

Mrk334: is a connection between nucleus activity and merging of a companion?

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Special Astrophysical Observatory

Russian Academy of Sciences



Big **T**elescope **A**lt-azimuthal (**BTA**) is the principal instrument of the Special Astrophysical Observatory (**SAO**) Russian Academy of Sciences.

The telescope is located near Mt. Pastukhova (Caucasus) at an altitude of 2070 m above sea level.

Main mirror diameter **6 m**

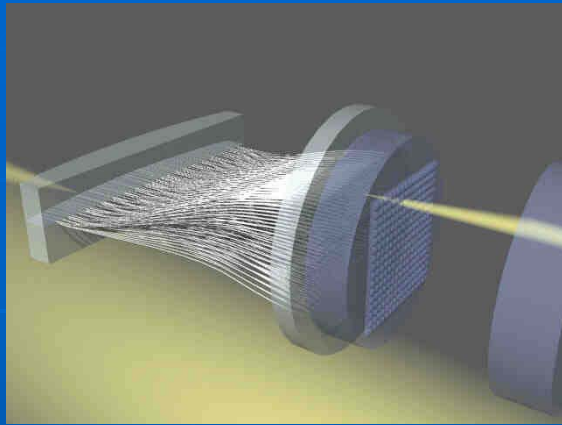
Focal ratio **(F/4)**

First light **1976**



WWW page:

<http://www.sao.ru>



MPFS=MultiPupil Fiber Spectrograph

Spatial sampling: 0.5", 0.75", 1.0"

Field of view: 16 x 16 spaxels

Spectral range: 3600-9600 Å Å

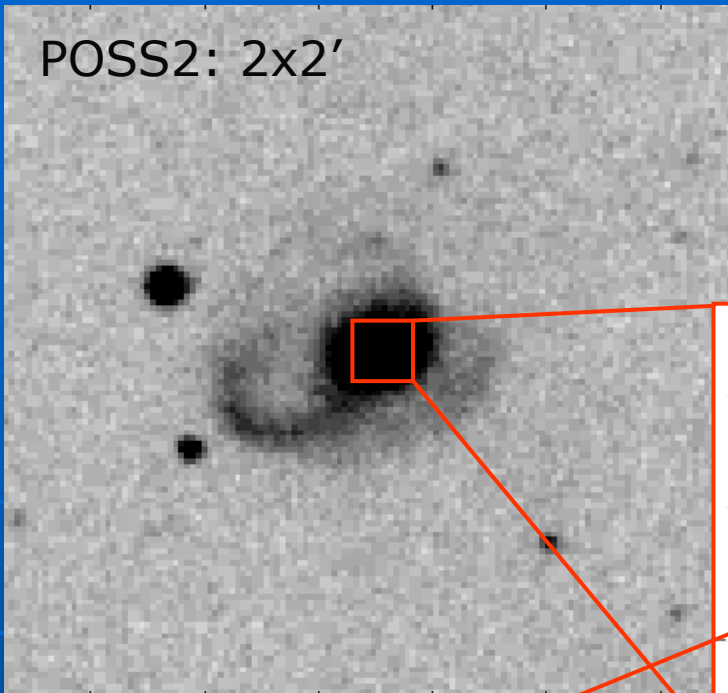
- Velocity fields and dispersion of stars
- Velocity fields in different emission lines of the ionized gas: $H\alpha$, $H\beta$, [OI],[OIII], [NI],[NII], [SII]
- Images in a continuum and in emission lines

SCORPIO = Spectral Camera with Optical Reducer for Photometric and Interferometrical Observations



- Broad-, medium- and narrow-band direct imaging
- 3D spectroscopy with the scanning Fabry-Perot Interferometer
- Long-slit spectroscopy
- Large-scale velocity fields of the ionized gas in the $H\alpha$ and/or [NII], [OIII] emission lines
- Images in a continuum and in emission lines
- Images in the broad-band filters B, V, R, I

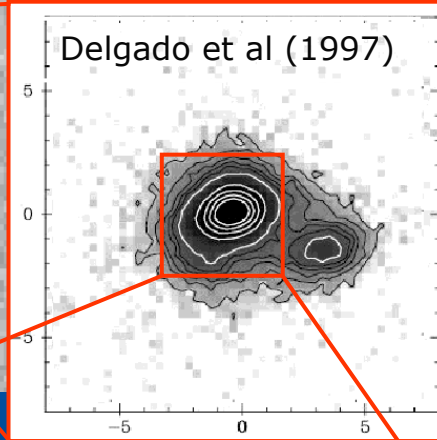
POSS2: 2x2'



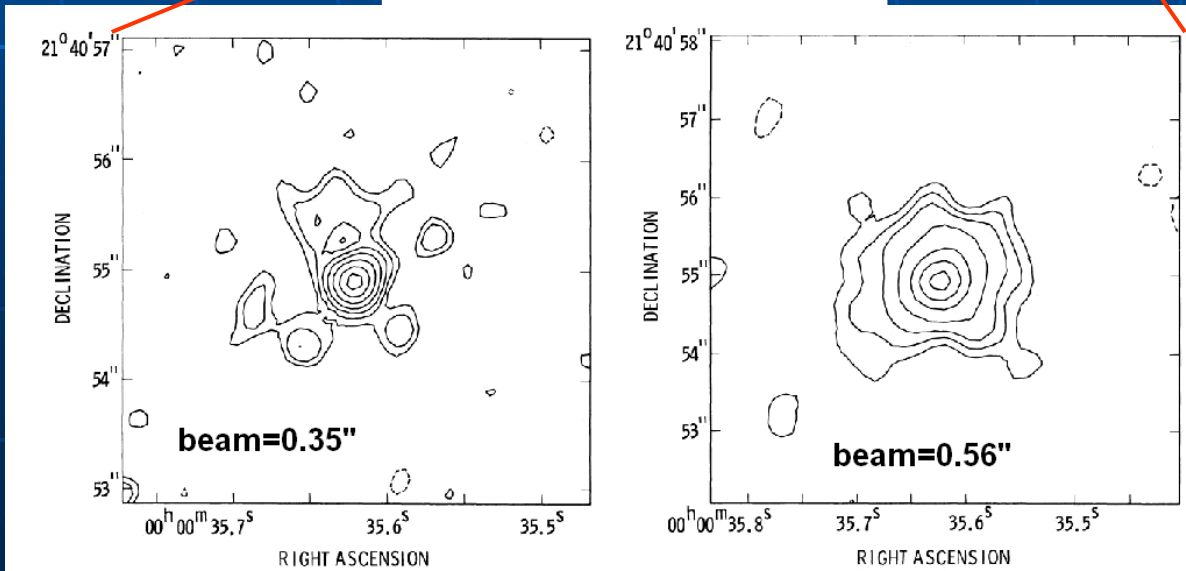
Mrk 334 (Sy1.8)
D=88 Mpc (430 pc/'')

