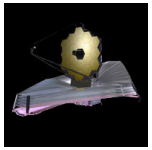

7196 - How Extreme is Pegasus W? Testing Galaxy Evolution at the Lowest Stellar Masses

Cycle: 4, Proposal Category: GO

INVESTIGATORS

Name	*Institution*
Dr. Ivanna Escala (PI)	**Space Telescope Science Institute**
Dr. Karoline Gilbert (CoI) (CoPI)	Space Telescope Science Institute
Dr. Erik Tollerud (CoI) (CoPI)	Space Telescope Science Institute
Dr. Kristen B W McQuinn (CoI) (CoPI)	Space Telescope Science Institute
Dr. David Nidever (CoI) (CoPI)	Montana State University - Bozeman
Prof. Justin Read (CoI) (ESA Member)	University of Surrey
Dr. Michelle L.M. Collins (CoI) (ESA Member)	University of Surrey
Dr. Sangmo Tony Sohn (CoI)	Space Telescope Science Institute
Prof. Evan Kirby (CoI)	University of Notre Dame
Prof. David Shih (CoI)	Rutgers the State University of New Jersey
Dr. Roger Cohen (CoI)	Eureka Scientific Inc.
Dr. Yao-Yuan Mao (CoI)	University of Utah
Ms. Izzy Gray (CoI) (ESA Member)	University of Surrey
Dr. Pol Massana (CoI)	NOIRLab - (AZ)
Dr. Lara Cullinane (CoI) (ESA Member)	Leibniz-Institut für Astrophysik Potsdam (AIP)
Tehreem Hai (CoI)	Rutgers the State University of New Jersey

OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
	1	Pegasus W Preimaging	NIRCam Imaging	(1) PEGW

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	2	Scheduled PA 3 target sets MSATA Gaia NIRCam ACS	NIRSpec MultiObject Spectroscopy	(5) PEGW_MPT_GAIA

ABSTRACT

Ultrafaint dwarf galaxies (UFDs) are thought to be the fossils of galaxies that formed nearly all of their stars at early times, and were quenched by the bath of UV photons during the epoch of reionization. However, nearly all UFDs studied to date are satellites of the Milky Way or M31, where tidal and ram pressure stripping can significantly impact the history of a UFD. Recent high-resolution simulations suggest that in isolated UFDs, extended star formation will occur even in very low-mass halos, and reionization alone may not be responsible for quenching all UFDs.

Pegasus W is a newly discovered UFD on the far side of the Local Group. Based on HST imaging of the resolved stars, the galaxy was quenched long after reionization, ~7 Gyr ago. With a stellar mass of only 6.5x10^4 solar masses, Peg W may prove to be the most extreme example of low-mass, star forming galaxies discovered to date. The combination of Peg W's low stellar mass, extended star formation, and relative isolation means that matching its observed properties will provide a stringent test of galaxy formation models. However, understanding the nature of Peg W and its evolutionary history depends on measuring its dark matter (DM) content, for which we have no constraints.

We propose NIRSpec observations of the stars in Peg W to measure its DM halo mass to determine whether Peg W's total mass is large enough to have shielded itself from reionization. These observations will provide strong constraints on the efficacy of reionization in quenching the lowest mass galaxies, and more broadly test our understanding of the physics of galaxy formation and evolution in the lowest mass systems.

OBSERVING DESCRIPTION

Our goal is to obtain medium-resolution NIRSpec MSA spectra of a minimum of 35 Pegasus W stars in order to measure the stellar velocity dispersion, with which we will estimate the dark matter halo mass of Pegasus W.

NIRSpec MSA observations:

To achieve our target sample size, we will observe three target sets with exposures set to reliably recover velocities of stars 3 magnitudes fainter than the tip of the red giant branch. We will use the G140H/F100LP grism/filter setup that provides medium-resolution spectra in the 0.9-1.8 micron wavelength range. A setup with single shutter slits provides roughly 15 potential Pegasus W stars in one target set.

In five hours of exposure time (20 groups per integration, 2 integrations per exposure, and 6 dither positions, with the NRSIRS2 readout pattern), a S/N over our wavelength range of 4 to 8 per pixel can be obtained for stars at our limiting magnitude. We will obtain 6 dither positions by designing 3 MSA configurations per target set and performing subpixel dithering at the planned position of each configuration to improve sampling of the line spread function.

NIRCam parallel observations:
We will observe NIRCam parallel observations in F140M and F277W. An astrometric analysis of the parallels will be used to determine the as-observed pointing and roll of the telescope, in order to attempt to improve upon corrections to the observed velocity based on the planned location of the sources in their shutters.

NIRCam pre-imaging observations:
The existing HST imaging will not provide adequate coverage of the MSA for performing target acquisition, due to the fact that all potential Pegasus W members will need to be placed on a single MSA quadrant, thereby substantially offsetting the MSA field of view from the HST imaging for any roll angle. Therefore, we require NIRCam preimaging observations. We will obtain a 3 row by 1 column mosaic with the FULL 3 dither pattern, which will provide the best spatial coverage for the MSA, regardless of assigned roll angle and quadrant on which the MPT finds the best success rate for observing Pegasus W members. We will observe with F115W and F277W, using 4 groups per integration, 2 integrations per exposure, with the BRIGHT1 readout pattern.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PEGW	RA: 23 53 14.9827 (358.3124279d) Dec: +22 06 8.68 (22.10241d) Equinox: J2000		
Comments: *Description=[]*				
(5)	PEGW_MPT_GAIA	RA: 23 53 14.9955 (358.3124812d) Dec: +22 06 8.61 (22.10239d) Equinox: J2000		
Comments: *Description=[]*				

Observation

Proposal 7196, Observation 1: Pegasus W Preimaging Mon Apr 06 17:00:19 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRCam Imaging

Diagnostics

(Pegasus W Preimaging (Obs 1)) Warning (Form): By selecting Target Placement = Module Gap the target coordinates will not fall on any detector unless an appropriate Mosaic, set of Dithers or Offset Special Requirement is specified.

(Visit 1:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:2) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:3) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:4) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:5) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:6) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:7) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:8) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 1:9) Warning (Form): Overheads are provisional until the Visit Planner has been run.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(1)	PEGW	RA: 23 53 14.9827 (358.3124279d) Dec: +22 06 8.68 (22.10241d) Equinox: J2000		

Comments:
Description=[]

Template

Module	Subarray	Target Placement
ALL	FULL	Module gap (large extended source)

Mosaic

Rows	Columns	Row Overlap %	Column Overlap %	Row shift (deg)	Column shift (deg)	Tile Order
3	1	10.0	10.0	0.0	0.0	DEFAULT

Dithers

#	Primary Dither Type	Primary Dithers	Subpixel Dither Type	Dither Size	Subpixel Positions
1	FULL	3	STANDARD		1

Spectral Elements

#	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
1	F115W	F277W	BRIGHT1	4	2	6	3	483.155	214066

Special Requirements	
	Sequence Visits within 53.0 Days Visits Same PA 2 After 1 by 60.0 Days to <None specified>

Observation

Proposal 7196, Observation 2: Scheduled PA 3 target sets MSATA Gaia NIRCam ACS Mon Apr 06 17:00:19 GMT 2026

Diagnostic Status: Warning

Observing Template: NIRSpec MultiObject Spectroscopy

Coordinated Parallel Template(s): NIRCam Imaging

Comments: We request these observations not be scheduled after observations of bright targets to avoid issues of persistence, given the faint nature of our targets.

Diagnostics

(Visit 2:1) Warning (Form): Data Excess over lower threshold

(Visit 2:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.

(Visit 2:1) Warning (Form): The recommended value is 8 Reference Stars for this template.

(Visit 2:1) Informational (Form): Visit schedulable, but most scheduling windows are when JWST is pointed in direction of greatest micrometeoroid impact risk. This is likely due to scheduling special requirements.

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(5)	PEGW_MPT_GAIA	RA: 23 53 14.9955 (358.3124812d) Dec: +22 06 8.61 (22.10239d) Equinox: J2000		

Comments:
Description=[]

Acquisition

NIRSpec MultiObject Spectroscopy	Reference Star Bin	Target	Filter	MSA Configuration	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Exposure Time	Optional ETC ID
1	Filter: F110W; Readout: NRSRAPID; 7 sources in 3 quads; [Reduced Accuracy]	SAME	F110W	Auto Acq MSA Config	NRSRAPID	3	1	4	171.788	

Template

NIRSpec MultiObject Spectroscopy	NIRCam Imaging
TA Method: MSATA	Module: ALL
HFF Readout Mode: false	Subarray: FULL
Obtain Confirmation Images: No	
Science Aperture: MSA Center	
Primary Candidate List: ABOVE HB (87 sources)	
Filler Candidate List: ABOVE HB (87 sources)	
Spectral Overlap Map: jwst-nirspec-g140h	
Spectral Overlap Threshold: 1.5	

