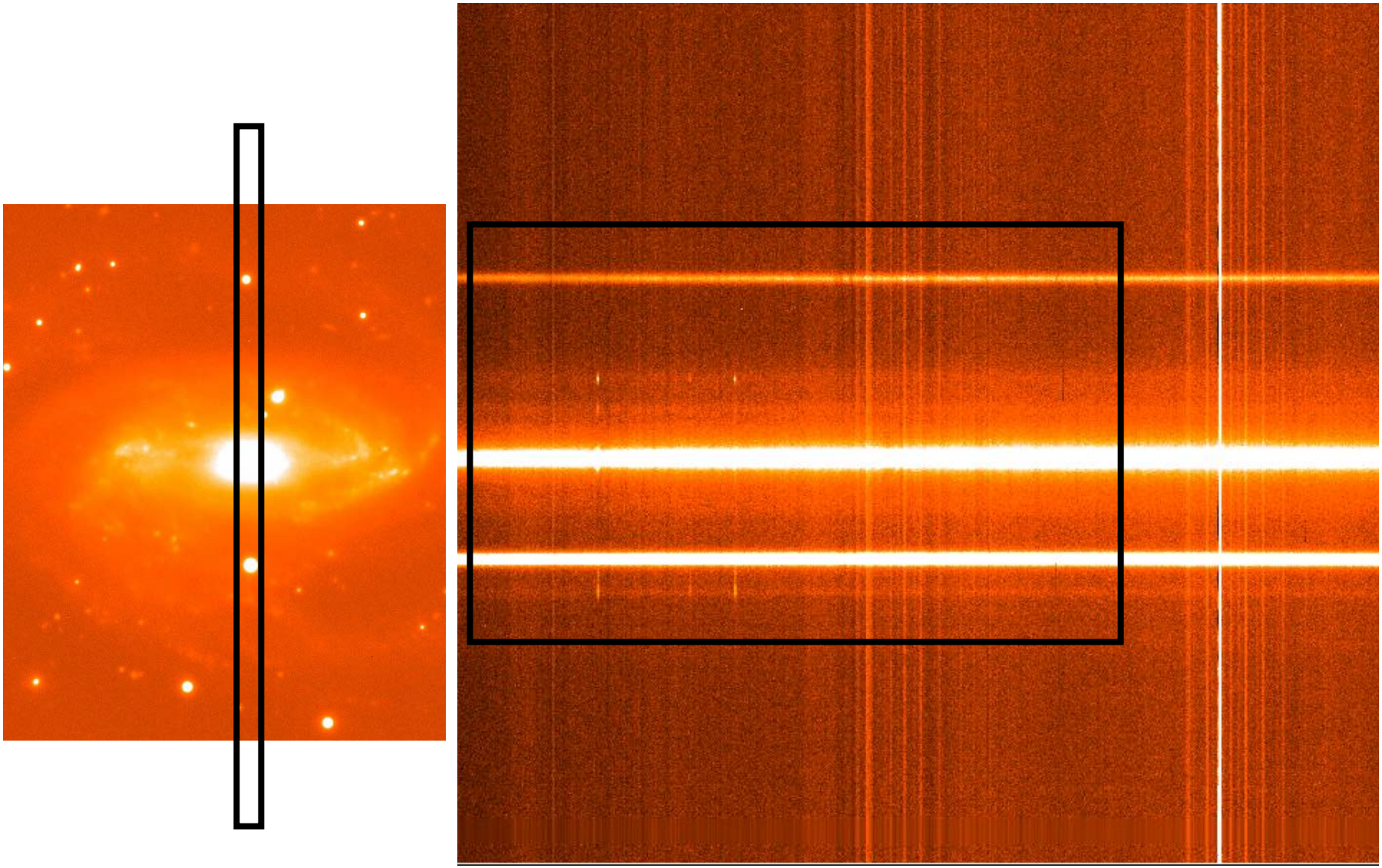
Ionized-gas kinematics: ESO 186-07



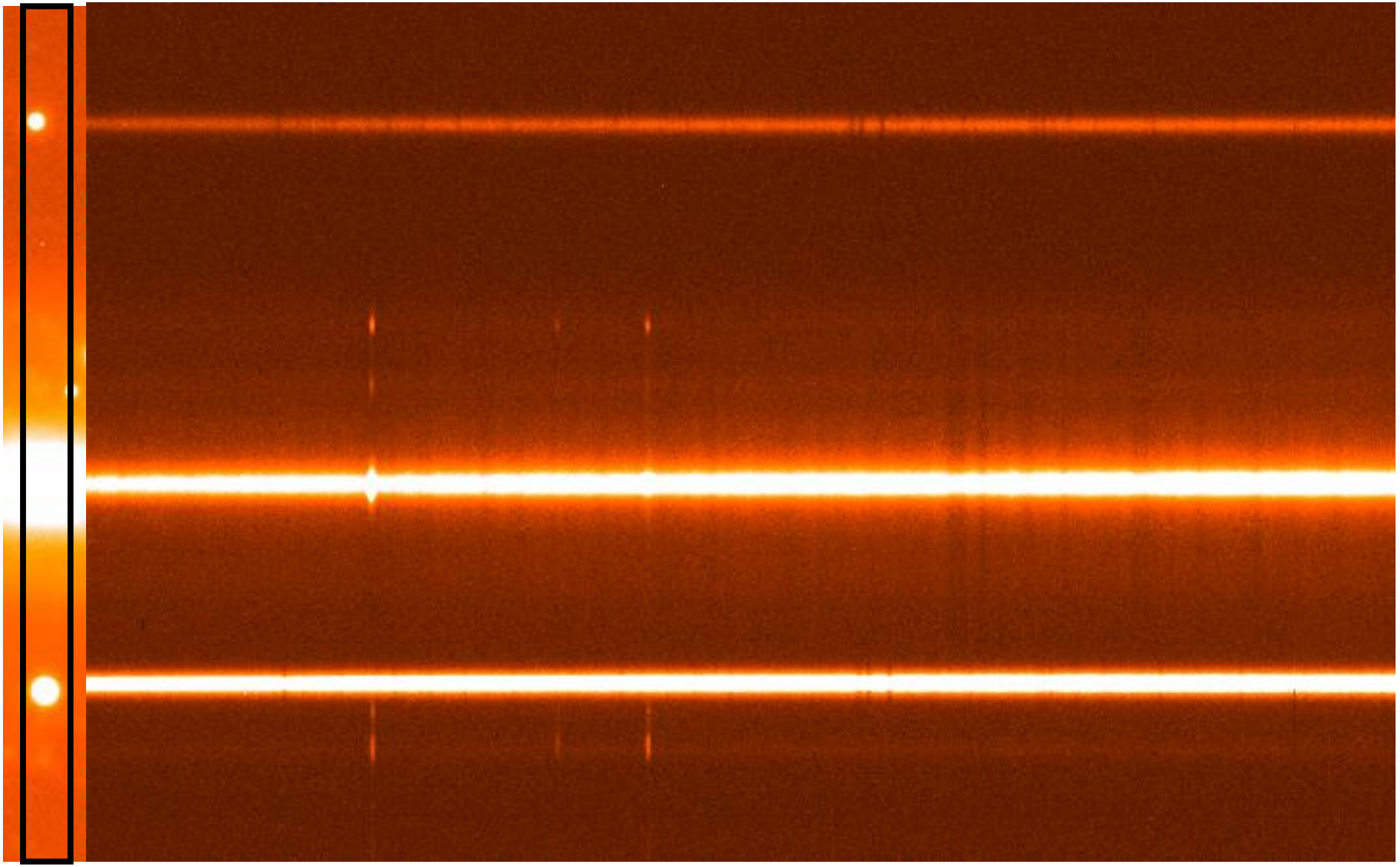
Ionized-gas kinematics: ESO 186-07



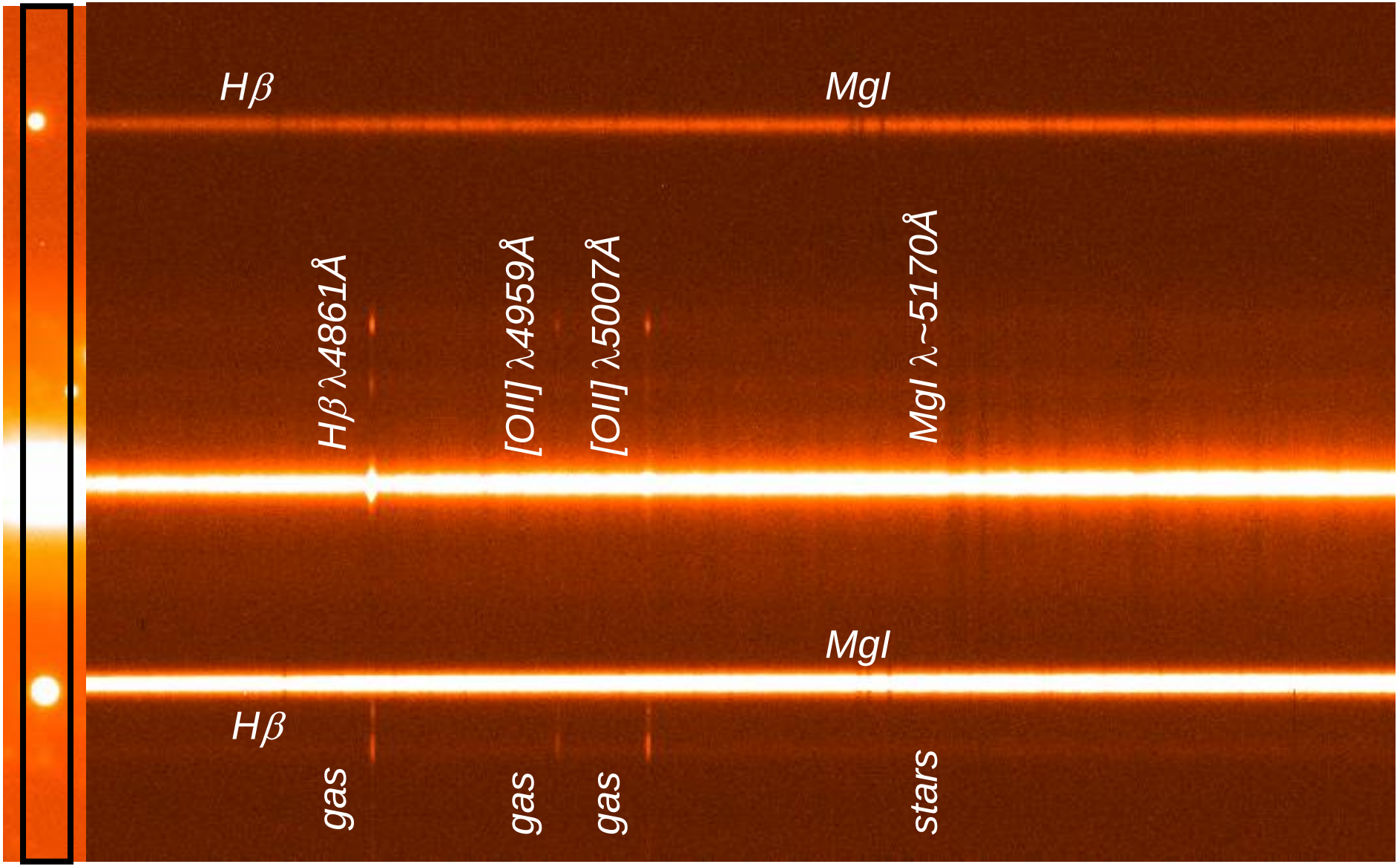
Ionized-gas kinematics: ESO 186-07



Ionized-gas kinematics: ESO 186-07

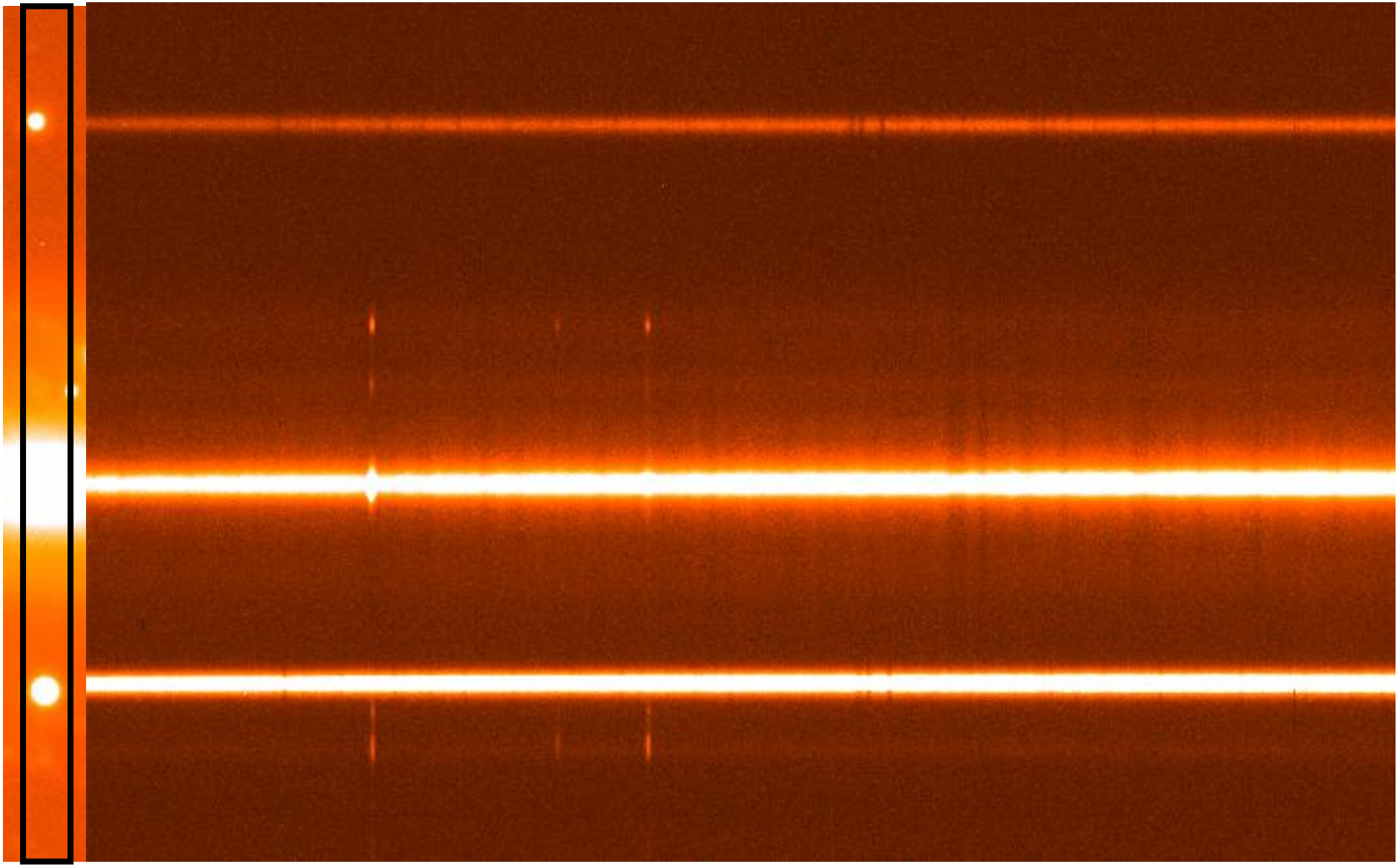


Ionized-gas kinematics: ESO 186-07

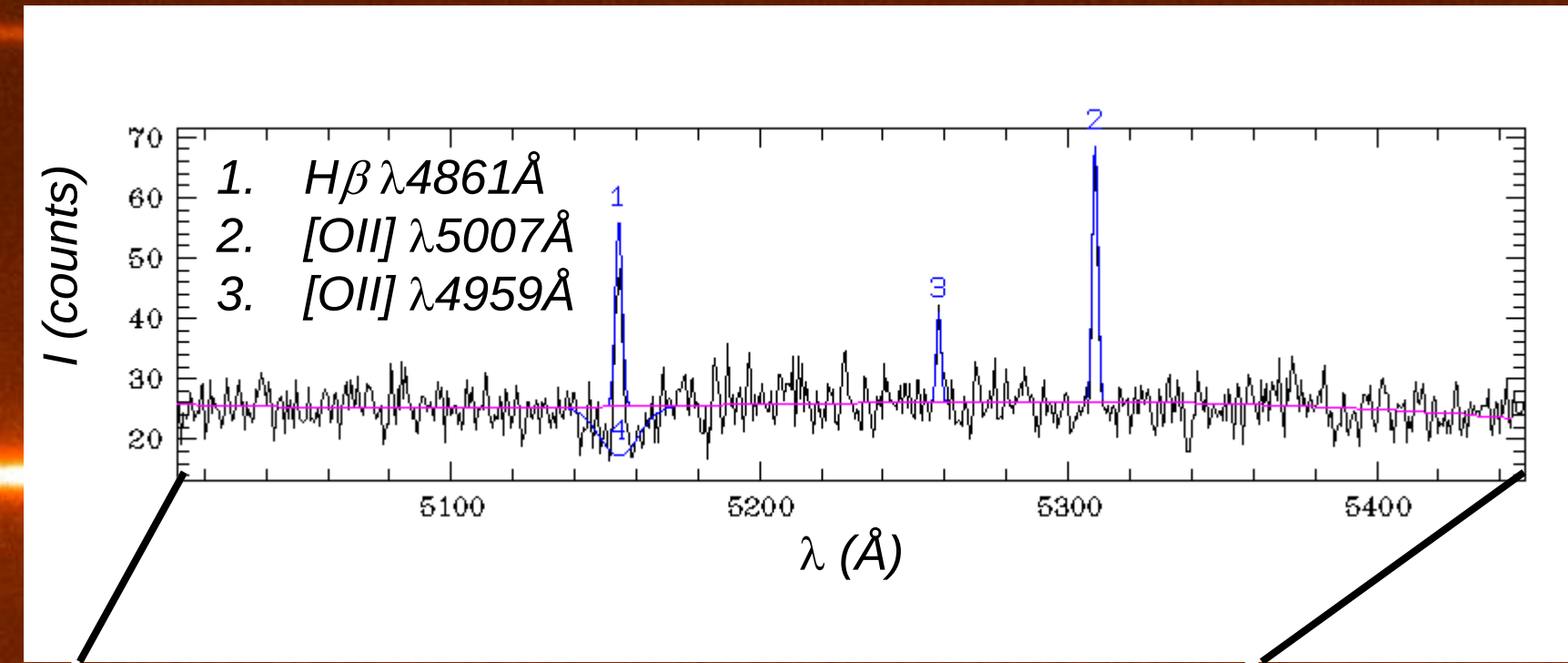


line	λ(Å)	type	line	λ(Å)	type
Ly_α	1215.67	EA	Fe I	4920.51	A
[O II]	3726.03	E	[O III] N1	4958.92	E
[O II]	3728.82	E	[O III] N2	5006.84	E
He II	3768.90	E	Mg I	5167.32	A
He I	3833.57	E	Mg I	5172.70	A
[Ne III]	3868.71	E	Mg I	5183.60	A
He I	3888.65	E	[N I]	5197.90	E
H_ζ	3889.05	EA	[N I]	5200.26	E
Ca II K	3933.66	A	Ca+Fe (E band)	5269.00	A
[Ne III]	3967.41	E	He I	5875.67	E
Ca II H	3968.47	A	Na I	5889.95	A
H_ϵ	3970.07	EA	Na I	5895.92	A
Mn I	4033.00	A	He II	5977.00	E
Fe I	4045.81	A	[O I]	6300.30	E
H_δ	4101.73	EA	[N II]	6548.03	E
Ca I, g band	4226.73	A	H_α	6562.80	EA
Fe I	4325.77	A	[N II]	6583.41	E
He II	4338.6	E	He I	6678.15	E
H_γ	4340.46	EA	[S II]	6716.47	E
[O III]	4363.21	E	[S II]	6730.85	E
Fe I	4383.55	A	[Ar III]	7135.78	E
He I	4471.50	E	[Ar IV]	7237.30	E
Cr I	4666.00	A	Ca II	8498.02	A
He II	4685.68	E	Ca II	8542.09	A
H_β	4861.31	EA	Ca II	8662.14	A

