



Counterrotating starforming disk in the S0 galaxy IC 560

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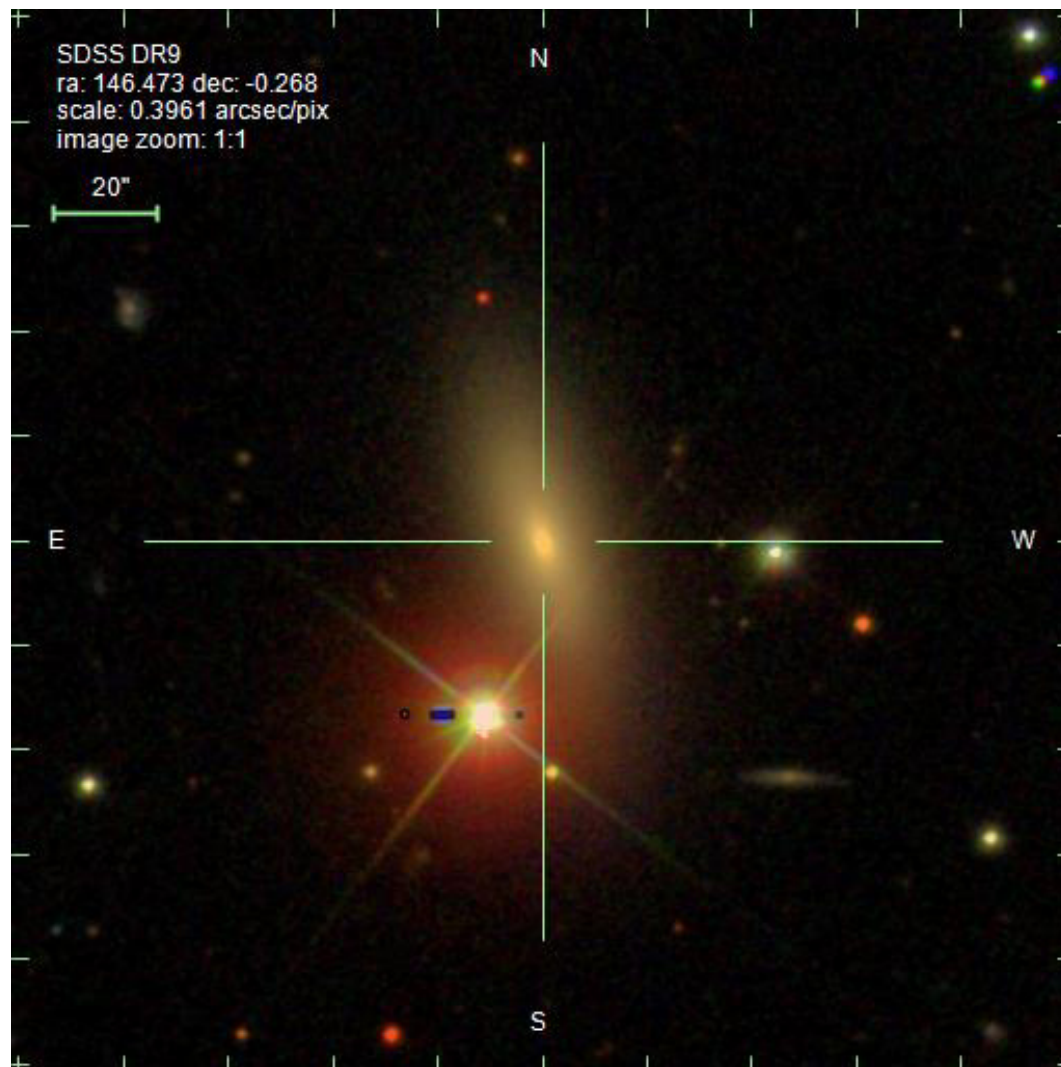
SAI MSU of M.V. Lomonosov

Multi-Spin Galaxies 2016

SAO, Nizhnij Arkhyz

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IC 560



M_B , mag (<i>HyperLeda</i>)	-18,32
M_K , mag	-22.1
v_{sys} , km/s (<i>NED</i>)	1853
Distance, Mpc (<i>NED</i>)	23
z (<i>NED</i>)	0,0062
Environment (<i>HyperLeda, NED</i>)	Galaxy from group NGC2967 (6 objects) [MK2011]

Observation

- The long-slit spectral observations were made with the spectrograph RSS installed at the 11m telescope SALT in the South African Astronomical Observatory during two nights : 4 and 6 January 2013.
- Summary exposition – 1 hour.
- The spectral range 3750 – 6850 Å, spectral resolution 5,5 Å, the slit width was 1,25 arcsecond.
- The slit has been aligned with the major axis of the galaxy; PA = 15°.

