10764 - X-Ray Activity and Winds in Young A Stars at the Epoch of Disk Clearing

Cycle: 14, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets*	*Configurations*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) HD-100453	ACS/SBC	1	21-Nov-2005 21:01:04.0	yes
02	(2) HD-169142	ACS/SBC	1	21-Nov-2005 21:01:24.0	yes

2 Total Orbits Used

ABSTRACT

Herbig Ae stars which are still accreting material from their protoplanetary disks show a gradual evolution in X-ray luminosity and hardness ratio. They resemble T Tauri stars in driving microjets which can be imagaged in Lyman alpha. Older A stars with more centrally cleared debris disks, like beta Pictoris, are not X-ray sources, but still have some stellar activity and can drive coronal winds. We wish to test the hypothesis that the change in the level of stellar activity and hardness of stellar activity signatues are linked to changes in the magnetic field strength and wind geometry. We are requesting 20 ksec of Chandra and 2 orbits of HST time to observe two late-A Herbig Ae stars which appear to be transitional between the accreting objects and the debris disks.

OBSERVING DESCRIPTION

To obtain the needed reference astrometry for the interpretation of the Chandra ACIS-S imaging, at wavelengths which preferentially sample plasma at chromospheric and transition region temperatures, we are requesting 2 orbits of HST time for ACS Solar-Blind Channel (SBC) at Lyman alpha (F122M) imaging of our two science targets. If feasible, we prefer to have the HST observations scheduled at times when the airglow background is low, but this is not essential.

Science Target Observations: We expect that the FUV Ly alpha imagery will have 2 (HD 100453) or more (up to 5 for HD 169142) stellar sources within 10" of the position of the Herbig Ae star, as well as any contribution from a stellar wind or substellar objects. Both stars have archival IUE data demonstrating the presence of a FUV continuum, emission lines, and Ly alpha emission. IUE data constrain these features to be within 3-5" of the Herbig Ae star. The IUE exposures are sufficiently short that the bulk of the measured Ly alpha flux is associated with the star (as demonstrated from the IUE SI files available at archive.stsci.edu/iue), and is not geocoronal. While the fluxes from both stars are comparable, as seen by IUE, the S/N is better for the HD 169142 observation. For that star, the ACS ETC estimates 30 c/s in the SBC with F122M, and a S/N in excess of 800 in a 2ks integration assuming average sky (airglow) conditions. This is comfortably below the MAMA detector bright

object limits and presents no difficulties for ACS observation.

Companions: HD 100453 has one known late-type companion, while HD 169142 appears to have at least 2, some 7.7" SW of the Herbig Ae star, as seen in NICMOS imagery obtained under HST-GO-10177. The composite spectral type of HD 169142B/C is M2.5Ve, based on optical spectra obtained in May-June 2005 at the Apache Point Observatory. The spectral type of the known HD 100453 companion is believed to also be M2-M3Ve. For the late-type companions, we have estimated UV fluxes from securely dated, chromospherically active stars in two limits: using the M1Ve
star AU Mic (d=9.8 pc), and the 25 Jupiter-mass brown dwarf 2MASSW 1207734 -393254 (Gizis et al. 2005). Both objects have archival STIS data (AU MIC also has GHRS). The FUV spectra of
both sources are characterized by a mixture of chromospheric, transition region,
and coronal (AU Mic) emission lines, with the strongest lines Ly alpha , C IV, and He II 1640 A .
In 2ks, ACS imagery should reach a limiting flux, in the presence of average geocoronal
Ly alpha emission of 0.04 times the AU Mic spectrum scaled to d=145 pc with S/N=6,
or S/N=4 in the event of high airglow backgrounds. Any late-type stellar companions
or luminous brown dwarfs similar to 2MASSW J1207334-393254 (Shipman et al. 2004)
should be detectable as point sources in such integrations, if well-separated from
the A star. AU Mic analogs will be detectable in the reduced, but not PSF subtracted
ACS imagery exterior to 0.06" for d=112 pc, and 0.12" for d=145 pc. Experience with deep
imagery with STIS suggests that PSF subtraction is feasible and should enable an additional factor of 20-50 gain in contrast.

Detection of a spatially resolved wind: Our experience with HD 100546 (Grady et al. 2005) with STIS suggests that a resolved wind component would be detectable (S/N=2) at r<1.2", after sky and PSF subtraction. We may also have extended emission from the circumstellar disk: Habart et al. (2005) discuss the spatial extent of PAH features for HD 169142. Our experience with HD 100546 suggests that such emission on the expected scale will be resolved by HST. The extend of the wind emission may determine whether it is separable from the Lyman alpha emission from the wind. However, the
NICMOS data for HD 169142 indicate a face-on viewing geometry for the disk.

Object Visibility for HST: The ACS SBC MAMA detector is a STIS flight spare with similar PSF to the STIS FUV MAMA. Both detectors suffer from the same detector scattering due to charge migration at the microchannel plate surface, resulting in a PSF with core and strong halo which is broader than the HST diffraction limit at FUV wavelengths. No change in imaging performance is expected with the change to 2 gyro operations. HD 100453 is a CVZ target under 3-gyro HST control and is viewable throughout the year. Under 2-gyro control the star has 250 days of high visibility and 78 days of low visibility during cycle 14. HD 169142 has a 3-gyro window from mid-Feb. through mid-Nov. Under 2-gyro control, the star has 132 days of high visibility and 61 days of low visibility in cycle 14

Joint Rather than Coordinated Observations: We will not object if the Chandra and HST observations are close in time, but we can accomplish all of our goals with joint rather than coordinated observations.

REAL TIME JUSTIFICATION

N/A.

CALIBRATION JUSTIFICATION

We will make use of existing ACS SBC deep PSF imagery data, and (at this time) do not anticipate needing dedicated calibration observations.

Visit

Proposal 10764, Visit 01 Tue Nov 22 02:01:28 GMT 2005

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.179 Line Spacing=0.116	Coordinate Frame=POS-TARG Pattern Orientation=20 Angle Between Sides=63.7 Center Pattern=false		(1), (2), (3), (4)

Fixed Targets

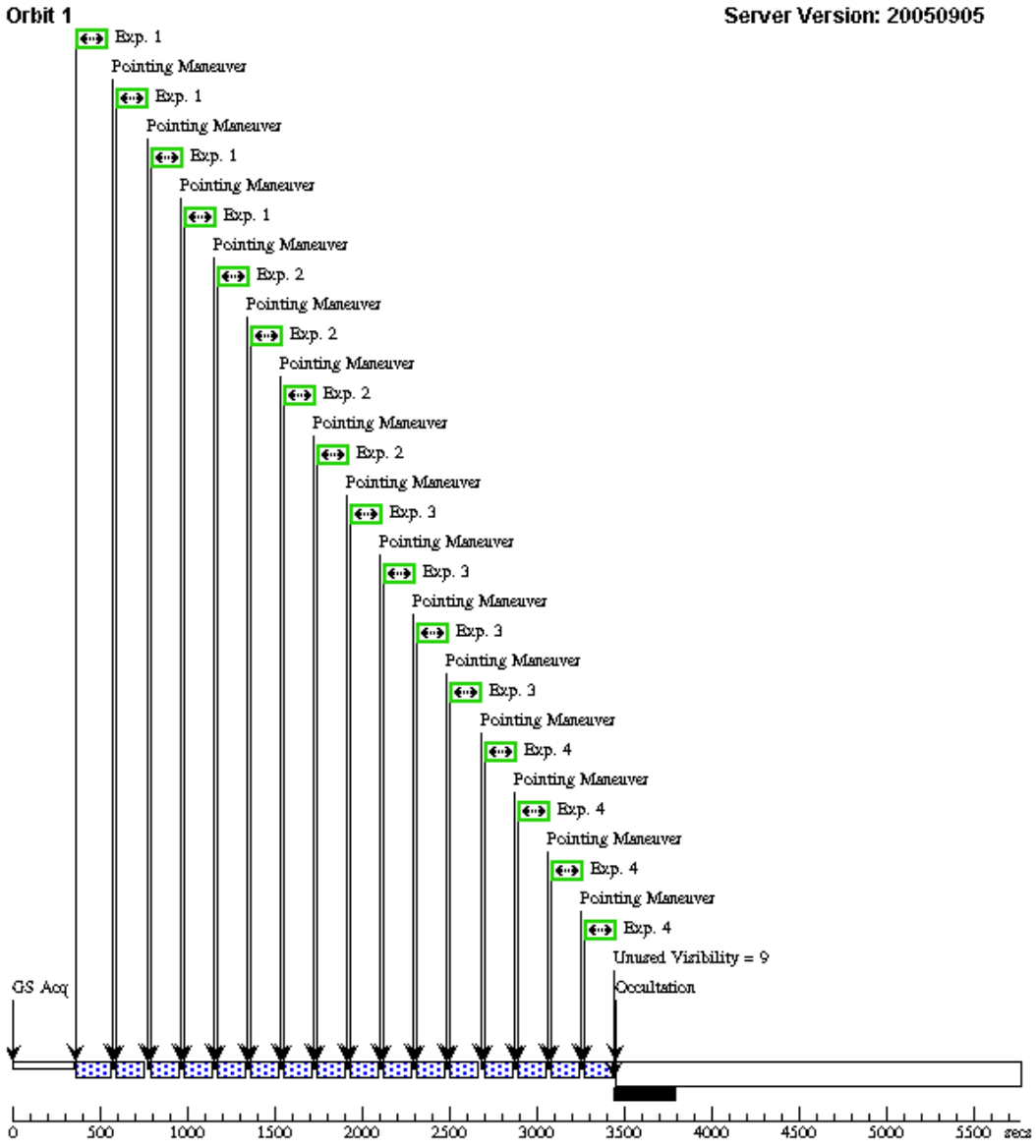
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	HD-100453	RA: 11 33 5.5767 (173.2732363d) Dec: -54 19 28.54 (-54.32459d) Equinox: J2000 Plate Id: (?)	Proper Motion RA: -0.00042s/yr Proper Motion Dec: -0.00472"/yr Parallax: 0.00897" Epoch of Position: 1991.25	V=7.79+/-0.1 F(1800 A)=7E-13 erg/cm/cm/s/A (photosphere)	Coordinate Source: HIPPARCOS/TYCHO_CATALOGUE

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Coordinates, proper motion and parallax in SIMBAD are from the Hipparcos catalog.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(1) HD-100453	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 1-1 (1)	100.0 Secs	
								[==>131.0 Secs (Pattern 1)] *[==>131.0 Secs (Pattern 2)]* *[==>131.0 Secs (Pattern 3)]* *[==>131.0 Secs (Pattern 4)]*	***[1]***
2		(1) HD-100453	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 2-2 (1)	100.0 Secs	
								[==>131.0 Secs (Pattern 1)] *[==>131.0 Secs (Pattern 2)]* *[==>131.0 Secs (Pattern 3)]* *[==>131.0 Secs (Pattern 4)]*	***[1]***
3		(1) HD-100453	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 3-3 (1)	100.0 Secs	
								[==>131.0 Secs (Pattern 1)] *[==>131.0 Secs (Pattern 2)]* *[==>131.0 Secs (Pattern 3)]* *[==>131.0 Secs (Pattern 4)]*	***[1]***
4		(1) HD-100453	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 4-4 (1)	100.0 Secs	
								[==>131.0 Secs (Pattern 1)] *[==>131.0 Secs (Pattern 2)]* *[==>131.0 Secs (Pattern 3)]* *[==>131.0 Secs (Pattern 4)]*	***[1]***

Orbit Structure



Visit

Proposal 10764, Visit 02 Tue Nov 22 02:01:30 GMT 2005

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/SBC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-SBC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.179 Line Spacing=0.116	Coordinate Frame=POS-TARG Pattern Orientation=20 Angle Between Sides=63.7 Center Pattern=false		(1), (2), (3), (4)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	HD-169142	RA: 18 24 29.7790 (276.1240792d) Dec: -29 46 49.37 (-29.78038d) Equinox: J2000 Plate Id: (?)	Proper Motion RA: -0.00036s/yr Proper Motion Dec: -0.0431"/yr Epoch of Position: 1991.25	V=8.15+/-0.1 F(1800 A)=8E-13 erg/cm/cm/s/ A (photosphere)	Coordinate Source: SIMBAD

Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.
Proper motion is from the Tycho Catalog. No parallax is given, but other authors have suggested d=145 pc for HD 169142.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1		(2) HD-169142	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 1-1 (1)	100.0 Secs	
								[==>119.0 Secs (Pattern 1)] *[==>119.0 Secs (Pattern 2)]* *[==>119.0 Secs (Pattern 3)]* *[==>119.0 Secs (Pattern 4)]*	***[1]***
2		(2) HD-169142	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 2-2 (1)	100.0 Secs	
								[==>119.0 Secs (Pattern 1)] *[==>119.0 Secs (Pattern 2)]* *[==>119.0 Secs (Pattern 3)]* *[==>119.0 Secs (Pattern 4)]*	***[1]***
3		(2) HD-169142	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 3-3 (1)	100.0 Secs	
								[==>119.0 Secs (Pattern 1)] *[==>119.0 Secs (Pattern 2)]* *[==>119.0 Secs (Pattern 3)]* *[==>119.0 Secs (Pattern 4)]*	***[1]***
4		(2) HD-169142	ACS/SBC, ACCUM, SBC-FIX	F122M			Pattern 4-4 (1)	100.0 Secs	
								[==>119.0 Secs (Pattern 1)] *[==>119.0 Secs (Pattern 2)]* *[==>119.0 Secs (Pattern 3)]* *[==>119.0 Secs (Pattern 4)]*	***[1]***

Orbit Structure