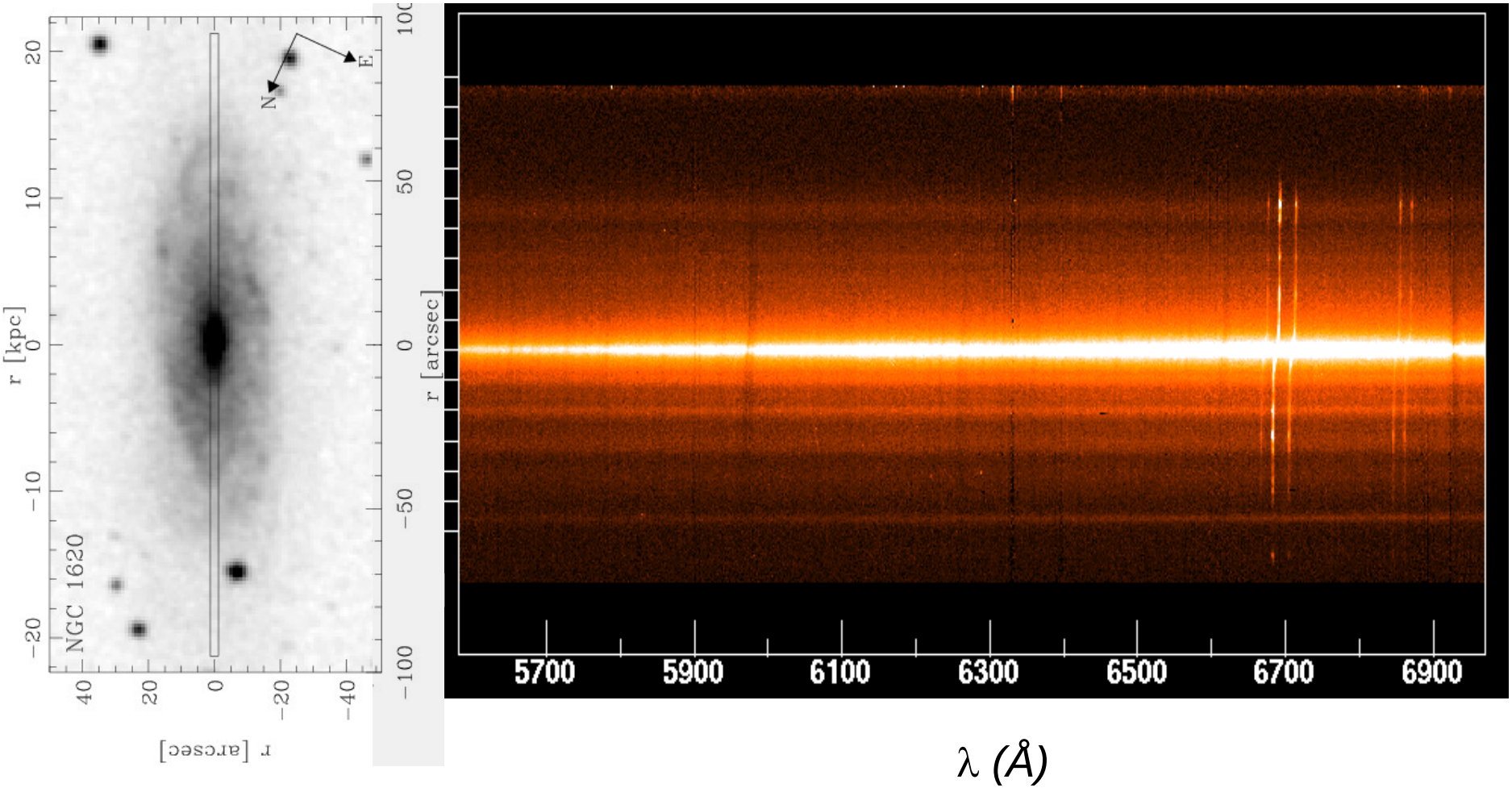
Ionized-gas kinematics: ESO 186-07



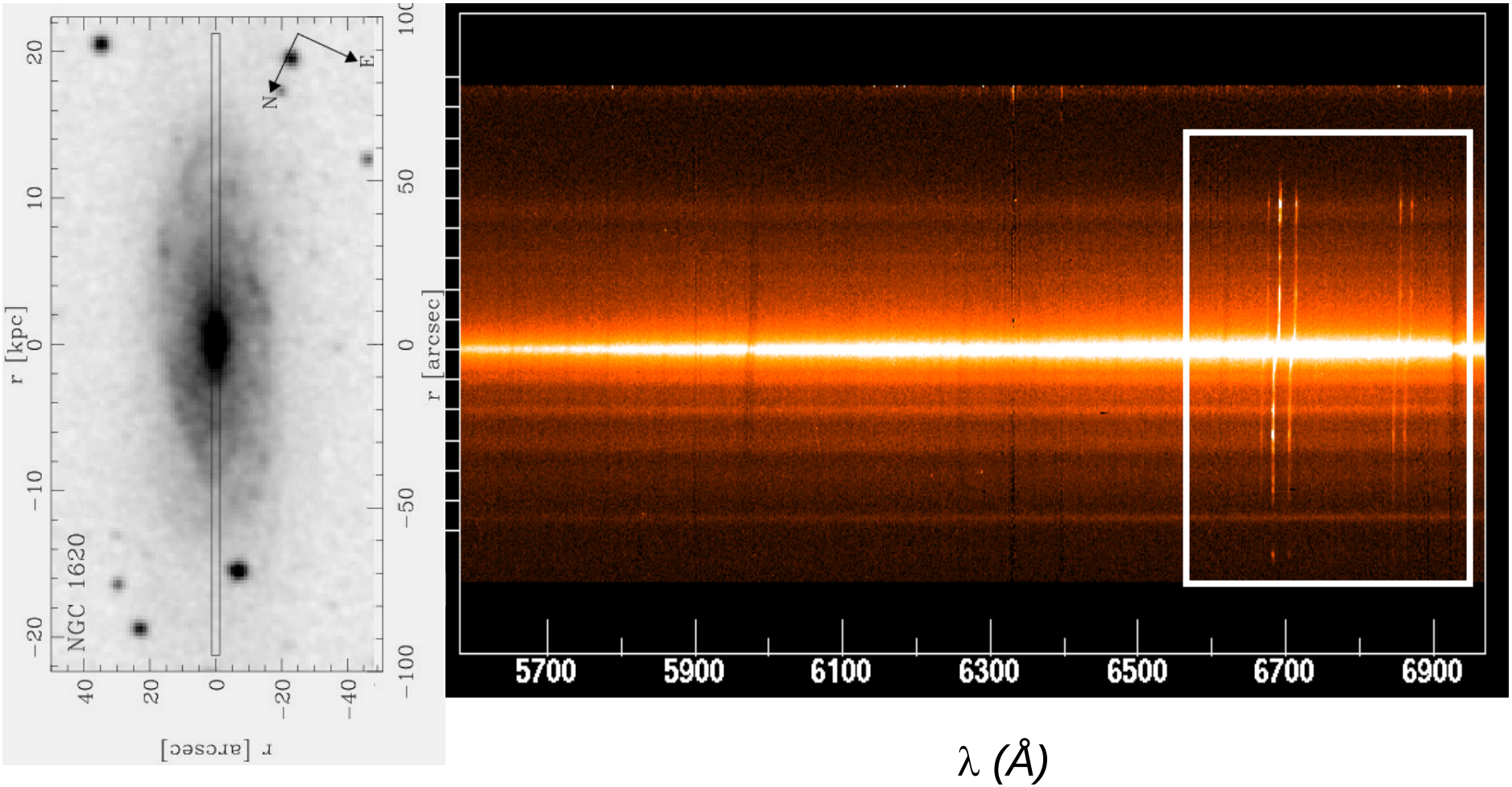
Ionized-gas kinematics: ESO 186-07



Ionized-gas kinematics: NGC 1620



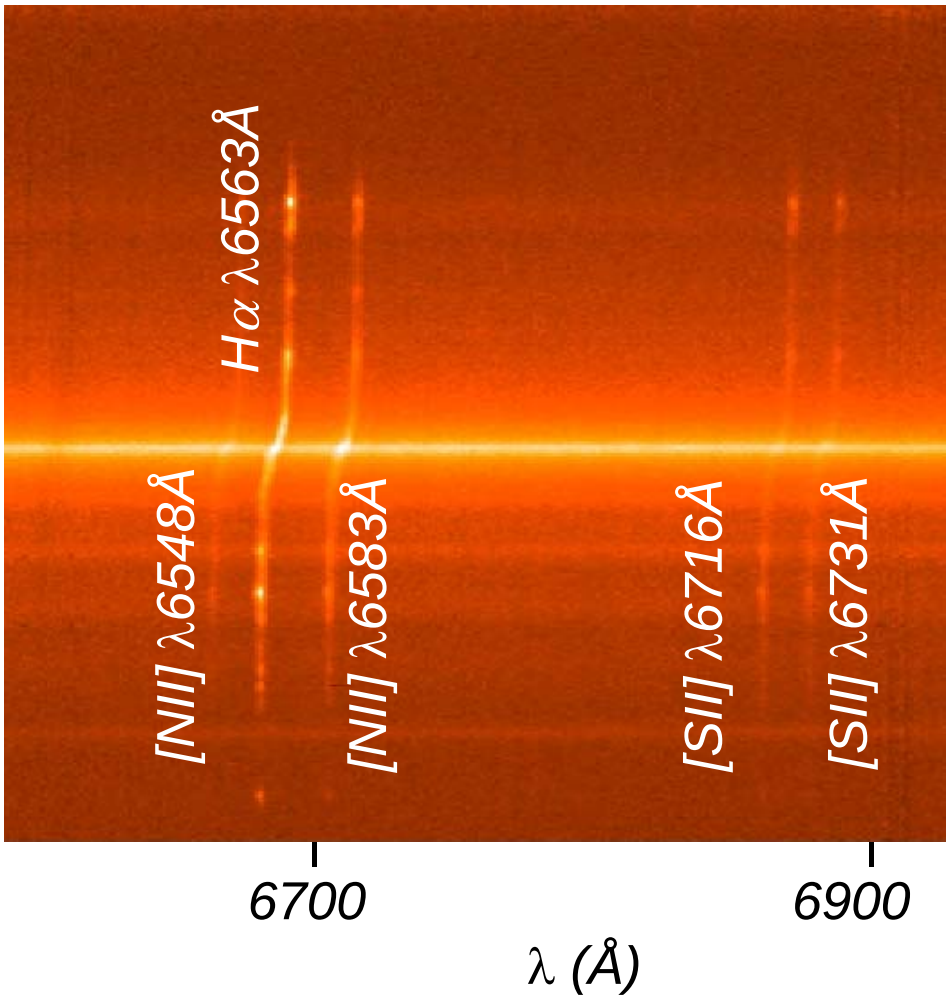
Ionized-gas kinematics: NGC 1620

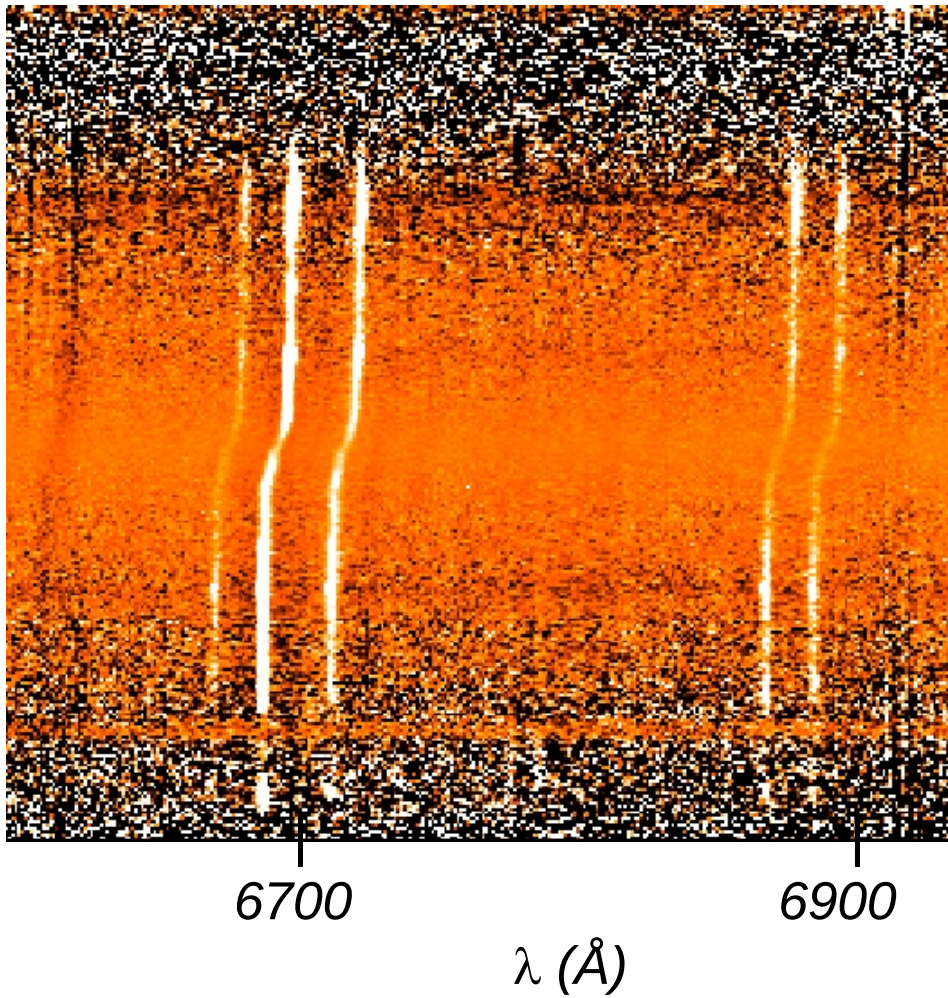


Ionized-gas kinematics: NGC 1620

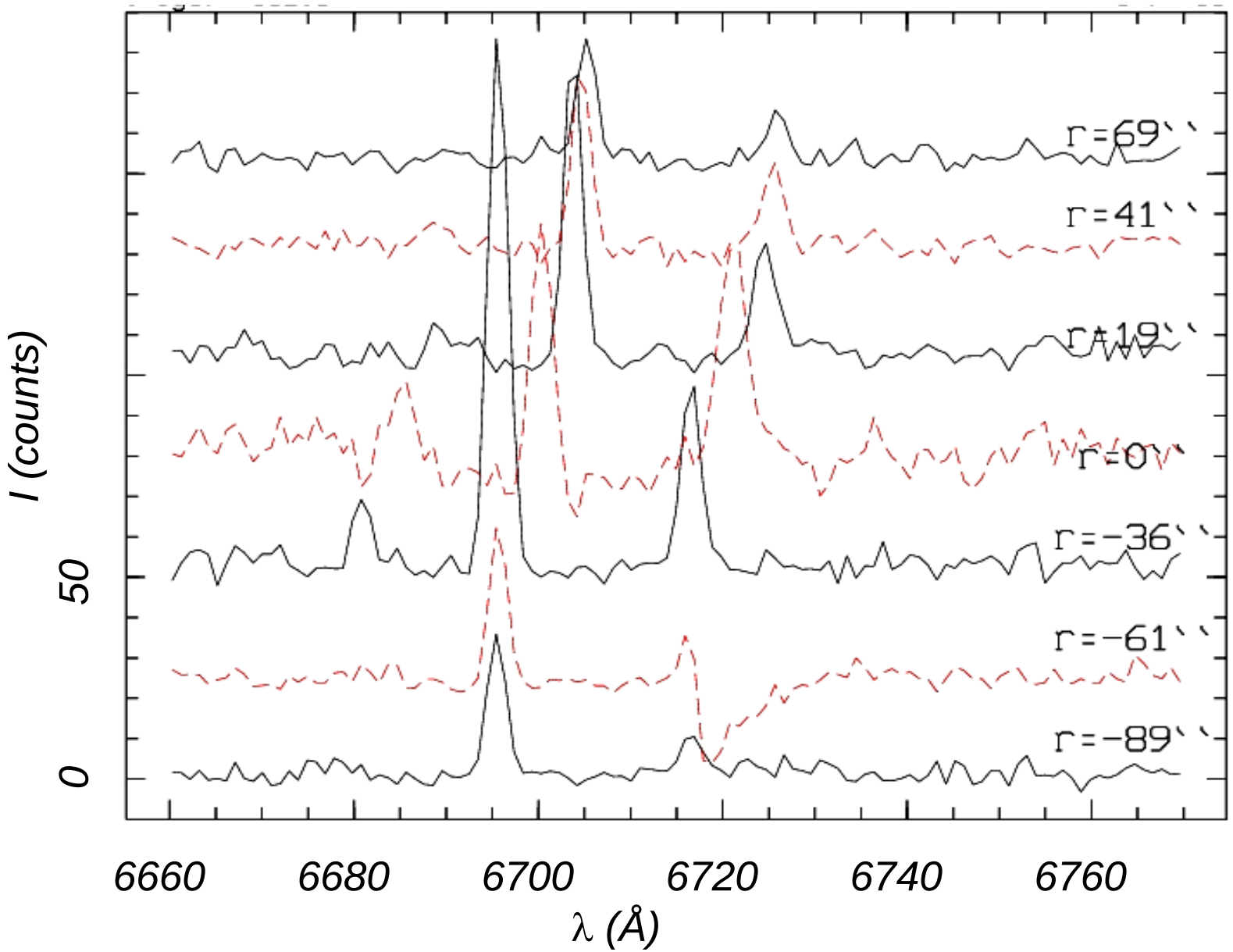
sky subtracted

continuum subtracted

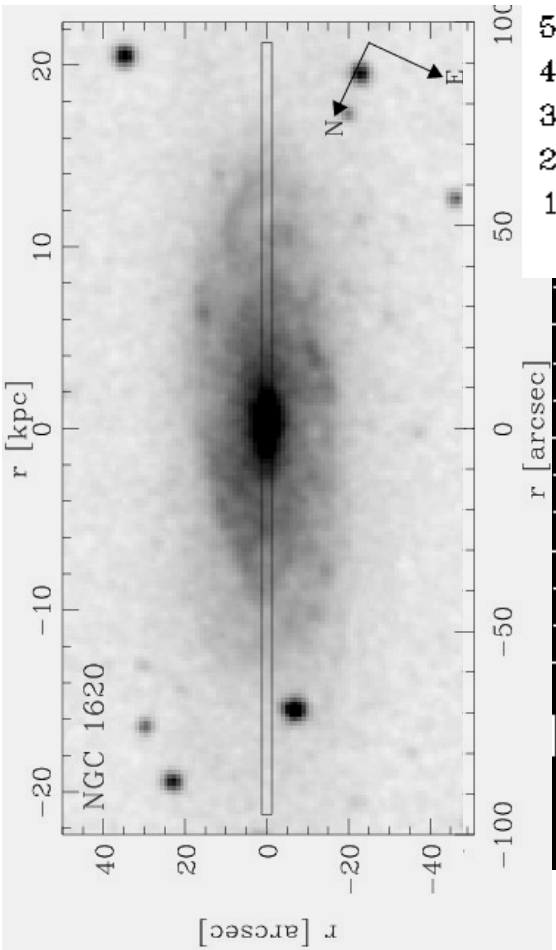


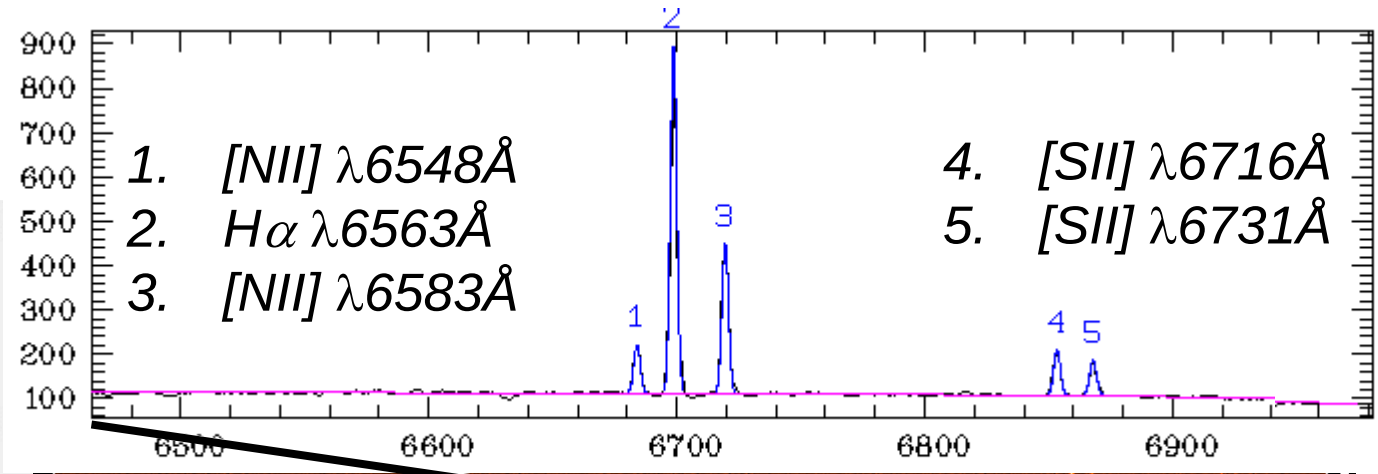


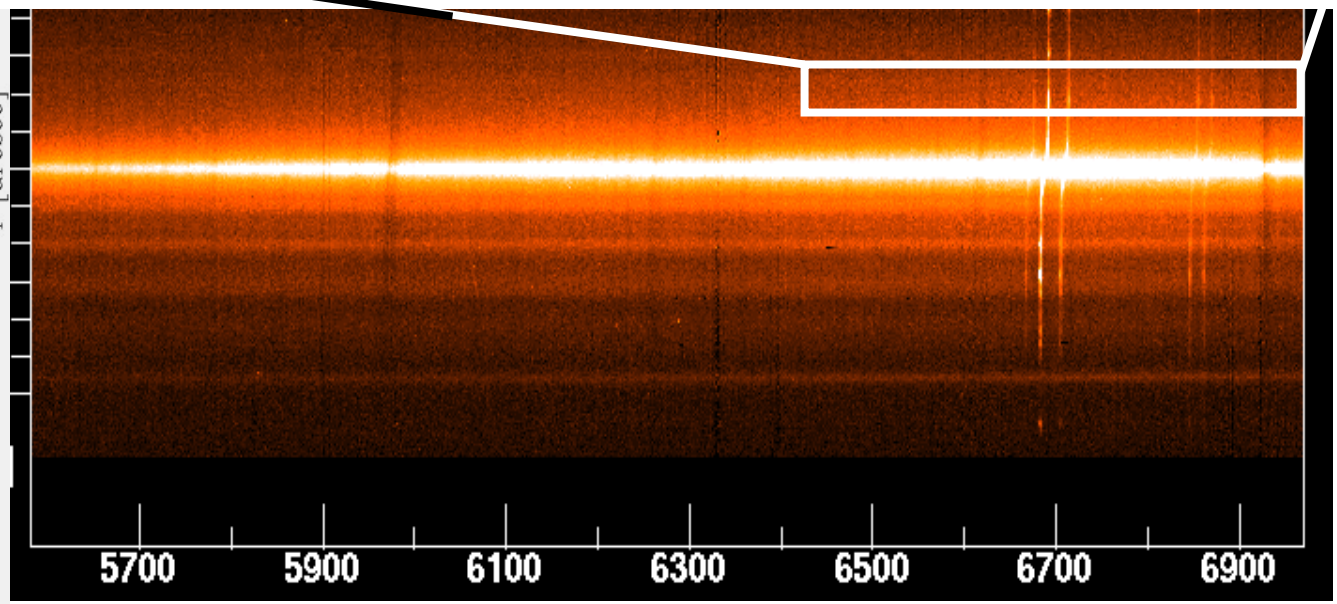
Ionized-gas kinematics: NGC 1620



Ionized-gas kinematics: NGC 1620

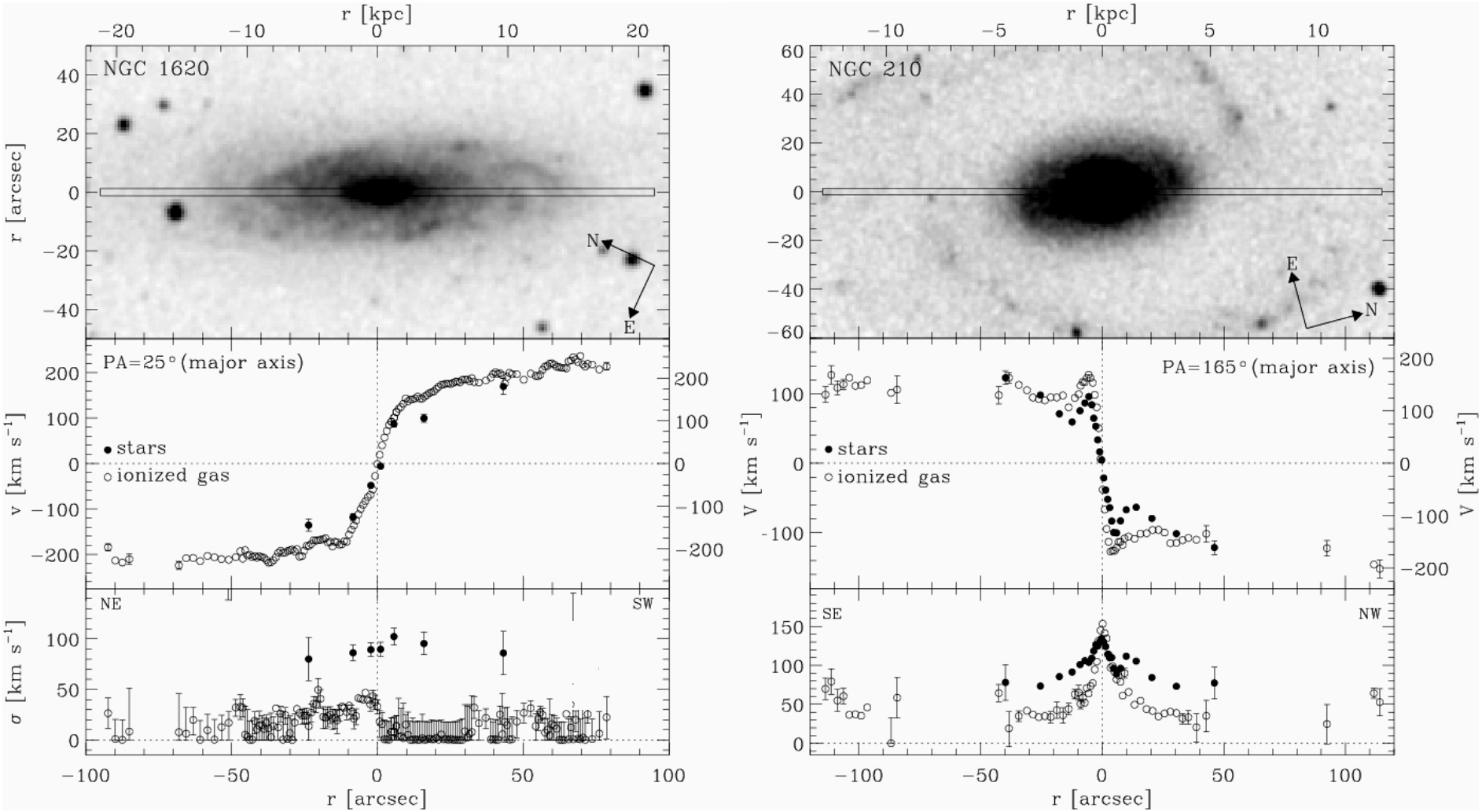






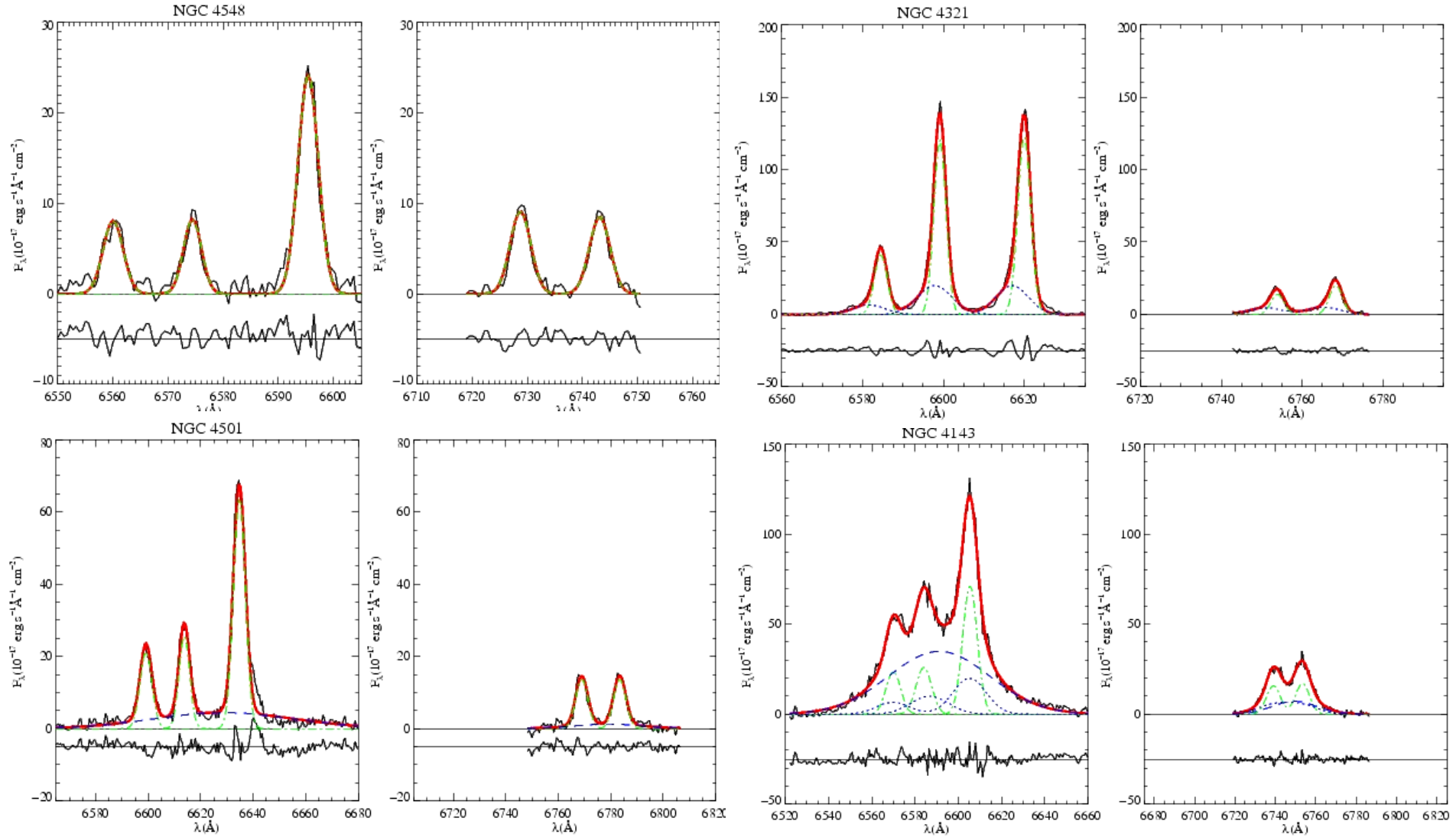
λ (Å)

Ionized-gas (and stellar) kinematics



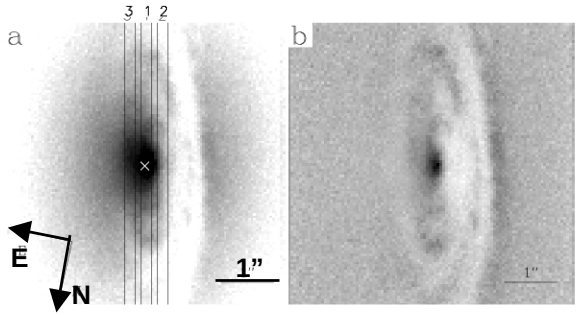
Pizzella et al. (2004)

Ionized-gas kinematics in galactic nuclei



Ionized-gas kinematics in galactic nuclei: NGC 4435

acquisition image
slits

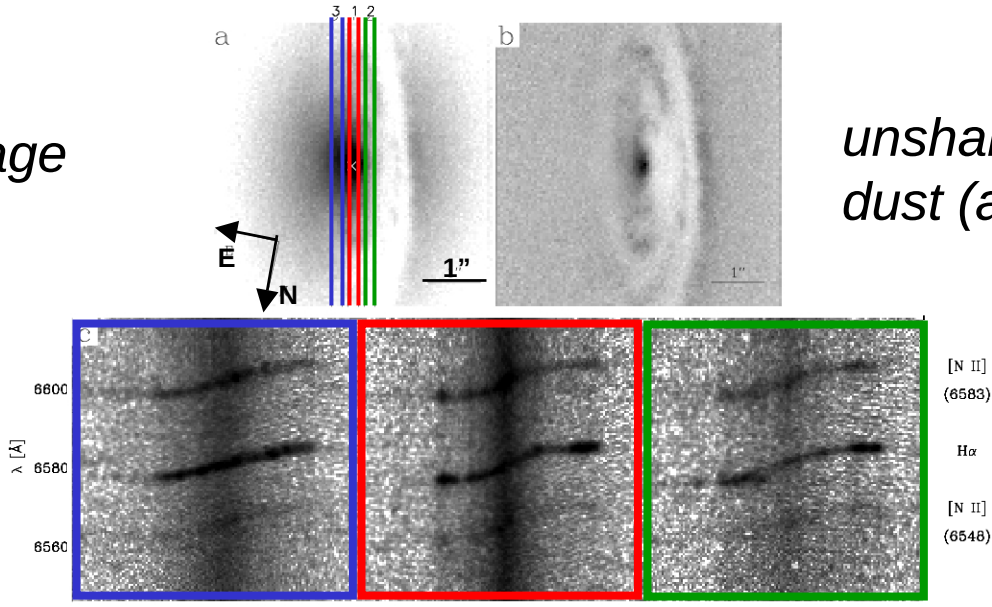


unsharp masking
dust (and gas) disk

Coccato et al. (2006)

Ionized-gas kinematics in galactic nuclei: NGC 4435

acquisition image slits



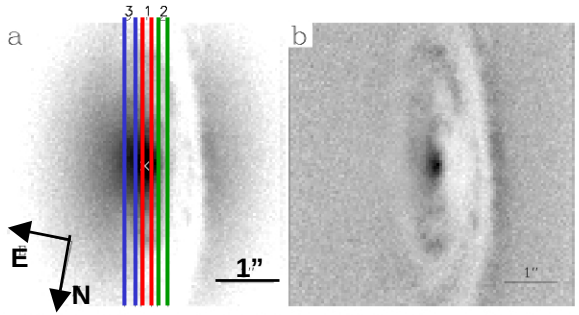
unsharp masking dust (and gas) disk

[NII] λ6583Å
Hα λ6563Å
[NII] λ6548Å

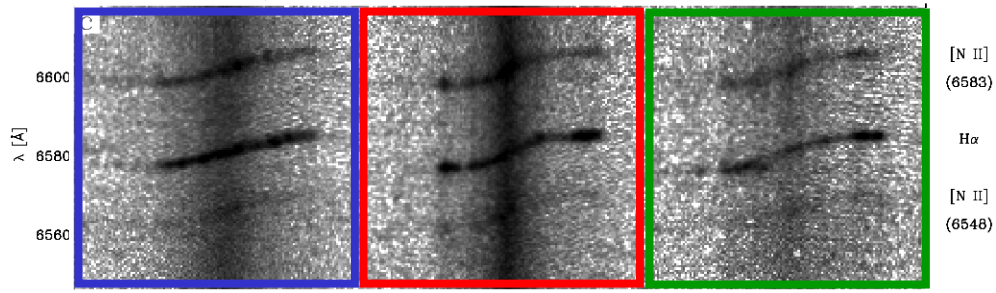
Coccato et al. (2006)

