



# 5437 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

Cycle: 3, Proposal Category: GO

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>
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Dr. Brendan Bowler (CoI)	University of Texas at Austin
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Dr. Jessica Ryan Lu (CoI)	University of California - Berkeley
Dr. Caroline Morley (CoI)	University of Texas at Austin
Dr. Stella Offner (CoI)	University of Texas at Austin
Dr. Megan Reiter (CoI)	Rice University
Dr. Yifan Zhou (CoI)	The University of Virginia

## OBSERVATIONS

<i>Folder</i>	<i>Observation</i>	<i>Label</i>	<i>Observing Template</i>	<i>Science Target</i>
W3 NIRSpec + NIRCам				
	1	Faint PRISM 1A Final 2, Bright PRISM + grisms 1A Final 2	NIRSpec MultiObject Spectroscopy	(1) W3-JWST-1A-FINAL
	2	Faint PRISM 2 Final 2, Bright PRISM + grisms 2 FINAL 2	NIRSpec MultiObject Spectroscopy	(2) W3-JWST-2-FINAL

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	3	Faint PRISM 3A FINAL 2, Bright PRISM + grisms 3A FINAL 2	NIRSpec MultiObject Spectroscopy	(3) W3-JWST-3A-FINAL

## ABSTRACT

Young brown dwarfs (BDs) and planetary-mass objects (PMOs) offer powerful tests of the universality of the IMF, the frequency and timescale of planet formation, and the typical atmospheric properties (and range of their variations) for analogs of directly-imaged and transiting planets, all at an extreme (protostellar mass and luminosity, disk mass, young age) where models are most strained. Most known PMOs are in nearby sparse populations, but these regions are small (with few PMOs) and spread out (limiting multiplexing). Given JWST’s superb sensitivity, the highest value is in source density rather than closeness or brightness. Distant, massive star-forming clusters offer more and denser targets, and HST has revealed them just in time for carefully optimized JWST follow-up.

We propose a highly multiplexed NIRSpec+NIRCam program for young BDs and PMOs, targeting 3 pointings in the young (0-8 Myr), massive (~10,000 members), and dense (R~12 arcmin) W3 cluster. We propose NIRSpec/MOS spectra of candidate young members from HST photometry (prism for 231 faint BDs and PMOs, grism and prism for 112 brighter BDs) to measure  $T_{\text{eff}}$ , gravity, accretion from emission lines, and disks from IR excess. We propose parallel NIRCam imaging in 12 filters (for SEDs, water bands indicating low  $T_{\text{eff}}$ , emission lines, and outflows) to seek the very bottom of the IMF (~2 MJup) and measure  $T_{\text{eff}}$ , accretion, and disks. Our program will deliver a large and robust census of the lowest-mass objects across varied environments, providing a new view of the IMF, disks, planet formation, and the atmospheres of analogs to the directly-imaged and transiting planets that drive much of JWST’s key science.

## OBSERVING DESCRIPTION

We propose a highly-multiplexed NIRSpec+NIRCam pilot program for young low-mass stars, brown dwarfs (BDs) and planetary mass objects (PMOs), targeting 3 pointings in the young, massive, and high-angular density W3 cluster.

We propose NIRSpec/MOS spectra of candidate cluster members:

- Prism spectra for 231 BDs and PMOs and 112 brighter BDs
- G140M/F100LP and G395M/F290LP grism spectra for the same 112 brighter BDs

With these we will measure  $T_{\text{eff}}$ , gravity, mass, accretion from emission lines, and disks from IR excess, and we will constrain the IMF down to ~10 MJup.

We propose coordinated parallel NIRCam imaging of adjacent fields in W3 in 12 filters:

- F115W, F162M, F210M, F300M, F335M, F360M, F444W, for SEDs and consistency with GTO programs targeting substellar objects in nearby star-forming regions
- F140M and F182M, centered on water absorption bands indicating low  $T_{\text{eff}}$
- F187N, F405N, and F470N, for accretion-driven emission lines

With these we will seek the very bottom of the IMF ( $\sim 2 M_{\text{Jup}}$ ) and measure  $T_{\text{eff}}$ , accretion, and disks.