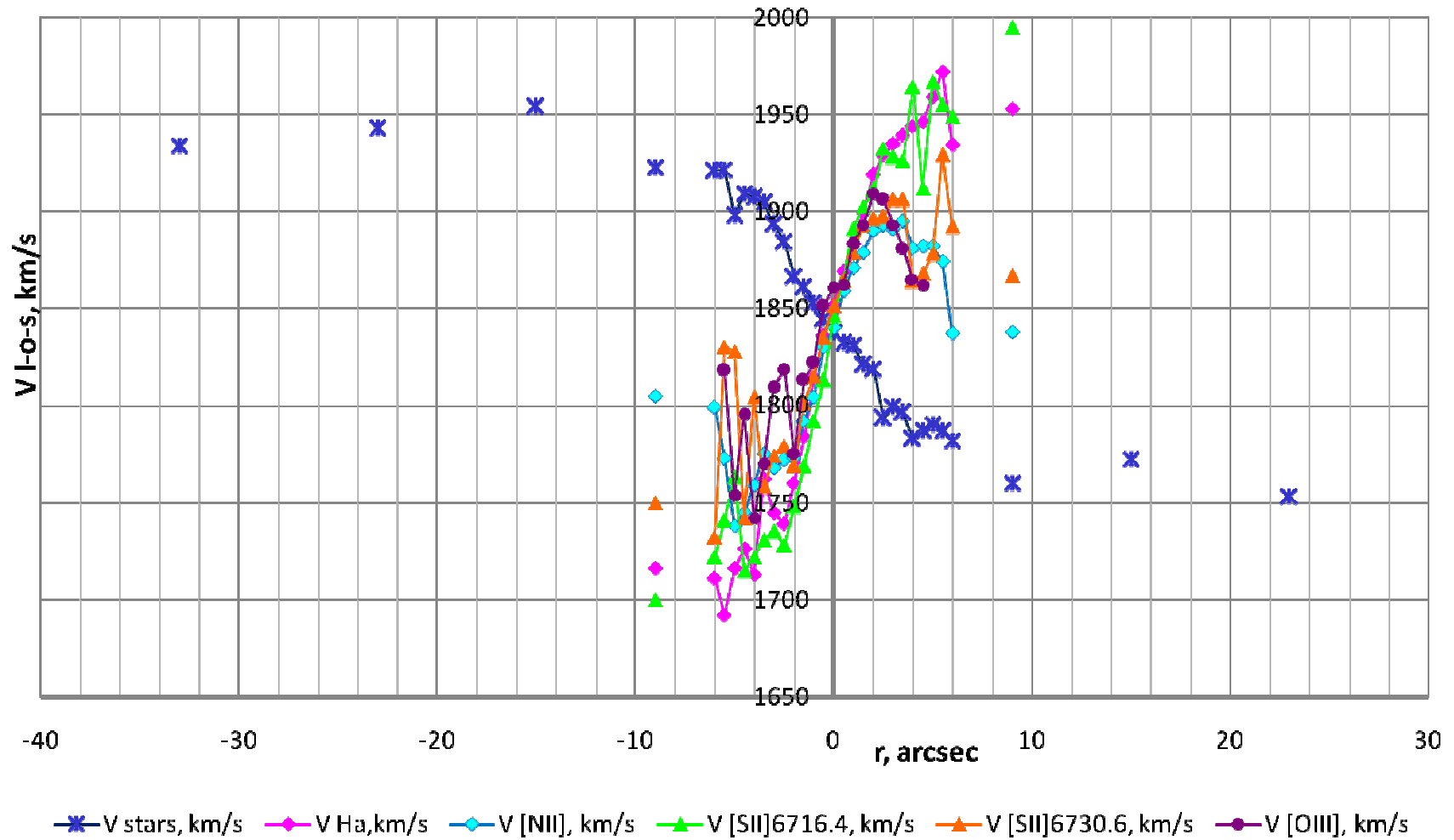
Kinematics of stars and gas in the IC 560

The line-of-sight velocities of the ionized gas in the galaxy were determined by means of Gaussian multi-component fitting of the [NII] λ 6548+6583+H α (emission)+H α (absorption) lines blend and the [OIII] λ 5006.9 and [SII] λ 6716.4, 6730.6 emission lines .

The line-of-sight velocities of stars in the galaxy were determined by means of cross-correlating blue-green part (4050-5590 Å) of the spectra with the spectrum of a K-giant star.

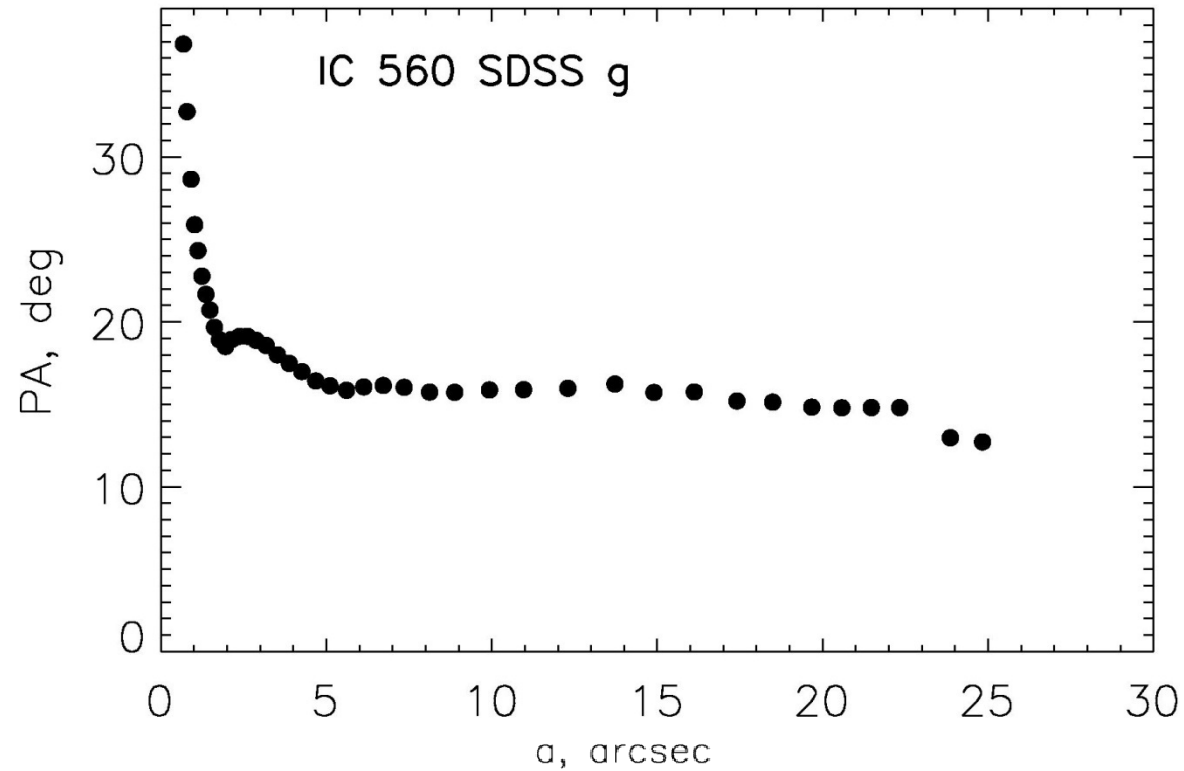
Kinematics of stars and gas in the IC 560

