The interaction of the outflow with the molecular disk in the Active Galactic Nucleus of NGC 6951

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Galaxies in 3D across the Universe

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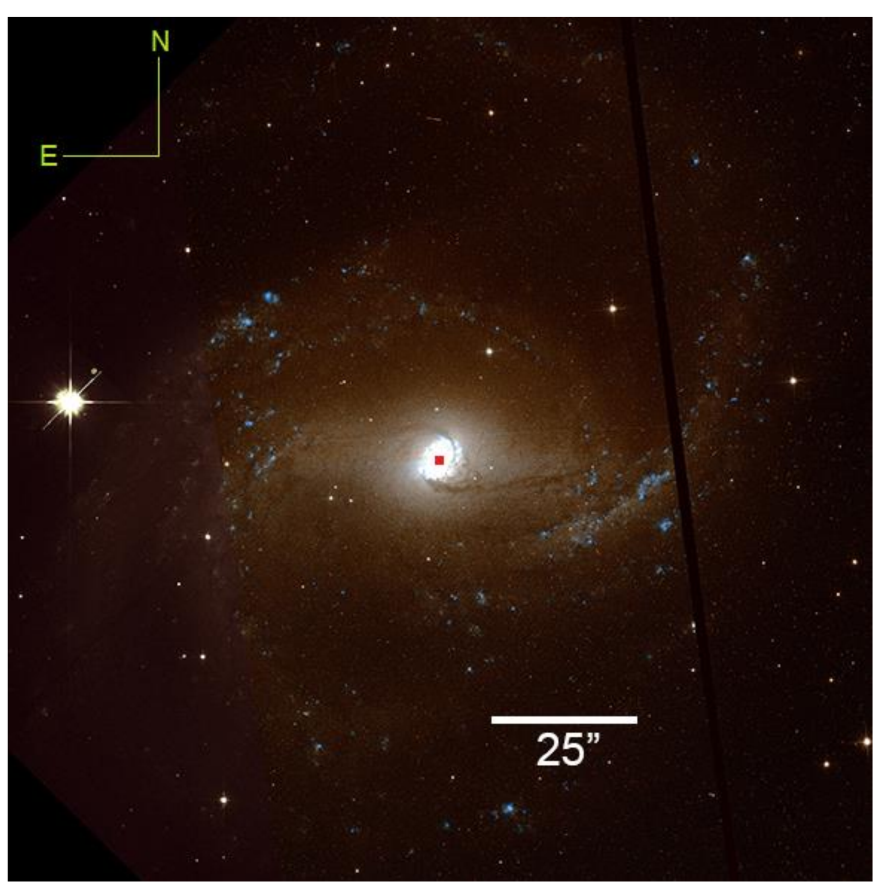
I – Introduction

The state of art about AGNs can be settled down by these unanswered questions: how a fraction of the gas is transported until reaching the accretion disk around the supermassive black hole? How is its growth regulated and how it affects the evolution of their host galaxies?

