



11224 - Unraveling Mira AB Accretion Mysteries

Cycle: 16, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

<i>Visit</i>	<i>Targets used in Visit</i>	<i>Configurations used in Visit</i>	<i>Orbits Used</i>	<i>Last Orbit Planner Run</i>	<i>OP Current with Visit?</i>
01	(1) MIRAAB	WFPC2	3	06-Jul-2007 21:13:09.0	yes

3 Total Orbits Used

ABSTRACT

Wind accretion is one of the most common yet poorly understood phenomena in astrophysics. A key step toward advancing our understanding of physical processes and accretion geometries in wind accreting systems is direct imaging of the individual components and mass flows. The nearby symbiotic binary Mira AB, composed of an AGB donor star and an accreting compact companion, is a unique target since it can be easily spatially resolved with the HST, and thus serves as a perfect test laboratory for accretion studies in wind interacting systems.

We propose to carry out WFPC2 observations of Mira AB following the HST and Chandra detections of an unprecedented outburst from the cool giant, and the discovery of an accretion stream showing for the first time evidence for a direct mass transfer between the components in a wind accreting system. High-angular-resolution multiwavelength imaging at UV /optical wavelengths will allow us to determine the properties of the ejected material as it flows throughout the binary and interacts with the Mira A circumstellar material and wind; the physical characteristics of mass transfer in this system and especially the role of the accretion stream between Mira A and Mira B; and the response of the system to the increased accretion rate onto Mira B following the outburst.

These results will provide crucial inputs and quantitative constraints to models of wind interacting systems and will also anchor our understanding of accretion processes in a wide range of interacting binaries that cannot be currently resolved, including in other symbiotics and more exotic systems such as accreting black holes and neutron stars in high-mass X-ray binaries.

OBSERVING DESCRIPTION

These observations will investigate the interaction between Mira A and B using multi-spectral imaging with the WFPC2 PC. We plan to carry out WFPC2 high-angular resolution imaging (0.046"/pixel) of Mira AB, using the dither mode in several filters. This would allow us to unambiguously study the components of the system (and the changes that have occurred since the last HST observation in 2004), including the ejected material, and the accretion stream between MiraA and MiraB.

We propose to carry out the observations during the last quarter of 2007 when MiraA is expected to be fainter than 8.5 magnitudes (based on AAVSOLPV predictions the MiraA optical minimum, $V < 9.5$ magnitude, is expected in November 2007). This will allow imaging with WFPC2 and will increase the contrast of different emitting components in the system, including the mass flow between the components and the region of interaction between the ejecta and the circumbinary material. MiraB itself is expected to be fainter than $V=10$ magnitude.

We have selected a set of filters to separate line and continuum emission, to distinguish shocked from photoionized gas, and to determine the shock speed or the nature of the photoionizing continuum. For example, the H-alpha, [OII] 3729A, and [OIII]5007A lines are bright, and they provide information on the ionization state of the gas. The [SII] 6731A/ H-alpha ratio will allow us to identify shocked vs. ionized gas emission, e.g., the ratio

will be ~ 0.4 for shocked gas, and smaller for photoionized gas. Further diagnostics will be provided using the [NeV] 3426Å line, e.g. the [NeV] line appears only at shock speeds above 150km/s. The O[III]4363Å/5007Å ratio gives the temperature which further constrains either the shock speed or the ionizing spectrum. We selected 9 filters covering the line and continuum emission. 6 of them are centered on emission lines, e.g. F344N[NeV], F375N[OII], F437N & F502N[OIII], F656NH, F673N[SiII]. We will compare our narrow-band images with continuum images obtained using the F160BW, F336W, F547M filters.

The dithered observations will be taken using all filters at each dither position before moving to the next position in order to minimize the overheads. Additional longer exposures for a couple of key filters will then be taken at the end of the dithered exposures in order to provide increased S/N for all components of the MiraAB system.

We note that in 2004 MiraB was $\sim 0.55''$ away from MiraA at a PA $\sim 110^\circ$. (GO-5822; GO-8298; GO-10091), and we had no trouble acquiring the targets and obtaining spectroscopy. Because of the long orbital period (>400 yrs) we do not expect that Mira-B has moved much since February 2004.

Proposal 11224 - Visit 01 - Unraveling Mira AB Accretion Mysteries

Sat Jul 07 01:13:16 GMT 2007

Visit	Proposal 11224, Visit 01, scheduling Diagnostic Status: No Diagnostics Scientific Instruments: WFPC2 Special Requirements: BETWEEN 01-SEP-2007:21:00:05 AND 30-DEC-2007:21:00:05									
	Patterns	#	Primary Pattern	Secondary Pattern	Exposures					
		(1)	Pattern Type=WFPC2-BOX Purpose=DITHER Number Of Points=4 Point Spacing=0.559 Line Spacing=0.559	Coordinate Frame=POS-TARG Pattern Orientation=26.57 Angle Between Sides=143.13 Center Pattern=false		(1-9)				
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	MIRAAB	RA: 02 19 20.7900 (34.8366250d) Dec: -02 58 39.50 (-2.97764d) Equinox: J2000		V=8.0+/-1.0	Reference Frame: ICRS				
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1	Mira UV218	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F160BW		POS TARG -5,-5	Pattern 1-9 (1)	2.0 Secs	
									[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	[2]
									[=>(Pattern 3)]	[3]
									[=>(Pattern 4)]	[3]
	2	Mira UV336	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F336W		POS TARG -5,-5	Pattern 1-9 (1)	2.0 Secs	
									[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	[2]
									[=>(Pattern 3)]	[2]
									[=>(Pattern 4)]	[3]
	3	Mira V547 M	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F547M		POS TARG -5,-5	Pattern 1-9 (1)	0.11 Secs	
									[=>(Pattern 1)]	[1]
									[=>(Pattern 2)]	[2]
									[=>(Pattern 3)]	[2]
									[=>(Pattern 4)]	[3]
4	Mira UV343 N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F343N		POS TARG -5,-5	Pattern 1-9 (1)	60.0 Secs		
								[=>(Pattern 1)]	[1]	
								[=>(Pattern 2)]	[1]	
								[=>(Pattern 3)]	[2]	
								[=>(Pattern 4)]	[3]	

Proposal 11224 - Visit 01 - Unraveling Mira AB Accretion Mysteries

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit	
Exposures (continued)	5	Mira UV375 N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F375N		POS TARG -5,-5	Pattern 1-9 (1)	30.0 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	[2]
									[==>(Pattern 3)]	[3]
									[==>(Pattern 4)]	[3]
	6	Mira V437N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F437N		POS TARG -5,-5	Pattern 1-9 (1)	10.0 Secs	
									[==>(Pattern 1)]	[1]
									[==>(Pattern 2)]	[2]
									[==>(Pattern 3)]	[3]
									[==>(Pattern 4)]	[3]
	7	Mira V656N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F656N		POS TARG -5,-5	Pattern 1-9 (1)	1.0 Secs	
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
								[==>(Pattern 3)]	[3]	
								[==>(Pattern 4)]	[3]	
8	Mira V673N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F673N		POS TARG -5,-5	Pattern 1-9 (1)	1.0 Secs		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
								[==>(Pattern 3)]	[3]	
								[==>(Pattern 4)]	[3]	
9	Mira V502N	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F502N		POS TARG -5,-5	Pattern 1-9 (1)	2.0 Secs		
								[==>(Pattern 1)]	[1]	
								[==>(Pattern 2)]	[2]	
								[==>(Pattern 3)]	[3]	
								[==>(Pattern 4)]	[3]	
10	Mira V502L ong	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F502N		POS TARG -5,-5		10.0 Secs		
								[==>]	[3]	
11	Mira UV375 long	(1) MIRAAB	WFPC2, IMAGE, PC1-FIX	F375N		POS TARG -5,-5		200.0 Secs		
								[==>]	[3]	