Merging remains:

- Tidal tail
- Secondary nucleus (Knot A)?



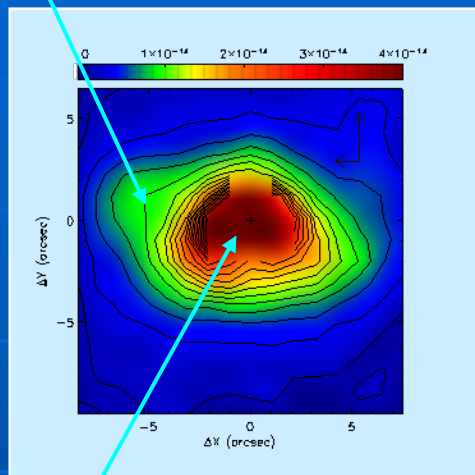
VLA, 6 cm (Ulvestad, 1982)



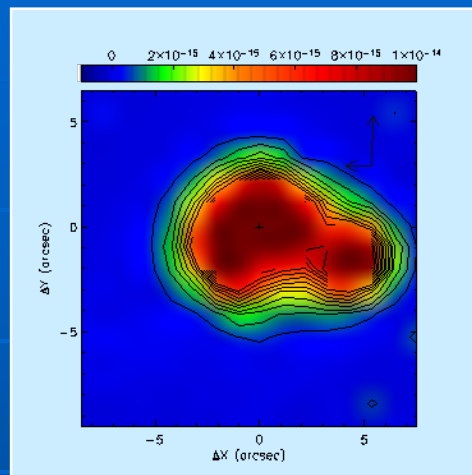
Extended non-thermal
radio source.

Knot C

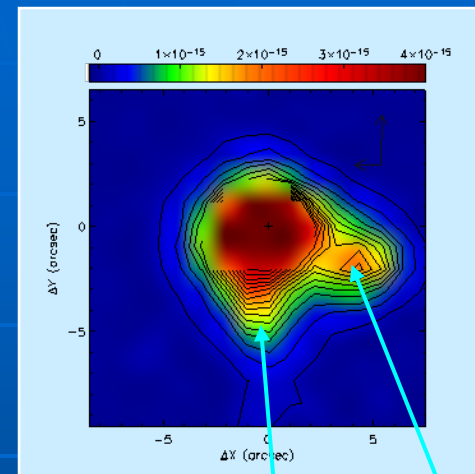
cont



Ha

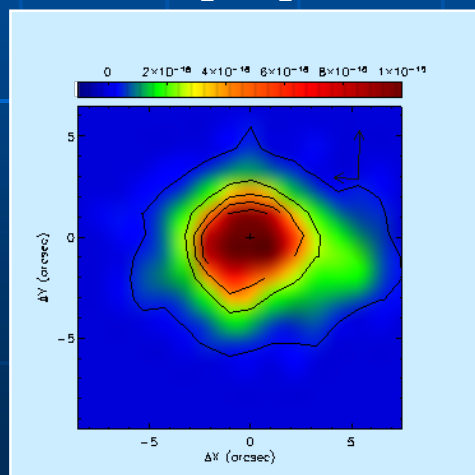


[OIII]

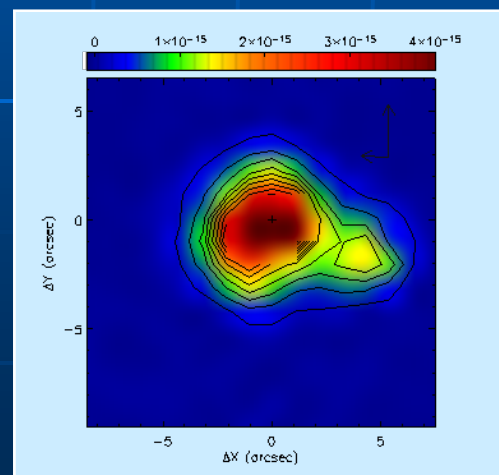


nucleus

[OI]