Line-of-sight velocities in IC 560



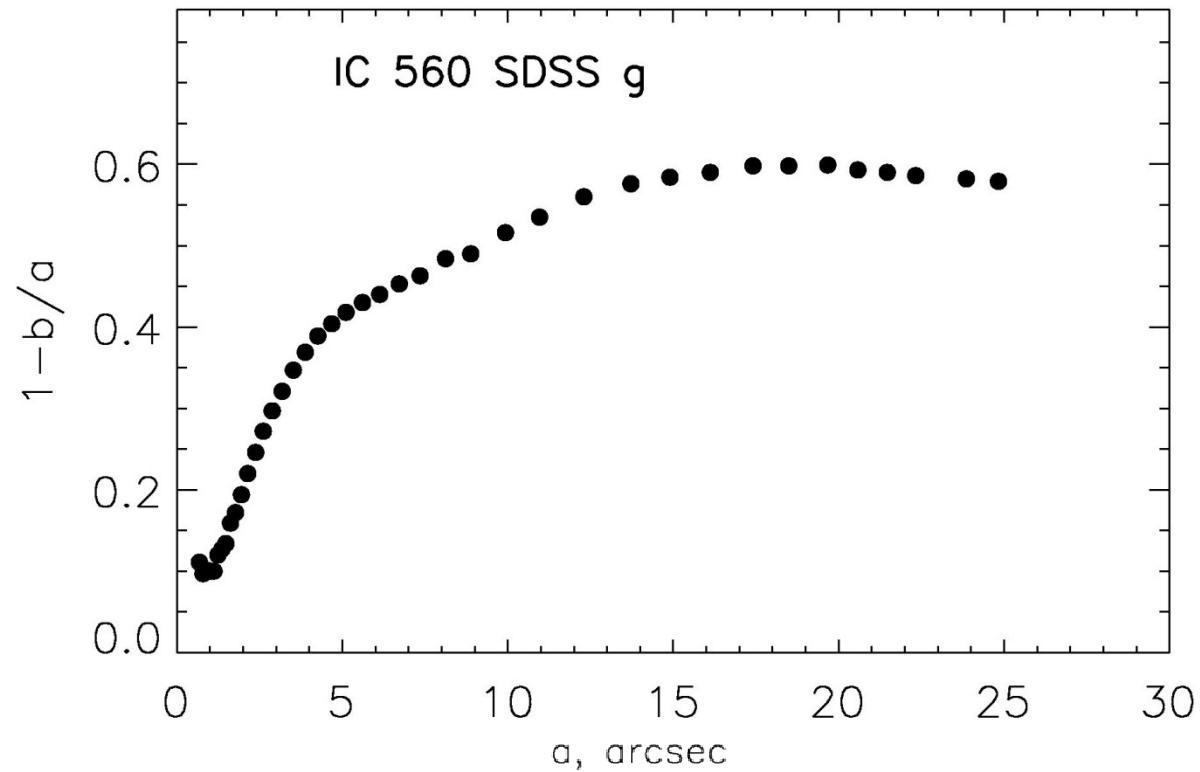
Results of the isophote analysis

1. Position angle of the galaxy IC 560 along the radius



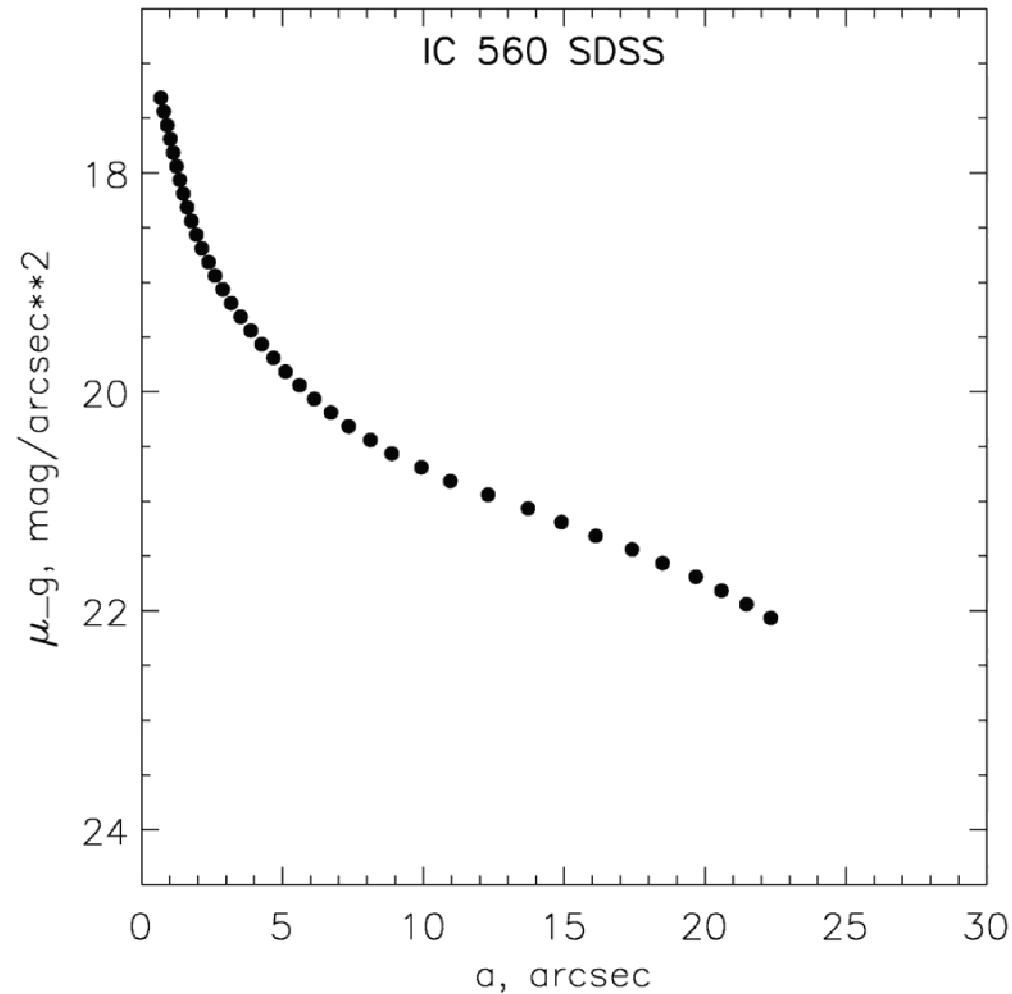
Results of the isophote analysis

2. The isophote ellipticity of the galaxy IC 560 along the radius



Results of the isophote analysis

3. Radial profile of the surface brightness of the galaxy IC 560