Proposal 5437 - Targets - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous	
	(1)	W3-JWST-1A-FINAL	RA: 02 26 49.2132 (36.7050550d) Dec: +61 55 4.85 (61.91801d) Equinox: J2000			
	<i>Comments:</i> <i>Description=[]</i>					
	(2)	W3-JWST-2-FINAL	RA: 02 26 19.0313 (36.5792971d) Dec: +61 59 2.41 (61.98400d) Equinox: J2000			
<i>Comments:</i> <i>Description=[]</i>						
(3)	W3-JWST-3A-FINAL	RA: 02 25 40.1287 (36.4172029d) Dec: +62 01 57.72 (62.03270d) Equinox: J2000				
<i>Comments:</i> <i>Description=[]</i>						

Proposal 5437 - Observation 1 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

Wed Sep 11 16:01:20 GMT 2024

<b>Observation</b>	<p><b>Proposal 5437, Observation 1: Faint PRISM 1A Final 2, Bright PRISM + grisms 1A Final 2</b></p> <p><b>Diagnostic Status: Warning</b></p> <p>Observing Template: NIRSpec MultiObject Spectroscopy</p> <p>Coordinated Parallel Template(s): NIRCcam Imaging</p>																																																												
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Proposal 5437 - Observation 1 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

	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
<b>Spectral Elements</b>	1	1 (PRISM/CLEAR)	c1 : Faint PRISM 1A Final 2	3 Shutter Slitlet	36.702098833333 34 Degrees 61.916511944444 444 Degrees	338.32079354528 84			9	9	2232.1
	2	1 (PRISM/CLEAR)	c1 : Faint PRISM 1A Final 2	3 Shutter Slitlet	36.702098833333 34 Degrees 61.916511944444 444 Degrees	338.32079354528 84			9	9	2232.1
	3	1 (PRISM/CLEAR)	c1 : Faint PRISM 1A Final 2	3 Shutter Slitlet	36.702098833333 34 Degrees 61.916511944444 444 Degrees	338.32079354528 84			9	9	2232.1
	4	2 (PRISM/CLEAR)	c1 : Bright PRISM + grisms 1A Final 2	3 Shutter Slitlet	36.703058666666 67 Degrees 61.909805277777 78 Degrees	338.32163469579 95			9	18	1313.0
	5	3 (G140M/F100LP)	c1 : Bright PRISM + grisms 1A Final 2	3 Shutter Slitlet	36.703058666666 67 Degrees 61.909805277777 78 Degrees	338.32163469579 95			9	9	2232.1
	6	4 (G395M/F290LP)	c1 : Bright PRISM + grisms 1A Final 2	3 Shutter Slitlet	36.703058666666 67 Degrees 61.909805277777 78 Degrees	338.32163469579 95			9	9	2232.1
<b>Spectral Elements</b>		<b>NIRCam Imaging</b>	<b>Short Filter</b>	<b>Long Filter</b>	<b>Readout Pattern</b>	<b>Groups/Int</b>	<b>Integrations/Exp</b>	<b>Total Integrations</b>	<b>Total Dithers</b>	<b>Total Exposure Time</b>	<b>ETC Wkbk.Calc ID</b>
	1	F140M	F405N+F444W	SHALLOW4	4	1	9	9	9	1835.988	
	2	F210M	F335M	SHALLOW4	4	1	9	9	9	1835.988	
	3	F162M+F150W2	F300M	SHALLOW4	4	1	9	9	9	1835.988	
	4	F187N	F470N+F444W	SHALLOW4	2	1	9	9	9	869.678	
	5	F182M	F360M	SHALLOW4	4	1	9	9	9	1835.988	
6	F115W	F444W	SHALLOW4	4	1	9	9	9	1835.988		
<b>Special Requirements</b>	Aperture PA Range 320 to 340 Degrees (V3 181.4254303 to 201.4254303) No Parallel Attachments MSA Scheduled Aperture PA 338.3234 to 338.3234 Degrees (V3 199.74881 to 199.74881)										

Proposal 5437 - Observation 2 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

Wed Sep 11 16:01:20 GMT 2024

<b>Observation</b>	<b>Proposal 5437, Observation 2: Faint PRISM 2 Final 2, Bright PRISM + grisms 2 FINAL 2</b> <b>Diagnostic Status: Warning</b> Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCcam Imaging																																																												
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<b>Spectral Elements</b>	1	1 (PRISM/CLEAR)	c1 : Faint PRISM 2 Final 2	3 Shutter Slitlet	36.574294875000 01 Degrees 61.987732777777 78 Degrees	316.99558855548 145			9	9	2232.1
	2	1 (PRISM/CLEAR)	c1 : Faint PRISM 2 Final 2	3 Shutter Slitlet	36.574294875000 01 Degrees 61.987732777777 78 Degrees	316.99558855548 145			9	9	2232.1
	3	1 (PRISM/CLEAR)	c1 : Faint PRISM 2 Final 2	3 Shutter Slitlet	36.574294875000 01 Degrees 61.987732777777 78 Degrees	316.99558855548 145			9	9	2232.1
	4	2 (PRISM/CLEAR)	c1 : Bright PRISM + grisms 2 FINAL 2	3 Shutter Slitlet	36.580583250000 004 Degrees 61.980901388888 89 Degrees	317.00113441474 576			9	18	1313.0
	5	3 (G140M/F100LP)	c1 : Bright PRISM + grisms 2 FINAL 2	3 Shutter Slitlet	36.580583250000 004 Degrees 61.980901388888 89 Degrees	317.00113441474 576			9	9	2232.1
	6	4 (G395M/F290LP)	c1 : Bright PRISM + grisms 2 FINAL 2	3 Shutter Slitlet	36.580583250000 004 Degrees 61.980901388888 89 Degrees	317.00113441474 576			9	9	2232.1
<b>Spectral Elements</b>	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID	
	1	F140M	F405N+F444W	SHALLOW4	4	1	9	9	1835.988		
	2	F210M	F335M	SHALLOW4	4	1	9	9	1835.988		
	3	F162M+F150W2	F300M	SHALLOW4	4	1	9	9	1835.988		
	4	F187N	F470N+F444W	SHALLOW4	2	1	9	9	869.678		
	5	F182M	F360M	SHALLOW4	4	1	9	9	1835.988		
6	F115W	F444W	SHALLOW4	4	1	9	9	1835.988			
<b>Special Requirements</b>	Aperture PA Range 315 to 340 Degrees (V3 176.4254303 to 201.4254303) No Parallel Attachments MSA Scheduled Aperture PA 317.0000 to 317.0000 Degrees (V3 178.42543 to 178.42543)										