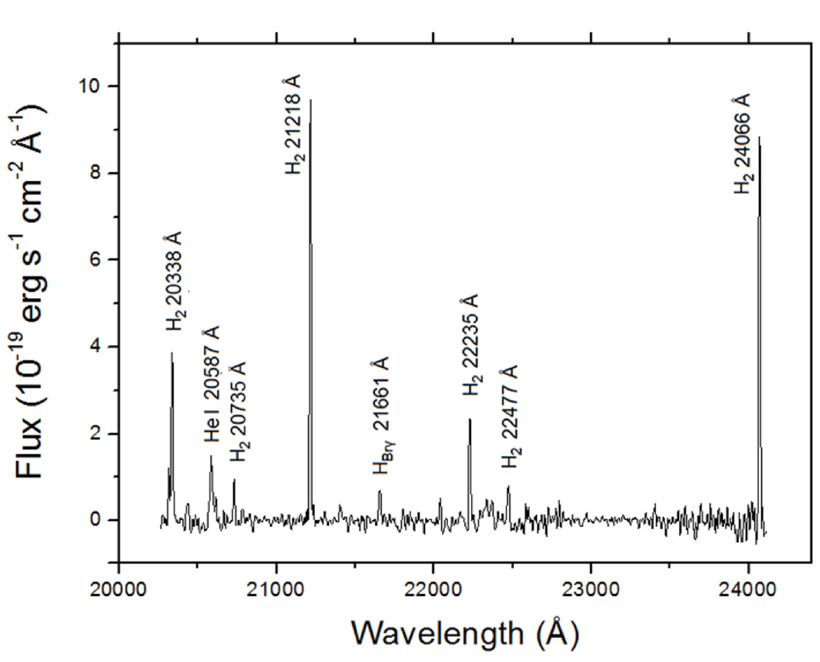
To answer these questions requires observations with high spatial resolution of nearby AGN, with adaptive optics . Here we present the nucleus of NGC 6951 in two IFS of the Gemini North Telescope: with NIFS in the NIR, and optical with GMOS public data (published by Storchi-Bergmann et al. 2007), complemented by HST images.



HST image of NGC 6951.

The red square is the FOV of 1”.68 x 1”.68 presented here.

The galaxy is a Seyfert 2, with a distance of 24 Mpc (1” = 117 pc). Here we show for the first time the connection between the molecular and ionized gas with unprecedented high resolution data (~0”.05) and image quality, in the central 200 pc of this galaxy.



The nuclear spectrum of NGC 6951 in K band with an aperture of 0”.4.

II – Methods

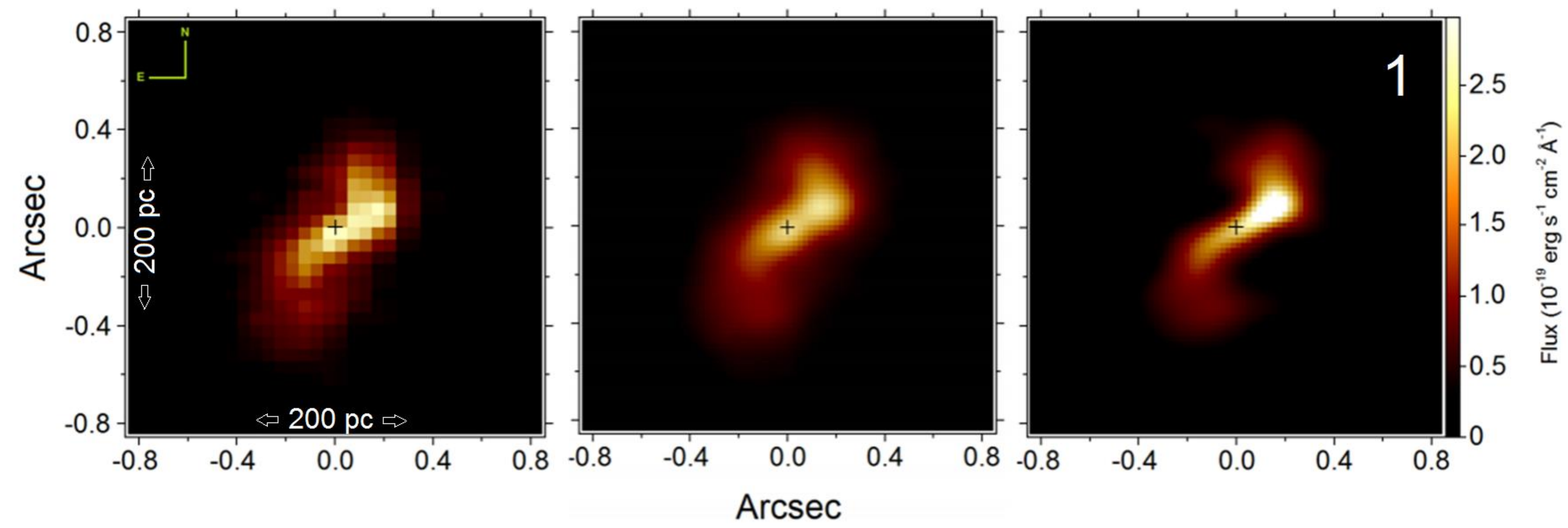
A – Differential Atmospheric Refraction Correction

B – Re-sampling and interpolation;

C – Butterworth filtering (high spatial and spectral frequencies removal);

D – Richardson-Lucy deconvolution with a symmetrized PSF of the calibration star;

E – Principal Component Analysis – PCA Tomography (Steiner et al. 2009)

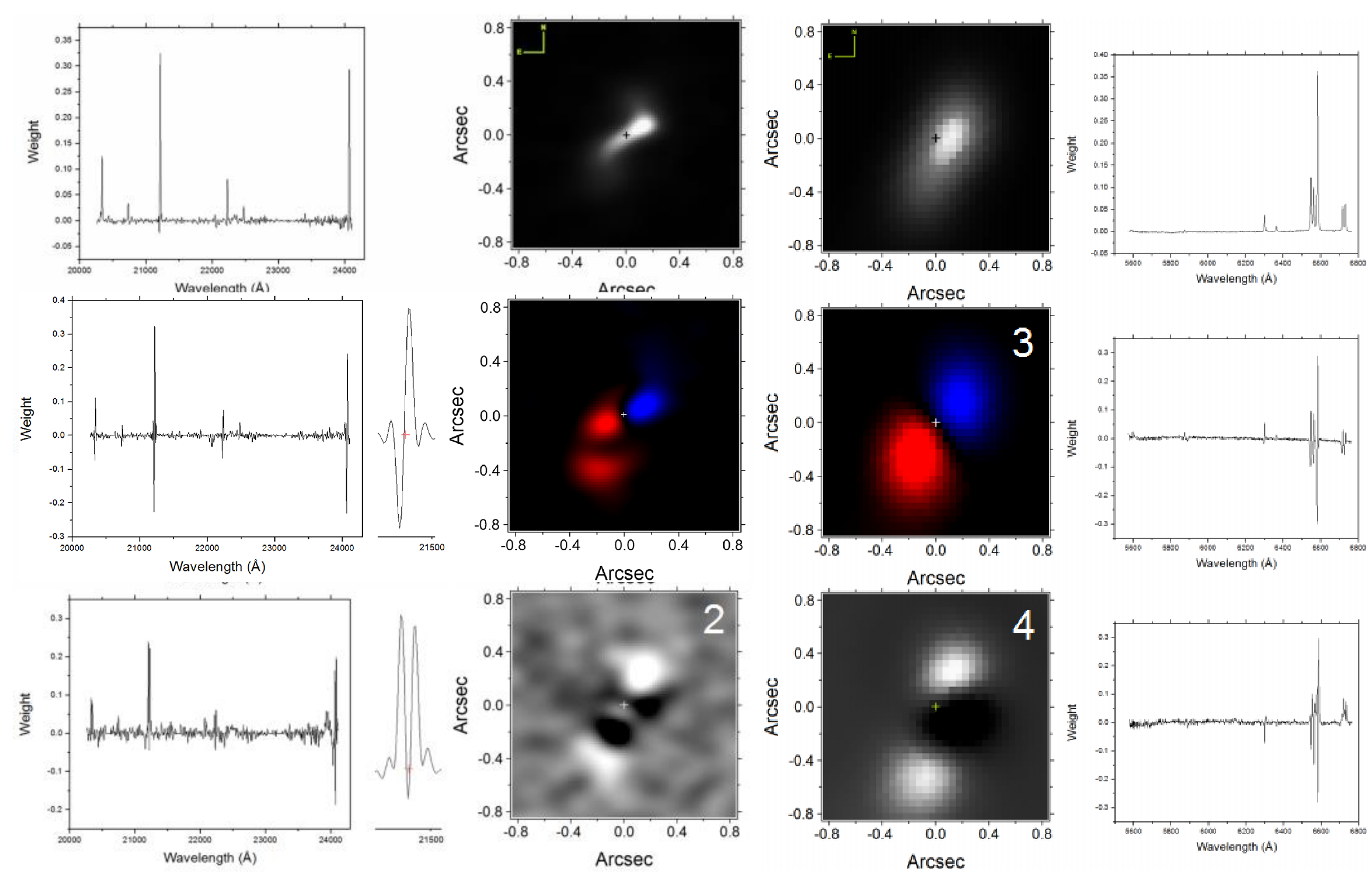


Average NIR data cube for the molecular lines after the reduction process and after the applied image processing techniques.