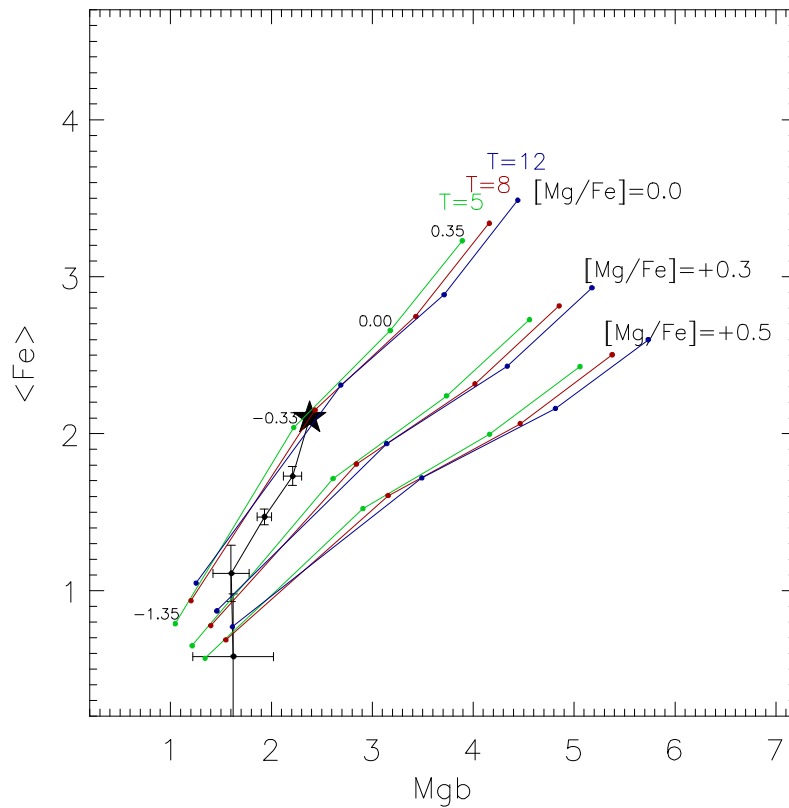


Stellar population properties

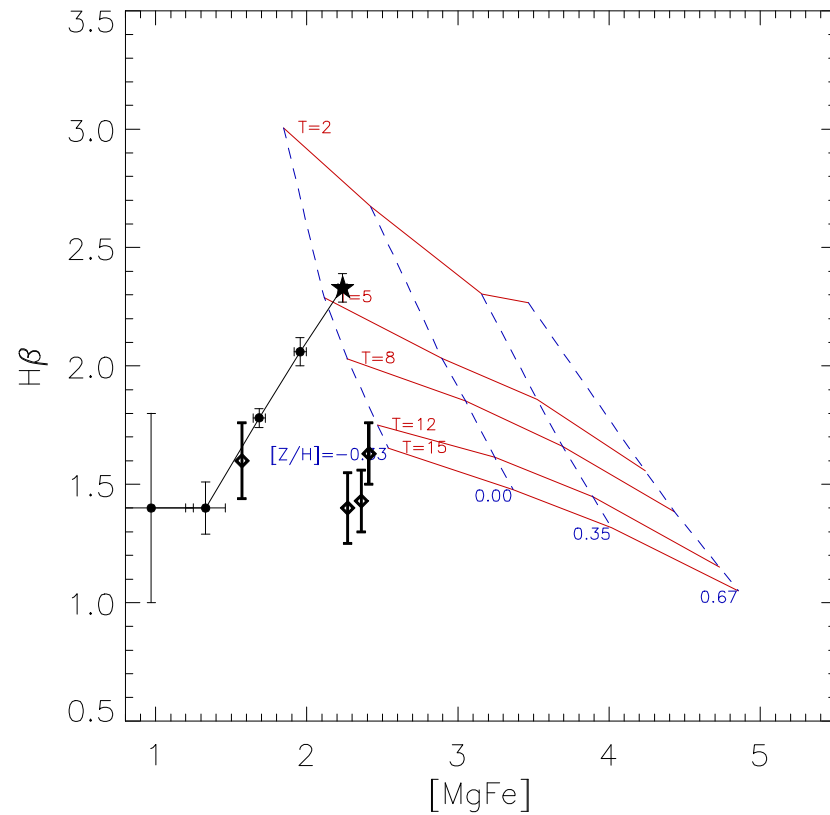
- Measurement of the Lick indices ($H\beta$, Mgb, Fe5270, Fe5335) along the radius (*major axis*).
- Estimation of the SSP-equivalent ages, metallicities and magnesium-to-iron abundance ratios by means of diagnostic diagram (Thomas D., Maraston C., Bender R., 2003).