Ionized-gas kinematics in galactic nuclei: NGC 4435

acquisition image
slits



unshap masking
dust (and gas) disk

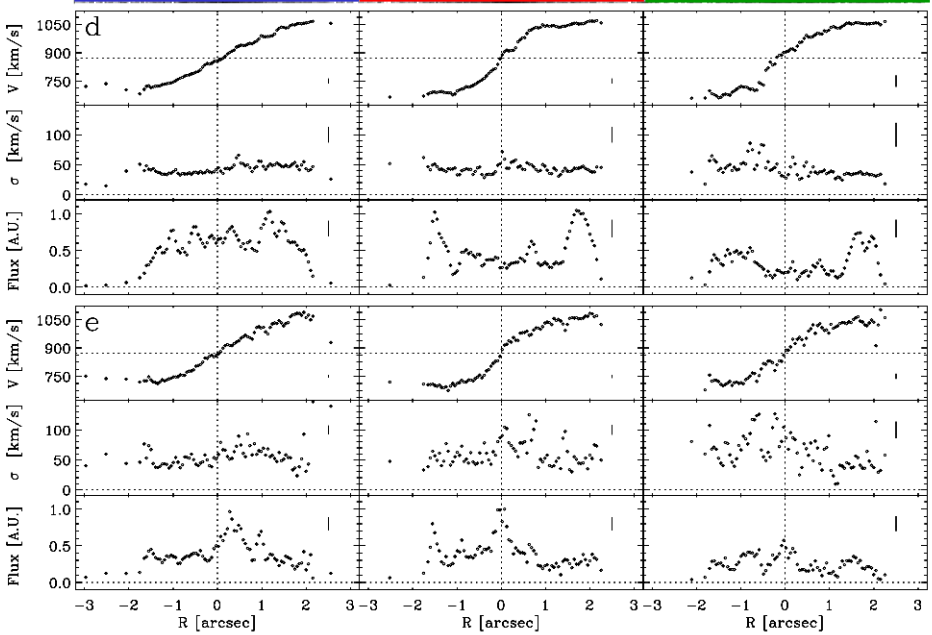


[NII] λ6583Å
Hα λ6563Å
[NII] λ6548Å

V

σ

Flux



Hα λ6563Å
kinematics

V

σ

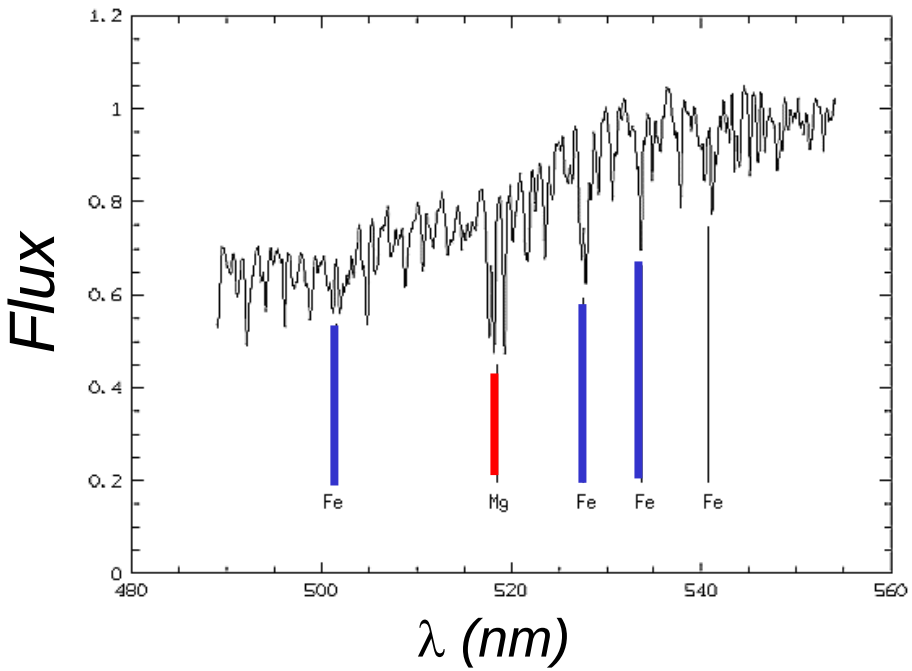
Flux

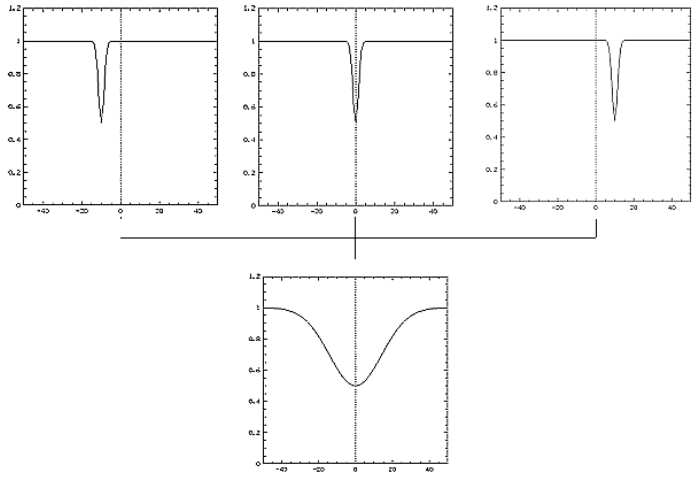
[NII] λ6583Å
kinematics

Coccato et al. (2006)

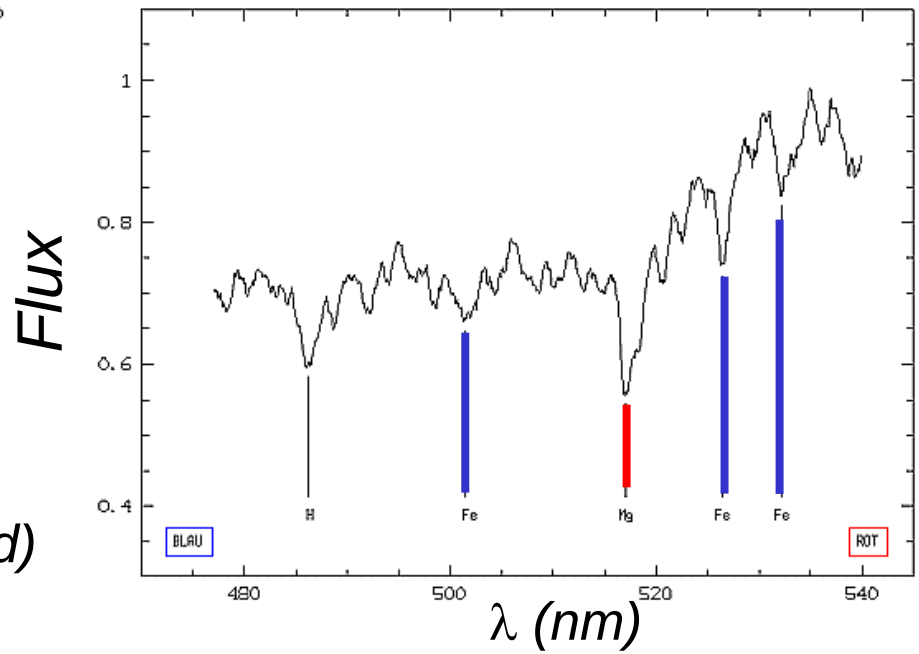
Stellar kinematics: Basics

KIII star





elliptical galaxy

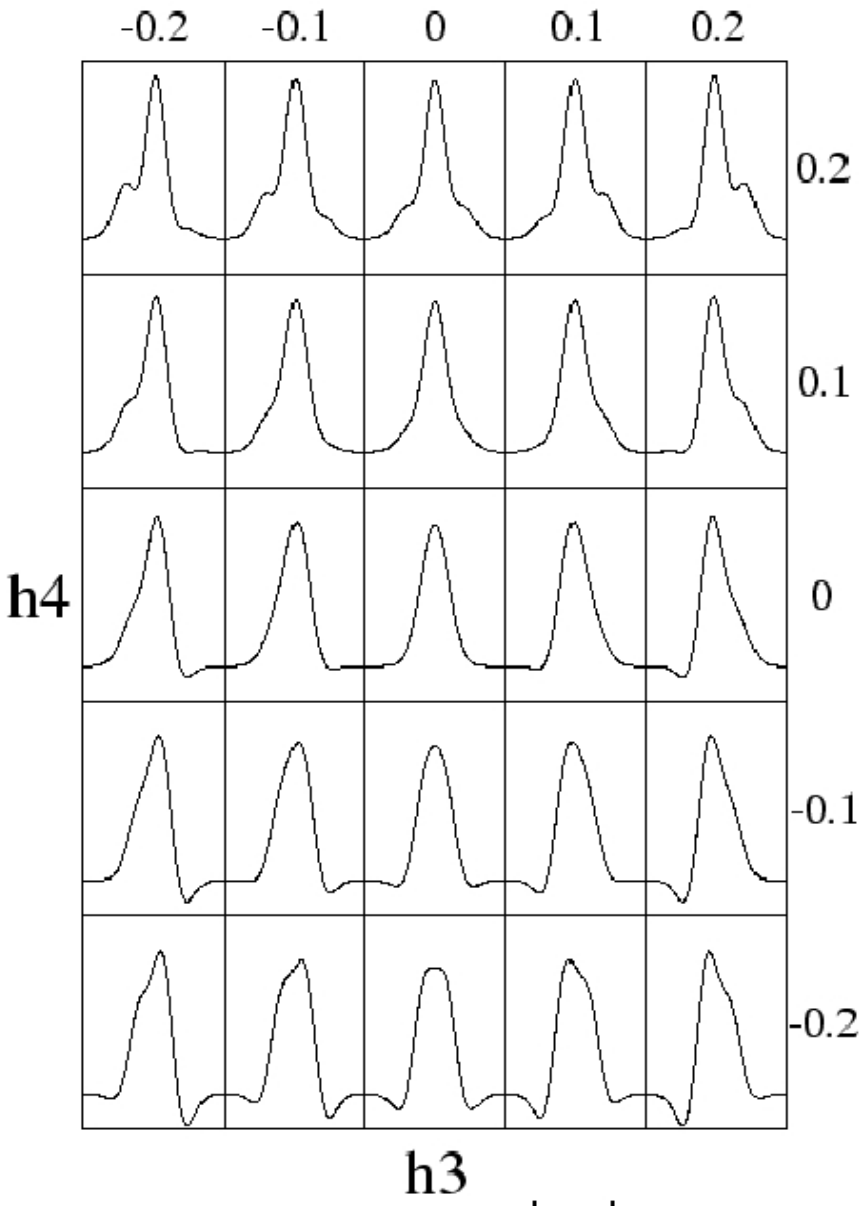


$$G(\lambda)= \int_{-\infty}^{+\infty} S[\lambda(1+v/c)]B(v|V,\sigma,h_3,h_4)dv$$

$G = S \otimes B$ *(Direct Fitting Method)*

$\tilde{G} = \tilde{S} \bullet \tilde{B}$ *(Fourier Quotient Method)*

Line of sight velocity distribution (LOSVD)



$$B(v) = I_0 \exp(-y^2/2)[1+h_3H_3(y)+h_4H_4(y)]$$

where

$$y = (v-v_{fit})/\sigma_{fit}$$

and

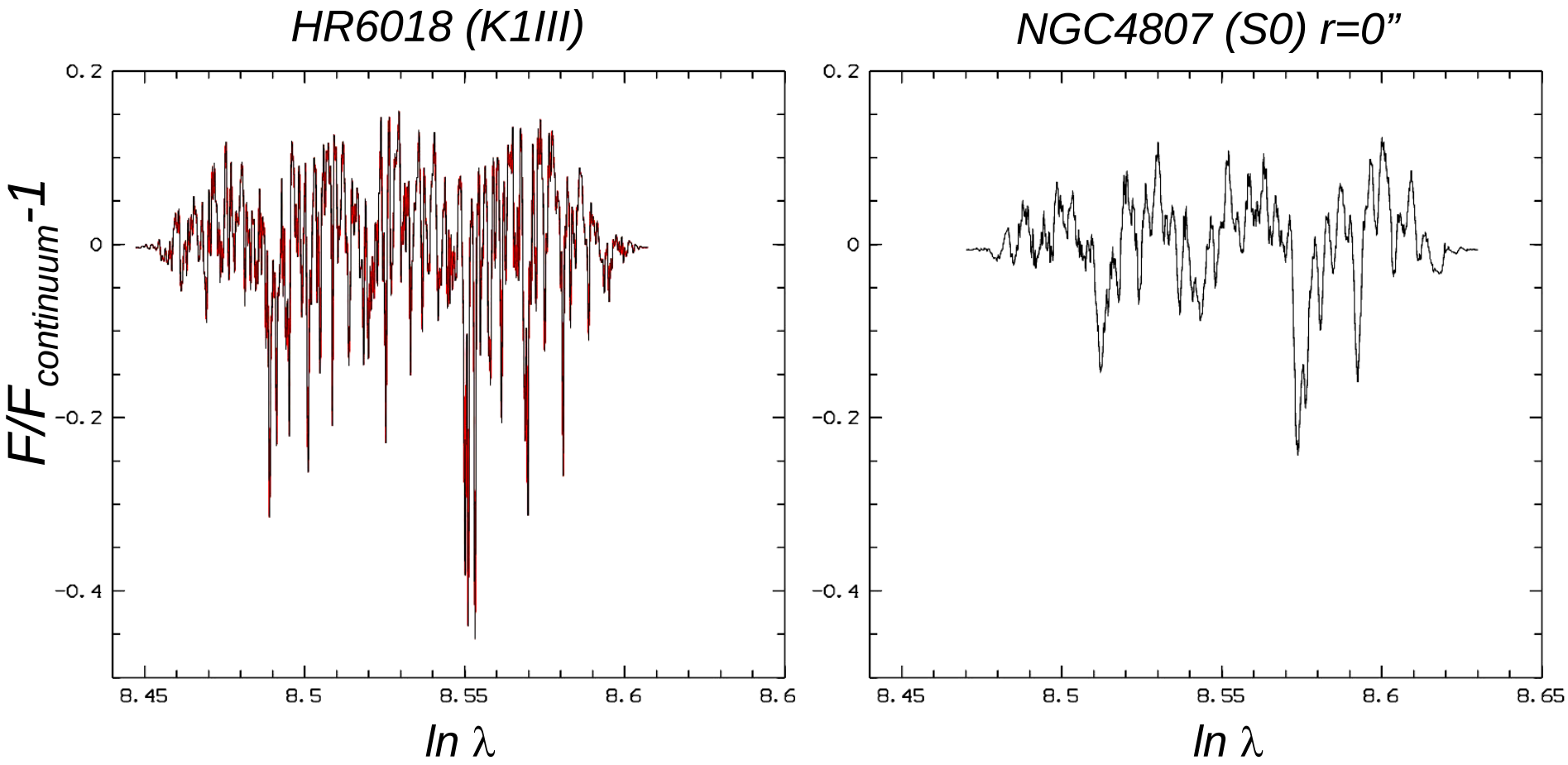
$$H_3(y) = (2\sqrt{2}y^3-3\sqrt{2}y)/\sqrt{6}$$