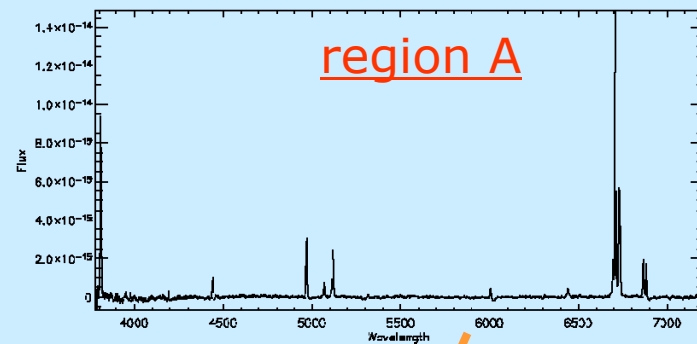
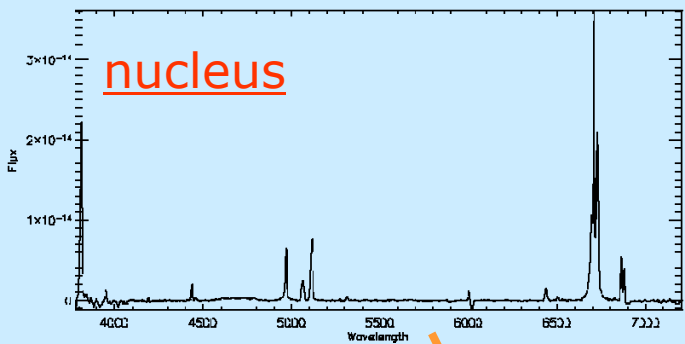


[SII]

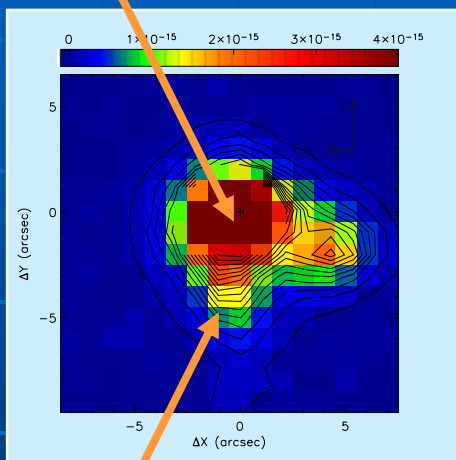


Knot B

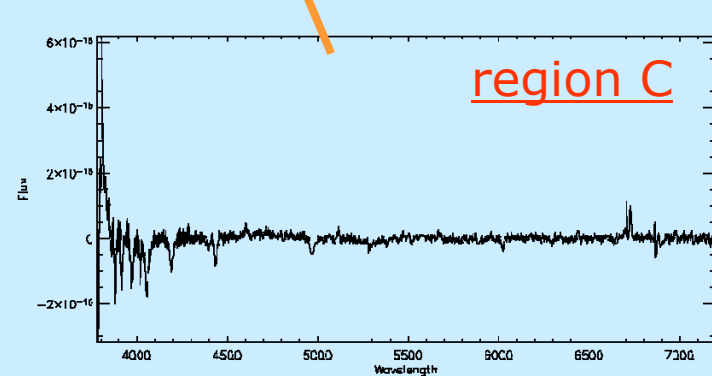
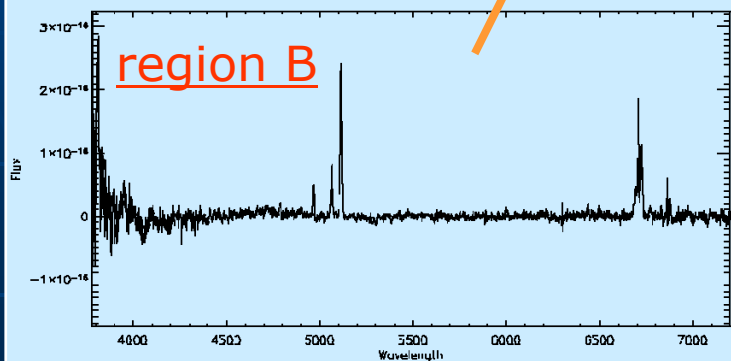
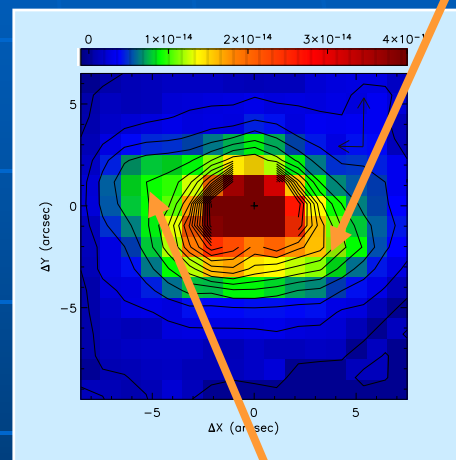
Knot A

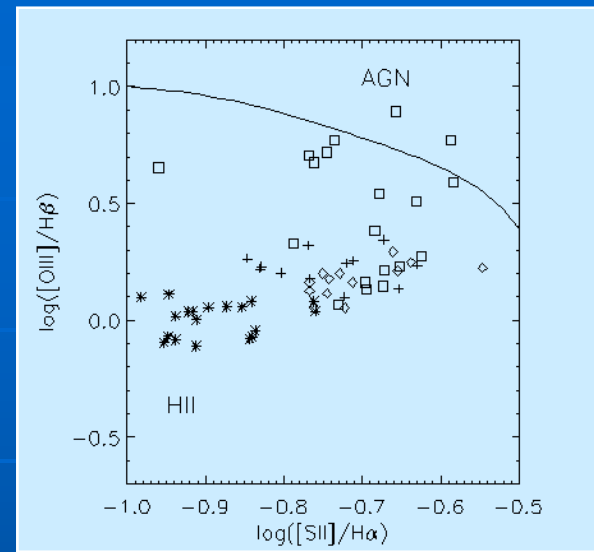
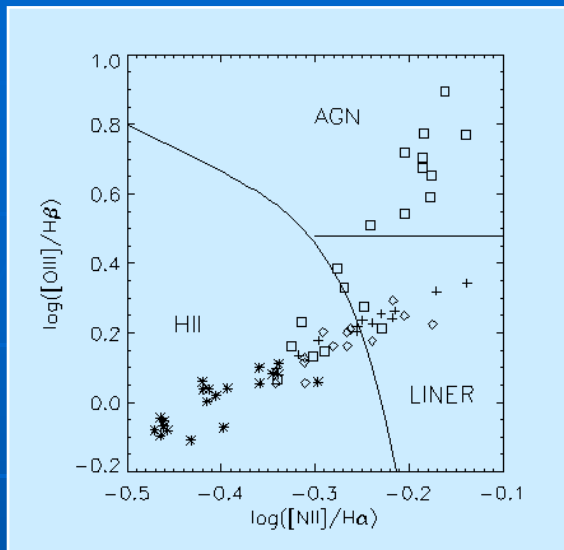