Stellar population properties

The estimate of magnesium-to-iron abundance ratios $[Mg/Fe]$ in the galaxy IC 560 along the radius



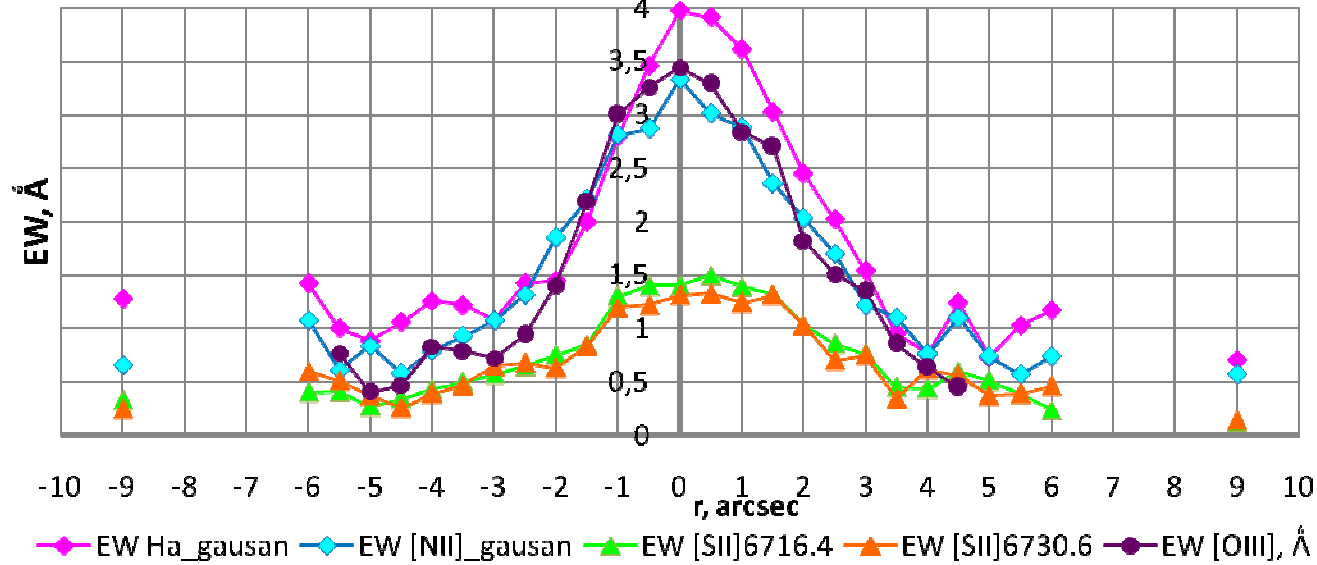
The estimate of SSP-equivalent ages and metallicities of the stellar population in the galaxy IC 560 in the center ($r < 4''$), in the ring-like region $4'' \leq r \leq 6''$ and $6'' < r < 12''$ and in the disk ($12'' \leq r \leq 22''$ and $22'' < r < 38''$)



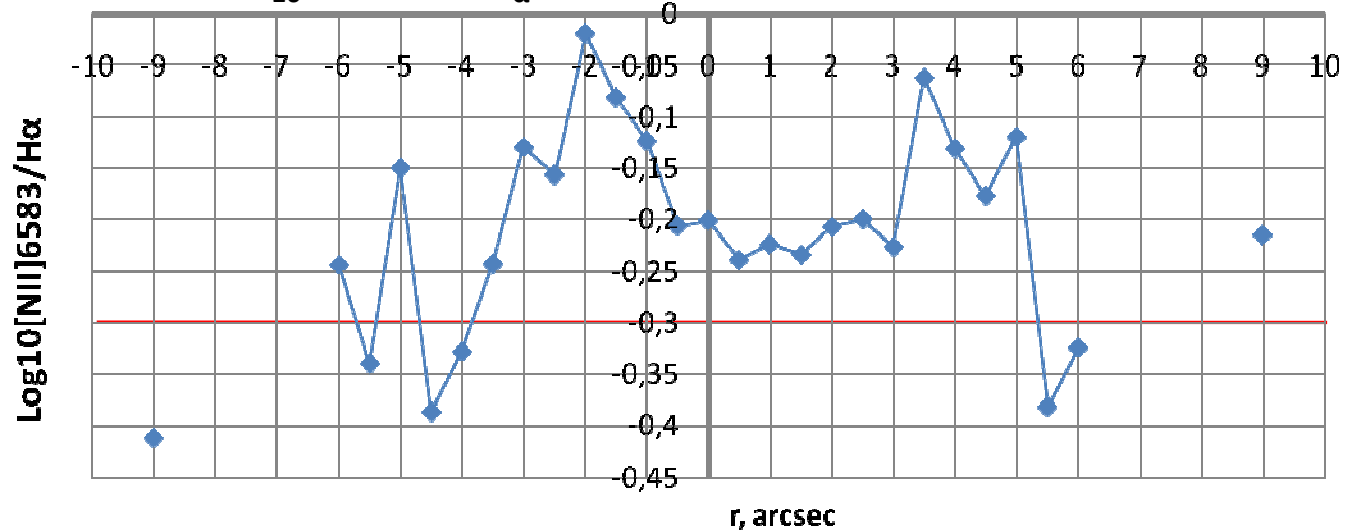
◇ - NGC 6356, NGC 6539, NGC 6838 and NGC 6171

