12518 - A New Lead on the White Dwarf Initial-to-Final Mass Relation

Cycle: 19, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) PHR1315-6555 (2) PHR1315-6555-OFFSET	WFC3/UVIS	2	27-Jun-2011 21:58:02.0	yes

2 Total Orbits Used

ABSTRACT

Any association between a planetary nebula (PN) and a Galactic open star cluster is an extremely valuable and potent astrophysical tool. This is because the accurate (<10%) cluster distance, as determined from a high quality color-magnitude diagram (CMD), constrains the physical parameters of the PN and its central star (CSPN) to exceptional precision. The age, and hence mass of the progenitor star can also be very tightly constrained from cluster isochrones. CSPN photometry also allows precise determination of its intrinsic luminosity and mass. The mass of the progenitor star, which can be related to the chemistry of the resulting PN (from spectroscopy), provides a rare additional datum for the fundamental white dwarf (WD) initial-to-final mass relation (IFMR) which intimately links WD properties to their main-sequence progenitors. A robust IFMR is a key component of using WD luminosity functions to constrain the age of the Galactic disk (field WD population) and open clusters (cluster population) and is also key to the build up of carbon and nitrogen in galaxies. We have discovered a unique PN/open cluster association to add to the IFMR. This

single-object proposal is designed to exploit the science inherent in this remarkable discovery.

OBSERVING DESCRIPTION

We plan to use WFC3 with the following broad filters: F200LP and F350LP to assure that the CS is correctly identified and to determine the UV continuum; the F555W and F814W filters will allow a determination of the visible continuum (since the nebula is well resolved) and also allow the construction of a deep CMD for the host cluster. The continuum exposures will be centered on the cluster, and line-dithered to ameliorate detector artifacts (particularly for the PN central star). We also plan an exposure of the PN with the F502N narrow-band filter (centered in UVIS1) to provide the detailed nebular microstructure in [O_III].

The broad wavelength coverage of these filters beginning in the near-UV where the star will be brightest gives us the opportunity to correctly identify the PN central ionizing star, which we have predicted to have V~23.5+/-1.0. A major additional by-product of the WFC3 field of view is that it is nearly identical to the size of the cluster, which affords the opportunity of a complete color-magnitude diagram for the host cluster. The existing literature CMDs from ground based observations are of rather low quality and suffer from image blending and field star contamination within this compact cluster.

In detail, we need exposures centered on the cluster of ~0.5 min plus >10 min in each of F555W and F814W to cover the full dynamic range of the cluster stars with S/N>=30 from above the red clump (V=16.5) to the faint CSPN (V~23.5). We also need the UV continuum with a 14 min and a 16~min exposure in F200LP and F350LP, respectively, which will yield S/N=20. Finally, we plan a ~15 min exposure in F502N, which will yield a S/N ~10 per resolution element. Splitting all exposures (except for the two at 30~s) and allowing for dither offsets between pairs for continuum exposures, plus orbit overheads and managing buffer dumps, requires 2 orbits for this program.

Visit

Proposal 12518, Visit 01, implementation Tue Jun 28 01:58:08 GMT 2011

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS

Special Requirements: (none)

Patterns

#	Primary Pattern		Secondary Pattern	Exposures
(1)	Pattern Type=WFC3-UVIS-DITHER-LINE Purpose=DITHER Number Of Points=2 Point Spacing=0.145 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=46.84 Angle Between Sides= Center Pattern=false		(2), (3), (5), (6)