[OIII]

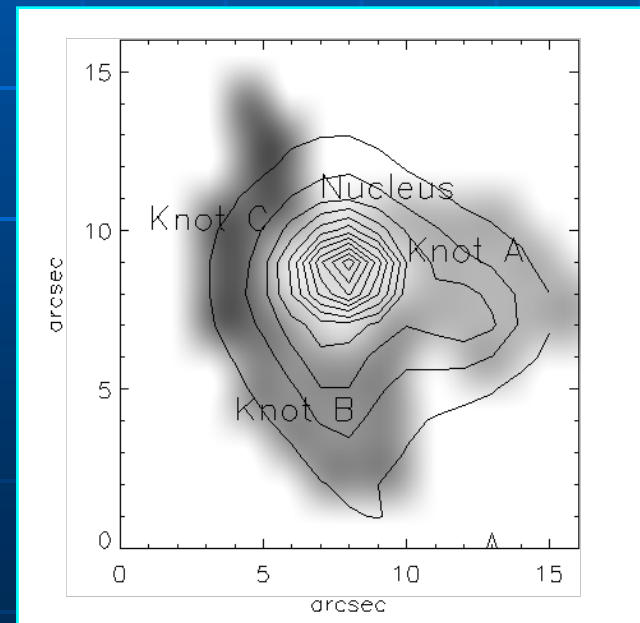
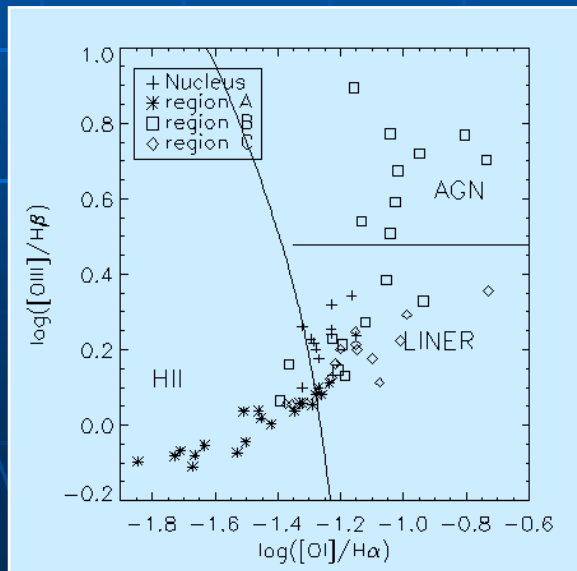


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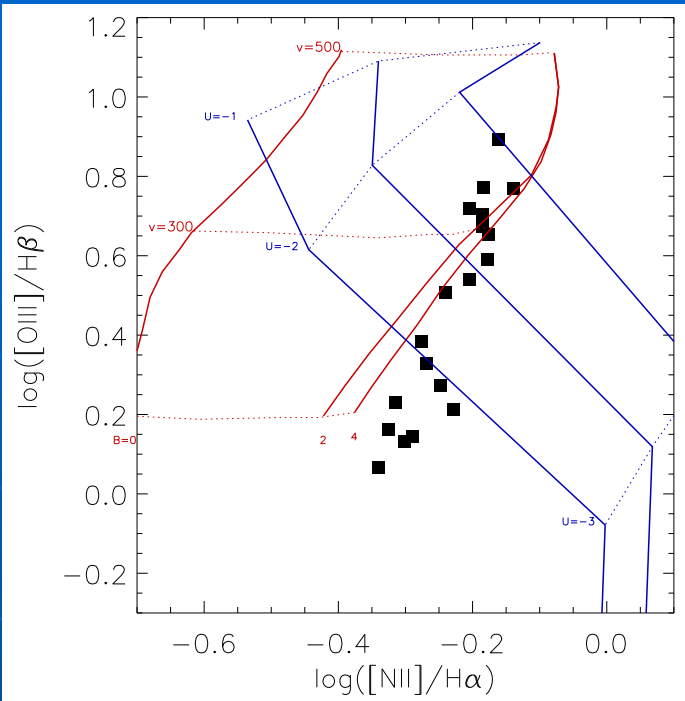




