Distribution of ionized gas in the galaxies with fading star formation

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We study the structure and kinematics of ionized gas in four early-type galaxies at different stages of the transition from the blue cloud of star-forming galaxies to the sequence of passively evolving galaxies. This sample was already studied in HI by Wong et al. (2015). Some galaxies present spatial offsets between gas reservoir and stellar discs. Consideration of ionized gas properties helps us to draw a conclusion about the processes that lead to a fast truncation of star formation on time-scales of several hundred Myr to 1 Gyr. Owing to the lack of neighboring galaxies, this rapid quenching appears most likely due to AGN activity. Using long-slit and 3D spectroscopic observations at the Russian 6-m telescope, we attempt to describe the misalignment between gaseous and stellar discs with the spatial resolution 5-10 times better than the HI data.

The sample and observations

We performed observations of Wong et al. 2015 sample at the SAO RAS 6-m telescope BTA with the SCORPIO-2 optical reductor (Afanasiev, Moiseev, 2011) working on the scanning Fabry-Perot interferometer and the long-slit spectrograph mode in 2015.
In order to obtain nebular spectra we subtracted the absorption model from galactic long-slit spectra using ULySS. For that purpose, the Elodie and Vaz Miles stellar libraries were accepted.
The velocity fields obtained from the observed data cubes were analyzed using the "tilted-ring" method: they were splited into 1″-wide elliptical rings in agreement with the adopted inclination and position angle of the major axis of the disc. In each ring, we fitted the observed distribution of the line-of-sight velocities by the circular rotation model. The inclination and system velocity were fixed after adopting the optimal values.

Parameters of the sample from Wong et al. (2015)

Galaxy	RA (J2000)	Dec. (J2000)	Redshift	Distance, Mpc	r	u−r	log(M*)
J1237+39	12:37:15.7	+39:28:59.3	0.02035	105	-20.9	2.16	10.3
J1117+51	11:17:33.3	+51:16:17.7	0.02767	113	-21.4	2.33	10.6
J0900+46	09:00:36.1	+46:41:11.4	0.02748	115	-21.3	2.20	10.5
J0836+30	08:36:01.5	+30:15:59.1	0.02561	84	-21.1	2.27	10.7

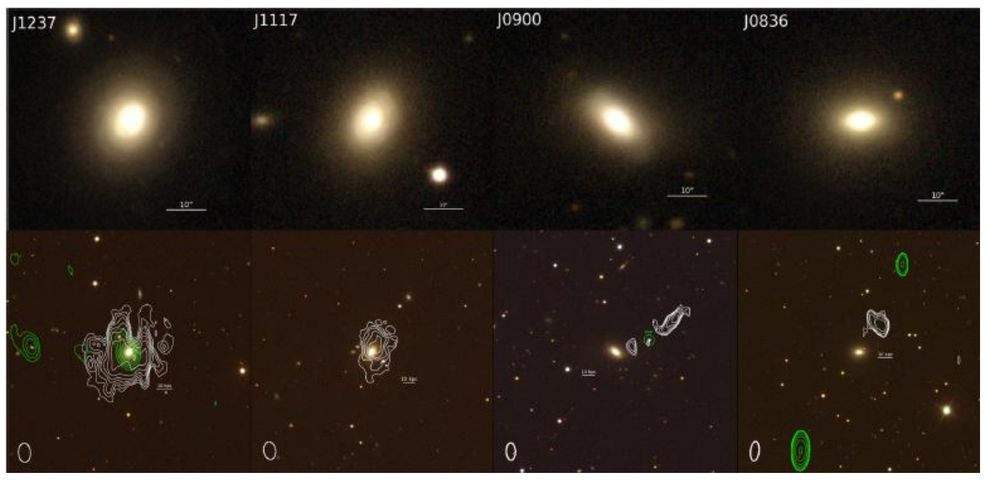


Table 1 (left) with optical properties of the objects; Fig.2: top row – SDSS optical images; bottom row – HI (white) and radio continuum (green)
(Table 1 and Fig. 2 from Wong et al.2015, respectively)