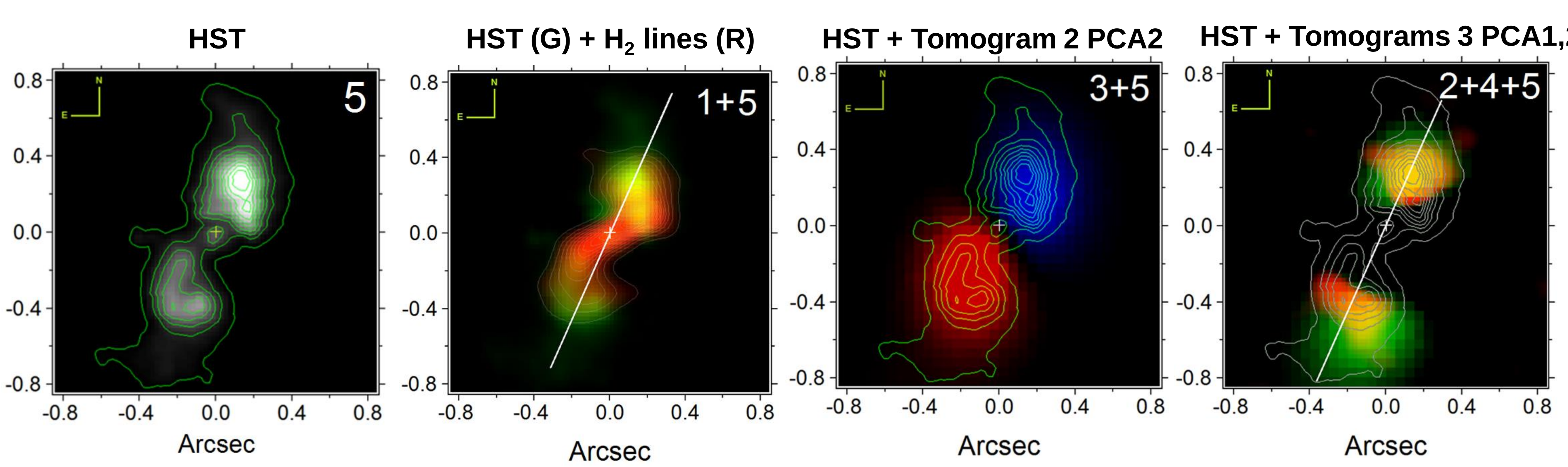
E

III – Results

PCA 1 – NIFS data cube (H_2 lines) **PCA 2 – GMOS data cube**

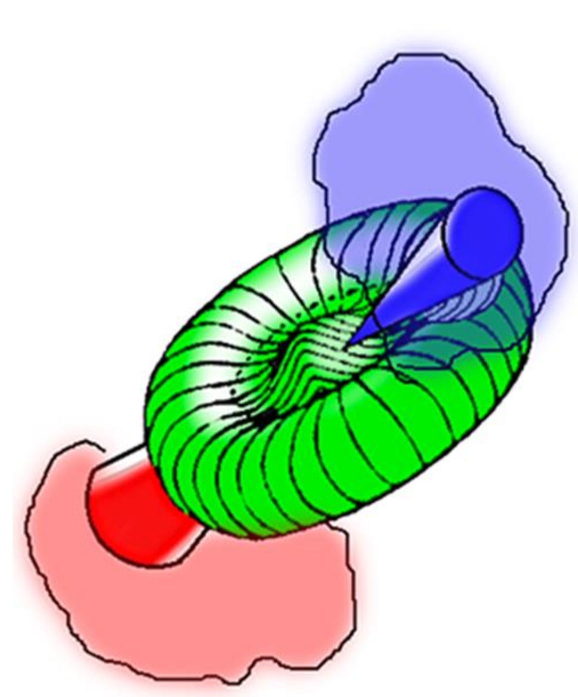


The PCA reveals in the second tomogram and autospectrum what we interpret as being the kinematics of a disk (PCA 1) and of an ionization cone (PCA 2). The third tomogram and autospectrum shows a correlation between the red and blue wings of the lines profiles, what is associated with a large velocity dispersion both in (PCA 1) and (PCA 2).



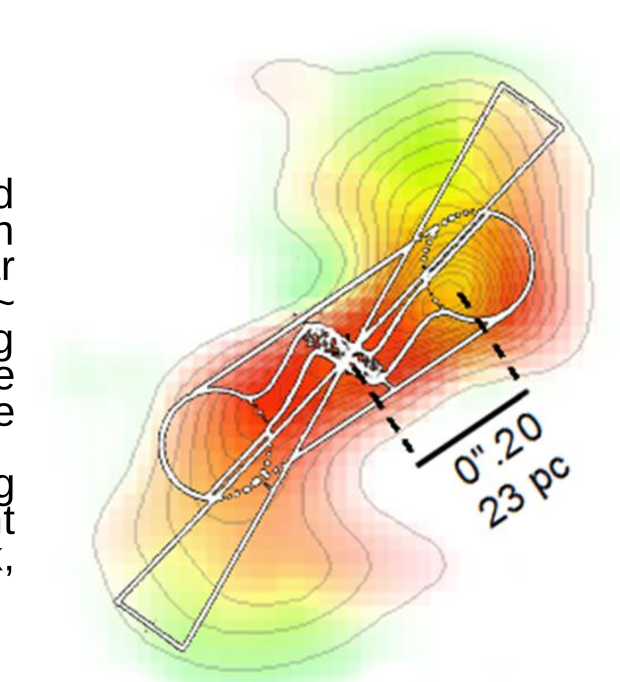
The images on the right are: (5) the HST filter *F658N* (Hα + [N II]), divided by the image in I band to highlight the ionized structure. (1+5) is the superposition of the previous image with the molecular structure, showing the large misalignment between the nuclear disk and the ionization cone. (3+5) is the detected ionization cone seen in the HST image and the tomogram 2 of PCA 2, in the optical; now is possible to know that the NW side of the cone is blueshifted and the SE redshifted. (2+4+5) is represented the regions where the gas has large velocity dispersion and thus, is more turbulent, both in the NIR and optical, together with the HST image of the cones. The white line gives the position angle for the radio emission of 156º (Zou & Gong 2012).

IV – The model for the nucleus of NGC 6951



We found an edge-on H_2 disk, with outer radius of 47 pc and velocity range of ± 40 km s^{-1}, which is misaligned in respect with the ionization cone and the radio PA. We analyzed the molecular lines ratio which is compatible with excitation by shocks with T~ 2000 K, and we interpret this scenario as being the jet colliding with the molecular disk, ejecting and heating the gas in the orientation of the ionization cones, what is also confirmed by the high dispersion velocities both in the optical and NIR lines.

In the left we adapted the scheme proposed by Zou & Gong (2012) where a highly misaligned jet hits a thick disk. In the right we ilustrate the proposed orientation of the jet inside the H_2 disk, generating the large-scale outflow.



V – References

May D, et al. 2014, in preparation.

Steiner J.E. et al. 2009, MNRAS 395, 64

Storchi-Bergmann T. et al. 2007 ApJ 670, 959

Zou S.F. & Gong B.P. 2012.

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