Proposal 5437 - Observation 3 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

Wed Sep 11 16:01:20 GMT 2024

<b>Observation</b>	<b>Proposal 5437, Observation 3: Faint PRISM 3A FINAL 2, Bright PRISM + grisms 3A FINAL 2</b> <b>Diagnostic Status: Warning</b> Observing Template: NIRSpec MultiObject Spectroscopy Coordinated Parallel Template(s): NIRCam Imaging																																																												
	(Visit 3:1) Warning (Form): Data Excess over middle threshold (Visit 3:1) Warning (Form): Overheads are provisional until the Visit Planner has been run.																																																												
<b>Fixed Targets</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th colspan="4">Targ. Coord. Corrections</th> <th colspan="4">Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(3)</td> <td>W3-JWST-3A-FINAL</td> <td>RA: 02 25 40.1287 (36.4172029d) Dec: +62 01 57.72 (62.03270d) Equinox: J2000</td> <td colspan="4"></td> <td colspan="4"></td> </tr> <tr> <td colspan="11"> <i>Comments:</i>                      Description=[]                 </td> </tr> </tbody> </table>											#	Name	Target Coordinates	Targ. Coord. Corrections				Miscellaneous				(3)	W3-JWST-3A-FINAL	RA: 02 25 40.1287 (36.4172029d) Dec: +62 01 57.72 (62.03270d) Equinox: J2000									<i>Comments:</i> Description=[]																											
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Proposal 5437 - Observation 3 - A Census to the Bottom of the IMF in W3: Atmospheres, Disks, Accretion, and Demographics

	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
<b>Spectral Elements</b>	1	1 (PRISM/CLEAR)	c1 : Faint PRISM 3A FINAL 2	3 Shutter Slitlet	36.414910666666 664 Degrees 62.029807777777 776 Degrees	209.56948031674 64			9	9	2232.1
	2	1 (PRISM/CLEAR)	c1 : Faint PRISM 3A FINAL 2	3 Shutter Slitlet	36.414910666666 664 Degrees 62.029807777777 776 Degrees	209.56948031674 64			9	9	2232.1
	3	1 (PRISM/CLEAR)	c1 : Faint PRISM 3A FINAL 2	3 Shutter Slitlet	36.414910666666 664 Degrees 62.029807777777 776 Degrees	209.56948031674 64			9	9	2232.1
	4	2 (PRISM/CLEAR)	c1 : Bright PRISM + grisms 3A FINAL 2	3 Shutter Slitlet	36.429662041666 67 Degrees 62.034050277777 77 Degrees	209.58250541938 892			9	18	1313.0
	5	3 (G140M/F100LP)	c1 : Bright PRISM + grisms 3A FINAL 2	3 Shutter Slitlet	36.429662041666 67 Degrees 62.034050277777 77 Degrees	209.58250541938 892			9	9	2232.1
	6	4 (G395M/F290LP)	c1 : Bright PRISM + grisms 3A FINAL 2	3 Shutter Slitlet	36.429662041666 67 Degrees 62.034050277777 77 Degrees	209.58250541938 892			9	9	2232.1
<b>Spectral Elements</b>	NIRCam Imaging	Short Filter	Long Filter	Readout Pattern	Groups/Int	Integrations/Exp	Total Integrations	Total Dithers	Total Exposure Time	ETC Wkbk.Calc ID	
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	5	F182M	F360M	SHALLOW4	4	1	9	9	1835.988		
6	F115W	F444W	SHALLOW4	4	1	9	9	1835.988			
<b>Special Requirements</b>	Aperture PA Range 195 to 210 Degrees (V3 56.4254303 to 71.4254303) No Parallel Attachments MSA Scheduled Aperture PA 209.5715 to 209.5715 Degrees (V3 70.99695 to 70.99695)										