J1237+39

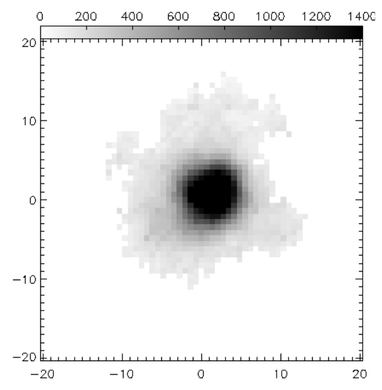
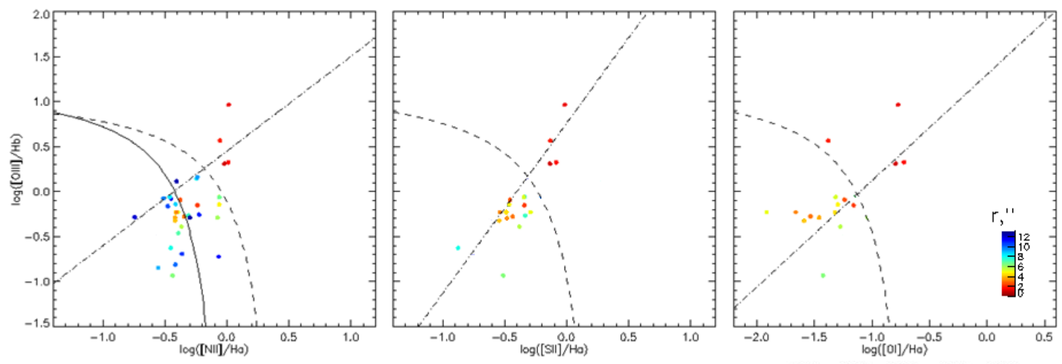
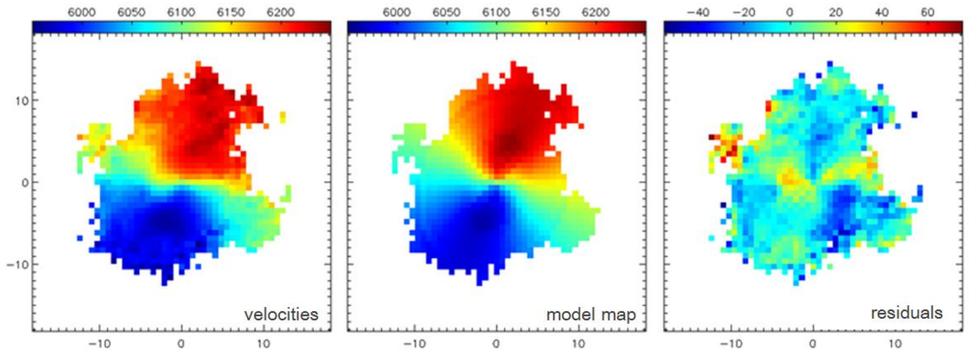


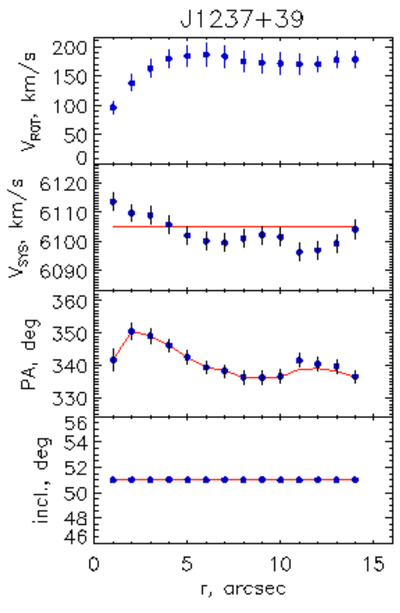
Image in the Hα emission line according to our FPI data



(top) Diagnostic diagrams for the [OIII]/Hβ line ratios as a function of [NII]/Hα, [SII]/Hα, and [OI]/Hα. The color of dots represents the perpendicular distance to the nucleus in kpc. Lines of separating star formation from shocks: the dashed line is [Kewley(2001)] curve, the solid line is [Kauffmann (2003)] curve; the dashed-dotted line separates LINER versus Seyfert according to [Schawinski (2007)]. We confirm nuclear LINER activity that was also mentioned in Wong et al., 2015.



(right) The results of modeling, red lines represent accepted values of model parameters: PA=330, *i*=51, V*sys*=6105 km/s.
(bottom) FPI data in the Hα emission line: observed velocity field, model map, and residual velocities.



J1117+51

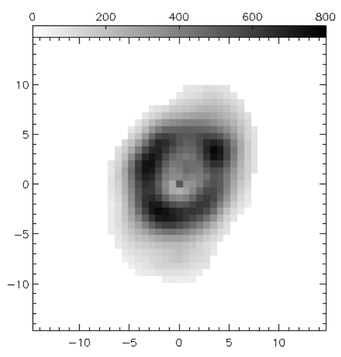
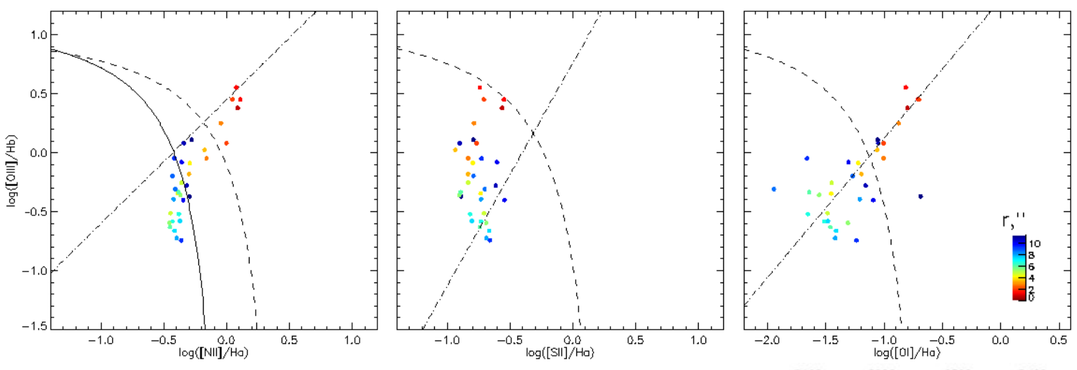
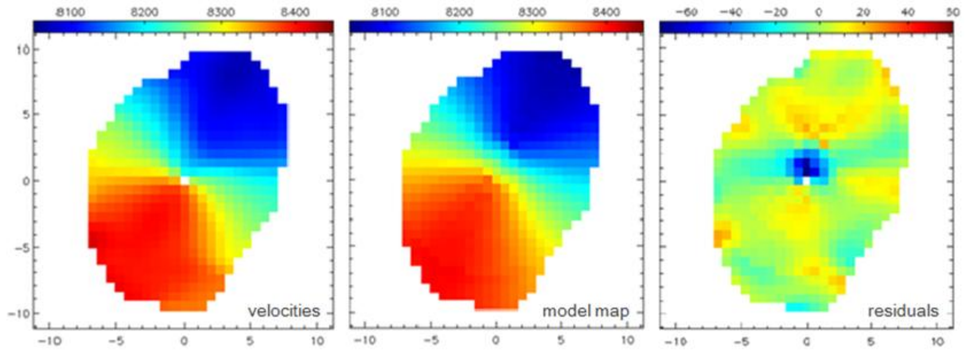


