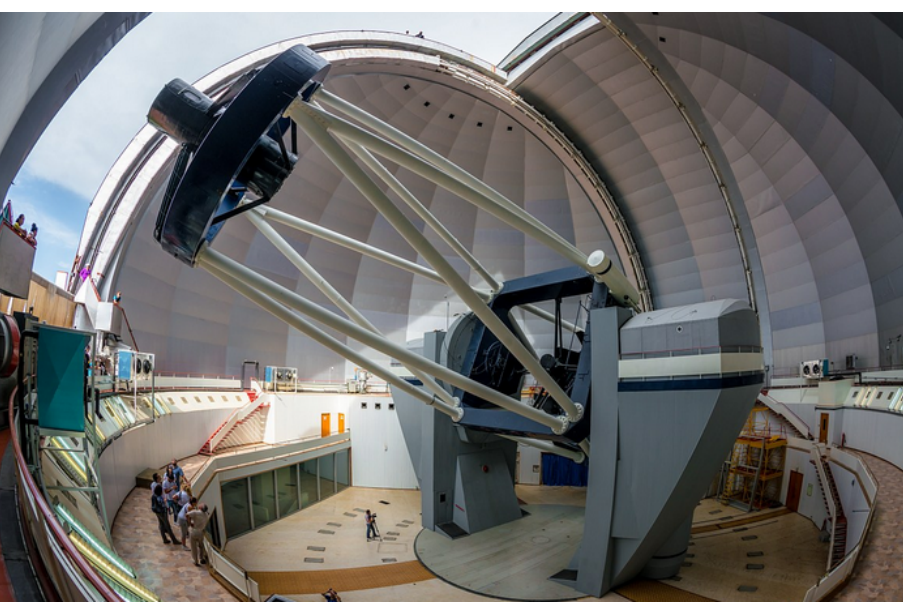




An interplay between radiative and kinetic AGN feedback in the Seyfert galaxy Mrk 783