Veilleux and Osterbrock, 1987

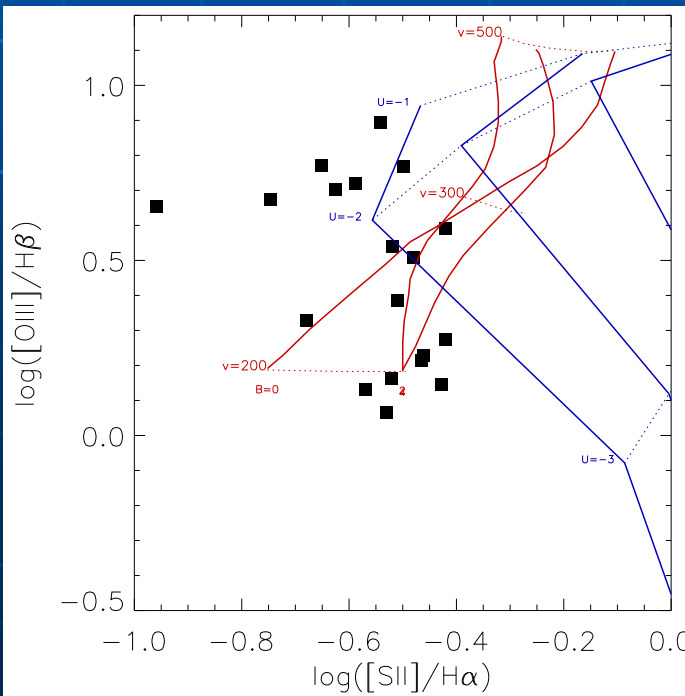


The ionization of the region B

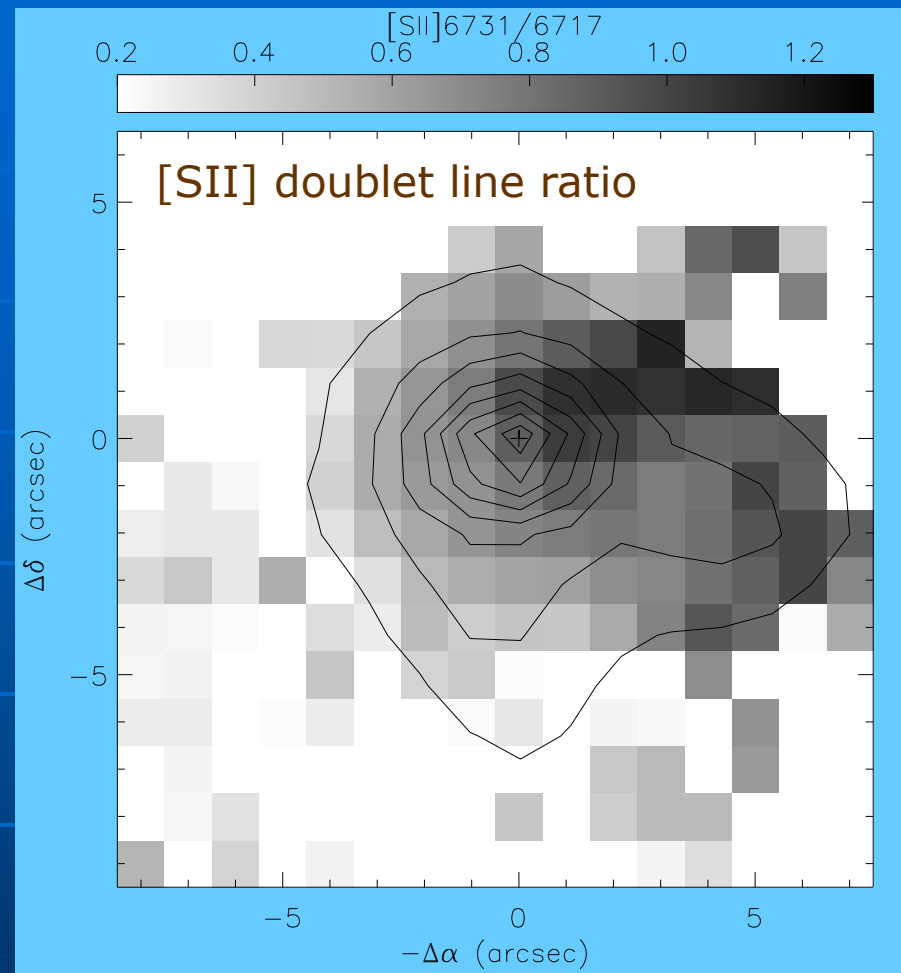
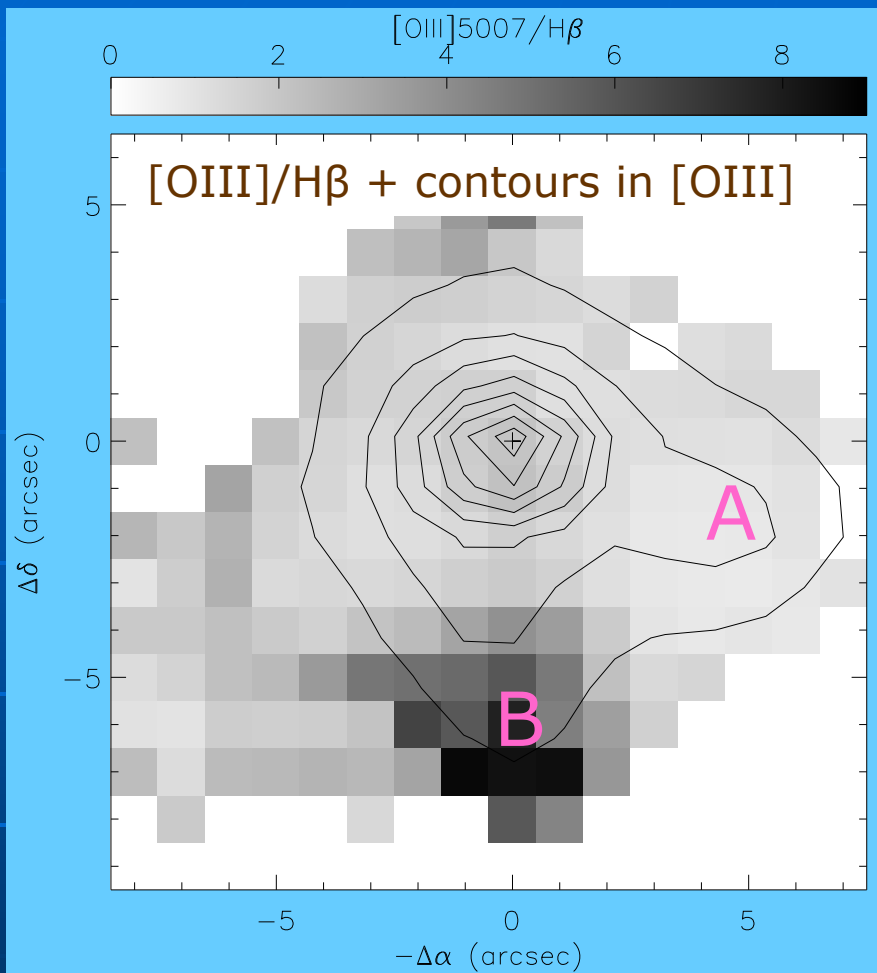


RED - Shock+precursor models (Dopita & Sutherland, 1995) for different velocities (v) and magnetic field (B)

BLUE - AGN optically thick photoionization sequences with realistic dust content (Groves et al., 2004) for different spectral slope (a) and ionization parameters (U)

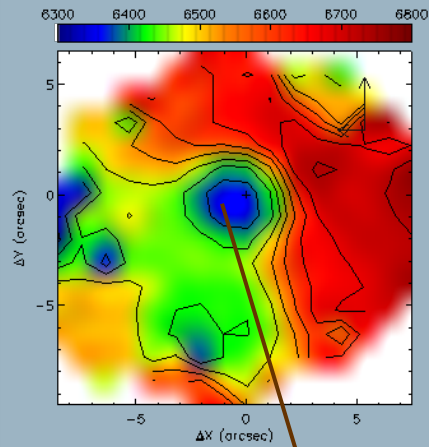


On these diagnostics diagrams the points distributed mainly along the shock velocity sequences (for $V=200$ - 300 km/s). Therefore in the Region B the ionization by shock waves **dominates** comparing with the AGN ionization.



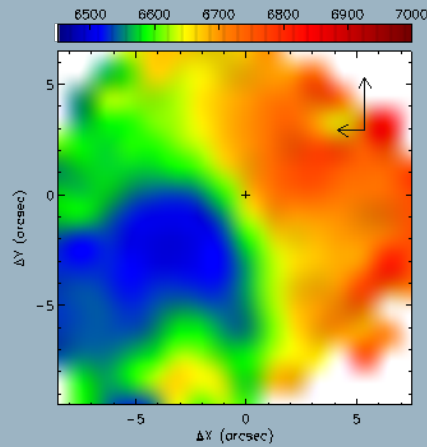
Region A: high gas density, photoionization (HII region)
Region B: low gas density, shocked excitation

[OIII]

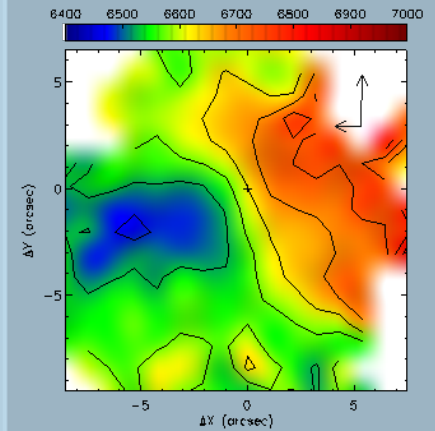


Rotation + outflow
from the nucleus
(excess of blue-
shifted velocities)

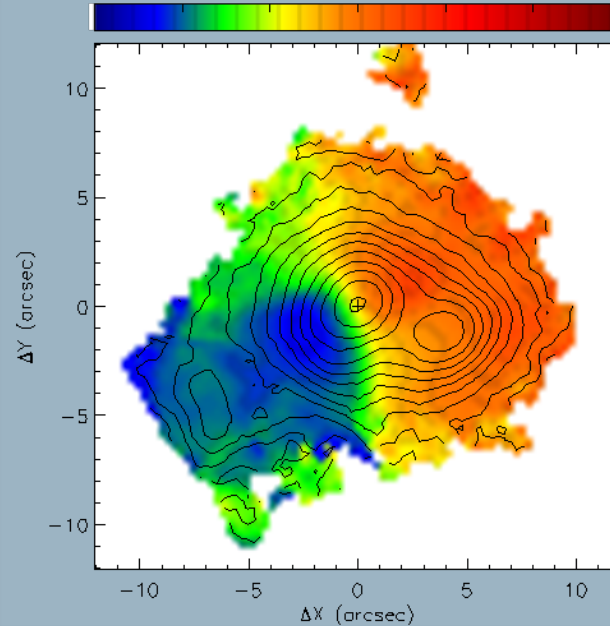
H α



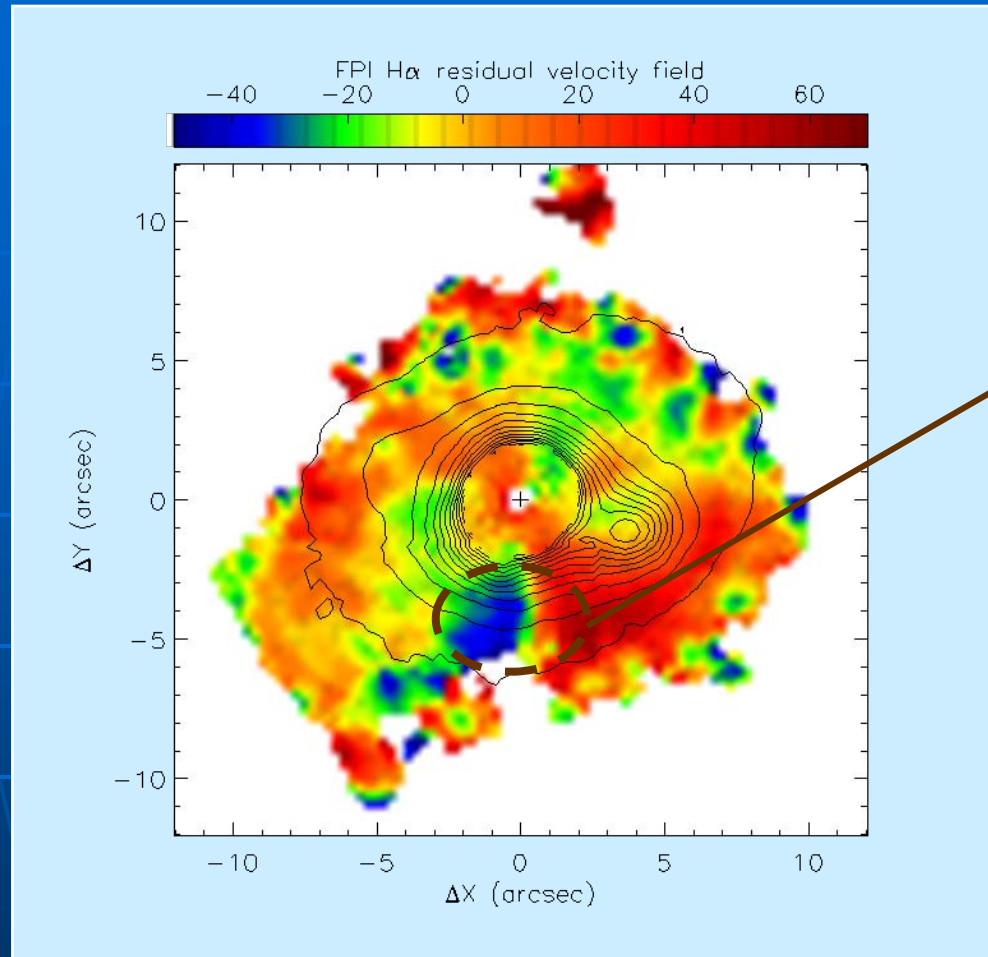
[SII]



6400 6500 6600 6700 6800 6900 7000



H α large scale
velocity field (FPI)



Strong non-circular
velocity perturbations
in the region B (± 50 km/s)

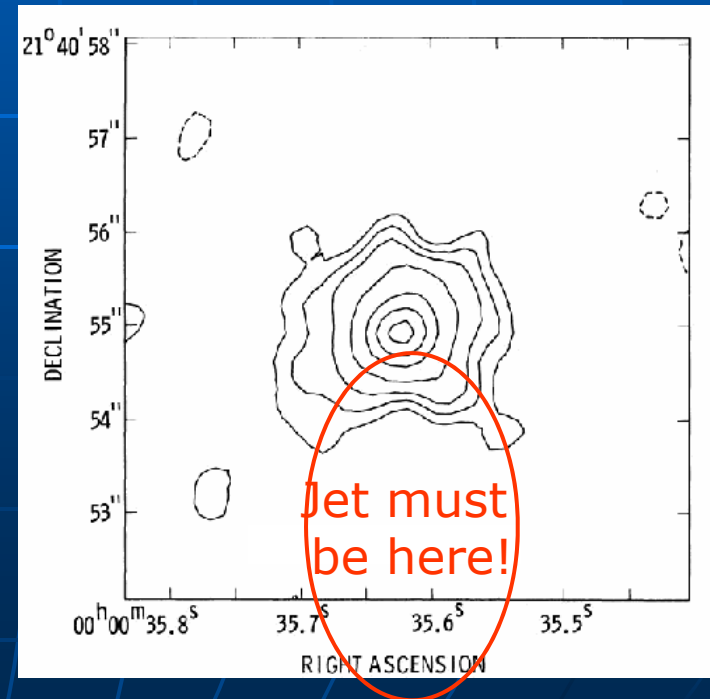
The origin of region B

- Low gas density
- High ionization (larger than in nucleus!)
- Significant contribution of shocks
- Line-of-sight velocity perturbations (gradient?)

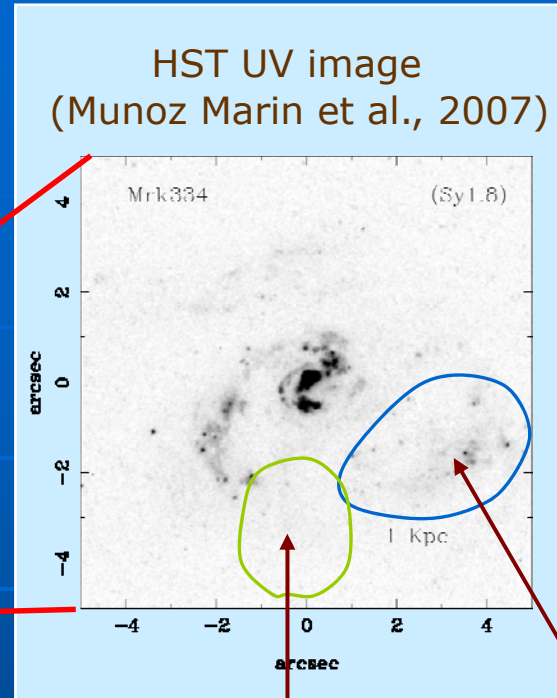
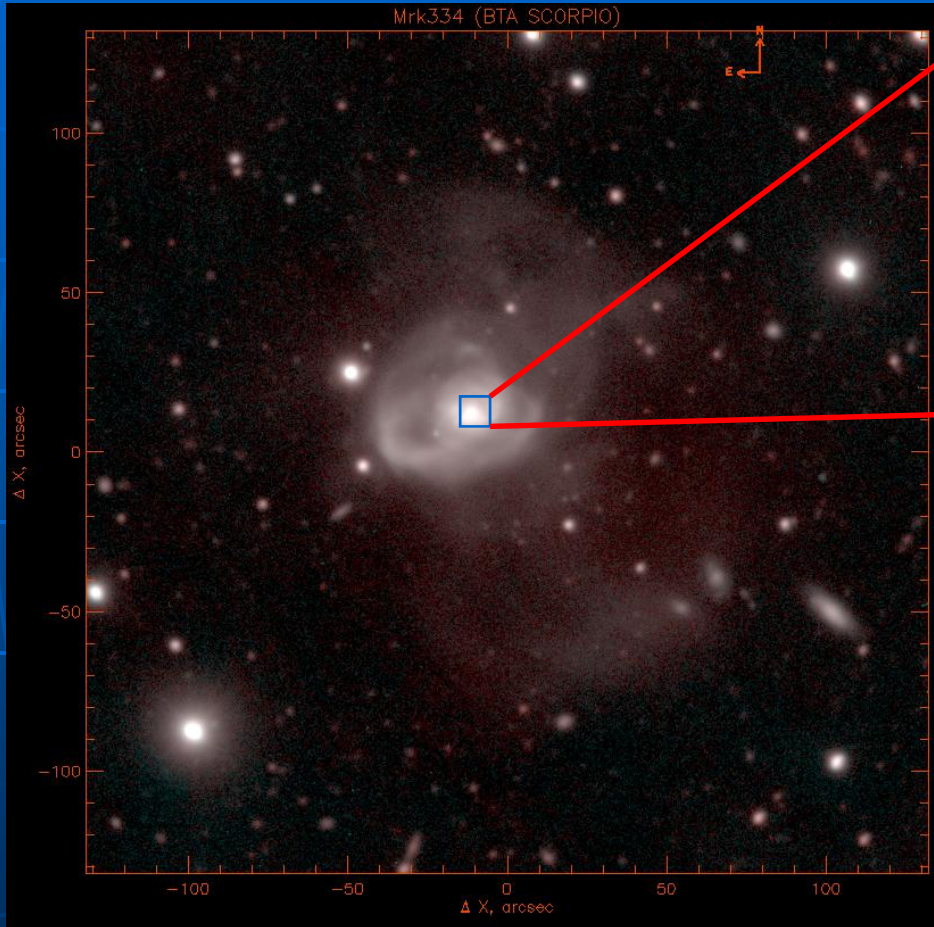
Is it a jet signature?