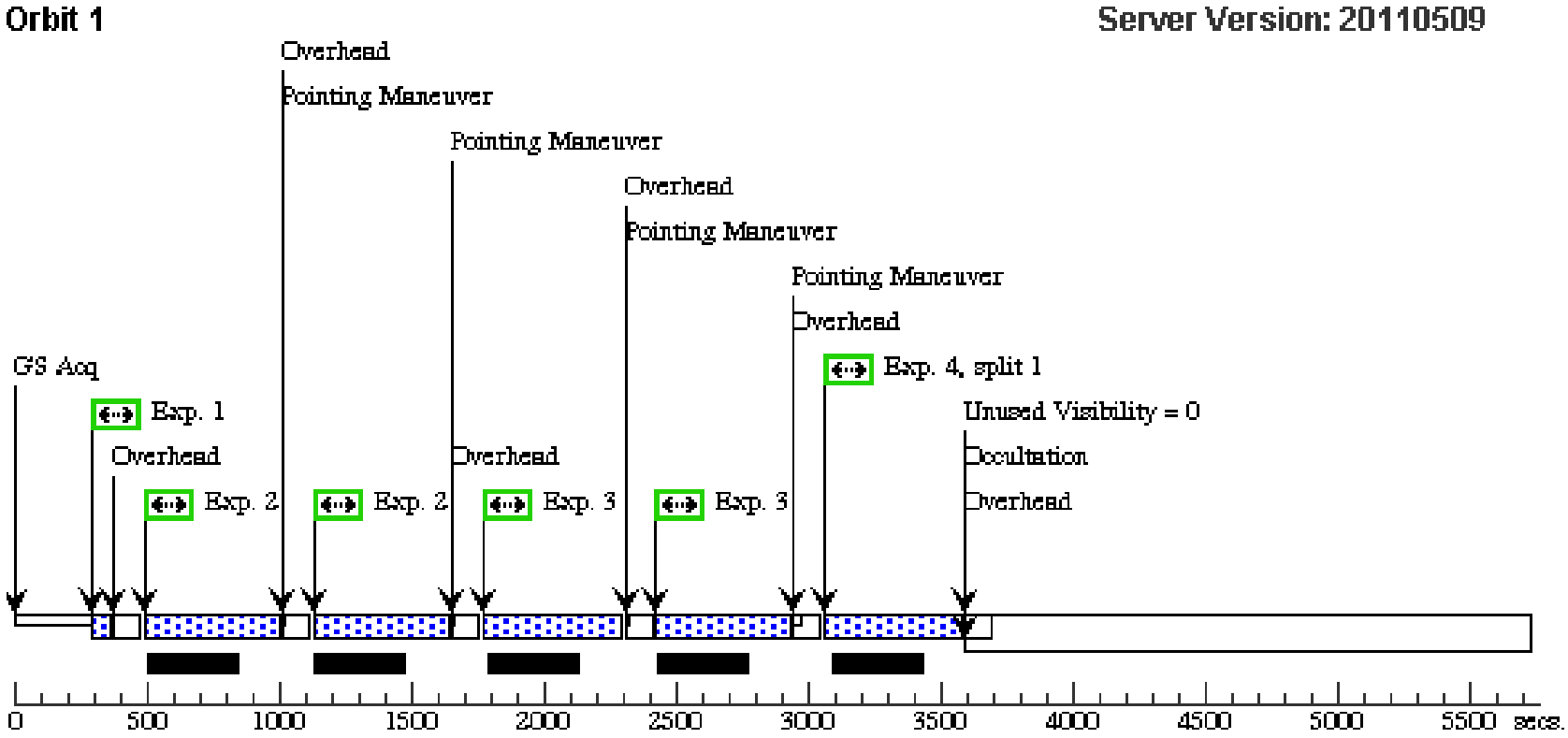
Fixed Targets

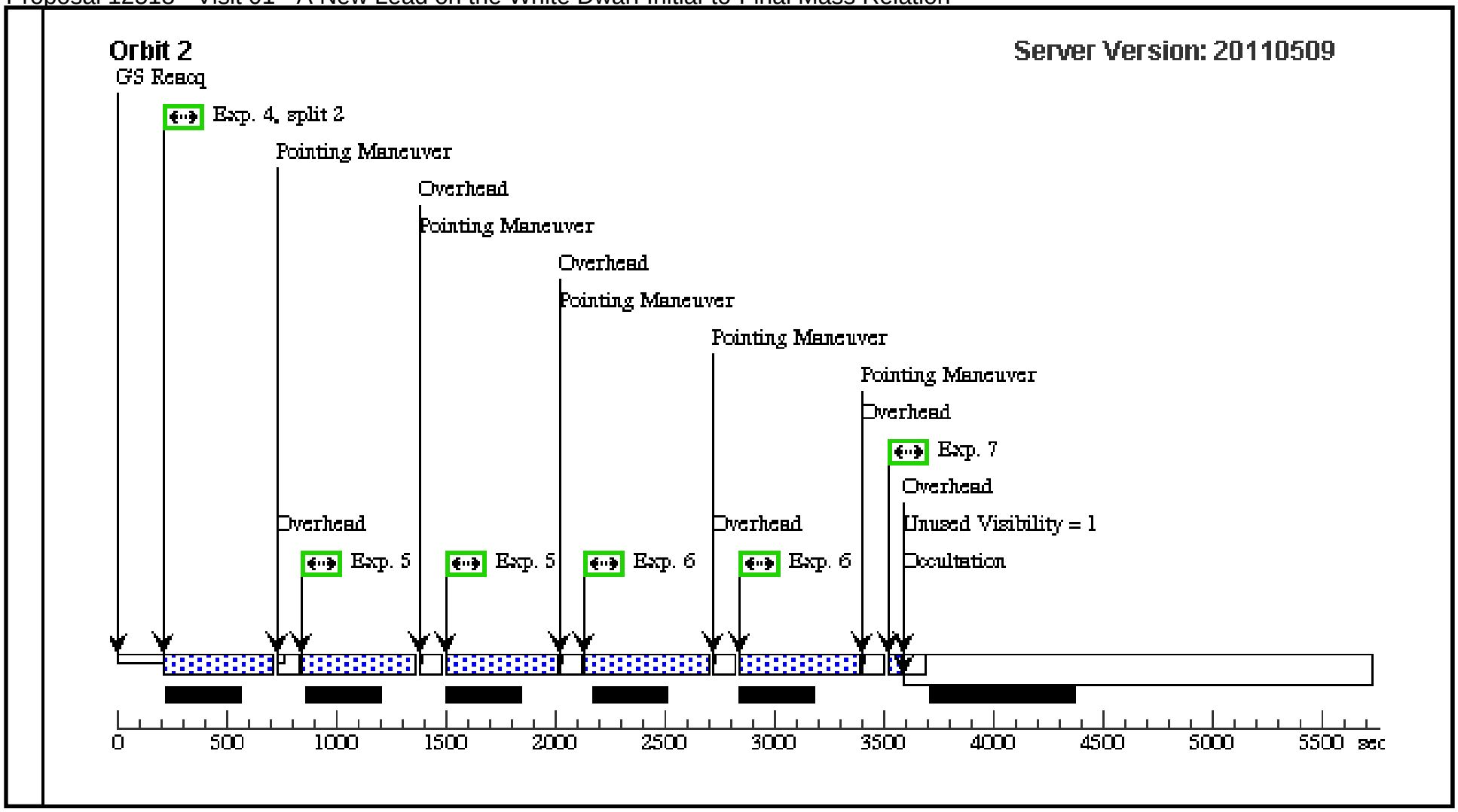
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	PHR1315-6555	RA: 13 15 18.9000 (198.8287500d) Dec: -65 55 1.00 (-65.91694d) Equinox: J2000		V=23.5+/-1.0 log F(Hb)=-13.31 ± 0.02; E(B-V)=0.75	Reference Frame: ICRS
Comments: Coordinates of PN from Parker, Q.A., et al. 2011, MNRAS, 413, 1835					
(2)	PHR1315-6555-OFFSET	Offset from PHR1315-6555 by RA Offset: -2.9 Secs Dec Offset: -15.0 Arcsec		V=19+/-4	Offset Position (PHR1315-6555-OFFSET) Reference Frame: ICRS
Comments: Coordinates of Open Cluster (center) from Parker, Q.A., et al. 2011, MNRAS, 413, 1835					

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
1	V short	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F555W	CR-SPLIT=NO	GS ACQ SCENARIO BASE1B3		36 Secs *[==>]*	 ***[1]***
2	V long	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F555W			Pattern 1, Exps 2-2 in Visit 01 (1)	510 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[1]***
3	I long	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F814W			Pattern 1, Exps 3-3 in Visit 01 (1)	510 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[1]***
4	[O_III]	(1) PHR1315-6555	WFC3/UVIS, ACCUM, UVIS1	F502N	CR-SPLIT=2			1000 Secs *[==>(Split 1)]* *[==>(Split 2)]*	 ***[1]*** ***[2]***
5	FUV	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F200LP			Pattern 1, Exps 5-5 in Visit 01 (1)	510 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[2]***
6	NUV	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F350LP			Pattern 1, Exps 6-6 in Visit 01 (1)	550 Secs *[==>(Pattern 1)]* *[==>(Pattern 2)]*	 ***[2]***
7	I short	(2) PHR1315-6555-OFFSET	WFC3/UVIS, ACCUM, UVIS	F814W	CR-SPLIT=NO			40 Secs *[==>]*	 ***[2]***

Orbit Structure




Orbit 2
Server Version: 20110509
GS Reacq
Exp. 4, split 2
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Overhead
Exp. 7
Overhead
Unused Visibility = 1
Occultation
Overhead
Exp. 5
Exp. 5
Exp. 6
Overhead
Exp. 6
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec