



14769 - Proper Motions of Two Local Prototype Dwarf Elliptical Galaxies NGC 147 and NGC 185

Cycle: 24, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Sangmo Tony Sohn (PI) (Contact)	Space Telescope Science Institute	tsohn@stsci.edu
Dr. Mark Fardal (CoI)	University of Massachusetts - Amherst	fardal@astro.umass.edu
Prof. Marla C. Geha (CoI)	Yale University	marla.geha@yale.edu
Prof. Puragra Guhathakurta (CoI)	University of California - Santa Cruz	raja@ucolick.org
Dr. Roeland P. van der Marel (CoI)	Space Telescope Science Institute	marel@stsci.edu
Dr. Gurtina Besla (CoI)	University of Arizona	gbesla@email.arizona.edu

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) NGC-147 ANY	ACS/WFC WFC3/UVIS	2	29-Jul-2016 15:33:35.0	yes
02	(1) NGC-147 ANY	ACS/WFC WFC3/UVIS	2	29-Jul-2016 15:33:37.0	yes
03	(2) NGC-185 ANY	ACS/WFC WFC3/UVIS	2	29-Jul-2016 15:33:38.0	yes
04	(2) NGC-185 ANY	ACS/WFC WFC3/UVIS	2	29-Jul-2016 15:33:40.0	yes

ABSTRACT

The factors governing the quenching of dwarf galaxies are of great importance to understanding galaxy formation. Deep HST photometry shows a significant difference in the quenching times between the otherwise seemingly similar dwarf elliptical galaxies NGC 147 and 185 in the halo of M31. The two galaxies are found close together on the sky with similar line-of-sight velocities, suggestive of a shared history. Measuring proper motions (PMs) of these two systems to constrain their orbits will allow us to differentiate between various quenching scenarios. We propose to target the same fields as the earlier deep HST observations, using the same instruments and orientations. For each galaxy, both the primary ACS and the parallel WFC3 fields will be used for PM measurements. We will use the same advanced techniques that allowed us to measure the PMs of M31 and Leo I. Thanks to the time baseline of 8 years, we expect to obtain one-dimensional PM accuracy of 25 km/s, far smaller than the velocity dispersion in the M31 halo. PM results will show whether these galaxies share a common dynamical history. We will convert the orbital energy of each galaxy to infall time, using correlations found in cosmological simulations. We will also compute orbits for both galaxies to find their pericenters as they orbit M31 and relate those to their tidal distortions, stellar streams, and differing gas content. Both galaxies also belong to M31's surprising "plane of satellites", and the PMs we obtain will test the nature of this plane. Together, these results will isolate the factors responsible for their differing quenching times. These will be the first PM measurements for dwarf galaxies of M31.

OBSERVING DESCRIPTION

To measure absolute proper motions of NGC 147/185, we will use compact background galaxies in the field of view (FOV) as stationary reference sources. We will measure the average motion of stars in the target galaxies between the first and second epoch with respect to these reference sources. Our analysis techniques and expected accuracies are described in the Phase I proposal. First epoch ACS/WFC and WFC3/UVIS data are available as part of previous HST program GO-11724 (PI: M. Geha). The present program will obtain second-epoch data.

The first-epoch ACS/WFC and WFC3/UVIS data were obtained using two filters (F606W and F814W) to make deep color magnitude diagrams that reach a few magnitudes below the main sequence turnoff of NGC 147/185. The available broad-band colors and depth are sufficient for separating member stars of these target galaxies, foreground stars, and background galaxies to first order. For the second epoch, it is therefore necessary to take data in only one of the filters. Our past experience shows that F606W provides the best astrometric handle on background galaxies so that will be the filter of our choice. We will observe NGC 147/185 using the exact same field configurations (telescope pointings and orientations) as the first-epoch observations to maximize the overlaps of both the primary ACS/WFC and parallel WFC3/UVIS fields between the first- and second-epoch data.

Proposal 14769 (STScI Edit Number: 0, Created: Friday, July 29, 2016 2:33:40 PM EST) - Overview

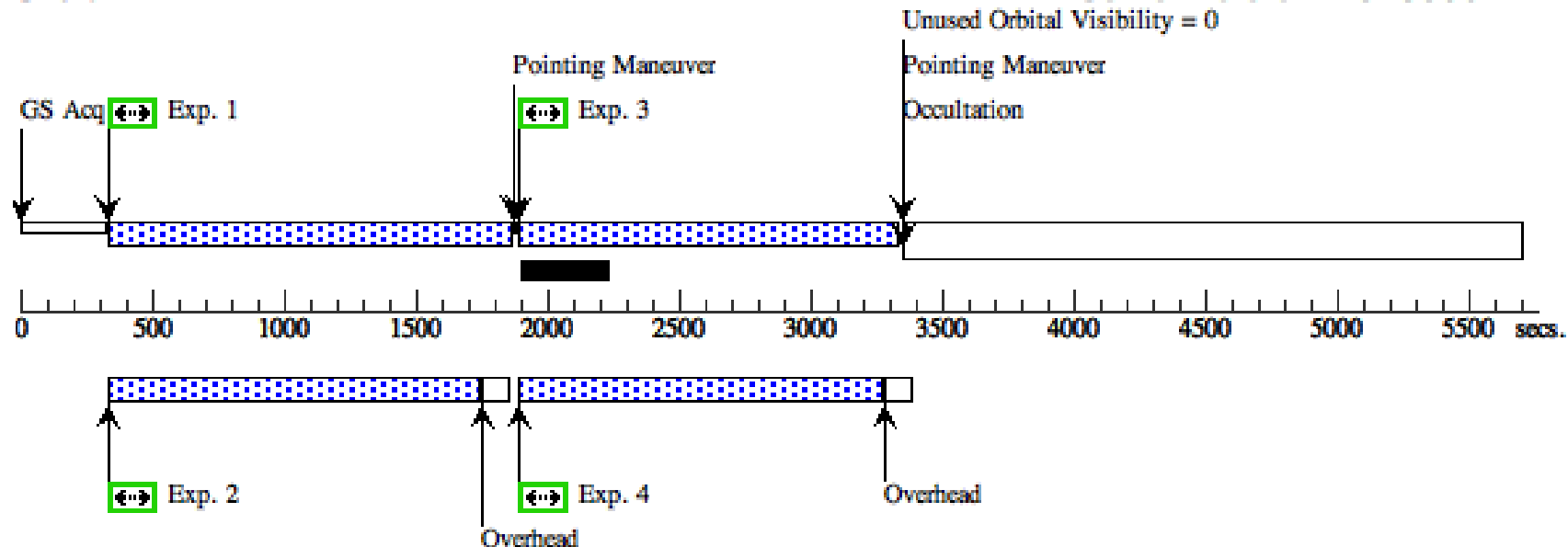
Individual exposures will be sub-pixel dithered and will last half an orbit. We will use customized dither patterns (via POS-TARG parameters) to maximize the pixel phase coverage.

Proposal 14769 - NGC147-01 (01) - Proper Motions of Two Local Prototype Dwarf Elliptical Galaxies NGC 147 and NGC 185

Visit	Proposal 14769, NGC147-01 (01), implementation								Fri Jul 29 19:33:40 GMT 2016		
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: WFC3/UVIS, ACS/WFC										
	Special Requirements: ORIENT 99.06D TO 99.06 D; GROUP 01,02 WITHIN 15D										
Comments: This is the first visit for obtaining second-epoch images of NGC 147. This visit spends 2 orbits in total with ACS/WFC being the primary and WFC3/UVIS being the pallalel instruments. For proper motion purpose, we require to match our telescope positions and orientations to the first-epoch observations. We have accordingly added the Visit Orientation Requirements. We have grouped Visits 01 and 02 and specified these to visits to be observed within a 15 day period so that all images of NGC 147 can be treated as a single-epoch data for astrometric analysis.											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous			
	(1)	NGC-147	RA: 00 32 51.1786 (8.2132442d) Dec: +48 22 37.89 (48.37719d) Equinox: J2000			V=9.5		Reference Frame: SIMBAD			
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.0000,0 .0000	Prime + Parallel Group 1-2 in NGC147-01 (01)	1320 Secs (1320 Secs) [==>]		[1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 1-2 in NGC147-01 (01)	1380 Secs (1380 Secs) [==>]		[1]
	3		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.1740,0 .2350	Prime + Parallel Group 3-4 in NGC147-01 (01)	1321 Secs (1321 Secs) [==>]		[1]
	4		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 3-4 in NGC147-01 (01)	1380 Secs (1380 Secs) [==>]		[1]
	5		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.3232,0 .1235	Prime + Parallel Group 5-6 in NGC147-01 (01)	1417 Secs (1417 Secs) [==>]		[2]
	6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 5-6 in NGC147-01 (01)	1427 Secs (1427 Secs) [==>]		[2]
	7		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.1005,0 .3305	Prime + Parallel Group 7-8 in NGC147-01 (01)	1417 Secs (1417 Secs) [==>]		[2]
	8		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 7-8 in NGC147-01 (01)	1427 Secs (1427 Secs) [==>]		[2]

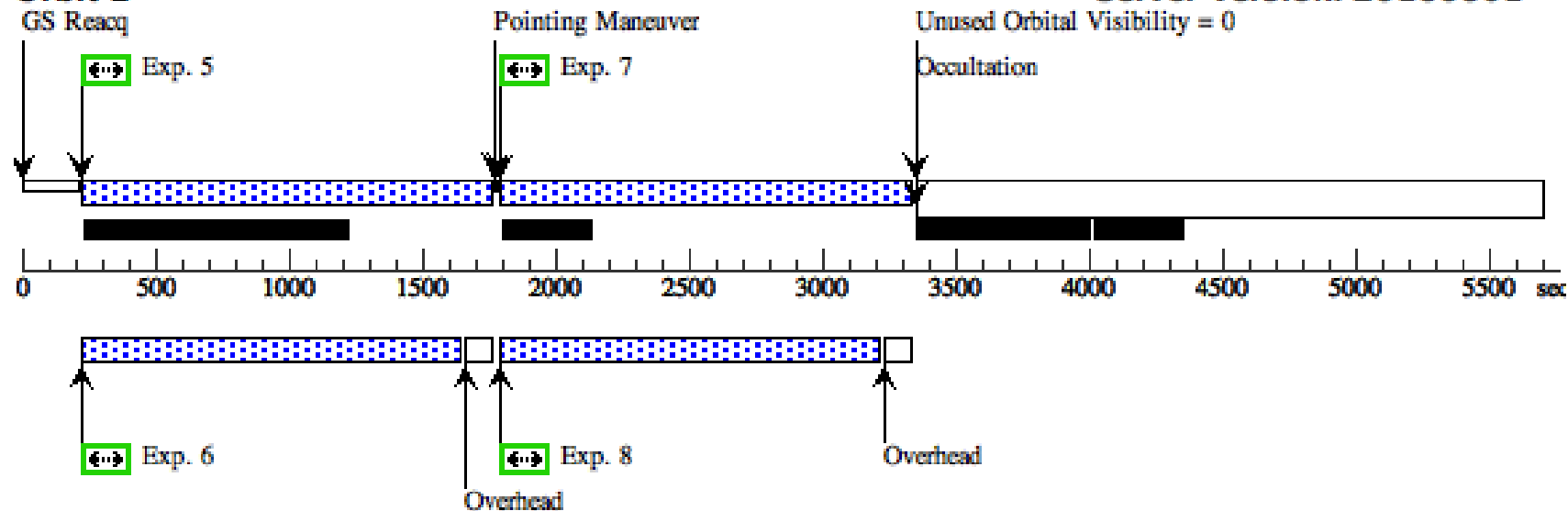
Orbit 1

Server Version: 20160601



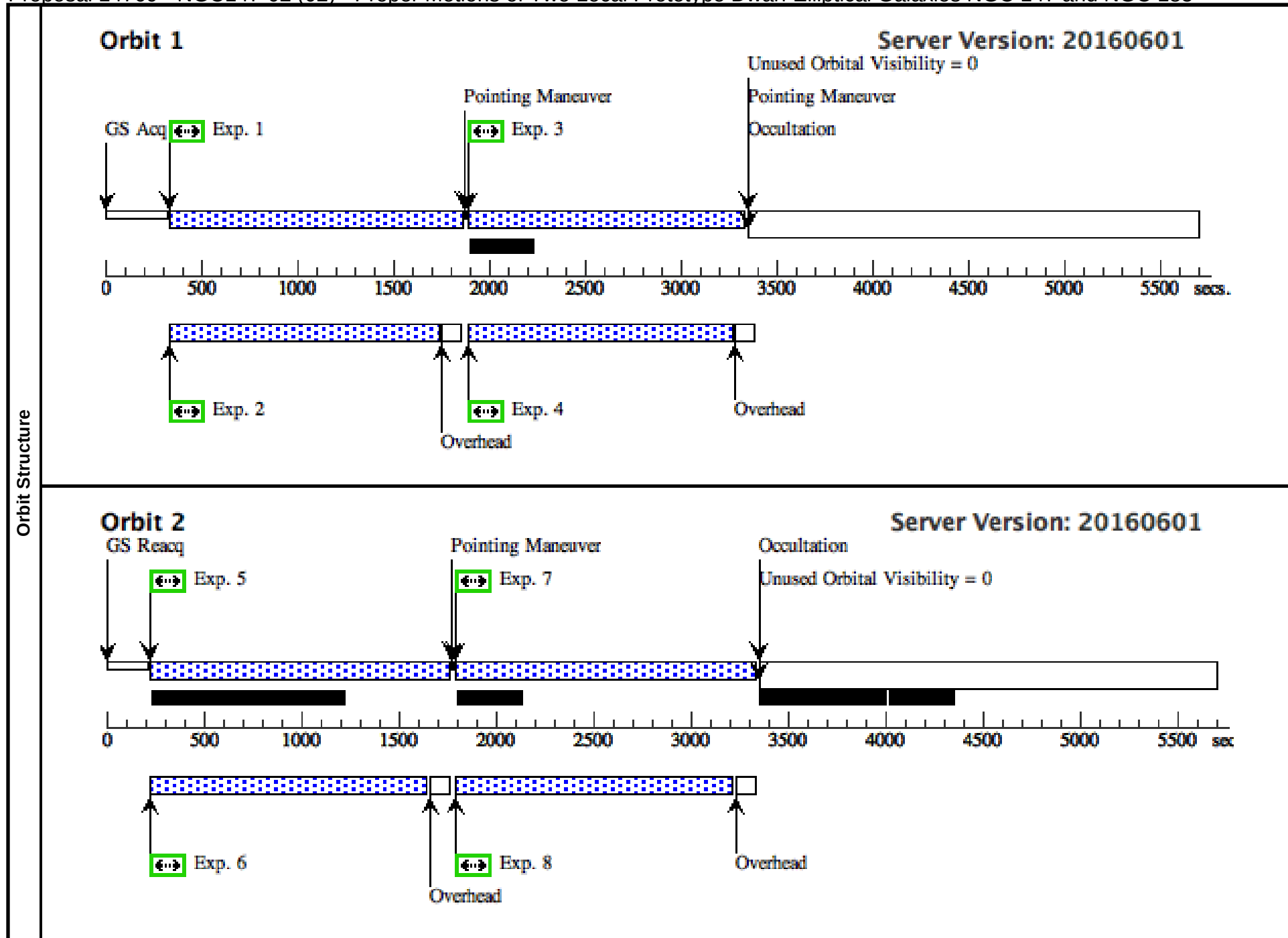
Orbit 2

Server Version: 20160601



Proposal 14769 - NGC147-02 (02) - Proper Motions of Two Local Prototype Dwarf Elliptical Galaxies NGC 147 and NGC 185

Visit	Proposal 14769, NGC147-02 (02), implementation						Fri Jul 29 19:33:41 GMT 2016			
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: WFC3/UVIS, ACS/WFC									
	Special Requirements: ORIENT 99.06D TO 99.06 D; GROUP 02,01 WITHIN 15D									
Comments: This is the second visit for obtaining second-epoch images of NGC 147. This visit spends 2 orbits in total with ACS/WFC being the primary and WFC3/UVIS being the pallalel instruments. For proper motion purpose, we require to match our telescope positions and orientations to the first-epoch observations. We have accordingly added the Visit Orientation Requirements. We have grouped Visits 01 and 02 and specified these to visits to be observed within a 15 day period so that all images of NGC 147 can be treated as a single-epoch data for astrometric analysis.										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(1)	NGC-147	RA: 00 32 51.1786 (8.2132442d) Dec: +48 22 37.89 (48.37719d) Equinox: J2000		V=9.5	Reference Frame: SIMBAD				
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.5075,0 .0505	Prime + Parallel Gro up 1-2 in NGC147-0 2 (02)	1320 Secs (1320 Secs) [==>]	[1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 1-2 in NGC147-0 2 (02)	1380 Secs (1380 Secs) [==>]	[1]
	3		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.6815,0 .2855	Prime + Parallel Gro up 3-4 in NGC147-0 2 (02)	1321 Secs (1321 Secs) [==>]	[1]
	4		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 3-4 in NGC147-0 2 (02)	1380 Secs (1380 Secs) [==>]	[1]
	5		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.8300,0 .1735	Prime + Parallel Gro up 5-6 in NGC147-0 2 (02)	1417 Secs (1417 Secs) [==>]	[2]
	6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 5-6 in NGC147-0 2 (02)	1427 Secs (1427 Secs) [==>]	[2]
	7		(1) NGC-147	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.6080,0 .3810	Prime + Parallel Gro up 7-8 in NGC147-0 2 (02)	1417 Secs (1417 Secs) [==>]	[2]
	8		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 7-8 in NGC147-0 2 (02)	1427 Secs (1427 Secs) [==>]	[2]

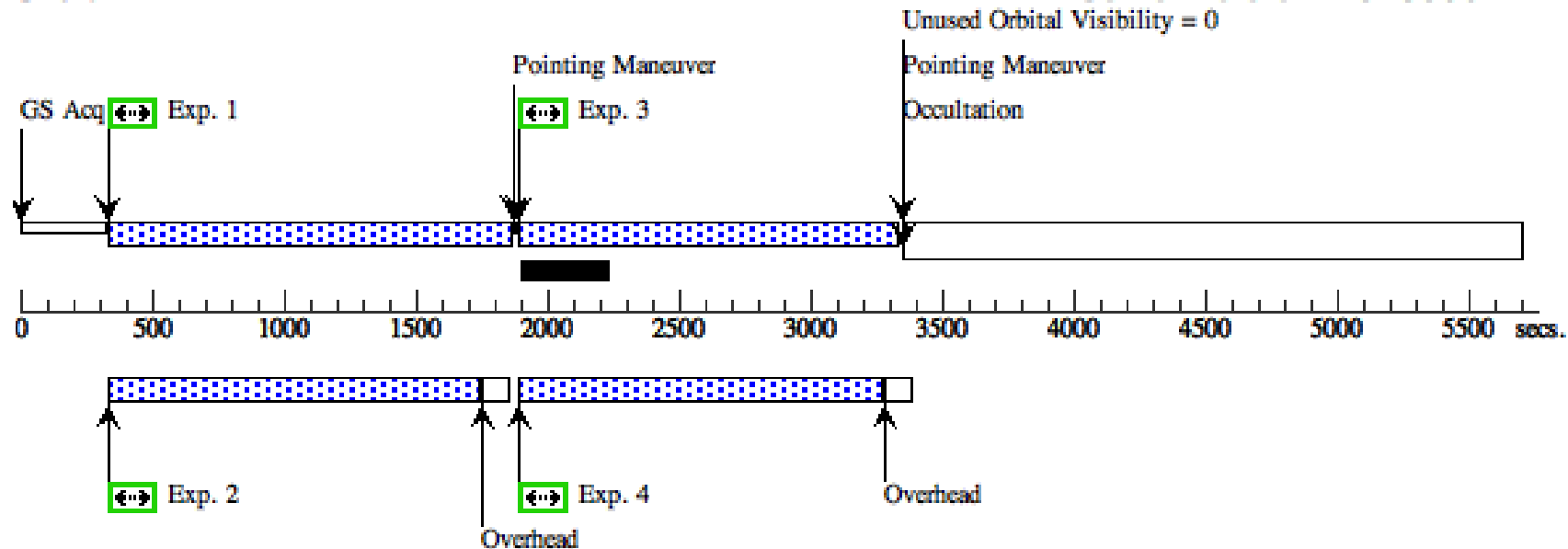


Proposal 14769 - NGC185-01 (03) - Proper Motions of Two Local Prototype Dwarf Elliptical Galaxies NGC 147 and NGC 185

Visit	Proposal 14769, NGC185-01 (03), implementation								Fri Jul 29 19:33:41 GMT 2016		
	Diagnostic Status: No Diagnostics										
	Scientific Instruments: WFC3/UVIS, ACS/WFC										
	Special Requirements: ORIENT 54.11D TO 54.11 D; GROUP 03,04 WITHIN 15D										
Comments: This is the first visit for obtaining second-epoch images of NGC 185. This visit spends 2 orbits in total with ACS/WFC being the primary and WFC3/UVIS being the pallalel instruments. For proper motion purpose, we require to match our telescope positions and orientations to the first-epoch observations. We have accordingly added the Visit Orientation Requirements. We have grouped Visits 03 and 04 and specified these to visits to be observed within a 15 day period so that all images of NGC 185 can be treated as a single-epoch data for astrometric analysis.											
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections		Fluxes		Miscellaneous			
	(2)	NGC-185	RA: 00 39 10.8027 (9.7950112d) Dec: +48 26 37.66 (48.44379d) Equinox: J2000			V=9.2		Reference Frame: SIMBAD			
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.										
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]		Orbit
	1		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.0000,0 .0000	Prime + Parallel Gro up 1-2 in NGC185-0 1 (03)	1320 Secs (1320 Secs) [==>]		[1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 1-2 in NGC185-0 1 (03)	1380 Secs (1380 Secs) [==>]		[1]
	3		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.1740,0 .2350	Prime + Parallel Gro up 3-4 in NGC185-0 1 (03)	1321 Secs (1321 Secs) [==>]		[1]
	4		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 3-4 in NGC185-0 1 (03)	1380 Secs (1380 Secs) [==>]		[1]
	5		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.3232,0 .1235	Prime + Parallel Gro up 5-6 in NGC185-0 1 (03)	1417 Secs (1417 Secs) [==>]		[2]
	6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 5-6 in NGC185-0 1 (03)	1427 Secs (1427 Secs) [==>]		[2]
	7		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.1005,0 .3305	Prime + Parallel Gro up 7-8 in NGC185-0 1 (03)	1417 Secs (1417 Secs) [==>]		[2]
	8		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 7-8 in NGC185-0 1 (03)	1427 Secs (1427 Secs) [==>]		[2]

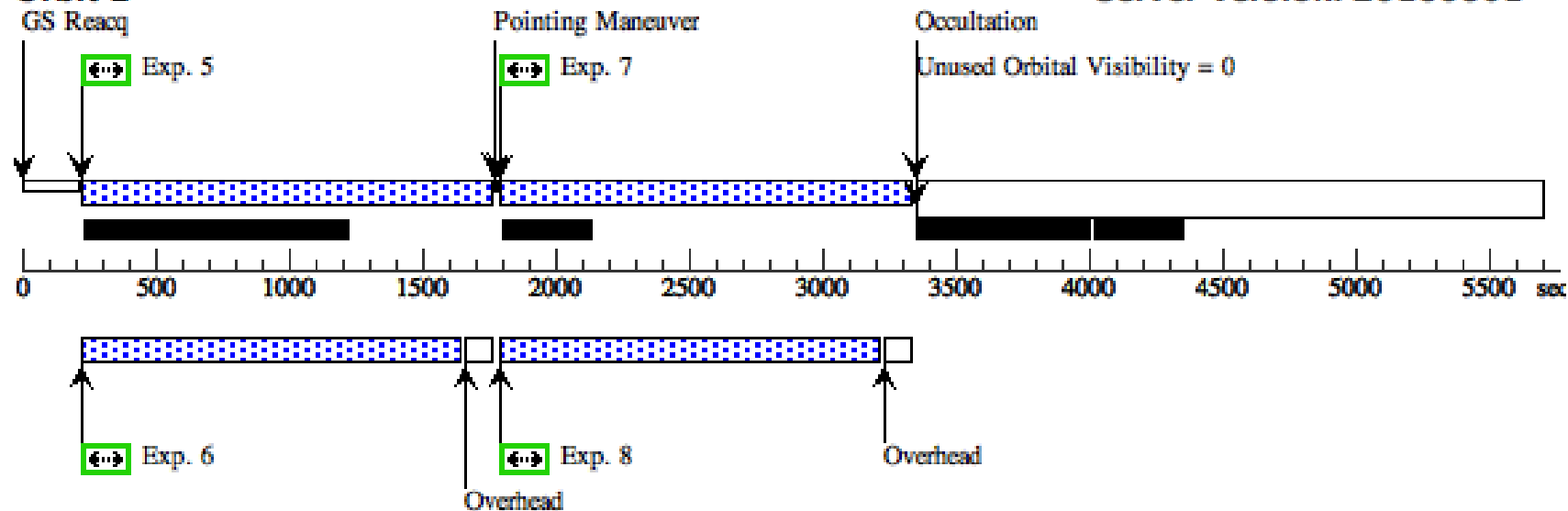
Orbit 1

Server Version: 20160601



Orbit 2

Server Version: 20160601



Proposal 14769 - NGC185-02 (04) - Proper Motions of Two Local Prototype Dwarf Elliptical Galaxies NGC 147 and NGC 185

Visit	Proposal 14769, NGC185-02 (04), implementation						Fri Jul 29 19:33:41 GMT 2016			
	Diagnostic Status: No Diagnostics									
	Scientific Instruments: WFC3/UVIS, ACS/WFC									
	Special Requirements: ORIENT 54.11D TO 54.11 D; GROUP 04,03 WITHIN 15D									
Comments: This is the second visit for obtaining second-epoch images of NGC 185. This visit spends 2 orbits in total with ACS/WFC being the primary and WFC3/UVIS being the pallalel instruments. For proper motion purpose, we require to match our telescope positions and orientations to the first-epoch observations. We have accordingly added the Visit Orientation Requirements. We have grouped Visits 03 and 04 and specified these to visits to be observed within a 15 day period so that all images of NGC 185 can be treated as a single-epoch data for astrometric analysis.										
Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous				
	(2)	NGC-185	RA: 00 39 10.8027 (9.7950112d) Dec: +48 26 37.66 (48.44379d) Equinox: J2000		V=9.2	Reference Frame: SIMBAD				
	Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.5075,0 .0505	Prime + Parallel Gro up 1-2 in NGC185-0 2 (04)	1320 Secs (1320 Secs) [==>]	 [1]
	2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 1-2 in NGC185-0 2 (04)	1380 Secs (1380 Secs) [==>]	 [1]
	3		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.6815,0 .2855	Prime + Parallel Gro up 3-4 in NGC185-0 2 (04)	1321 Secs (1321 Secs) [==>]	 [1]
	4		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 3-4 in NGC185-0 2 (04)	1380 Secs (1380 Secs) [==>]	 [1]
	5		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.8300,0 .1735	Prime + Parallel Gro up 5-6 in NGC185-0 2 (04)	1417 Secs (1417 Secs) [==>]	 [2]
	6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 5-6 in NGC185-0 2 (04)	1427 Secs (1427 Secs) [==>]	 [2]
	7		(2) NGC-185	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.6080,0 .3810	Prime + Parallel Gro up 7-8 in NGC185-0 2 (04)	1417 Secs (1417 Secs) [==>]	 [2]
	8		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Gro up 7-8 in NGC185-0 2 (04)	1427 Secs (1427 Secs) [==>]	 [2]

