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Gaseous Streaming Motions Around the Nucleus of M 81

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We present two-dimensional stellar and gaseous kinematics of the inner $119 \times 255\,\mathrm{pc}^2$ of the LINER/Seyfert 1 galaxy M 81 on the basis of observations obtained with the Integral Field Unit of the Gemini Multi-Object Spectrograph (GMOS-IFU) on the Gemini North telescope at a spatial resolution of ~ 10 pc, over the wavelength range 5600–7000 Å. Our goal is to map the gas-streaming motions toward the nucleus suggested by the presence of a dusty nuclear spiral previously observed in *HST* images (Simões Lopes *et al.* 2007). Such structures have been shown to be associated with inward gas motions in previous studies by our group (Fathi *et al.* 2006; Storchi-Bergmann *et al.* 2007).

The gaseous velocity centroids and velocity dispersions were obtained by fitting Gaussians to the [N II]λ6584 emission line. The Penalized Pixel Fitting (pPXF) technique (Cappellari & Emsellem 2004) was employed to obtain the stellar velocity centroids and velocity dispersions. In order to isolate non-circular motions, a residual map was constructed by subtracting the stellar from the gaseous velocity centroid. After subtraction, there are mostly blueshifts in the gas on the far side of the galaxy and a few small redshifts on the near side, suggesting inflow if the gas is in the plane of the galaxy. Alternatively, part of the gas may be outflowing to high latitudes, perpendicularly toward the plane.

As a novel approach to map features of the gaseous velocity field, we applied the method of principal component analysis (PCA) to our data (Steiner *et al.* 2009). The result is the separation of the information into a system of uncorrelated coordinates ordered by principal components of decreasing variance. The second principal component shows double peaks in the Hα+[N II] emission lines, with the blue and red peaks slightly blueshifted and slightly redshifted by $\sim 80\,\mathrm{km\,s^{-1}}$, respectively, relative to the systemic velocity. We interpret this as due to a compact bipolar outflow or rotation that is not resolved in the data. The third, fourth, and sixth principal components reveal a compact gas disk ($\sim$17 pc in diameter) in rotation around the nucleus. A detailed discussion on the emission-line flux distribution and excitation, as well as more details on the stellar and gaseous kinematics will be presented in a forthcoming paper.

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