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The SAO RAS 6m telescope

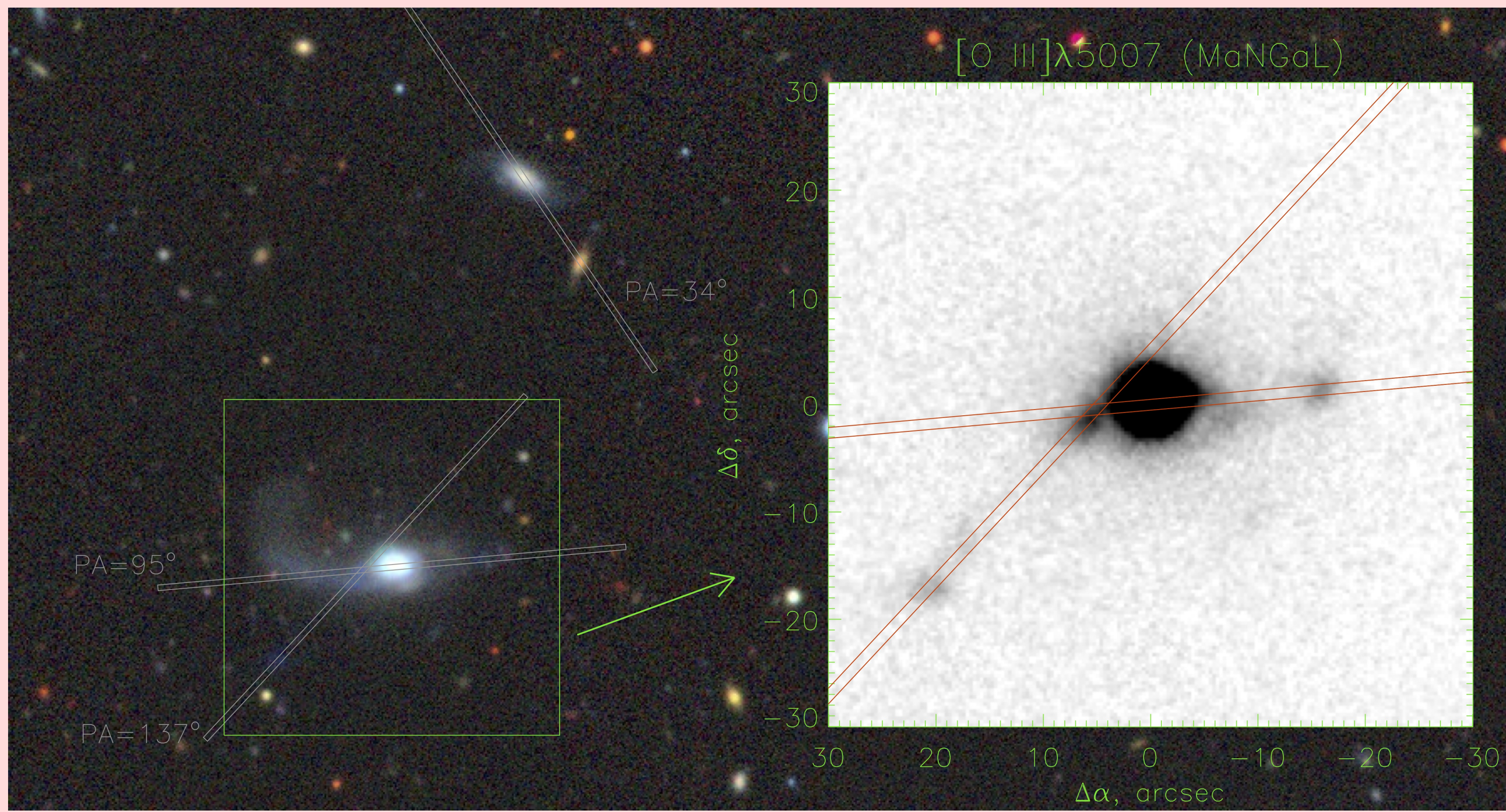


The SAI MSU 2.5 telescope and mt. Elbrus

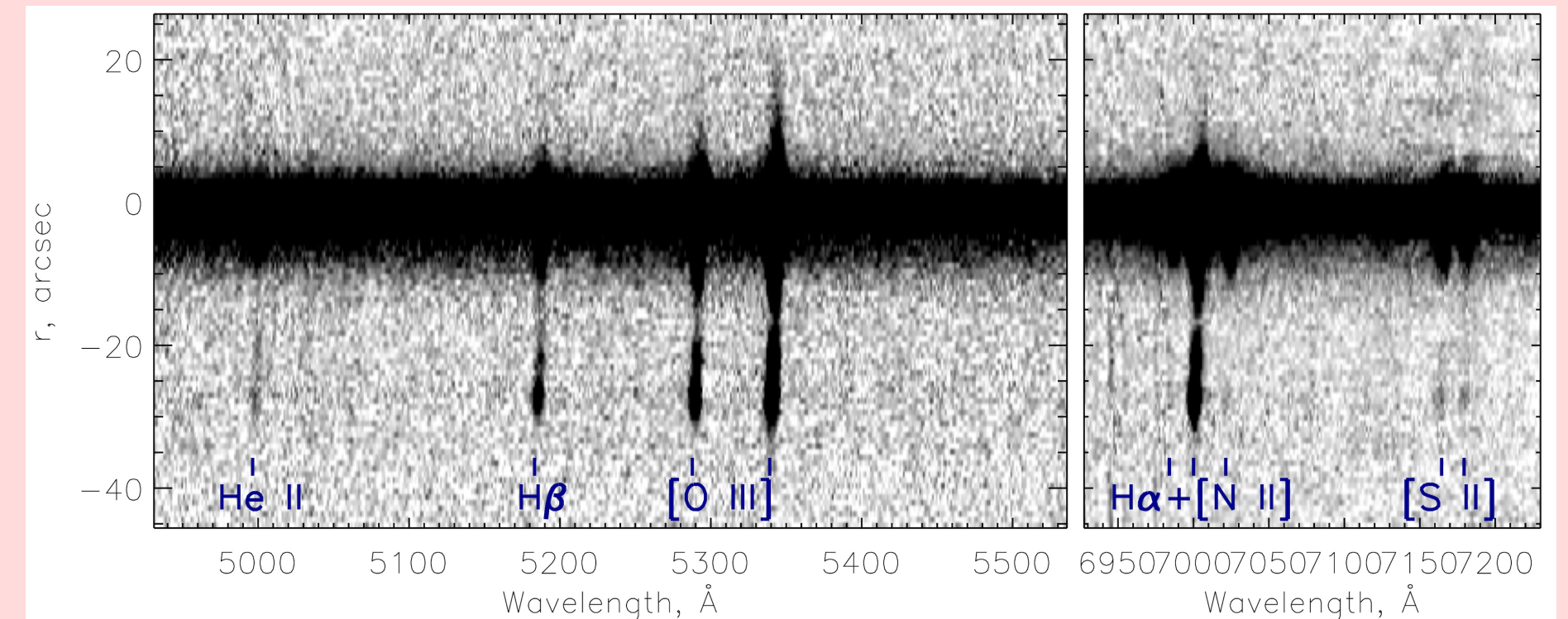
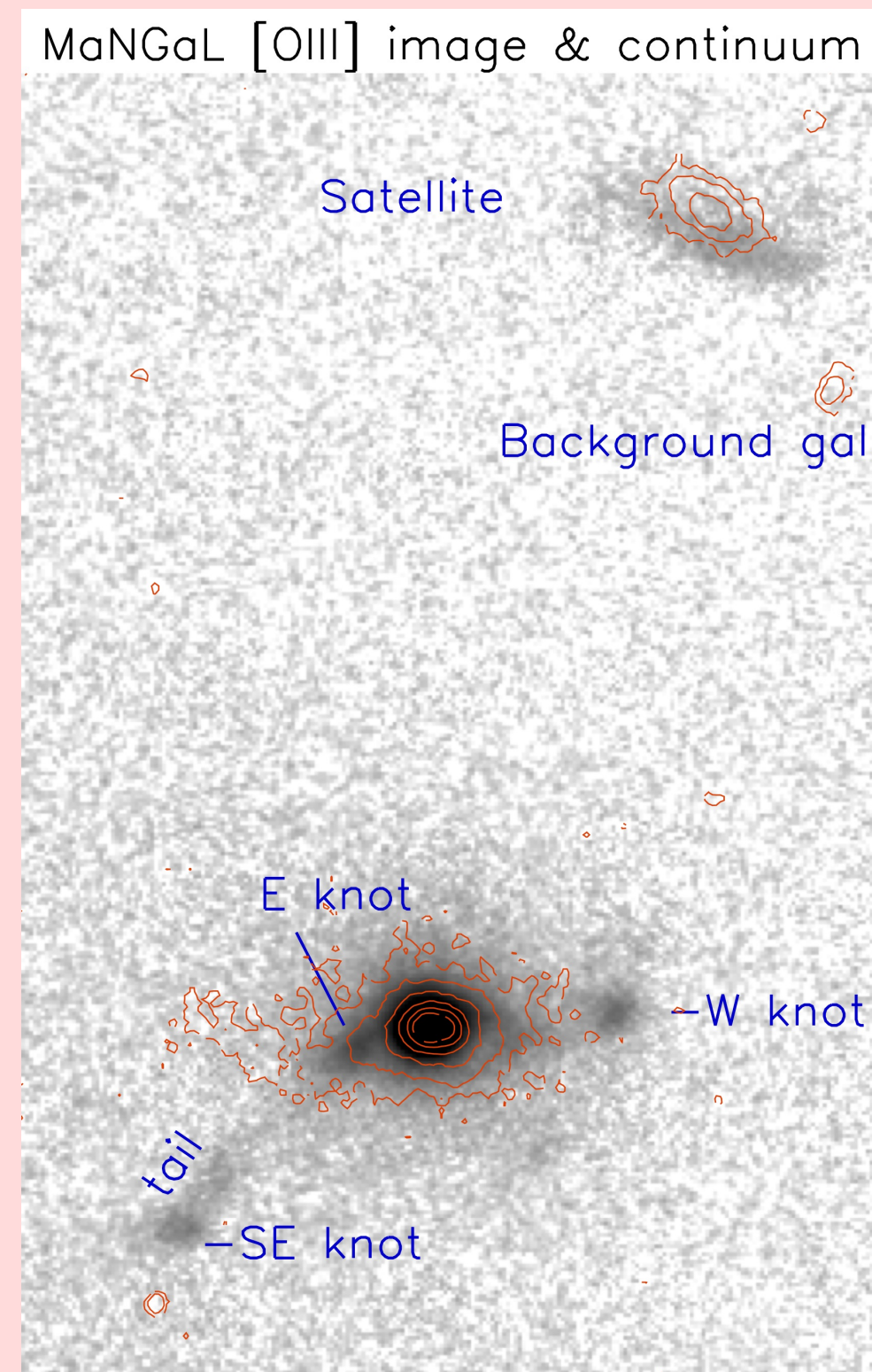
Mrk783 is a narrow-line Sy1 galaxy ($z=0.0673$, scale 1.35 kpc"), that holds the small-scale jet and the large-scale radio emission. Congiu et al. (2017a) concluded that the extended radio emission observed in Mrk783 might be a relic and that the source might be in a quiescent period of its activity cycle. The optical images reveal low surface brightness extended structures detected on both sides of the galaxy nucleus and looks like tidal tails observed in interacting galaxies. The emission in [OIII], H β and H α lines were tracked along the radio jet direction up to ~ 35 kpc from the nucleus according the Magellan spectroscopic observations (Congiu et al. 2017b). All this facts inspired us to do more in-depth research of the ionized gas in this Seyfert galaxy. Using the long-slit spectroscopic observations and [OIII] mapping we analyze the ionization properties throughout the discovered gaseous structures, discuss their nature and restore the possible orientation of the ionization cone.

