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Direct Evidence for AGN-Driven Winds in a $z = 1.5$ Radio Galaxy

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Feedback from AGN is a key component in most current models of galaxy formation and evolution. For the most massive galaxies, heating and removal of gas by the AGN could precipitate an abrupt quenching of star formation during a dramatic blow-out phase. The "smoking gun" for such a scenario would be direct evidence of powerful outflows associated with the jet. I present some preliminary results of a program to look for these in high-z radio galaxies (HzRGs). Recent observations of the $z = 1.5$ radio galaxy 3C 230 obtained with the NIFS integral-field spectrograph and Altair laser adaptive optics facility on Gemini North are shown. These reveal with unprecedented resolution the complex kinematics of this system in redshifted Hα and [N II] emission. The bi-polar velocity field is aligned with the jet axis, with a kinematic center associated with the radio core itself, and turbulent edges approaching the galaxy's escape velocity. This suggests a gas mass of roughly $10^{11}\,M_\odot$ has been propagating outwards for 10^7 to 10^8 years, corresponding to a mass loss of roughly $10^{2-3}\,M_\odot$ yr^{-1}, based on its velocity and spatial extent. This is in good agreement with the energetics and typical ages of radio jets, and likely heralds the onset of the "red and dead" stage for this HzRG.

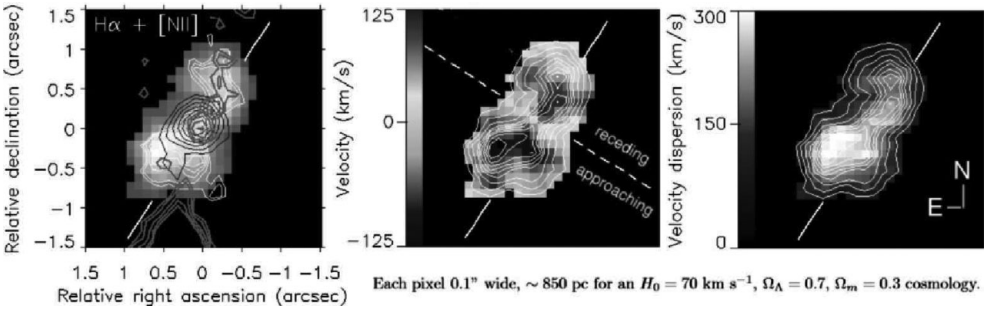

Figure 1. An image of 3C 230 produced by summing the Gemini adaptive optics (AO) Hα+[N II] spectrum in each spatial pixel. Overplotted are flux contours from CFHT AO in K band (black; Steinbring *et al.* 2002), *HST* WFPC2 F702W (white), and VLA A array at 8.4 GHz (grey; de Koff *et al.* 2000 (kindly provided by Teddy Cheung). White lines are along the radio jet. The new Gemini velocity and velocity-dispersion fields are shown with flux contours overplotted. Note the concurrence of the highest velocity with the narrowest part of the rest-frame optical emission and the bright knot in the radio jet, approximately 2 pixels (1.7 kpc) northwest of the core. There is a dramatic bi-polar flow, with turbulent edge-brightened regions along the skock front of the expanding bubble.

References

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