$$H_4(y) = (4y^4-12y^2+3)/\sqrt{24}$$

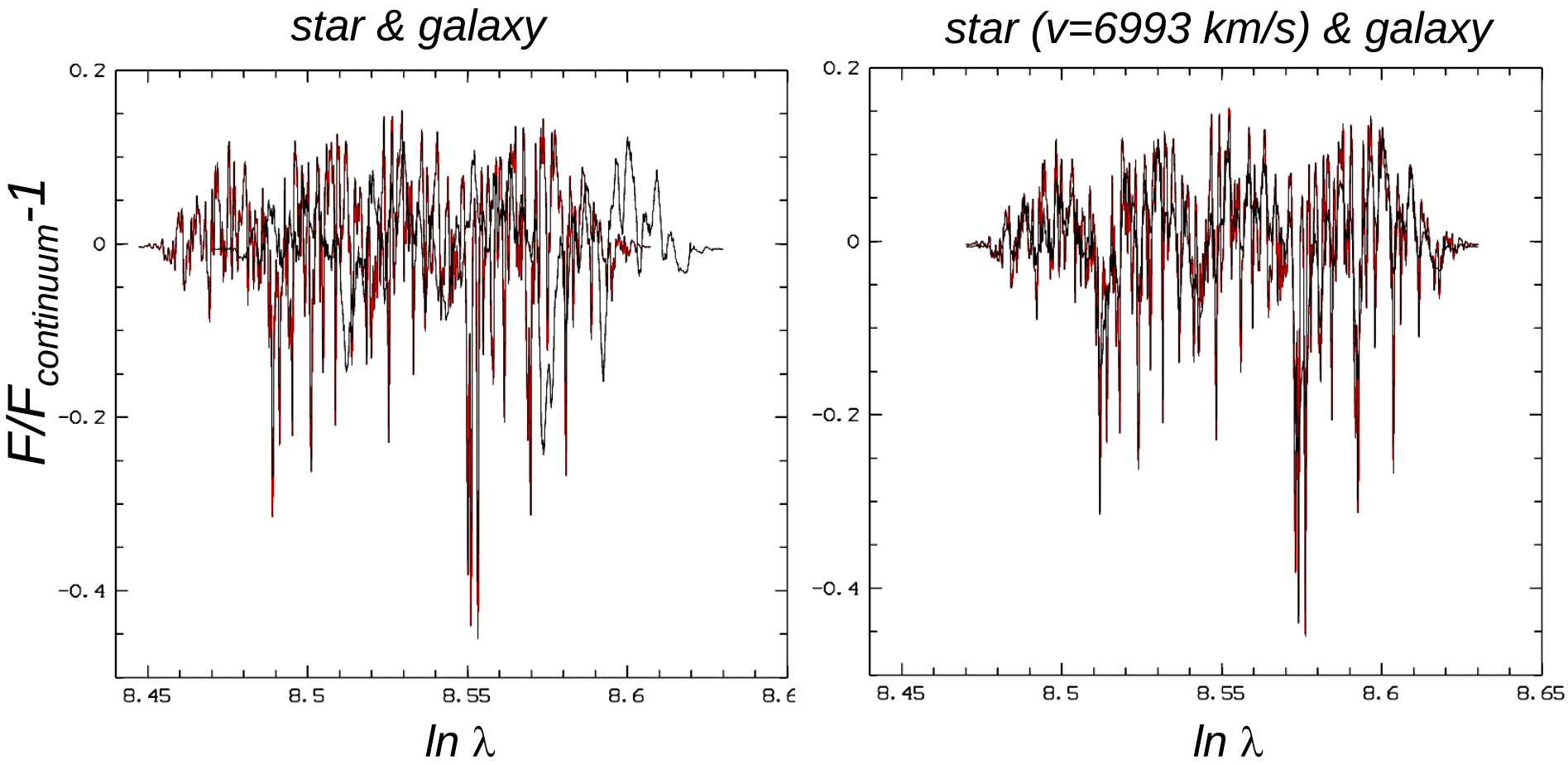
are the Gauss-Hermite basis functions

Gerhard (2003)
van der Marel & Franx (2003)

Stellar kinematics: LOSVD

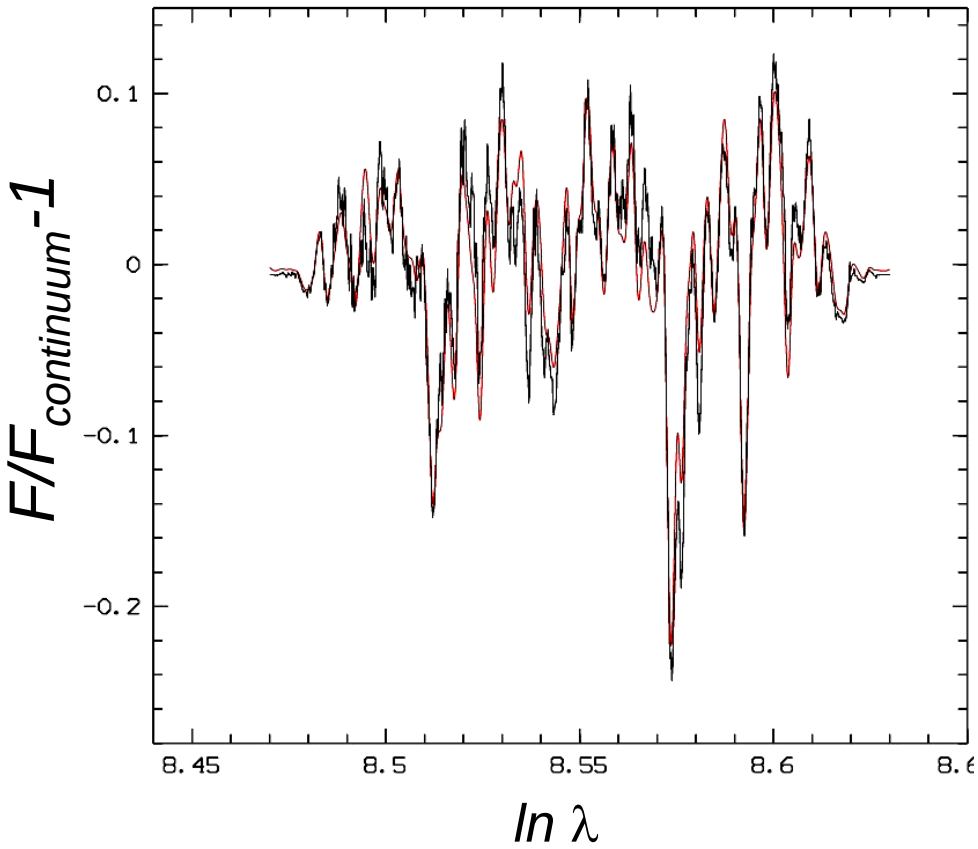


Stellar kinematics: LOSVD

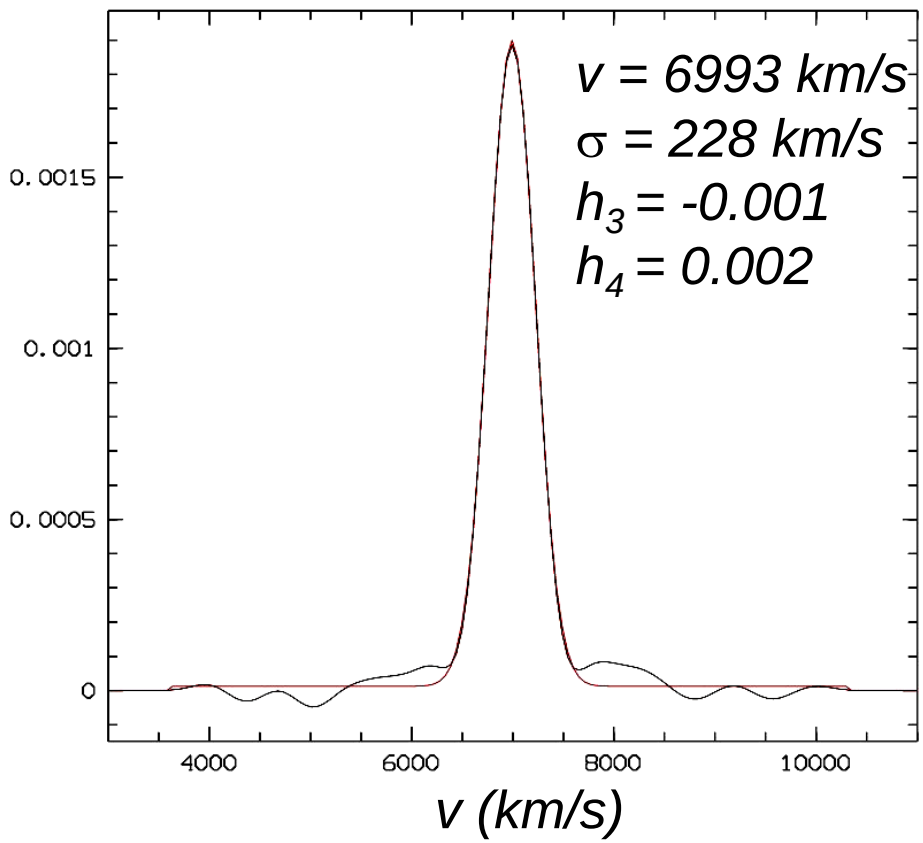


Stellar kinematics: LOSVD

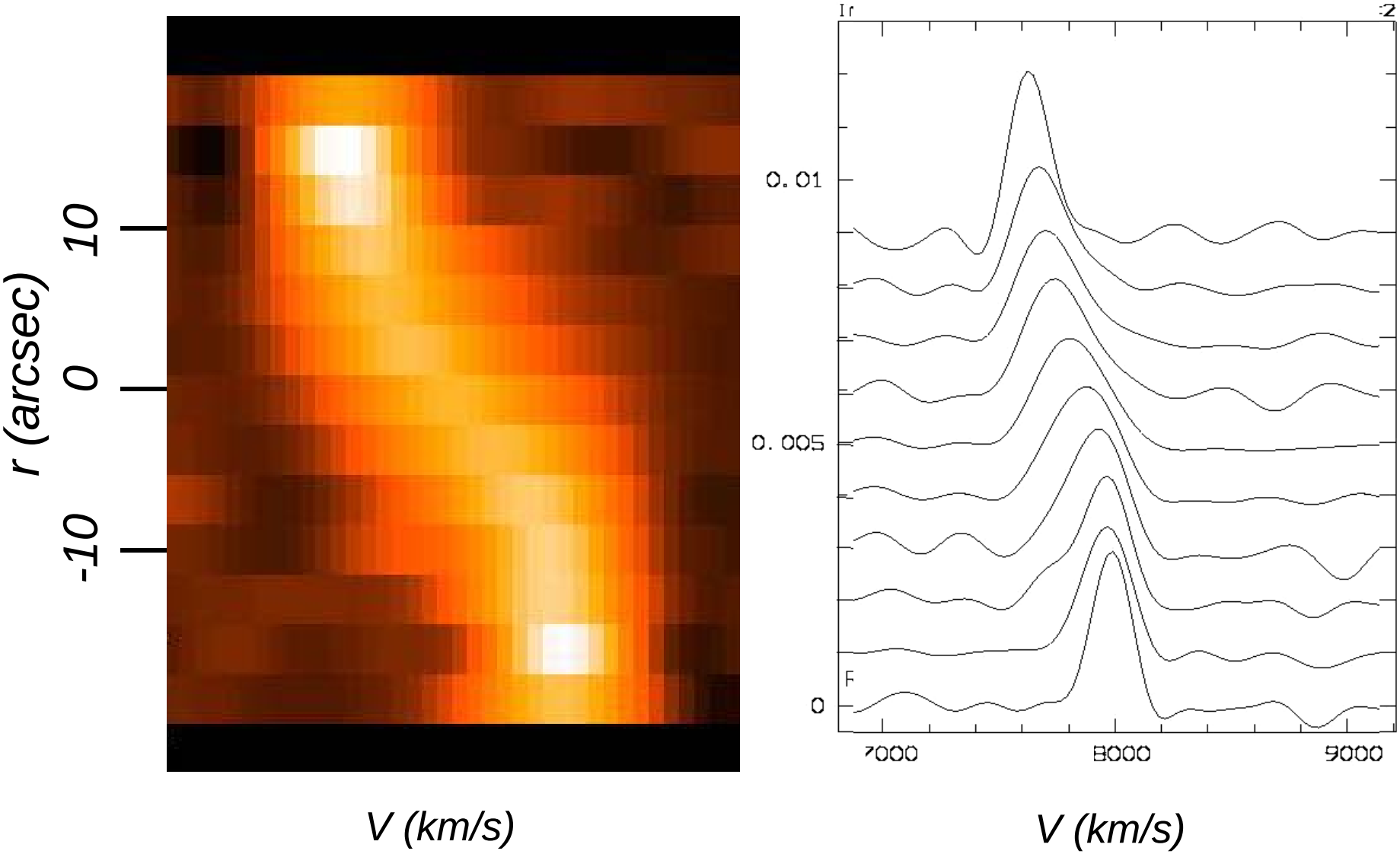
star & galaxy



LOSVD & fit



LOSVD: NGC 4807



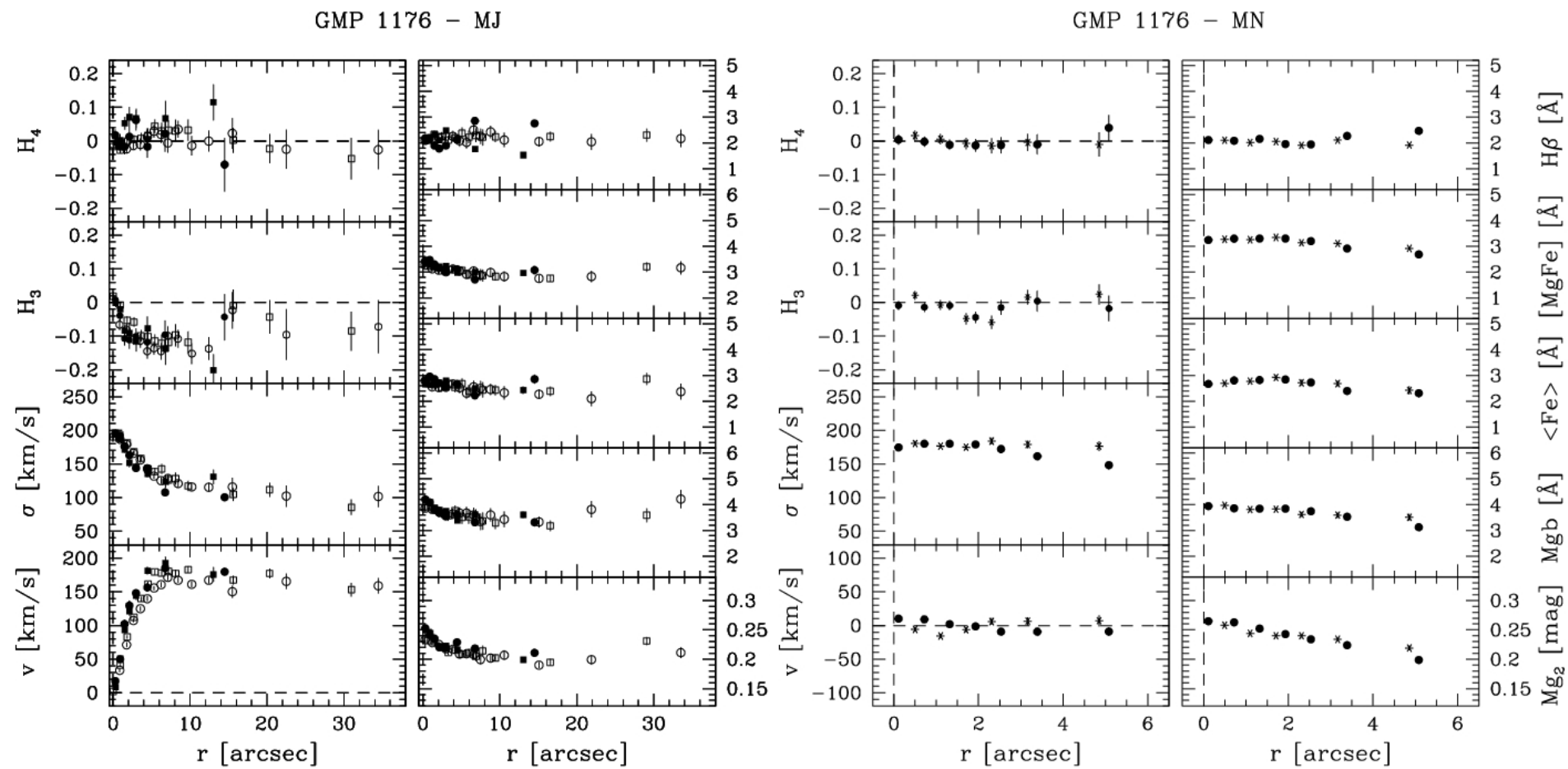
Stellar kinematics: NGC 4931

major axis

kinematics *line indices*

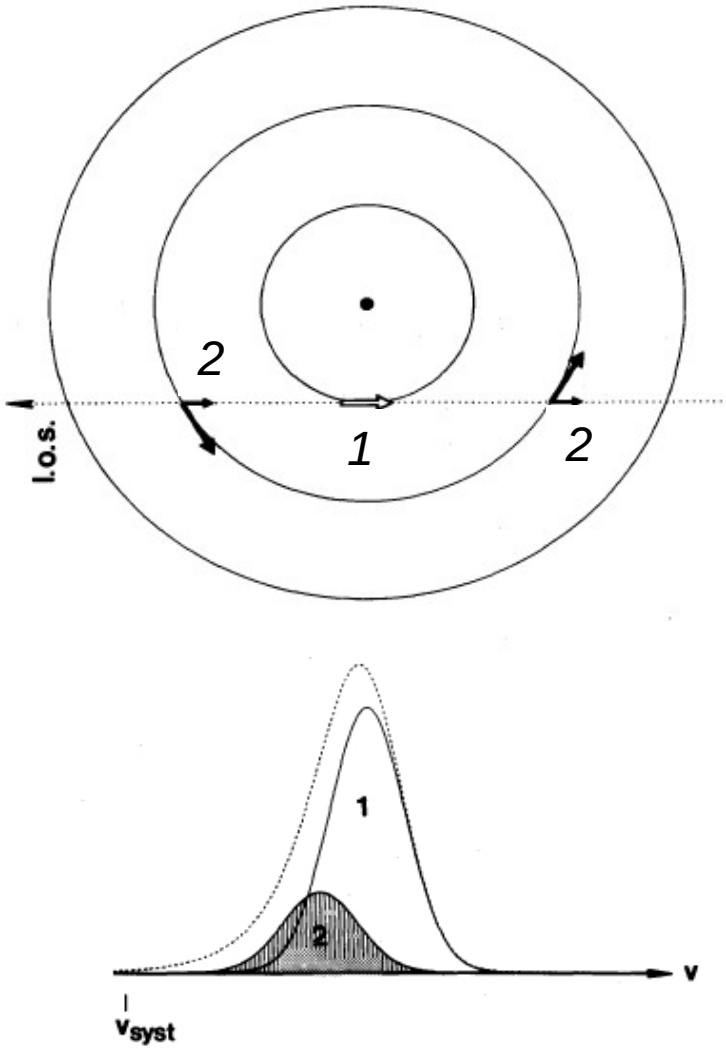
minor axis

kinematics *line indices*



Corsini et al. (2006)

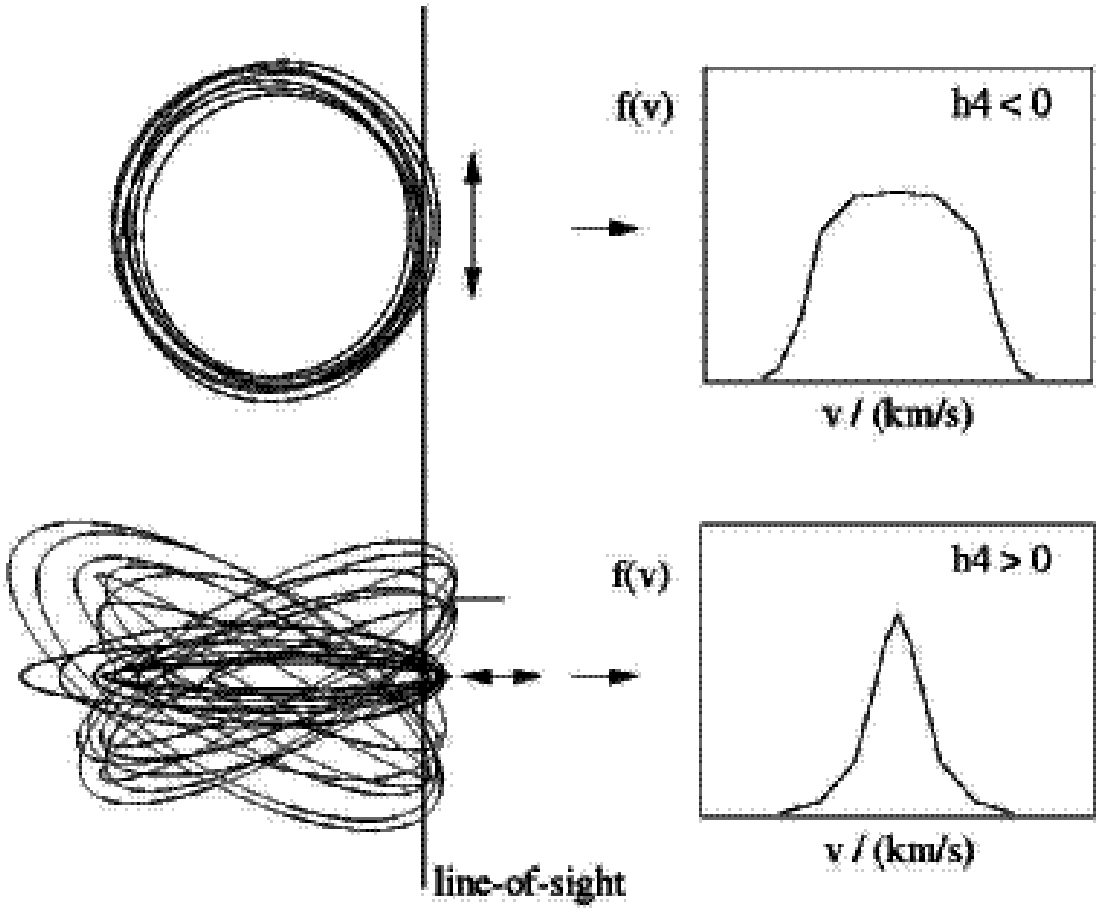
LOSVD: h_3



V>0 (receding) h_3<0
V<0 (approaching) h_3>0

Bender et al. (1990)

LOSVD: h_4

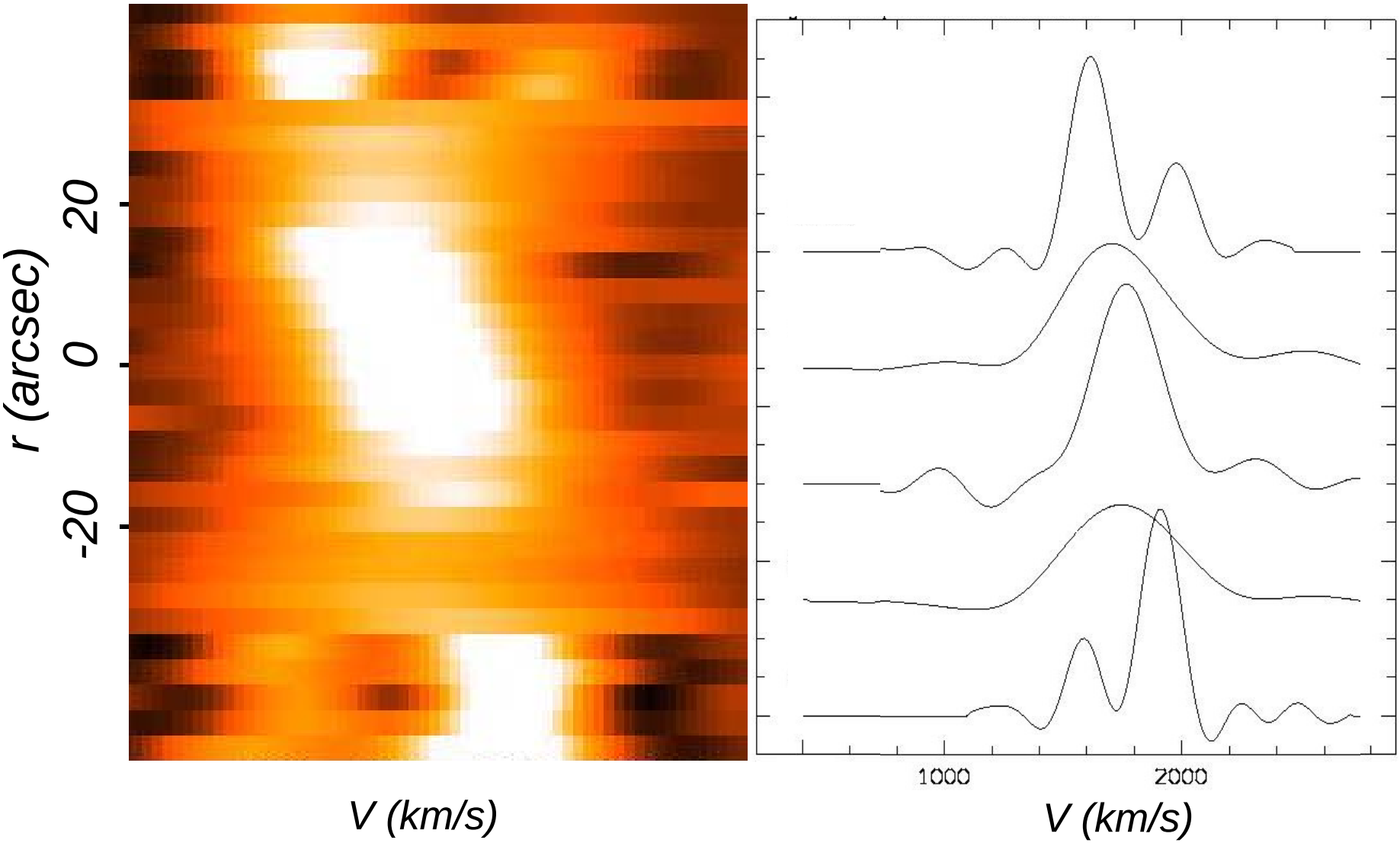


tangential anisotropy $h_4<0$

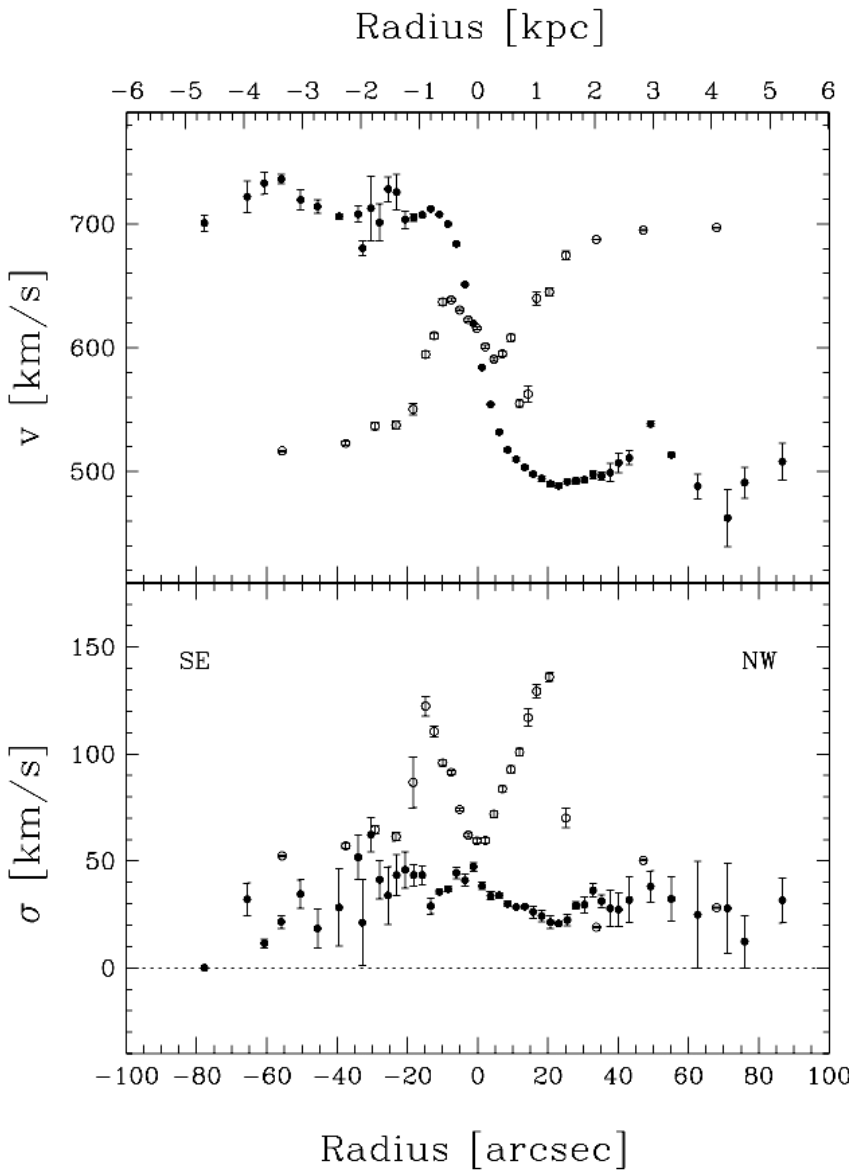
radial anisotropy $h_4>0$

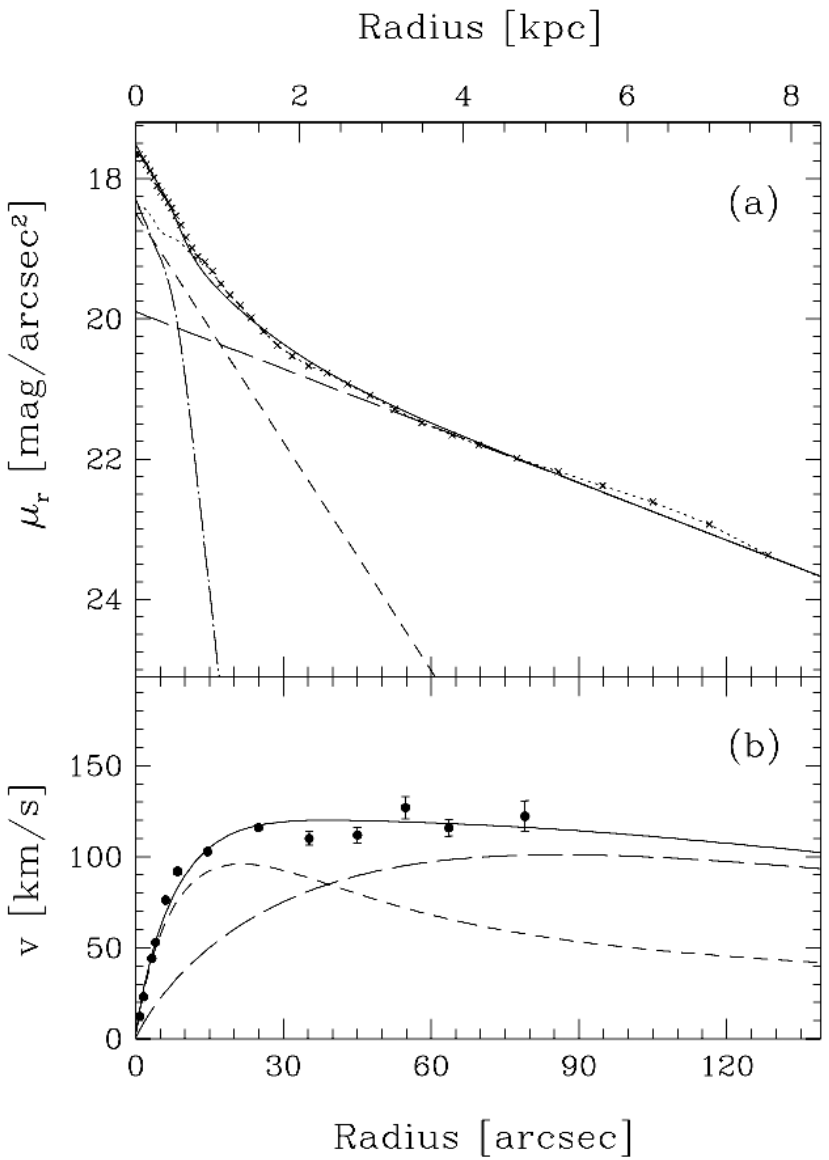
stolen to R. Saglia

LOSVD: Stellar counterrotation



Counterrotating stellar disks: NGC 3593

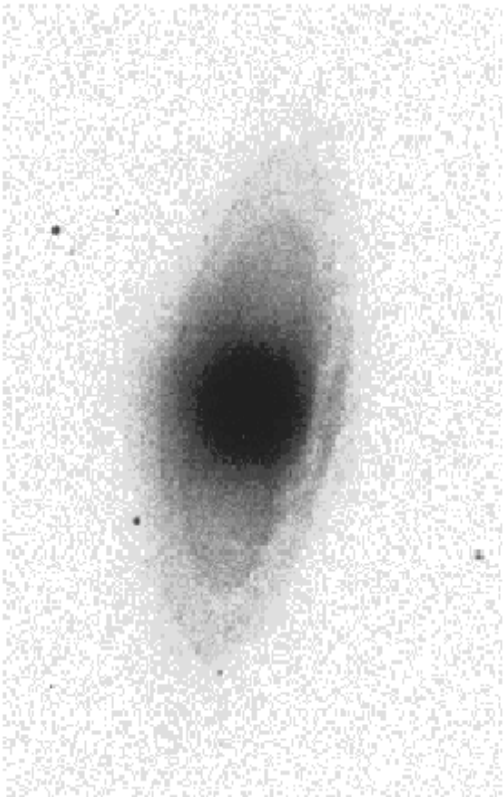




Bertola et al. (1996)

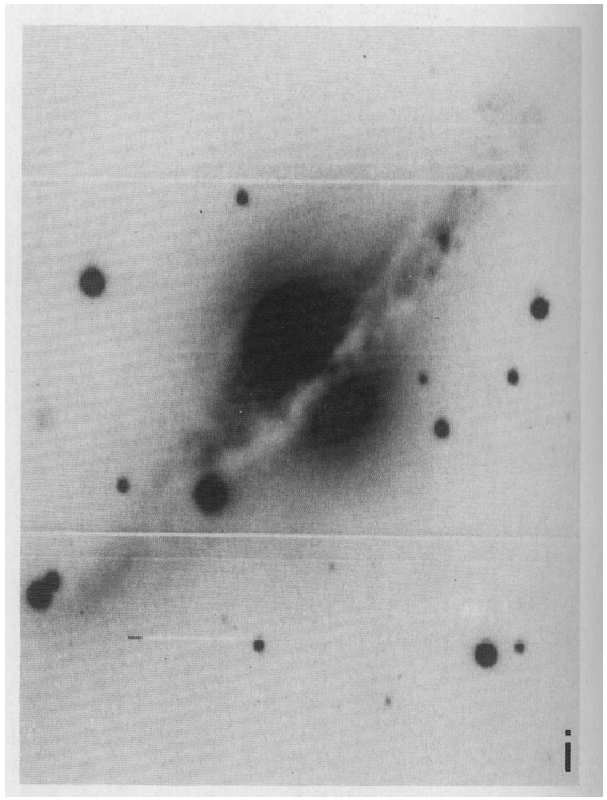
Morphological peculiarities and kinematical decouplings