Observations

Image in the [O III] $\lambda 5007$ emission line was obtained at the 2.5-m telescope of the Caucasus Mountain Observatory of SAI MSU with the tunable filter photometer MaNGaL (Mapper of Narrow Galaxy Lines, Moiseev et al. 2020). We have mapped [O III] $\lambda 5007$ emission up to the surface brightness level $3.6 \cdot 10^{-17}$ erg s $^{-1}$ arcsec $^{-2}$ (S/N>3). The MaNGaL image reveals an extended system of emission knots and diffuse ionized gas surrounding the main galaxy (see figures). Also a significant line emission was detected in the galaxy SDSS J130257.20+162537.1 located at 95 kpc projected distances to the north of Mrk 783. Spectral observations of the most interesting emission regions were performed with the SCORPIO-2 multi-mode focal reducer 6-m telescope of the SAO RAS (Afanasiev & Moiseev 2011) in the long-slit mode. Slits positions are displayed on the figures below.



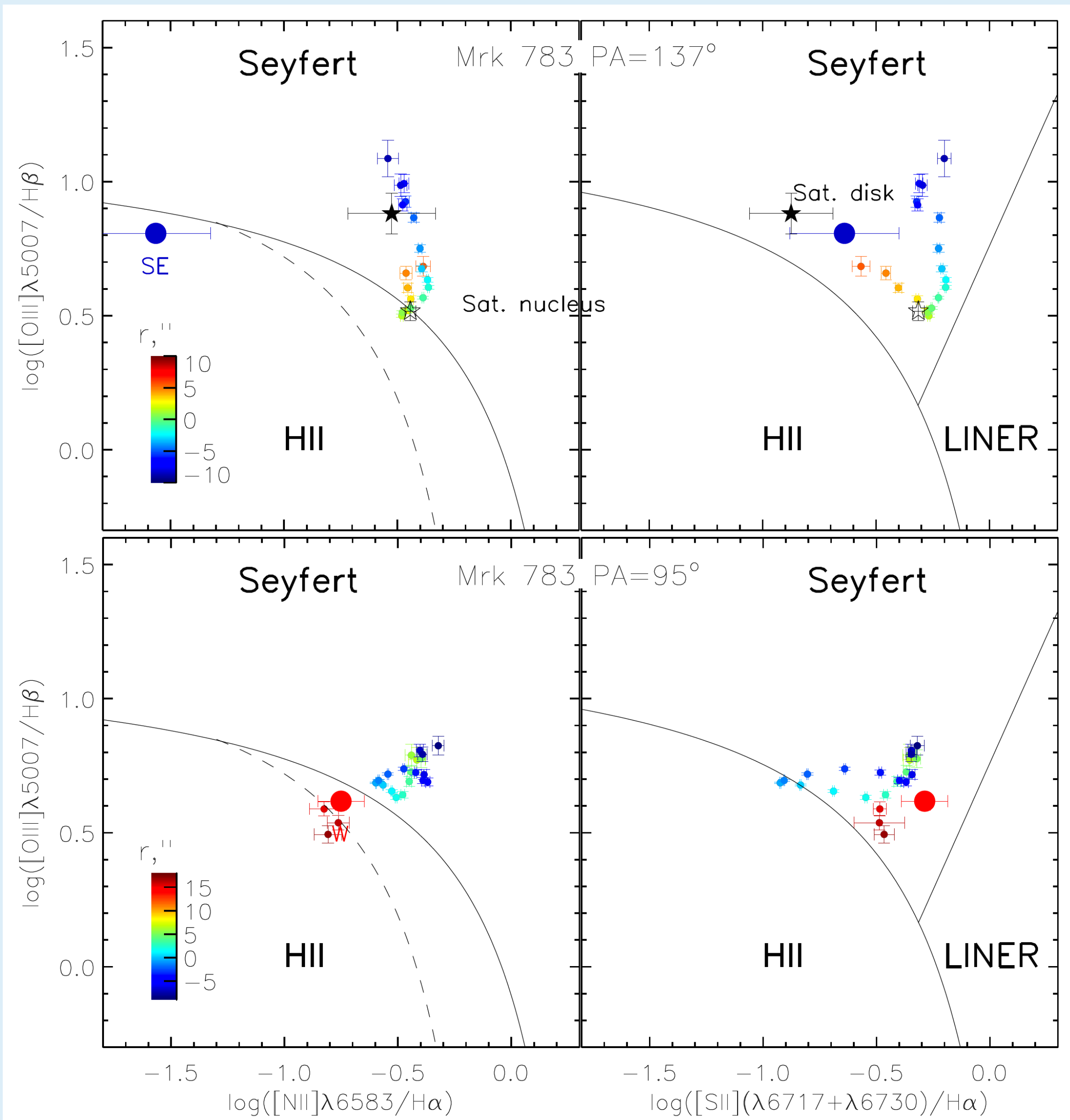
DECaLS DR10 color image of Mrk783 together with the MaNGaL/2.5m [O III] $\lambda 5007$ map. The SCORPIO-2 slit positions are shown by grey and red lines.



