Fourier Imaging Spectroscopy of the Galactic Center

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Abstract. We present results from a series of imaging spectroscopy observations of the Galactic center in the ~2 μm region. The scans were made with the CFHT imaging FTS in June 1995 and, compared to the recent 3D results of Krabbe *et al.* (1995), have improved field of view, spatial, and spectral resolution. Here we only show results of our Brγ scan.

1. Observations

The CFHT imaging FTS (Maillard 1995) works by coupling the facility Fourier Transform Spectrometer (Maillard and Michel 1982) and "Redeye" infrared camera (Simons *et al.* 1993) to work as a single instrument. The spatial resolution of images is seeing limited with 0.33 arcsec/pixel sampling. The system is designed to reimage the CFHT f/35 focal plane onto an infrared array through the FTS optics by a special optical interface, creating a pair of complementary images that modulate in intensity as the interferometer is stepped through a scan. The infrared camera records an image at each interferometer step. From the recorded data, spectra at points in the field can be extracted through straightforward aperture photometry of complementary regions in the field of view. It is also possible to invert an entire raw data cube, making a four-dimensional processed cube (x, y, σ, intensity) from which monochromatic images can be extracted and manipulated. Some of the unique advantages of this instrument over other imaging spectrometers in use at observatories include:

1. Easily tuned spectral resolution from 1.0-2.5 μm up to R~10^4.
2. Both emission and absorption line observations are practical.
3. Wavenumber calibration is intrinsic to the data.

Scans were recorded of the Galactic center during the nights of 12-15 June 1995 at CFHT. A number of filters were used to isolate various spectral features of interest in and around IRS 16, including Brγ, He I, He II, H_2, and CO. Scan resolutions were typically ~5000 with the prominent source IRS 7 located in the

$\sim$23" field of the instrument to help register the raw data cubes during post-processing. In this report preliminary results are given for the Brγ scan while the other scans through various bandpasses are further reduced and interpreted.

2. Brγ Results

Shown in Figure 1 is a coadded image made from 10 separate broadband exposures in the Brγ scan to illustrate the targets sensed in the IRS 16 region. Surrounding that image are spectra for various sources in the field calibrated in velocity around the Brγ line. They have a resolution of $\sim$45 km/s. A number of objects are narrow-line emission sources while IRS 13, 16SW, and 16NE show broad-line emission, suggestive of stellar winds surrounding these sources. In order to boost spectral signal-to-noise all spectra were derived through $\sim$2 arcsec apertures centered on sources, which is substantially broader than the $\sim$0.8" resolution of the images. This helped reduce effects of time varying seeing and astigmatism from the telescope. In Figure 2 are narrow band images around the Brγ 0 km/s line which have had a mean continuum image subtracted off in order to show only Brγ emission. Residual flux around bright stars is due to seeing variations during the time the scan was made. A spot denoting the fixed position of IRS 7 is shown in all of the images. A streamer of gas with a continuously varying velocity is clearly seen. This emission tracks from a point near IRS 10, south and around IRS 16 in a comma shape. The basic results shown here agree well with past observations made by Herbst *et al.* (1993) who demonstrated good correlation between the Brγ and Ne II gas steamers and concluded this gas is orbiting around a point within $\sim$1" of the radio position of Sgr A*. Additional scans were recorded in various bandpasses that are currently under analysis and not shown here.

References

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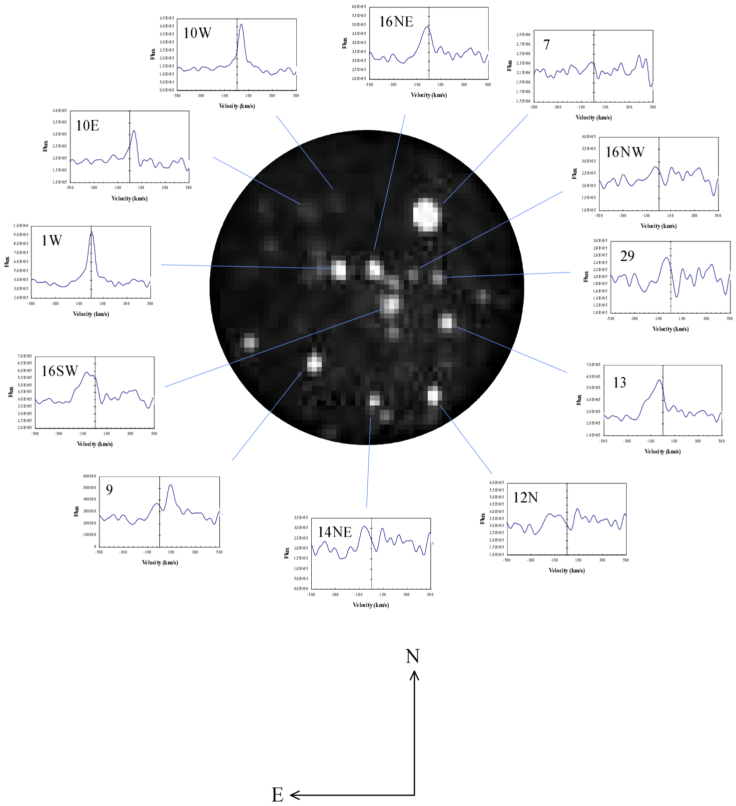

Figure 1. A montage of spectra for various sources in the IRS 16 region is shown.

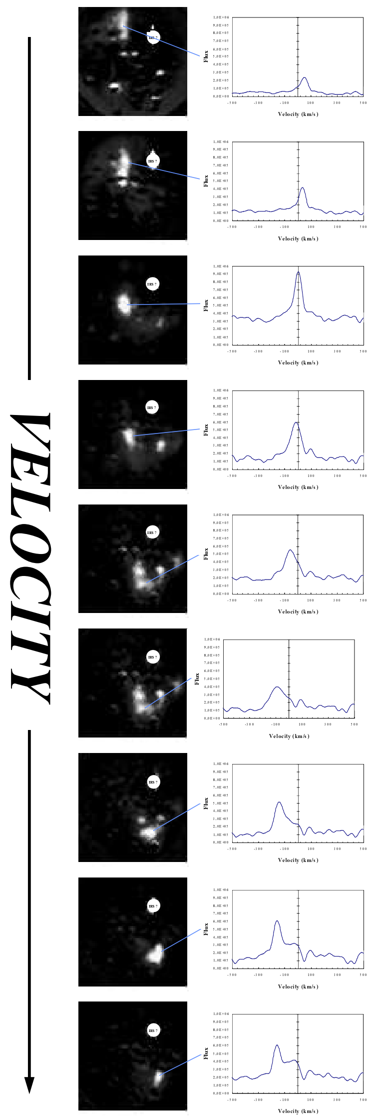

Figure 2. A series of images straddling the Brγ 0 km/s line is shown. A streamer of gas that loops around IRS 16 is detected.