NGC 4698 (Sab)



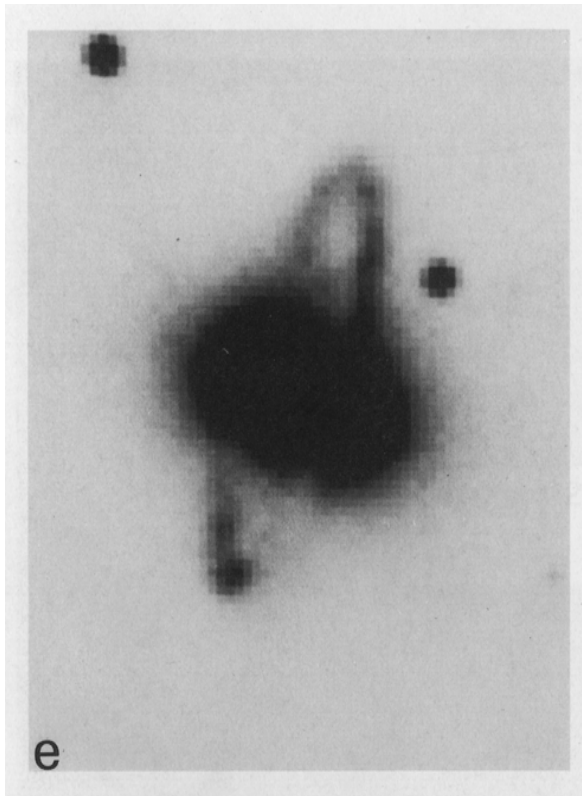
CAG Panel 76

NGC 4672 (Sa pec)



PRC C-42 Plate 146

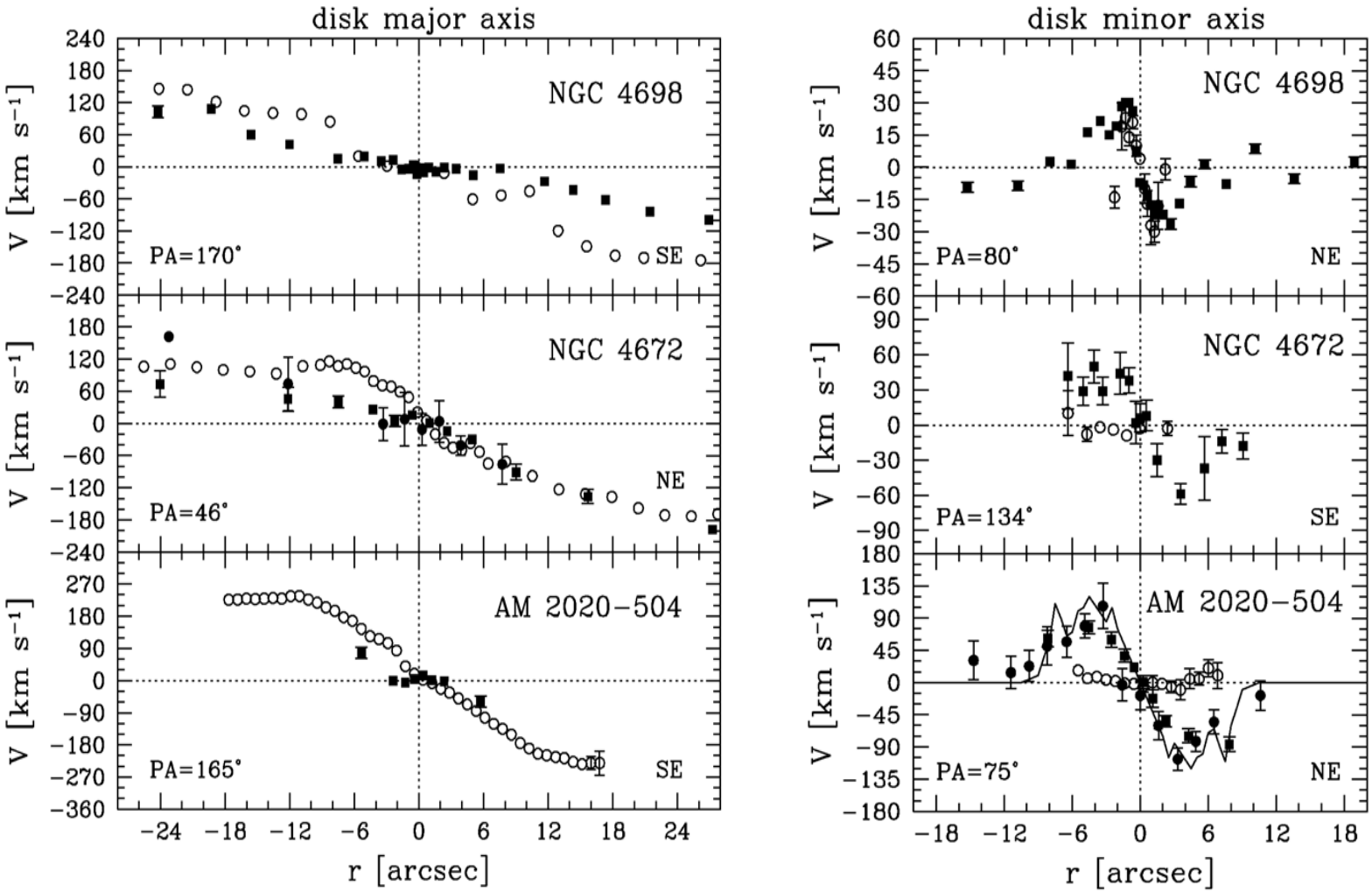
AM 2020-504 (PR E4)



PRC B-19 Plate 145

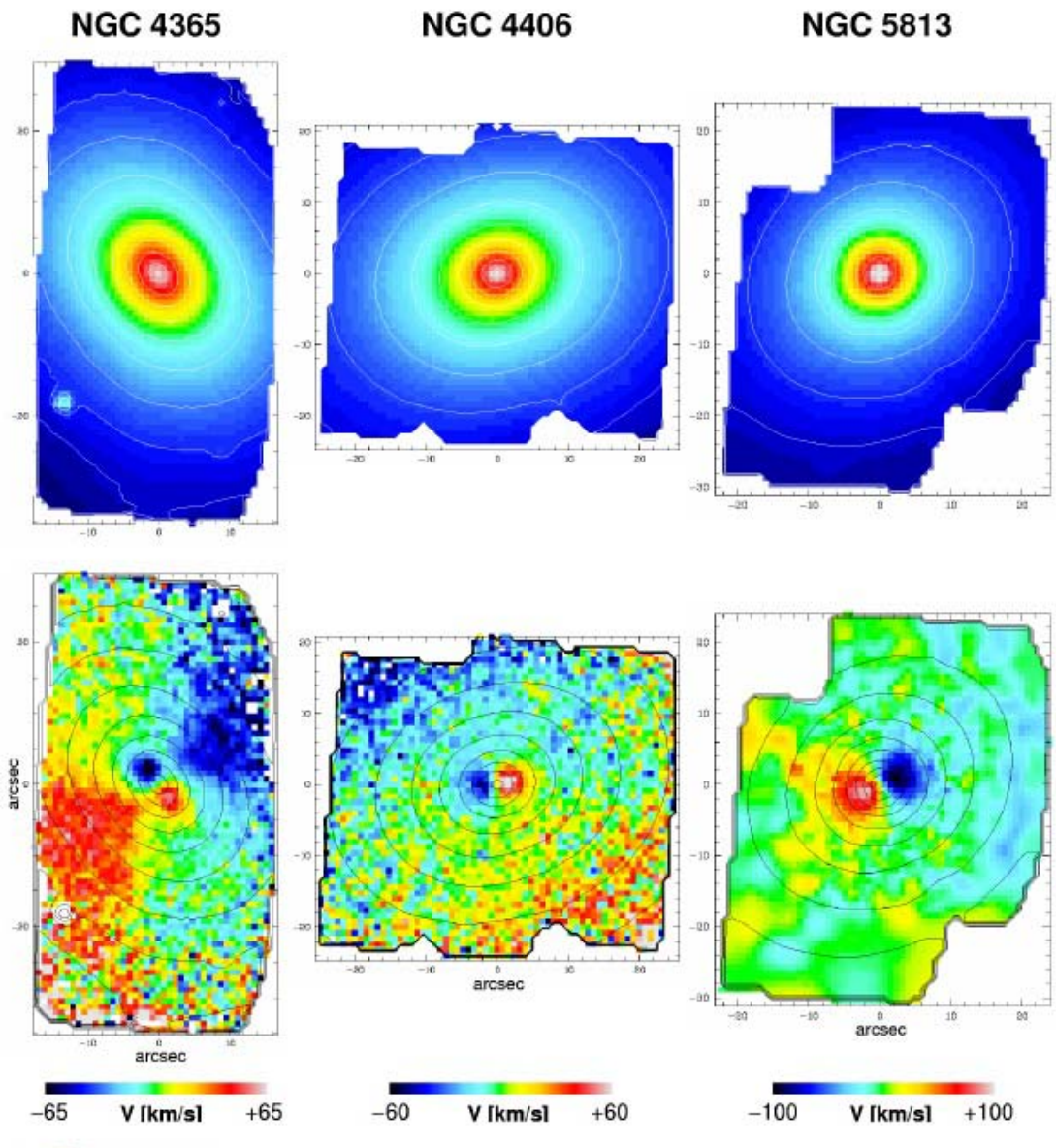
Bertola & Corsini (1999)

Kinematical decouplings: long-slit spectroscopy



Bertola & Corsini (1999)

Kinematical decouplings: 2D spectroscopy



Emsellem et al. (2003)