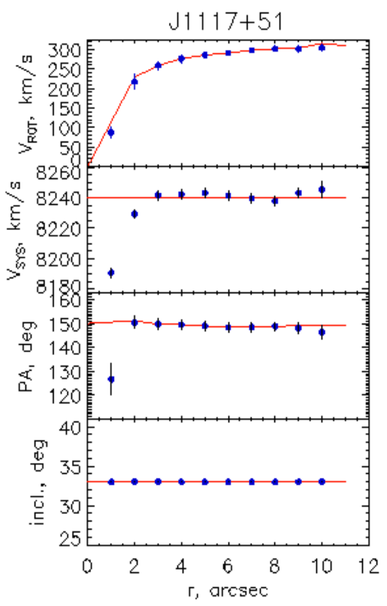
Image in the Hα emission line according to our FPI data



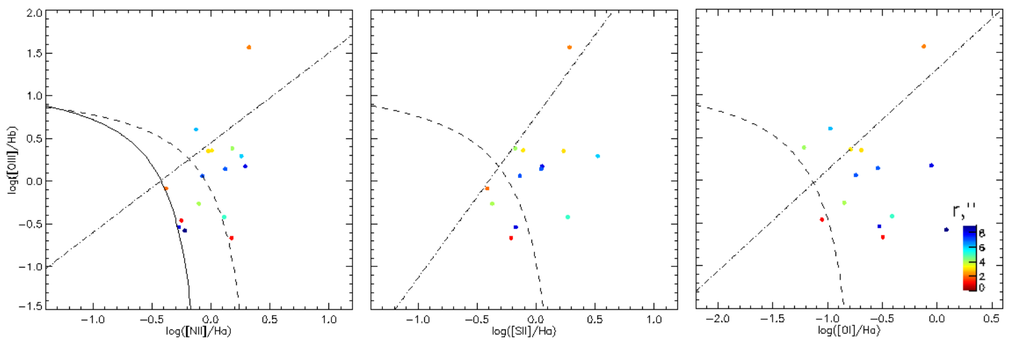
(top) Diagnostic diagrams for the [OIII]/Hβ line ratios as a function of [NII]/Hα, [SII]/Hα and [OI]/Hα.
Designations are all the same. The character of nuclear activity is undefined, in Wong et al. (2015) it's LINER (perhaps without stellar model subtraction).



(right) The results of modeling, red lines represent accepted values of model parameters: PA=150, *i*=33, V*sys*=8240 km/s.
(bottom) FPI data in the Hα emission line: observed velocity field, model map, and residual velocities. We can see a negative deviation from the system velocity in the nucleus (~70 km/s).



J0900+46 and J0836+30



J0900+46: according to BRT diagrams, there is no star-formation. This is in a good agreement with Wong et al. (2015).
In **J0836+30**, after removing absorption model, we found no standing out emission lines. It lies in agreement with Wong et al., 2015, where it is said that the gas reservoir could be expelled from galactic disc by the AGN activity.

Conclusions

The HII kinematics and distribution are in a good agreement with the conclusions of Wong et al. (2015) based on the HI data.
J1237+39 and J1117+51 are at the earliest stage of quenching – the star-forming processes still occur as we can see on the BPT diagrams. In J1237+39, we observe symmetric rotating disc with moderate disturbances. In J1117+51 nucleus, the deviation from the system velocity is noticeable, we can also observe a ring structure in Hα.
At more advanced stages of quenching, star-formation has almost stopped (J0900+46), or emission lines are too feeble, perhaps because of the physical expulsion of entire gas reservoir (J0836+39).

References

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