13441 - Co-latitudinal Radial Velocity Profile Confirmation Via Differential Proper Motion of the Bipolar Egg Nebula

Cycle: 21, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Ms. Rachael Tomasino (PI) (Contact)	**University of Denver**	**rachael.tomasino@du.edu**
Dr. Toshiya Ueta (CoI) (AdminUSPI)	University of Denver	tueta@du.edu
Dr. Djazia Ladjal (CoI)	University of Denver	djazia.ladjal@du.edu
Dr. Hyosun Kim (CoI)	Academia Sinica, Institute of Astronomy and Astrophysics	hkim@asiaa.sinica.edu.tw

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) V1610-CYG	ACS/WFC	1	20-Jun-2013 21:18:55.0	yes

1 Total Orbits Used

ABSTRACT

Requesting the use of ACS/WFC for one orbit to obtain a deep 3rd epoch exposure of the Cygnus Egg Nebula. The proposed observation of the Egg will not only yield multi-epoch snapshots of the circumstellar arcs but also determine the co-latitudinal velocity field that helps break the degeneracy in model fitting. Full 3-D model calculations, done by CoI Kim, have already quantified the co-latitudinal dependence due to the binary orbital motion, relating the orbital speed of the binary stars to the resulting structural pattern in the circumstellar density distributions. We will be able to constrain the orbital properties of the Egg Nebula via a new set of specific model fitting. The duplication of the epoch 2 observation (PI: W. Sparks) is by design and with a baseline between the 2nd and 3rd epoch of more than 11 years, there is a lower limit shift of 1.32 pixels for the slower

moving arcs and it will be more than enough to perform a differential proper-motion study. The Cygnus Egg Nebula is a proto-planetary nebula, which means that the circumstellar density structure still retains valuable clues pertaining to the early asymptotic giant branch mass loss history and initial development of their aspherical shell structure. One of the most peculiar characteristics of the circumstellar shell structure of the Egg Nebula is the co-presence of the nebula's signature bipolar lobes and rather circular concentric arcs superposed on top of each other. There is no consensus among researchers on their origins, especially because of the paradox due to the co-presence of the circular arcs and bipolar lobes.

OBSERVING DESCRIPTION

For this proposed study, we request the use of one orbit to image the Egg Nebula with ACS/WFC using F606W (with CLEAR2). We will duplicate the ACS/WFC observations on 2002 October 16 (CAL/ACS-9586; PI: W. Sparks) because this observation set uses the longest exposure time among all the previous observations of the Egg Nebula (i.e., to secure the maximum depth) while securing a long enough time interval (~ 11 yr) for the differential proper-motion investigation. However, we will not perform imaging polarimetry part of the CAL/ACS-9586 as we found that the scattering in the Egg Nebula cannot be explained by a simple single-scattering of the single central source and that the data are not particularly useful in the differential proper-motion investigation. The WFPC2 observation set of GTO/WF2-6221 does not provide long enough exposure than the CAL/ACS set. While the most recent WFC3 observation set of GO-11580 goes deeper in some filters, there will not be long enough time interval [mere 4 yr] to be suitable for the differential proper-motion measurements. Hence, our choice of ACS/WFC is justified.

It is important to have a cleanest and deepest image possible, because we want to capture the concentric arcs to the faintest ends as possible. The previous CAL/ACS observations spent a total exposure time of 1469 sec. Including the science exposure overhead times (5.5 min for ACQ, 4/2.5 min for set-up, and 0.5 min for each dither slew), we determine that to maximize the estimated 50 minutes of available observing time in one orbit, we will perform 4-point dither (to remove of pixel anomalies and the chip gap and to improve the image sampling) with each exposure 565 sec, which will yield the total exposure time of 2260 sec. Hence, our choice of exposure time and dithering parameters is justified.

By using the same instrument, filter, and aperture as the previous CAL/ACS obser- vations but increasing the exposure time it will result in a deeper image with a better signal-to-noise ratio. We want to make sure that we gain about equal or better signal-to-noise ratio provided that the image fidelity of ACS/WFC has been degraded over time from years of use in space: hence we will use one full orbit. Moreover, the better signal-to-noise ratio image will provide better constraints for model fitting with 3-D hydrodynamical model calculations as has been performed for AFGL 3068 (Kim & Taam 2012b).

Visit

Proposal 13441, Visit 01 Fri Jun 21 01:19:03 GMT 2013

Diagnostic Status: No Diagnostics

Scientific Instruments: ACS/WFC

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=ACS-WFC-DITHER-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.265 Line Spacing=0.187	Coordinate Frame=POS-TARG Pattern Orientation=20.67 Angle Between Sides=69.05 Center Pattern=false		(1)

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	V1610-CYG Alt Name1: EGG-NEBULA Alt Name2: CRL2688	RA: 21 02 18.8400 (315.5785000d) Dec: +36 41 41.10 (36.69475d) Equinox: J2000		V=17	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) V1610-CYG	ACS/WFC, ACCUM, WFC	F606W			Pattern 1, Exps 1-1 in Visit 01 (1)	500 Secs (2260 Secs) *[==>565.0 Secs (Pattern 1)]* *[==>565.0 Secs (Pattern 2)]* *[==>565.0 Secs (Pattern 3)]* *[==>565.0 Secs (Pattern 4)]*	*[1]*

Orbit Structure