Fragments of the 2D spectrum with $PA = 137^\circ$. In the most distant ($r=26-30''$ or 35-41 kpc) SE knot we detected the HeII $\lambda 4686$ line that is indicative of direct AGN ionization together with the high-excitation [OIII] $\lambda 4959,5007$ doublet. Low excitation [NII] $\lambda 6548,6583$ and [SII] $\lambda 6717,6731$ lines and hydrogen Balmer lines (H α and H β) are also visible.

Mrk 783 with the satellite SDSS J130257.20+162537.1: the [O III] emission line image with contours of image in the continuum. It is clearly seen that highly ionized gas in satellite placed asymmetrically relative its nucleus — we can observe it mostly on the side nearest to the Mrk 783.

Gas ionization state



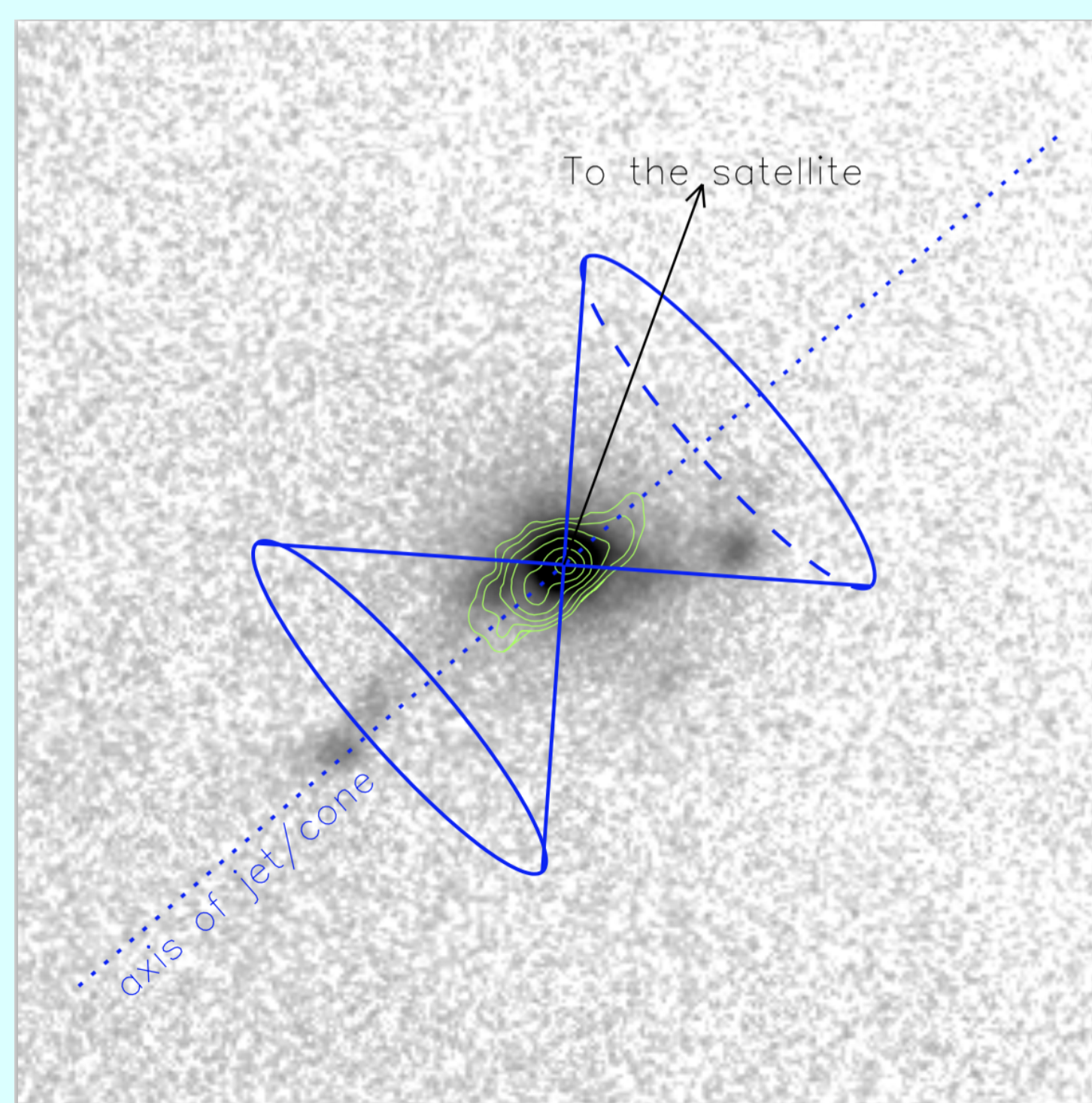
Line ratio (BPT, after Baldwin et al. 1981) diagrams along two position angles in Mrk 783. Dividing lines between HII regions, AGN, and the composite nucleus are taken from Kewley et al. (2001) and Kauffmann et al. (2003). The open and filled black stars in the top panels show line ratios for the nuclear and external regions of the satellite. The ionization state in W and SE knots as well as the satellite outskirts seem to be caused by AGN radiation.

References

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Conclusions

- Mrk 783 forms a gravitationally bound pair with SDSS J130257.20+162537.1 This follows from:
 - (i) the difference of their systemic velocities is about 60 km s $^{-1}$;
 - (ii) the projected distance is 99 kpc;
 - (iii) the stellar mass derived from r- and z-band photometry is about 1/5-1/8.
 However, the disturbed morphology and tidal structures are most likely caused by merging with another pre-existing companion—a gas-rich dwarf galaxy.
- Most of the gaseous structures detected in the emission lines are ionized by the AGN radiation but not by the radio jet. This is indicated by lines ratio at BPT diagrams, the presence of relatively bright HeII $\lambda 4686$ line and dynamically cold gas (the range of line of sight velocities is ± 100 km/s, the velocity dispersion < 150 km/s).
- Part of the gas illuminated by the cone belongs to the stellar tidal structure, but the most distant SE-knot is a part of the external gaseous structure without a stellar counterpart. Gas in this region has a low metallicity (0.05-0.1 Z_{sun}) according to the low [NII]/H α ratio.



The [O III] emission line image with contours of radio continuum at 5 GHz according Congiu et al. (2017a). Proposed orientation of the ionization cone is shown.

- External regions of the satellite gaseous disk at the nearest side to Mrk 783 fall into the ionizing cone. This fact makes the Mrk 783 system **perhaps the most extreme example among nearby AGN galaxies of the cross-ionization of a galactic disk by a companion.**
- A comparison of the ionizing luminosity required to create the most distant emission knots (including the satellite's disk) with the current bolometric luminosity of the nucleus indicates that there has been no significant decreasing ionizing radiation during the last 0.1–0.3 Myr.
- Mrk 783 can be considered as a ‘Hanny’s Voorwerp precursor’, i.e., a galaxy that demonstrates signs of sequential switching from kinematics (radio-dominated) to radiation (ionization-dominated) AGN modes, in the moment before its ionization luminosity falls.**

This study was recently published:

