16916 - Discovery of 3 Ultra-Faint Dwarf Candidates Outside the MW Halo

Cycle: 29, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*
Dr. Kristen B W McQuinn (PI) (Contact)	**Rutgers the State University of New Jersey**
Dr. Yao-Yuan Mao (CoI)	University of Utah
Dr. Andrew Eugene Dolphin (CoI)	Raytheon Technologies
Prof. David Shih (CoI)	Rutgers the State University of New Jersey
Prof. Matthew Buckley (CoI)	Rutgers the State University of New Jersey

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) LEO-M ANY	ACS/WFC WFC3/UVIS	1	14-Mar-2023 17:00:37.0	yes
02	(2) LEO-K ANY	ACS/WFC WFC3/UVIS	1	14-Mar-2023 17:00:38.0	yes
04	(2) LEO-K ANY	ACS/WFC WFC3/UVIS	1	14-Mar-2023 17:00:40.0	yes
03	(3) PEGASUS-W ANY	ACS/WFC WFC3/UVIS	1	14-Mar-2023 17:00:41.0	yes

4 Total Orbits Used

ABSTRACT

The lowest mass galaxies known to date - aptly named 'ultra-faint dwarf galaxies' - orbit the Milky Way (MW) as satellites. Follow-up study of these objects have revealed systems that are the oldest, most metal-poor, and most dark matter-dominated galaxies known. They hold the potential for constraining dark matter on small scales, placing limits on the mass threshold for successful galaxy formation, and defining the impact reionization has on small galaxy halos. Such galaxies are predicted to be present in large numbers in the Local Group (and throughout the universe), yet they have belied detection due the challenges in finding instrinsically small and faint systems in a very big sky.

We have discovered three ultra-faint dwarf galaxy candidates in the Dark Energy Spectrscopic Instrument (DESI) Legacy imaging data located outside the halo of the MW at distances estimated to be between 0.4-0.7 Mpc. In contrast to the population of ultra-faint dwarfs discovered as satellites of the MW, these galaxy candidates appear to be outside the halo of the MW system, providing a unique opportunity to test galaxy formation theories without the competing effects of a halo environment. We request 1 orbit of HST per target to confirm their detection, measure secure distances, and determine their structural properties. Their properties will be compared with those of ultra-faint dwarf satellites of MW and M31, as well as isolated very low-mass galaxies. We will determine their star formation histories from their resolved stellar populations to test whether they are quenched, have extended (or delayed) star formation over cosmic times, or distinct characteristics.

OBSERVING DESCRIPTION

The observations included ACS/WFC and WFC3/UVIS imaging in the F606W and F814W filters. The data will be used to confirm that the targets are galaxies, measure the distances to the systems from resolved stars (TRGB and/or Horizontal Branch methods), characterize the stellar properites (star formation histories and metallicities), and measure the structural parameters of the galaxies. The parallel pointings will allow us to observe a field region next to our targets. We will thus be able to estimate more precisely the number of background/foreground contaminants present in our ACS fields.

Each of the 3 targets will be observed for 1 orbit. We use a 5x5 pixel dither implemented using pos-targ (equivalent to the ACS WFC DITHER LINE pattern #14) to reject cosmic rays and handle hot pixels. The first pointing is executed with both filters in ACS and with both filters in WFC3 parallel fields. After the dither, the observations are then repeated. The exposure time per orbit is split roughly equally between the F606W and F814W filters.

In order to obtain 4 exposures in both ACS and WFC3 in one orbit and accomodate buffer dumps during exposures, we have added a special requirement to the visibility interval (following the counsel of the STScI help desk). This did not impact schedulablity appreciably.

Each visit is 1-orbit. We have place ORIENT constraints to ensure we maximum coverage of the stellar disk and prevent the galaxy centers from falling in the ACS chip gap, while avoiding nearby bright stars.

Visit

Proposal 16916, LEO M (01), completed Tue Mar 14 21:00:41 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 255D TO 290 D; VISIBILITY INTERVAL 3285 S

Fixed Targets

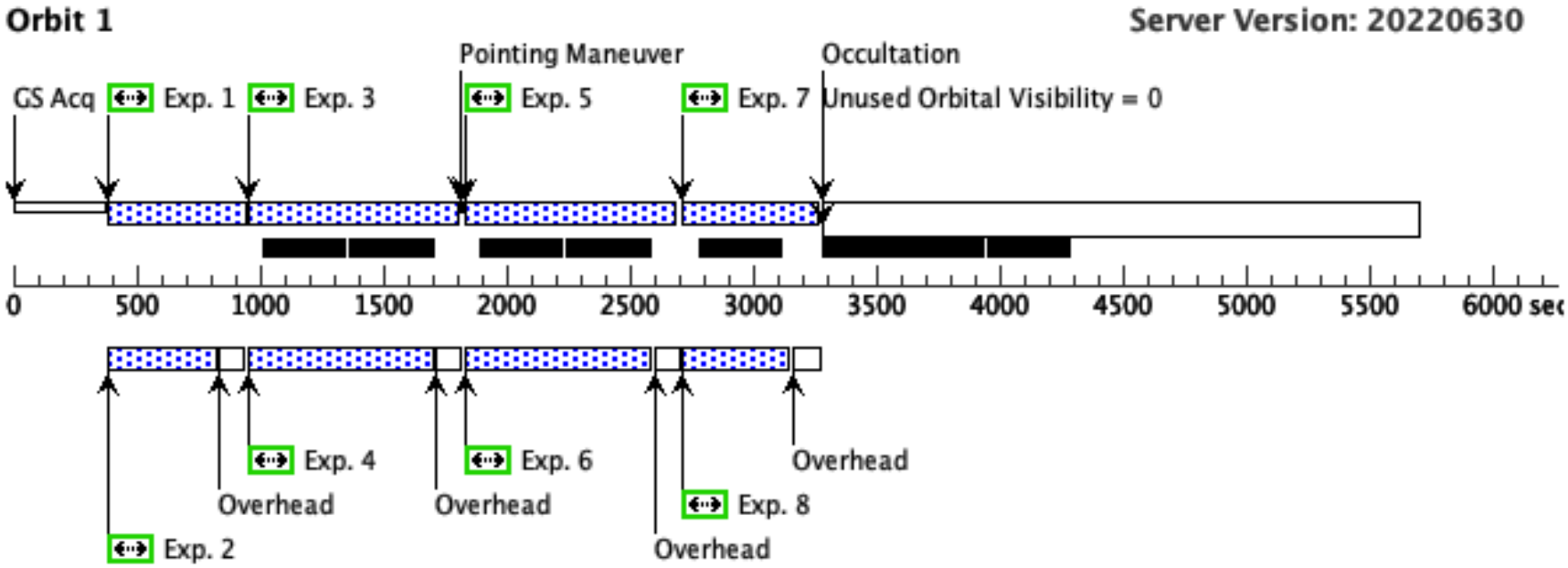
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	LEO-M	RA: 11 05 18.9449 (166.3289371d) Dec: +25 20 58.57 (25.34960d) Equinox: J2000		V=17	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DWARF SPHEROIDAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) LEO-M	ACS/WFC, ACCUM, WFC	F606W			Prime + Parallel Group 1-2 in LEO M (01)	350 Secs (350 Secs) *[==>]*	 ***[1]***
2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 1-2 in LEO M (01)	410 Secs (410 Secs) *[==>]*	 ***[1]***
3		(1) LEO-M	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 3-4 in LEO M (01)	670 Secs (670 Secs) *[==>]*	 ***[1]***
4		ANY	WFC3/UVIS, ACCUM, UVIS	F814W			Prime + Parallel Group 3-4 in LEO M (01)	730 Secs (730 Secs) *[==>]*	 ***[1]***
5		(1) LEO-M	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.247,0.267	Prime + Parallel Group 5-6 in LEO M (01)	670 Secs (670 Secs) *[==>]*	 ***[1]***
6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 5-6 in LEO M (01)	730 Secs (730 Secs) *[==>]*	 ***[1]***
7		(1) LEO-M	ACS/WFC, ACCUM, WFC	F814W		SAME POS AS 5	Prime + Parallel Group 7-8 in LEO M (01)	375 Secs (375 Secs) *[==>]*	 ***[1]***
8		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=11		Prime + Parallel Group 7-8 in LEO M (01)	410 Secs (410 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 16916, LEO K (02), failed Tue Mar 14 21:00:41 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 75D TO 95 D; VISIBILITY INTERVAL 3285 S

Fixed Targets

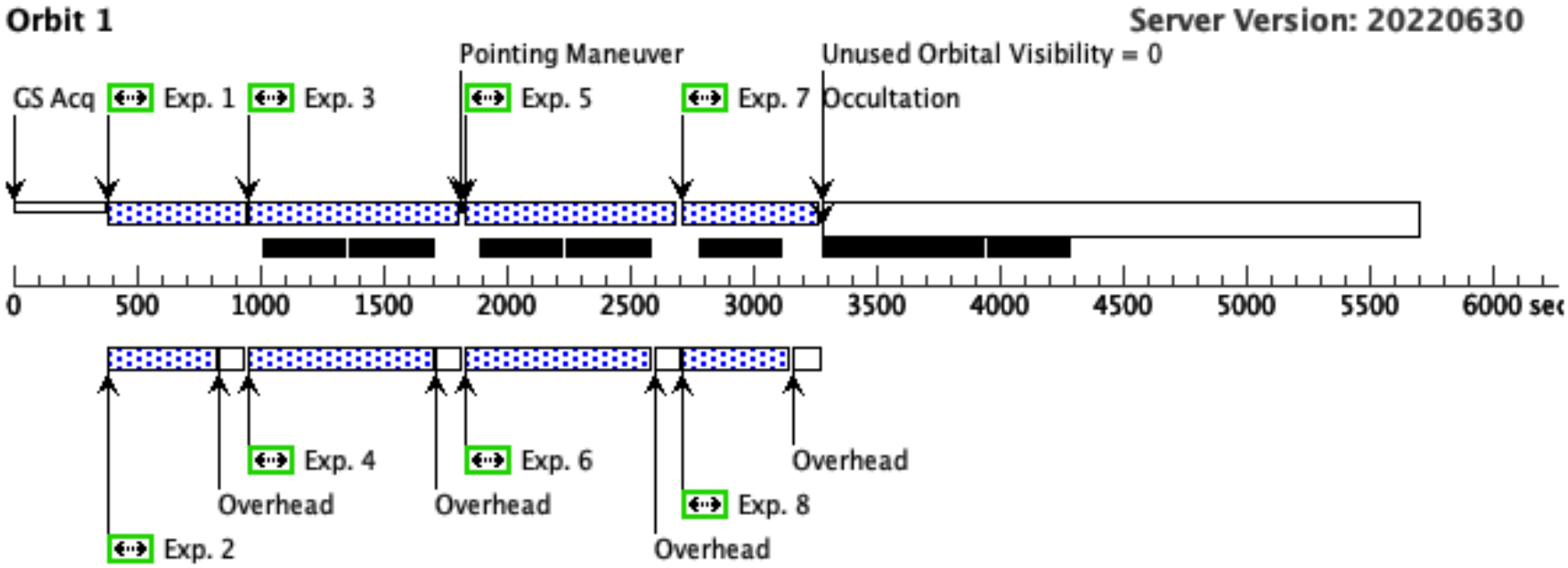
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	LEO-K	RA: 09 24 4.2998 (141.0179158d) Dec: +16 30 24.05 (16.50668d) Equinox: J2000		V=17	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DWARF SPHEROIDAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) LEO-K	ACS/WFC, ACCUM, WFC	F606W			Prime + Parallel Group 1-2 in LEO K (02)	350 Secs (350 Secs) *[==>]*	 ***[1]***
2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 1-2 in LEO K (02)	410 Secs (410 Secs) *[==>]*	 ***[1]***
3		(2) LEO-K	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 3-4 in LEO K (02)	670 Secs (670 Secs) *[==>]*	 ***[1]***
4		ANY	WFC3/UVIS, ACCUM, UVIS	F814W			Prime + Parallel Group 3-4 in LEO K (02)	730 Secs (730 Secs) *[==>]*	 ***[1]***
5		(2) LEO-K	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.247,0.267	Prime + Parallel Group 5-6 in LEO K (02)	670 Secs (670 Secs) *[==>]*	 ***[1]***
6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 5-6 in LEO K (02)	730 Secs (730 Secs) *[==>]*	 ***[1]***
7		(2) LEO-K	ACS/WFC, ACCUM, WFC	F814W		SAME POS AS 5	Prime + Parallel Group 7-8 in LEO K (02)	375 Secs (375 Secs) *[==>]*	 ***[1]***
8		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=11		Prime + Parallel Group 7-8 in LEO K (02)	410 Secs (410 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 16916, LEO K (04) Tue Mar 14 21:00:42 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 75D TO 95 D; VISIBILITY INTERVAL 3285 S

Fixed Targets

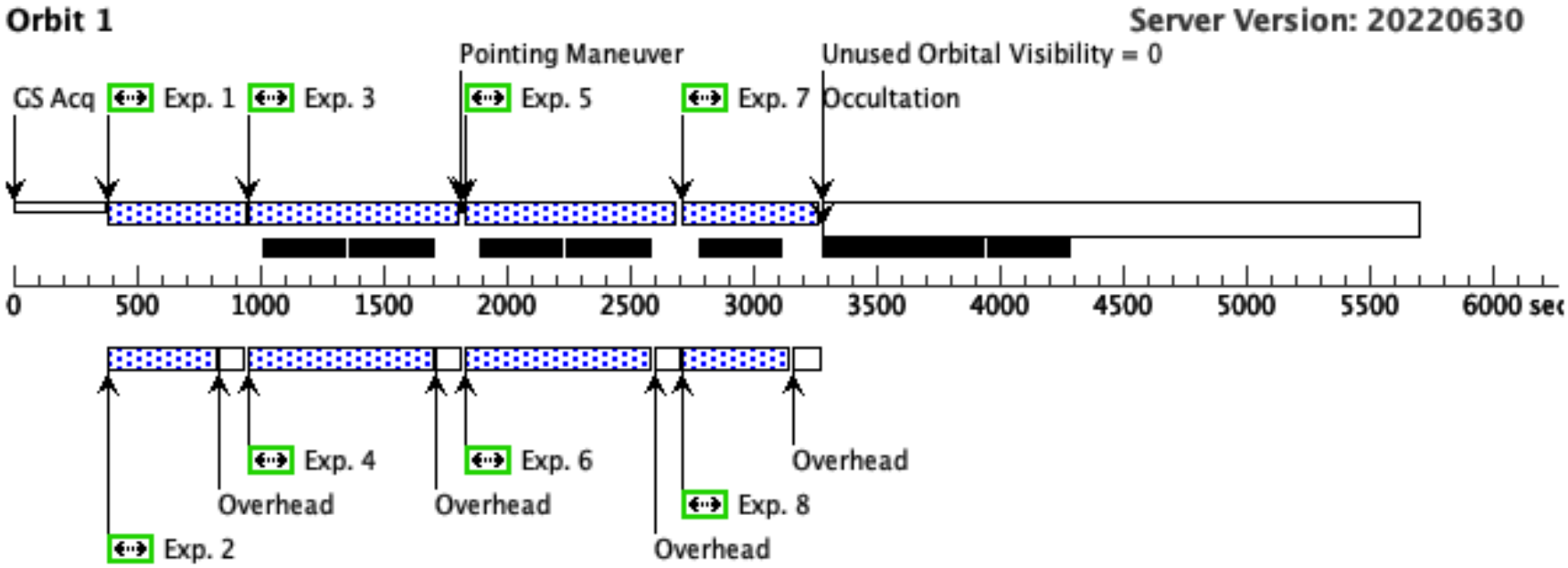
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(2)	LEO-K	RA: 09 24 4.2998 (141.0179158d) Dec: +16 30 24.05 (16.50668d) Equinox: J2000		V=17	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DWARF SPHEROIDAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(2) LEO-K	ACS/WFC, ACCUM, WFC	F606W			Prime + Parallel Group 1-2 in LEO K (04)	350 Secs (350 Secs) *[==>]*	 ***[1]***
2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 1-2 in LEO K (04)	410 Secs (410 Secs) *[==>]*	 ***[1]***
3		(2) LEO-K	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 3-4 in LEO K (04)	670 Secs (670 Secs) *[==>]*	 ***[1]***
4		ANY	WFC3/UVIS, ACCUM, UVIS	F814W			Prime + Parallel Group 3-4 in LEO K (04)	730 Secs (730 Secs) *[==>]*	 ***[1]***
5		(2) LEO-K	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.247,0.267	Prime + Parallel Group 5-6 in LEO K (04)	670 Secs (670 Secs) *[==>]*	 ***[1]***
6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 5-6 in LEO K (04)	730 Secs (730 Secs) *[==>]*	 ***[1]***
7		(2) LEO-K	ACS/WFC, ACCUM, WFC	F814W		SAME POS AS 5	Prime + Parallel Group 7-8 in LEO K (04)	375 Secs (375 Secs) *[==>]*	 ***[1]***
8		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=11		Prime + Parallel Group 7-8 in LEO K (04)	410 Secs (410 Secs) *[==>]*	 ***[1]***

Orbit Structure



Visit

Proposal 16916, PEGASUS W (03), completed Tue Mar 14 21:00:42 GMT 2023

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: ORIENT 225D TO 249 D; VISIBILITY INTERVAL 3285 S

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(3)	PEGASUS-W	RA: 23 53 14.2288 (358.3092867d) Dec: +22 05 35.54 (22.09321d) Equinox: J2000		V=17	Reference Frame: ICRS

Comments:
Category=GALAXY
Description=[DWARF SPHEROIDAL]

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(3) PEGASUS-W	ACS/WFC, ACCUM, WFC	F606W			Prime + Parallel Group 1-2 in PEGASUS W (03)	350 Secs (350 Secs) *[==>]*	 ***[1]***
2		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 1-2 in PEGASUS W (03)	410 Secs (410 Secs) *[==>]*	 ***[1]***
3		(3) PEGASUS-W	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 3-4 in PEGASUS W (03)	670 Secs (670 Secs) *[==>]*	 ***[1]***
4		ANY	WFC3/UVIS, ACCUM, UVIS	F814W			Prime + Parallel Group 3-4 in PEGASUS W (03)	730 Secs (730 Secs) *[==>]*	 ***[1]***
5		(3) PEGASUS-W	ACS/WFC, ACCUM, WFC	F606W		POS TARG 0.247,0.267	Prime + Parallel Group 5-6 in PEGASUS W (03)	670 Secs (670 Secs) *[==>]*	 ***[1]***
6		ANY	WFC3/UVIS, ACCUM, UVIS	F606W			Prime + Parallel Group 5-6 in PEGASUS W (03)	730 Secs (730 Secs) *[==>]*	 ***[1]***
7		(3) PEGASUS-W	ACS/WFC, ACCUM, WFC	F814W		SAME POS AS 5	Prime + Parallel Group 7-8 in PEGASUS W (03)	375 Secs (375 Secs) *[==>]*	 ***[1]***
8		ANY	WFC3/UVIS, ACCUM, UVIS	F814W	FLASH=11		Prime + Parallel Group 7-8 in PEGASUS W (03)	410 Secs (410 Secs) *[==>]*	 ***[1]***

Orbit Structure