Mapping NGC 2110 nuclear outflows with GMOS-IFU

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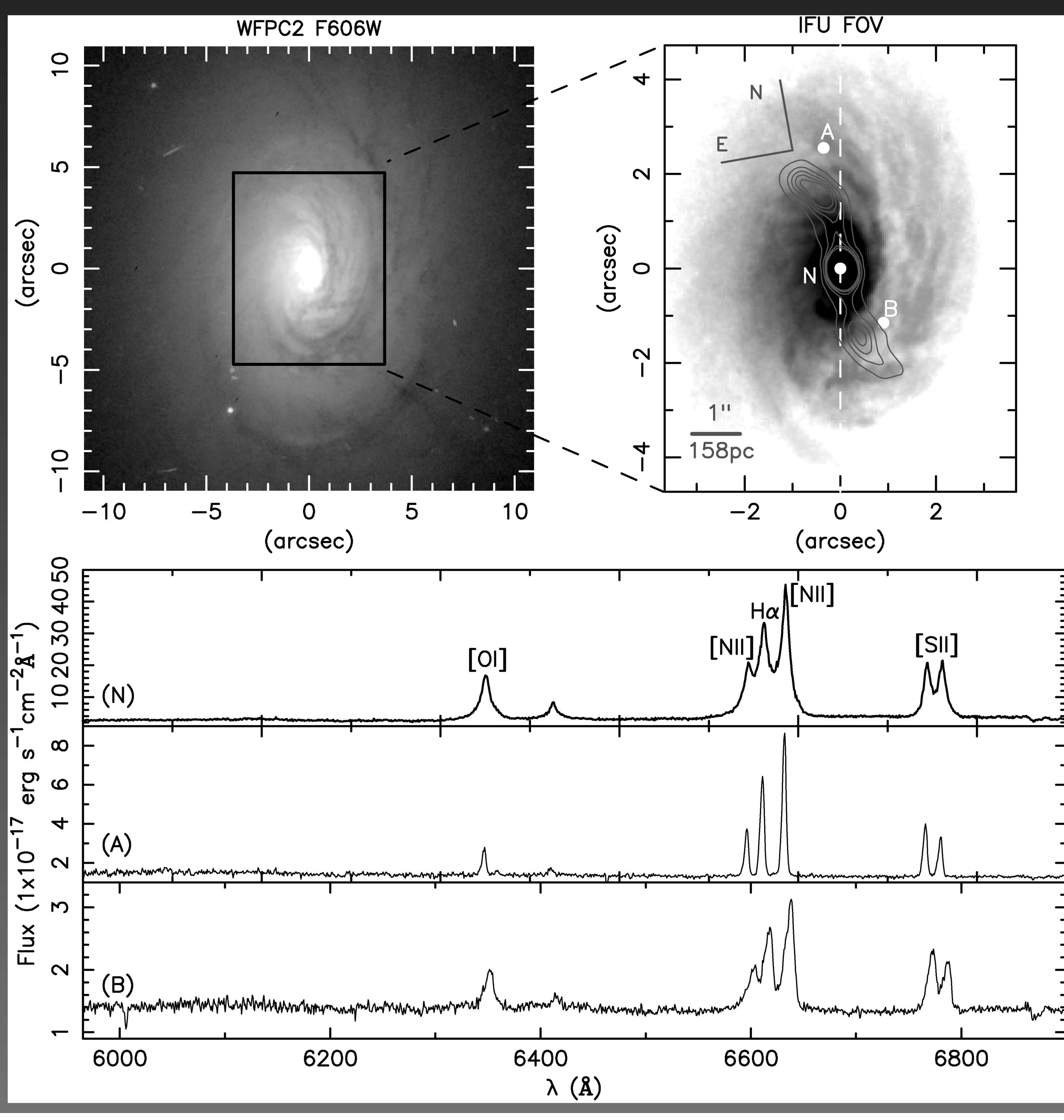
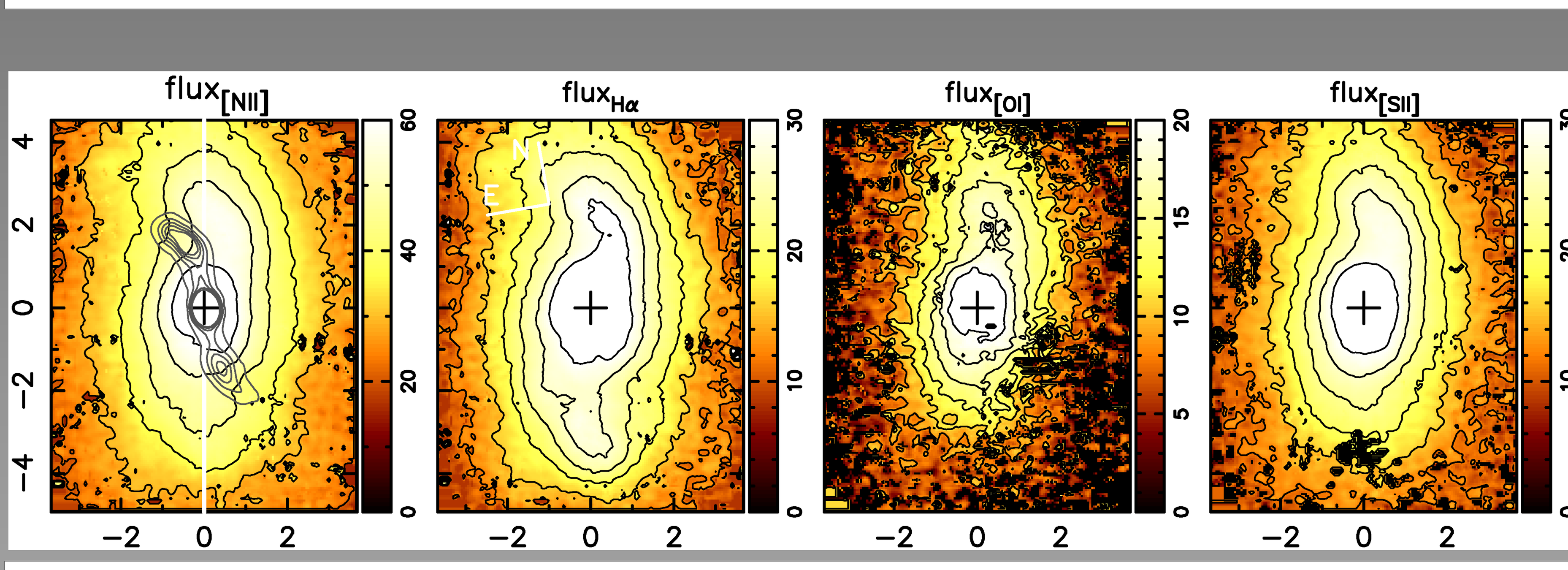
Goals: map the gaseous and stellar kinematics and the gas excitation in the central region of NGC2110, a nearby (30.2 Mpc) S0 galaxy harboring a Seyfert 2 AGN.

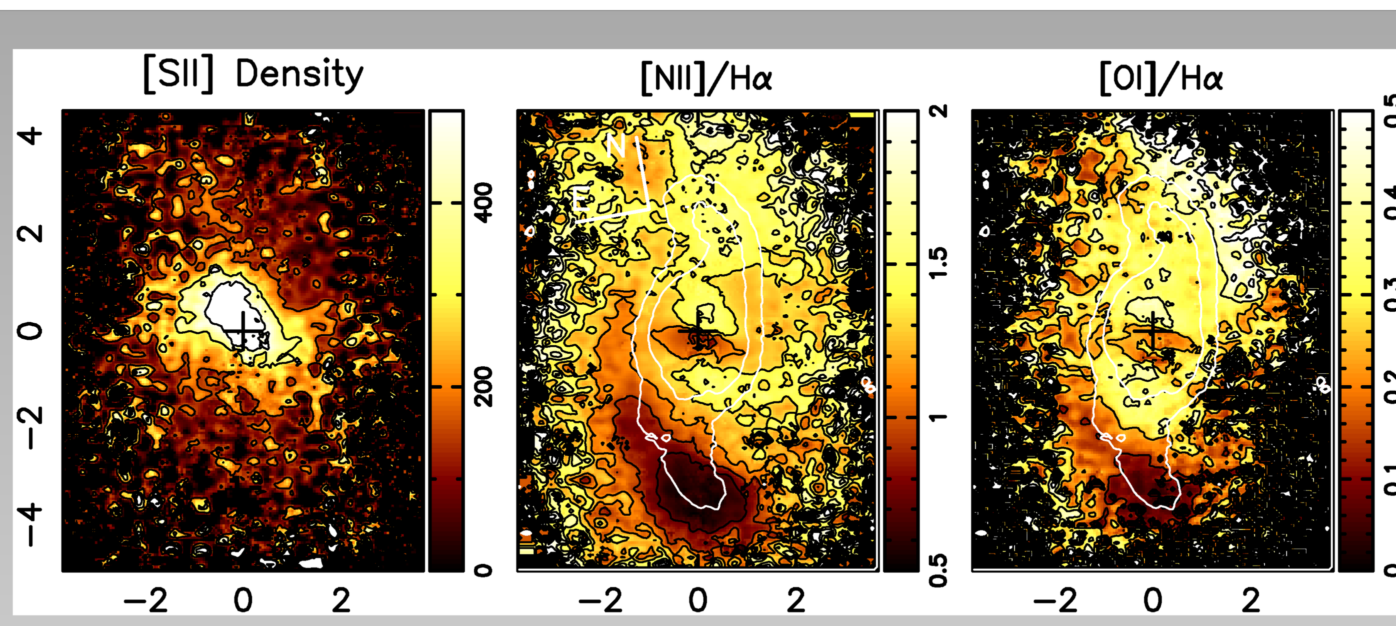
Data: obtained with the GMOS-IFU at the Gemini South telescope; angular coverage of 7 x 10 arcsec² around the nucleus; seeing of 0.6 arcsec (94.8 pc); spectral resolution of 66 km/s; wavelength range of 5600-7000Å.



