14344 - The HH 24 Jet Complex: Collimated and Colliding Jets from a Newborn Multiple Stellar System

Cycle: 23, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Bo Reipurth (PI) (Contact)	**University of Hawaii**	**reipurth@ifa.hawaii.edu**
Prof. John Bally (CoI)	University of Colorado at Boulder	john.bally@colorado.edu
Dr. Alejandro Raga (CoI)	Universidad Nacional Autonoma de Mexico (UNAM)	raga@nucleares.unam.mx
Dr. Colin Aspin (CoI)	University of Hawaii	caa@ifa.hawaii.edu

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(2) HH24JET4 ANY	ACS/WFC WFC3/IR	2	15-Dec-2015 21:17:35.0	yes

2 Total Orbits Used

ABSTRACT

The HH 24 complex constitutes the richest concentration of collimated bright Herbig-Haro jets known, and they originate from a small grouping of newborn binary and multiple systems. At least 6 jets are identified in deep groundbased optical interference images, and a similar number of sources in infrared images. We propose to do the first HST study of this complex, using H-alpha and [SII] filters. HST 0.05" to 0.1" angular resolution (20 to 40 AU at d~400 pc) is needed to resolve the shocks and their post-shock cooling layers for comparison with advanced numerical modeling. Our emphasis here is to explore outflows from a multiple system of newborn stars. Many of the jets show clear evidence of wiggling. The theory of jet motion from binary systems coupled with disk precession is now understood, and we will interpret the jet wiggles in this framework. Additionally,

two of the HH 24 jets are showing evidence for a collision, a unique situation not seen anywhere else, and HST resolution is needed for comparison with gas-dynamic studies of jet-jet collisions. Two of the HH 24 jets are bright in the infrared [FeII] 1.644 line. In this line the main jet can be traced all the way to the source, which is the most important region for understanding the effects of binarity on the jet structure. We also apply for a second-epoch [SII] image in Cycle 23. This allows us, in addition to deriving the bulk motion, to determine such processes as expansion of the jet beam, sideways ejection in a working surface, turbulent and chaotic motions, and the effect of instabilities.

OBSERVING DESCRIPTION

We have tried to determine absolute fluxes of knots in the HH 24 jet No.4 from our groundbased data. The main body of the jet ranges from 1.2x10-15 to 1.2x10-14 erg sec-1 cm-2 arcsec-2 in [SII] (this does not include the bright knot in the collision region, which is much brighter). For 0.04" pixels the exposure time calculator for WFC3 indicates that we will get a S/N of 10 for exposure times ranging from 1900 sec to 26000 sec. The H-alpha emission has about the same range in fluxes (although distributed very differently from the [SII] knots). In both cases we are photon-limited, that is, out of the read noise. In the infrared [FeII] 1.644 micron line, we measure a flux in our groundbased images of 2x10-15 erg sec-1 cm-2 arcsec-2 in the brightest knot in the HH 24 jet No.4 (again not in the very bright collision zone at the end of the jet). The exposure time calculator indicates that we get a S/N of 10 in 478 sec. The jet fades steadily along its body by about a factor 100. Hence in practical terms the exposure time decides how far out along the jet that we can get meaningful results.

In the first visit (2 orbits) we observe the HH 24 complex in H-alpha (F656N) with the standard 4 point dithering by WFC3/UVIS. The second visit (2 orbits) is the same as the first visit, but in [SII] (F673N). The third visit (2 orbits) observe [FeII] in the F164N filter using the WFC3/IR detector, and a total of 6 sequences with dithering are used. The pointing of the IR visit is slightly different from the H-alpha/[SII] visits in order to better focus on the jet No.4 lobes. We would like these 3 visits observed as close together as possible, not exceeding a month in interval. This is important due to the significant tangential motion of the objects, so the closer in time the visits can be made, the better.

Besides the primary WFC3 observations, we have received permission (Request Number 74858) to execute coordinated parallel observations with ACS/WFC. These parallel observations are done in the H-alpha filter F658N for all orbits, and they target the objects HH 19/20/21, which are the working surfaces of the HH 24 jet. The HH 19/20/21 objects are very extended, and therefore are observable for a range of Orient Angle between 82 and 110 D. The ideal Orient would be between 82 and 96 D, but any angle up to 110D will be satisfactory, if needed for scheduling purposes.

Visit

Proposal 14344, VisitIR (01), implementation Wed Dec 16 02:17:37 GMT 2015

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/IR, ACS/WFC

Special Requirements: ORIENT 82D TO 82 D

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(2)	Pattern Type=WFC3-IR-DITHER-BOX-MIN Purpose=DITHER Number Of Points=4 Point Spacing=0.572 Line Spacing=0.365	Coordinate Frame=POS-TARG Pattern Orientation=18.528 Angle Between Sides=74.653 Center Pattern=true		(1-2)
(3)	Pattern Type=WFC3-IR-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.45 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=131.788 Angle Between Sides= Center Pattern=false		(3-4)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HH24JET4	RA: 05 46 8.8000 (86.5366667d) Dec: -00 10 3.00 (-.16750d) Equinox: J2000		V=35	Reference Frame: ICRS

Comments: The HH 24 jet complex contains shocks with fluxes ranging over many orders of magnitude, from the brighest knots to weak diffuse emission.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	FeII164	(2) HH24JET4	WFC3/IR, MULTIACCUM, IR	F164N	SAMP-SEQ=STEP100; NSAMP=15		Pattern 2, Exps 1-2 in VisitIR (01) (2) Prime + Parallel Group 1-2 in Pattern 2, Exps 1-2 in VisitIR (01)	899.233261 Secs (3596.933 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]* *[==>(Pattern 3)]* *[==>(Pattern 4)]*	 ***[1]*** ***[2]***
2	ACSpar	ANY	ACS/WFC, ACCUM, WFC	F658N			Pattern 2, Exps 1-2 in VisitIR (01) (2) Prime + Parallel Group 1-2 in Pattern 2, Exps 1-2 in VisitIR (01)	700 Secs (3130 Secs) *[==>721.0 Secs (Pattern 1)]* *[==>803.0 Secs (Pattern 2)]* *[==>803.0 Secs (Pattern 3)]* *[==>803.0 Secs (Pattern 4)]*	 ***[1]*** ***[2]***
3	FeII164	(2) HH24JET4	WFC3/IR, MULTIACCUM, IR	F164N	SAMP-SEQ=STEP100; NSAMP=15		Pattern 3, Exps 3-4 in VisitIR (01) (3) Prime + Parallel Group 3-4 in Pattern 3, Exps 3-4 in VisitIR (01)	899.233261 Secs (1798.467 Secs) *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[2]***
4	ACSpar	ANY	ACS/WFC, ACCUM, WFC	F658N			Pattern 3, Exps 3-4 in VisitIR (01) (3) Prime + Parallel Group 3-4 in Pattern 3, Exps 3-4 in VisitIR (01)	700 Secs (1606 Secs) *[==>803.0 Secs (Pattern 1)]* *[==>803.0 Secs (Pattern 2)]*	 ***[2]***

Orbit Structure