Reference Stars

Visit	ID	RA	Dec	Magnitude	Visit	ID	RA	Dec	Magnitude
1	402	358.310838	22.094217	20.18400001525879	1	423	358.316048	22.109758	21.111000061035156
1	412	358.301266	22.114767	20.726999282836914	1	427	358.352646	22.087704	21.420000076293945
1	414	358.342723	22.129297	20.888999938964844	1	435	358.354789	22.097502	21.69700050354004
1	420	358.322555	22.107316	21.062000274658203					

Dithers

#	Dither Type
1	NONE

Spectral Elements

NIRSpec MultiObject Spectroscopy	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
1	1 (G140H/F100LP)	c1		358.33132820833333 Degrees 22.115918333333333 Degrees	20.574296664910076	0.125		1	2	2946.956
2	1 (G140H/F100LP)	c1		358.33132820833333 Degrees 22.115918333333333 Degrees	20.574303701570265	-0.125		1	2	2946.956
3	1 (G140H/F100LP)	c2		358.33095283333336 Degrees 22.116049166666667 Degrees	20.574155938350884	0.125		1	2	2946.956
4	1 (G140H/F100LP)	c2		358.33095283333336 Degrees 22.116049166666667 Degrees	20.574162975063842	-0.125		1	2	2946.956
5	1 (G140H/F100LP)	c3		358.33095283333336 Degrees 22.116049166666667 Degrees	20.574155938350884	0.125		1	2	2946.956
6	1 (G140H/F100LP)	c3		358.33095283333336 Degrees 22.116049166666667 Degrees	20.574162975063842	-0.125		1	2	2946.956
7	1 (G140H/F100LP)	c4		358.328801 Degrees 22.114423333333335 Degrees	20.573344965124207	0.125		1	2	2946.956
8	1 (G140H/F100LP)	c4		358.328801 Degrees 22.114423333333335 Degrees	20.573352001299902	-0.125		1	2	2946.956
9	1 (G140H/F100LP)	c5		358.328425625 Degrees 22.114553888888889 Degrees	20.573204246203064	0.125		1	2	2946.956
10	1 (G140H/F100LP)	c5		358.328425625 Degrees 22.114553888888889 Degrees	20.573211282432009	-0.125		1	2	2946.956
11	1 (G140H/F100LP)	c6		358.328425625 Degrees 22.114553888888889 Degrees	20.573204246203064	0.125		1	2	2946.956
12	1 (G140H/F100LP)	c6		358.328425625 Degrees 22.114553888888889 Degrees	20.573211282432009	-0.125		1	2	2946.956
13	1 (G140H/F100LP)	c7		358.33673166666665 Degrees 22.113446388888889 Degrees	20.576321362074048	0.125		1	2	2946.956
14	1 (G140H/F100LP)	c7		358.33673166666665 Degrees 22.113446388888889 Degrees	20.576328397766083	-0.125		1	2	2946.956

NIRSpec MultiObject Spectroscopy	Exposure Specification	MSA Configuration	Nod Pattern	Pointing	Aperture PA	Dispersion Offset (Shutters)	Cross-Dispersion Offset (Shutters)	Total Dithers	Total Integrations	Total Exposure Time
15	1 (G140H/F100LP)	c8		358.3363563333333 Degrees 22.113577222222222 Degrees	20.57618064672271	0.125		1	2	2946.956
16	1 (G140H/F100LP)	c8		358.3363563333333 Degrees 22.113577222222222 Degrees	20.57618768246788	-0.125		1	2	2946.956
17	1 (G140H/F100LP)	c9		358.3363563333333 Degrees 22.113577222222222 Degrees	20.57618064672271	0.125		1	2	2946.956
18	1 (G140H/F100LP)	c9		358.3363563333333 Degrees 22.113577222222222 Degrees	20.57618768246788	-0.125		1	2	2946.956

Spectral Elements

NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	Optional ETC ID
1	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	214066
2	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
3	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
4	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
5	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
6	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
7	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
8	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
9	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
10	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
11	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
12	F140M	F277W	SHALLOW4	10	2	2	1	1062.94	
13	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
14	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
15	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
16	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
17	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	
18	F140M	F277W	SHALLOW4	10	3	3	1	1599.779	

Special Requirements

No Parallel Attachments
MSA Scheduled Aperture PA 20.5672 to 20.5672 Degrees (V3 241.99263 to 241.99263)

2 After 1 by 60.0 Days to <None specified>