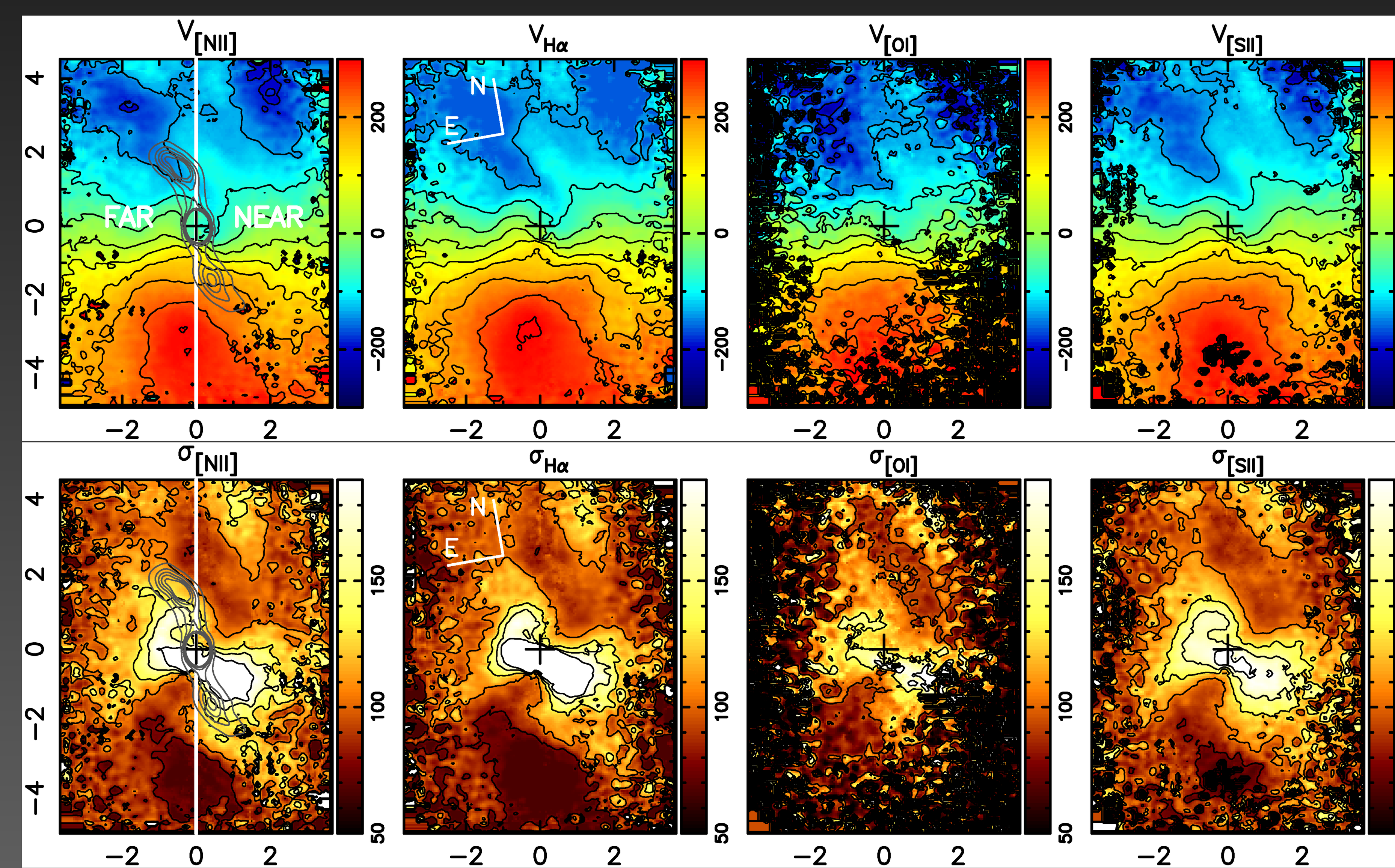
Spatial coverage and sample spectra: **Top left:** WFPC2 F606W image of the galaxy. Central rectangle shows the FOV of IFU observations; **Top right:** zoom in showing region covered by observations; contours trace the radio jet. Note spirals roughly parallel to the radio jet. **Bottom:** Spectra corresponding to regions N, A and B in the top right image. Dotted white line: line of nodes.



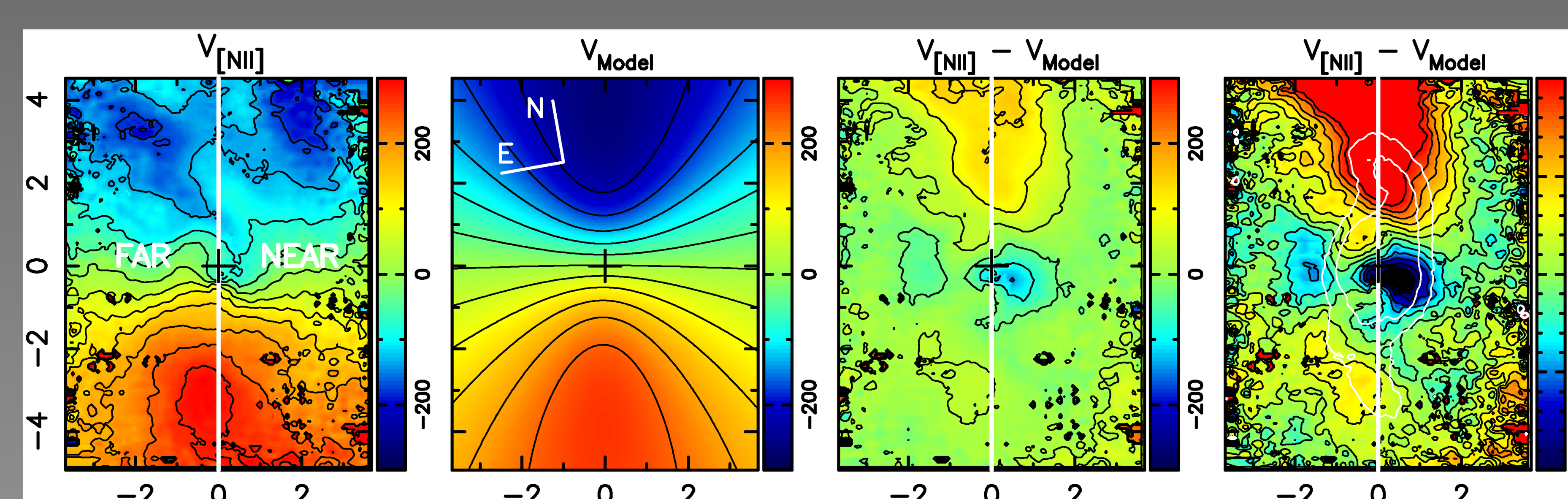
Gas flux distributions: Gaseous centroid velocities, velocity dispersions and flux distributions were obtained fitting Gaussians to the [NII], Hα, [OI] and [SII] emission lines. Two spiral arms are noticeable, north and south of the nucleus, both bending in a similar way to the radio jet. The southern arm is more prominent in the Hα flux distribution.



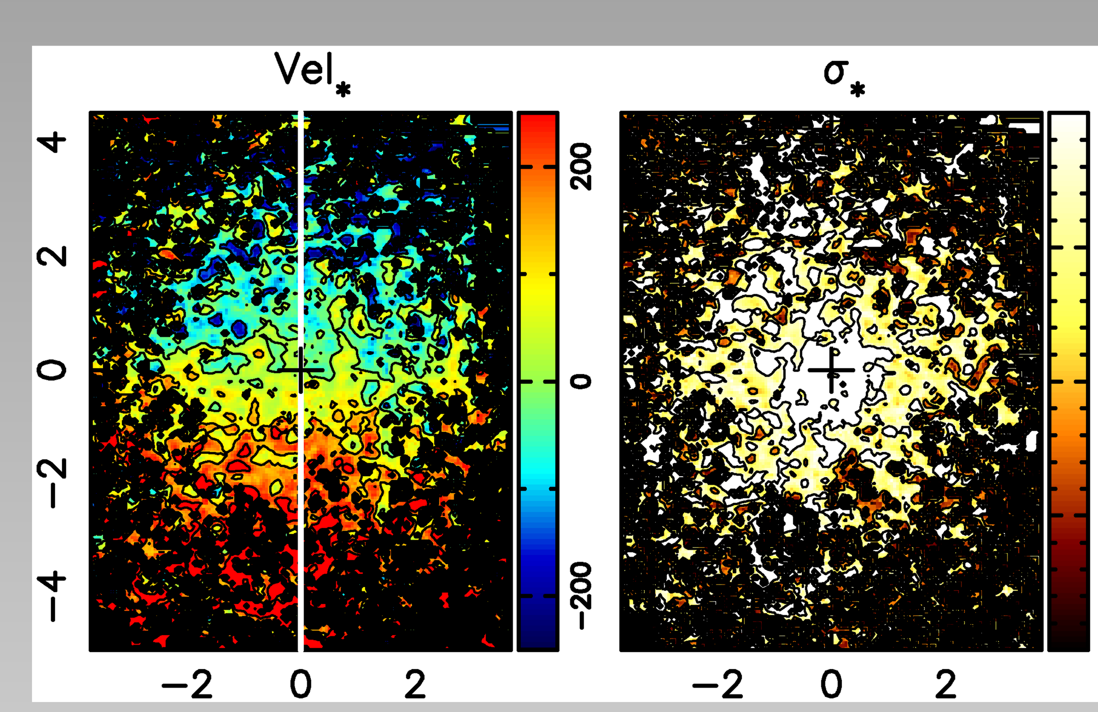
Line ratios and density: NII/Hα and [OI]/Hα line ratios present lower values in the southern spiral (as marked by the contours) and just south of the nucleus. Higher values occur mainly north, specially in regions cospatial to the northern spiral, and in a region ~1 arcsec south. Gas density is highest at the nucleus and to ~2 arcsec northeast.



Gaseous kinematics: Gaseous centroid velocities and velocity dispersions. Straight white line is the line of nodes. The centroid velocity field presents a disturbed rotation pattern. The velocity dispersion has the highest values northeast and southwest of the nucleus, cospatial with distortions in the isovelocity curves. The lowest values of the velocity dispersion are seen north and south of the nucleus, in regions cospatial with the spirals seen in the flux distributions.



Modeling of gaseous centroid velocity field: We modeled the gaseous centroid velocity field assuming a spherical potential with pure circular motions. We then subtracted the model from the gaseous velocity field in order to isolate non-circular motions. The model is a good fit of the centroid velocity field, although residuals of the order of 100 km/s are present southwest and north of the nucleus. The residuals show a compact region southwest of the nucleus where gas is moving towards us and a more extended region to the north where gas is moving away from us. We interpret these residuals as due to a biconical outflow.



Stellar Kinematics: Obtained using the pPFX (penalized pixel fitting) technique (Cappellari & Emsellem 2004). Stellar velocity field displays rotation pattern similar to the gaseous one. In the inner 1.5 arcsec the velocity dispersion reaches ~200 km/s; decreasing outwards to ~150 km/s.

Conclusions

- The flux distribution of the [NII], Hα, [OI] and [SII] emission lines displays two spirals arms, one south and one north of the nucleus. Low velocity dispersion and NII/Hα and [OI]/Hα ratio values in the south arm suggest the presence of an HII region.
- The gaseous kinematics present a clear rotation pattern, although deviations from simple rotation are present. The subtraction of a model velocity field reveals blueshifted residuals southwest of the nucleus and redshifted residuals north. We interpret these residuals as due to a biconical outflow distorted by interactions with the galaxy ISM. The increase in the [NII]/Hα ratio -- characteristic of AGN narrow line regions, support this interpretation.
- Origin of spiral arms: an HII region to the south and the receding end of a biconical outflow to the north. Although both spirals may appear related to the radio jet, our data does not support any relation, suggesting that the radio jet is not aligned with the outflow seen in the optical.