Gaseous component in the galaxy IC 560

EW of the emission lines variation in the galaxy IC 560

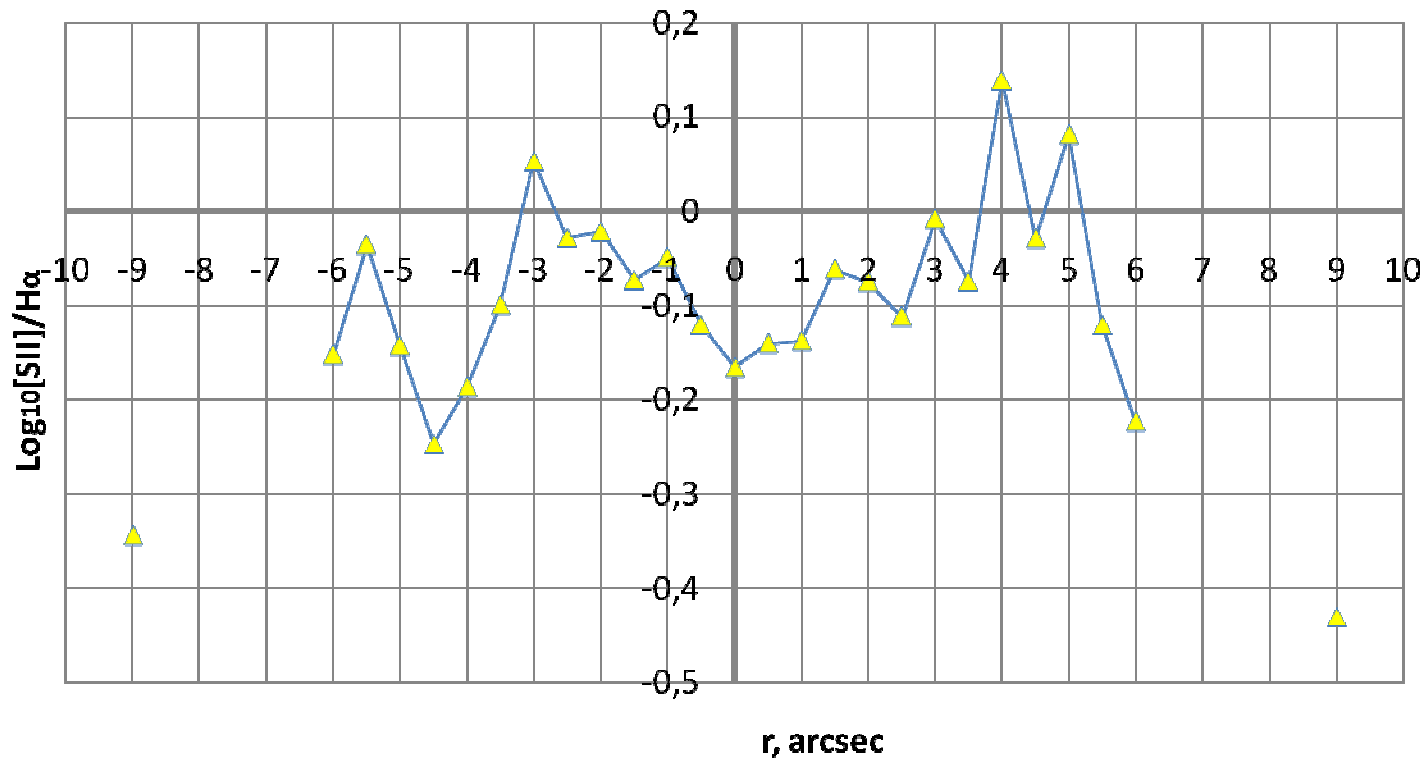


Log₁₀[NII]6583/H_α along the radius of the galaxy IC 560



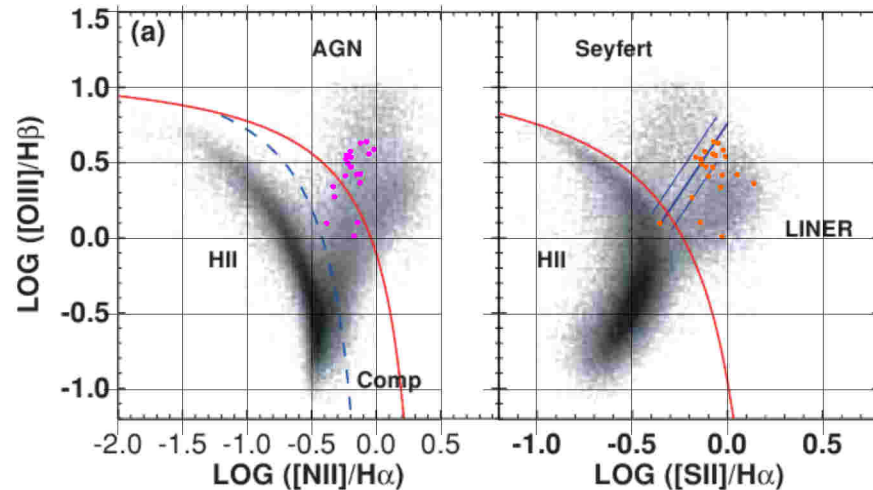
Gaseous component in the galaxy IC 560

$\text{Log}_{10} [\text{SII}]_{\lambda} / \text{H}\alpha$ along the radius of the galaxy IC 560

