Mapping of Stellar Kinematics in the inner 180pc of NGC 1068

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Introduction

The NGC 1068 is located at 14.4 Mpc and harbors a Seyfert 2 Active Galactic Nuclei (AGN). Even being too close, there aren’t high resolution measurements of stellar kinematics in the literature. In this work, we present a stellar kinematics of the central region of NGC 1068 by fitting the CO absorptions in the H and K bands. We used as stellar templates the spectra of 60 late-type stars from the K-band Gemini Library of stellar spectra (Winge, Riffel & Storchi-Bergmann, 2009, ApJS, 183, 186). In regions where the K-band CO absorptions are absent in the spectra of the galaxy, due to dust emission and/or affected by the [Ca VII]:2.322 μm line emission, we fitted the H-band stellar absorptions using the spectra of 5 stars from Gemini Data Archive in order to measure of stellar kinematics.

Observations and data reduction

The observations were done with NIFS and the data reduction was done with the software IRAF and followed standard procedures.

Fig. 1 - Spectra of five late-type stars used as stellar templates for the H-band from public NIFS data in the Gemini archive. They were used to obtain measurements of stellar kinematics in the locations with strong [Ca VII]:2.322 μm and/or dust emission. The bottom spectrum is for NGC 1068 extracted at 0.5” NE from nucleus.

Results

We used the penalized Pixel-Fitting (pPXF; Cappellari & Emsellem, 2004, PASP, 116, 138) method to measure the stellar kinematics in the center region of NGC 1068, from fit the stellar absorption CO absorptions bandheads in the in the galaxy spectra in the H (1.62 μm) and K (2.3 μm) bands.

Fig. 2 - At center we show the velocity dispersion map, the H-band mask and the pseudo-slit along the major axis (dashed line). Around it, we show resulting (in red) and the observed spectra (in black).

Fig. 3 - Stellar kinematics extracted within a pseudo-slit along the galaxy minor axis (PA=-10º) at top, and major axis (PA=80º) at bottom.

Fig. 4 - At right we show a residual map obtained from stellar velocity map (left) and rotating disc model for map velocity (center) for circular orbits in a Plummer gravitational potential.

Conclusions

• We observed that stellar velocity field present a typical rotation pattern and velocity dispersion map shows a drop in the nuclear region.

• The highest sigma values are up to 190 km s⁻¹ in regions more distant than 1” from nucleus and decrease to 100 km s⁻¹ close to nucleus.

• This σ-drop may be due to a compact cold nuclear disk which has experienced recent star formation.

• In order to obtain the systemic velocity, mass and other kinematic parameters we fit a rotating disc model for the velocity field and we found the systemic velocity of the galaxy Vsys = 1160.3 km s⁻¹ and a bulge of 3.8 x 10⁸ solar masses.