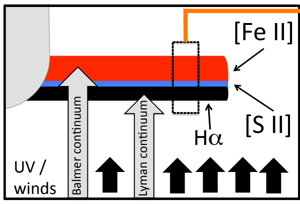
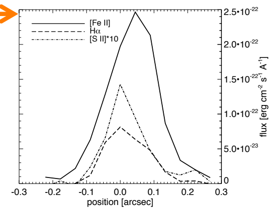
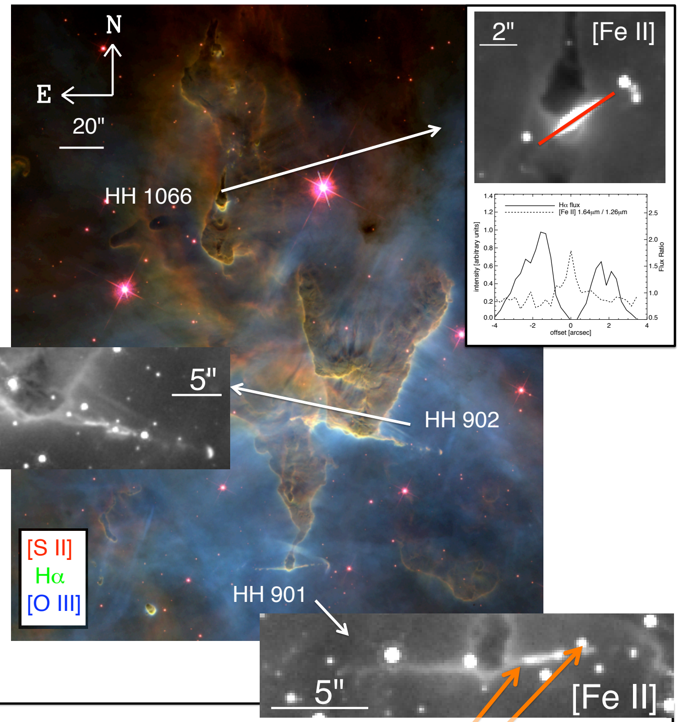
Near-IR [Fe II] emission tracing massive jets from intermediate-mass stars in Carina

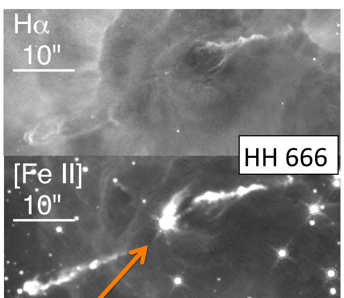
Megan Reiter, Nathan Smith Steward Observatory, University of Arizona 933 N. Cherry Ave Tucson AZ 85721





- Herbig-Haro (HH) objects are emission-line features associated with protostellar outflows
- HH jets in Carina are irradiated and photoionized by >65 O-type stars
  - → unshocked material is illuminated
  - → jet properties can be derived using photoionization theory (from known Q_H)
- Lyman continuum completely absorbed by H, creates **ionization front in jet body**
- **high n_H in jet core shields Fe** from ionization to Fe^{++}, **collisionally excites near-IR [Fe II] lines**





New narrowband **[Fe II] 1.26 μm and 1.64 μm** WFC3-IR images of 4 HH jets in the Carina nebula reveal massive, neutral atomic jet cores. Near-IR [Fe II] lines are useful because:

- they trace **high density**, low ionization material
- IR wavelengths **penetrate extinction in the globules**, in some cases **connecting the HH jet to its IR driving source**
- both lines originate from the a^4D level, so the ratio is set by atomic physics, thus comparing intrinsic and observed $\mathcal{R}$ = λ16435 / λ12567 yields the reddening

Near-IR [Fe II] images reveal dense, neutral gas not seen in previous studies of the Hα emission, raising the estimated mass-loss rates by an order of magnitude.

mass loss rate into the jet

distance before jet is completely evaporated

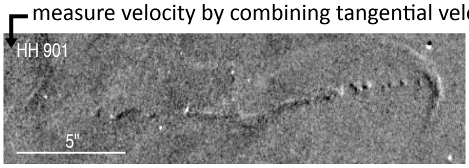
$$= L_1 = \frac{\dot{M}}{\dot{m}} = \rho v A = \mu n_H m_H v \pi r^2$$
$$= f \pi \mu m_H c_{II} n_e(r_I) r(d)$$

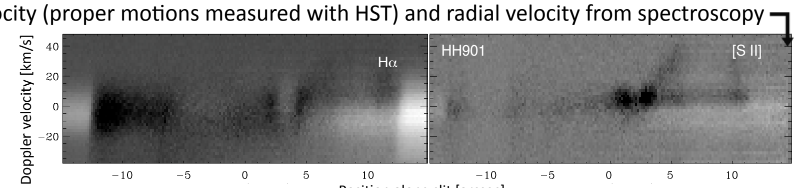
jet photoablation rate per unit length

- higher mass-loss rates imply higher accretion rates → **jets driven by intermediate-mass protostars**
- mass-loss rate estimates derived from the Hα emission measure assume the jets are fully ionized → miss most of the mass

Coming soon: kinematic information is essential for direct measurement of the jet mass-loss rate.

measure velocity by combining tangential velocity (proper motions measured with HST) and radial velocity from spectroscopy





→ by combining kinematics with improved density estimates, we will derive the detailed mass-loss history of the HH jets in Carina