BUT:

- No counter-jet
- There are no any elongated structures in radio emission



Deep image (V+R) from BTA

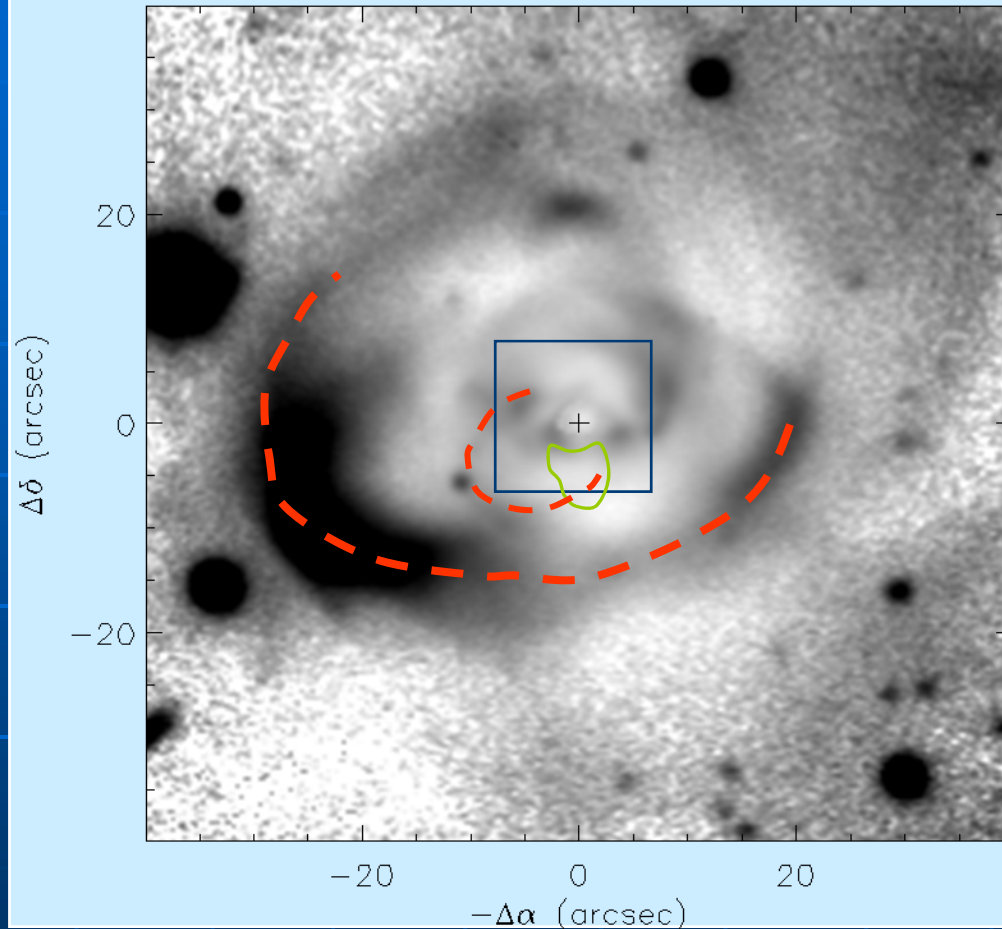


A
(OB stars)

B
(no emission)

We find new numerous faint elongated structures (tidal debris) on the different spatial scales

R-image minus bulge+disk model



Interaction between gaseous disk of Mrk 334 and precessing tidal debris of the companion: strong shock on the disk crossing (Region B)

Conclusion

We studied in details the morphology, kinematics and gas ionization in Seyfert galaxy Mrk334. On the distances 1-3kpc from the active nucleus we found an unusual region in the disk of Mrk334, that can be a place of satellite debris flying through the disk of this Sy galaxy. The merging of Mrk334 and its companion can be a trigger of AGN fuelling.

THANK YOU!