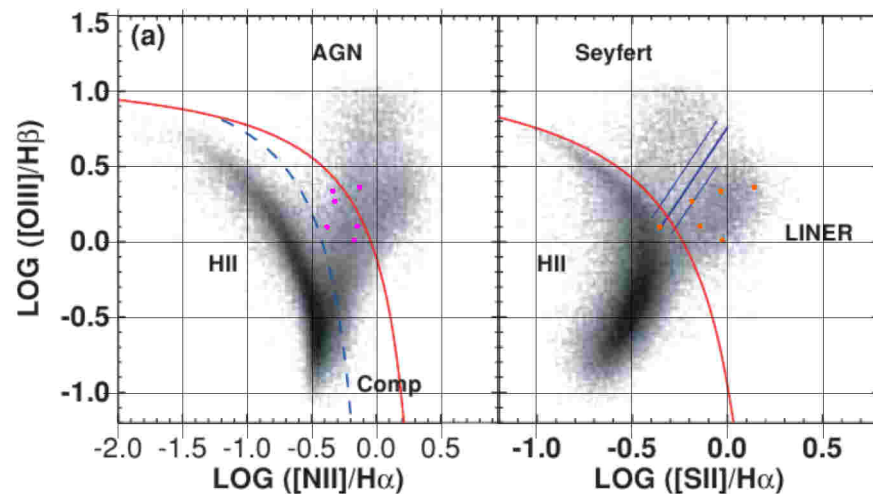


Gaseous component in the galaxy IC 560

BPT-diagnostic diagrams (Kewley L.J. et al., 2006) to separate gas excitation mechanisms



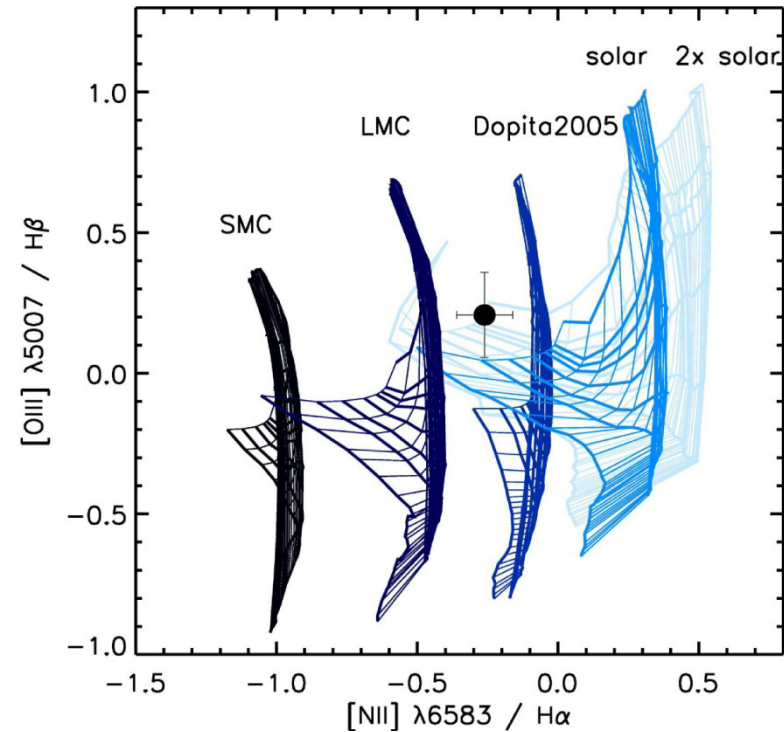
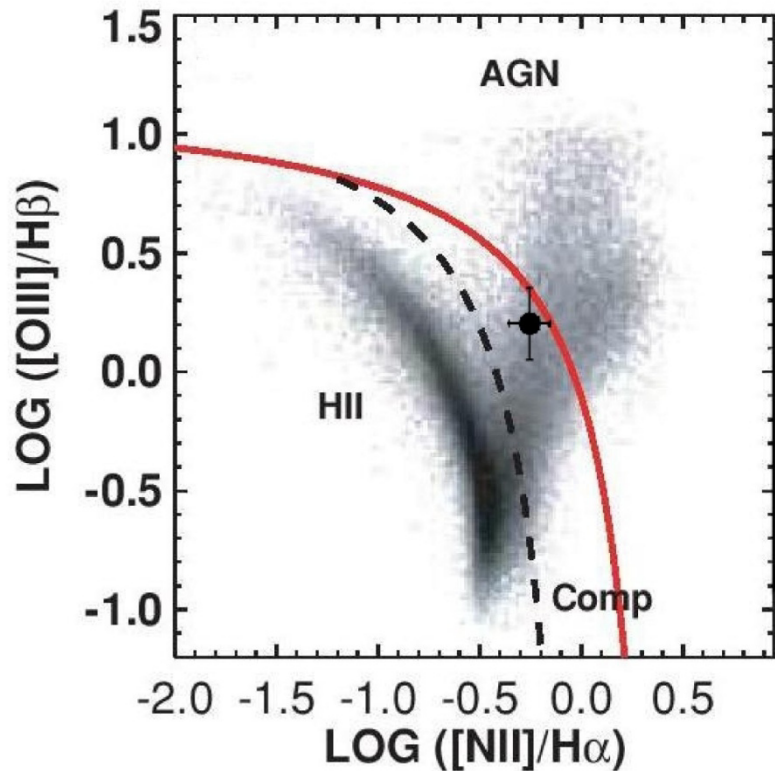
- for all measurements in the gaseous disk of IC 560



