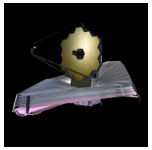

2974 - The Hubble constant at 1.9% from spatially resolved kinematics of gravitational lens

Cycle: 2, Proposal Category: GO

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OBSERVATIONS

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
Observation Folder				
J1206+4332				

Folder	*Observation*	*Label*	*Observing Template*	*Science Target*
	2		NIRSpec IFU Spectroscopy	(2) J1206+4332.LENSGALAXY
B1608+656				
	3		NIRSpec IFU Spectroscopy	(3) B1608+656.LENSGALAXY
J1721+8842				
	4		NIRSpec IFU Spectroscopy	(4) J1721+8842.LENSGALAXY

ABSTRACT

The Hubble tension is arguably the most tantalizing crack in LCDM's model. If the 8% difference between the Hubble constant measured from the local distance ladder from SH0ES and that from Planck is real, then new physics is needed. Independent methods are needed to confirm or rule out the tension.

Gravitational time delays have been used to measure H0 to 2% precision based on 7 lenses, and found to be in agreement with SH0ES. The measurement relied on assuming that the mass density profiles of massive elliptical galaxies are described by a power-law or stars + Navarro Frenk White dark matter halos. However, if these standard mass profile assumptions are lifted, the precision is limited by the mass sheet degeneracy (MSD). The MSD is broken by stellar kinematics of the lens galaxies. For the same sample of 7 lenses, the precision on H0 worsens to 8% using ground based unresolved stellar velocity dispersions, without assumptions on the mass profile.

We propose to obtain a 1.9% measurement of H0, sufficient to distinguish SH0ES and Planck at 4-sigma, fully accounting for the MSD in the error budget. This requires spatially resolved stellar kinematics of the lens galaxies, necessary to break both the mass sheet degeneracy in lens models and the mass anisotropy degeneracy in dynamical models. Only JWST with the NIRSPEC IFU has sufficient resolution, PSF stability, and sensitivity to obtain this data. In order to be able to reach 1.9% precision on H0 we need a total of 8 lenses with JWST kinematics, carefully selected for the quality of the time delays and other ancillary data. Four are scheduled to be observed in Cycle-1. We propose to observe the remaining 4 in Cycle-2.

OBSERVING DESCRIPTION

We will obtain deep spectroscopic observations with the NIRSpec IFU of four galaxies lensing quasars with measured time delays. The spectra will be use to measure spatially resolved kinematics, and, in combination with existing data, measure the Hubble constant to 1.9% precision. We will employ the G140M/F100LP disperser/filter set-up to target the Ca II triplet features, which are shifted into the near-infrared given the redshifts of the lens galaxies. The lens galaxies effective radii fit within one single IFU field of view. We choose the orientation to minimize contamination by the bright quasar images. We apply a standard four-point dither pattern to eliminate defects and cosmic ray hits. The NRSIRS2 readout pattern is

adopted, as recommended for long integrations on faint objects. The exposure time is calculated to reach S/N of 20/AA out to the effective radius, which is necessary to measure stellar velocity dispersion with 5% precision and meet our target precision on H0.

Proposal 2974 - Targets - The Hubble constant at 1.9% from spatially resolved kinematics of gravitational lens

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	J1206+4332.LENSGALAXY	RA: 12 06 29.6700 (181.6236250d) Dec: +43 32 18.82 (43.53856d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Elliptical galaxies]*				
(3)	B1608+656.LENSGALAXY	RA: 16 09 13.9400 (242.3080833d) Dec: +65 32 27.96 (65.54110d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Elliptical galaxies]*				
(4)	J1721+8842.LENSGALAXY	RA: 17 21 44.2500 (260.4343750d) Dec: +88 42 21.56 (88.70599d) Equinox: J2000		
Comments: *Category=Galaxy* *Description=[Elliptical galaxies]*				

Observation

Proposal 2974, Observation 2

Wed Aug 09 16:04:03 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: PA requirement needed to minimize QSO contamination within the IFU FOV.

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(2)	J1206+4332.LENSGALAXY	RA: 12 06 29.6700 (181.6236250d) Dec: +43 32 18.82 (43.53856d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Elliptical galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	25	4	false	true	NONE	4	16	29411.202	145108
2	G140M/F100LP	NRSIRS2	25	4	false	true	NONE	4	16	29411.202	145108

Special Requirements

Aperture PA Range 290.57253418 to 346.57253418 Degrees (V3 151.6 to 207.6)

Observation

Proposal 2974, Observation 3

Wed Aug 09 16:04:03 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: PA requirement needed to minimize QSO contamination within the IFU FOV.

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(3)	B1608+656.LENSGALAXY	RA: 16 09 13.9400 (242.3080833d) Dec: +65 32 27.96 (65.54110d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Elliptical galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	25	3	false	true	NONE	4	12	22058.402	145108

Special Requirements

Aperture PA Range 10.1 to 36.1 Degrees (V3 231.12746582 to 257.12746582)
Aperture PA Range 100.1 to 126.1 Degrees (V3 321.12746582 to 347.12746582)
Aperture PA Range 190.1 to 216.1 Degrees (V3 51.12746582 to 77.12746582)
Aperture PA Range 280.1 to 306.1 Degrees (V3 141.12746582 to 167.12746582)

Observation

Proposal 2974, Observation 4

Wed Aug 09 16:04:03 GMT 2023

Diagnostic Status: Warning

Observing Template: NIRSpec IFU Spectroscopy

Comments: PA requirement needed to minimize QSO contamination within the IFU FOV.

Diagnostics

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

Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Miscellaneous
(4)	J1721+8842.LENSGALAXY	RA: 17 21 44.2500 (260.4343750d) Dec: +88 42 21.56 (88.70599d) Equinox: J2000		

Comments:
Category=Galaxy
Description=[Elliptical galaxies]

Template

TA Method
NONE

Dithers

#	Dither Type	Size	Starting Point	Number of Points	Points
1	4-POINT-DITHER				

Spectral Elements

#	Grating/Filter	Readout Pattern	Groups/Int	Integrations/Exp	Leakcal	Dither	Autocal	Total Dithers	Total Integrations	Total Exposure Time	ETC Wkbk.Calc ID
1	G140M/F100LP	NRSIRS2	25	3	false	true	NONE	4	12	22058.402	145108

Special Requirements

Aperture PA Range 35.9 to 61.9 Degrees (V3 256.92746582 to 282.92746582)
Aperture PA Range 125.9 to 151.9 Degrees (V3 346.92746582 to 12.92746582)
Aperture PA Range 215.9 to 241.9 Degrees (V3 76.92746582 to 102.92746582)
Aperture PA Range 305.9 to 331.9 Degrees (V3 166.92746582 to 192.92746582)