- only for the measurements in the region $4'' \leq r \leq 6''$ in the gaseous disk where presumably star-forming process dominated

Gaseous component in the galaxy IC 560

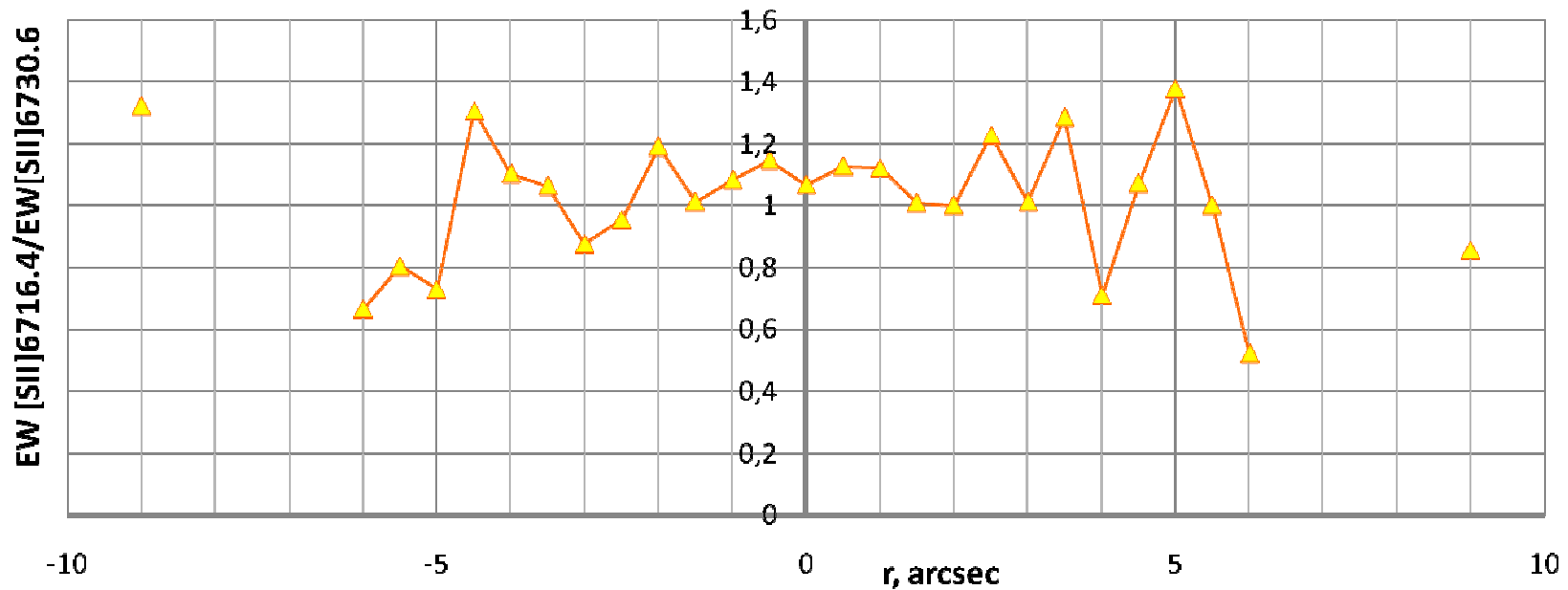
BPT-diagnostic diagrams (Kewley L.J. et al., 2006; Allen M.G. et al., 2008) to separate gas excitation mechanisms



Gaseous component in the galaxy IC 560

Estimation electron density in the ionized gas by using relation $EW[SII]_{6716.4}/EW[SII]_{6730.6}$ and nomogramme by Osterbrock & Ferland (2006)

Ratio $EW[SII]_{6716.4}/EW[SII]_{6730.6}$ along the radius of the galaxy IC 560



r, arcsec	$EW[SII]_{6717}/EW[SII]_{6731}$	$\Delta EW[SII]_{6717}/EW[SII]_{6731}$	$\langle Ne \rangle, cm^{-3}$
-5	0,92	$\pm 0,12$	700
0	1,08	$\pm 0,03$	400
5	0,94	$\pm 0,15$	600

Gaseous component in the galaxy IC 560

Estimation gas metallicity by using formula (Pettini & Pagel, 2004) only for regions with gas excitation dominated by the star-forming :

$$12+\log(\text{O}/\text{H})=8,90+0,57*(\log\{[\text{NII}]\lambda 6583/\text{H}\alpha\})$$

Comparison stellar and gaseous metallicities in the galaxy IC 560

Distance from the center r, arcsec	Stellar metallicity, [Z/H]	Gaseous metallicity (respect to solar value), $12+\log(\text{O}/\text{H})-8,66$
-4...-12	< -0,33	+0,04±0,04
+4...+12	< -0,33	+0,11±0,01

Conclusion

- In the lenticular galaxy IC 560 ionized gas is detected.
- The ionized gas, presumably, is excited by star-forming process observed in a ring-like region with the radius of 1 kpc.
- The **gaseous disk** of IC 560 is **counterrotating** with respect to the stellar disk.
- At the same distances from center the stellar and gaseous metallicities are different: the gas reveals solar oxygen abundance while the stellar population at the same radius is metal-poor.
- In this way, metal-rich gas was accreted from another galaxy, not from cosmological filaments containing primordial metal-poor gas.

Thank you for attention!