



# 16760 - First detection of an isolated stellar mass black hole with astrometric microlensing

Cycle: 29, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
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## 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) OGLE-2011-BLG-0462	WFC3/UVIS	2	29-Jul-2021 15:03:51.0	yes
02	(1) OGLE-2011-BLG-0462	WFC3/UVIS	2	29-Jul-2021 15:03:52.0	yes

4 Total Orbits Used

## ABSTRACT

We propose to confirm the detection of the first isolated black hole (BH), OB110462. We analyzed archival HST data with improved astrometric techniques and demonstrate that the 3 sigma lower mass limit of OB110462 is 5 Msun, making it a solid BH detection. However, the allowed mass range of the BH is quite wide (68% CI of 9-31 Msun), due to the lack of sufficient time baseline of the archival data. We propose to obtain a new measurement of the target, now 10 years after the lensing event, in order to better constrain the baseline proper motion. This will allow the mass constraints of the BH to be improved by a factor of at least 2. This will provide the first mass measurement of an isolated BH, which will inform theoretical models of massive star death, the Milky Way BH mass distribution, and the population of BH-BH binaries discovered via gravitational waves.

## **OBSERVING DESCRIPTION**

We will observe two additional epochs of OB110462 in order to increase our time baseline to more precisely measure its proper motion, and in turn its mass. In order to match past observations and better understand color-dependent astrometric effects, we will image using WFC3-UVIS in both F814W and F606W filters. For observations in each filter, we will dither a small amount 5-6 times to sample the pixel phase and maximize our SNR. We will also take our observations in the same ORIENT as the past observations to minimize astrometric systematics due to unmodeled camera distortion and seasonal effects.

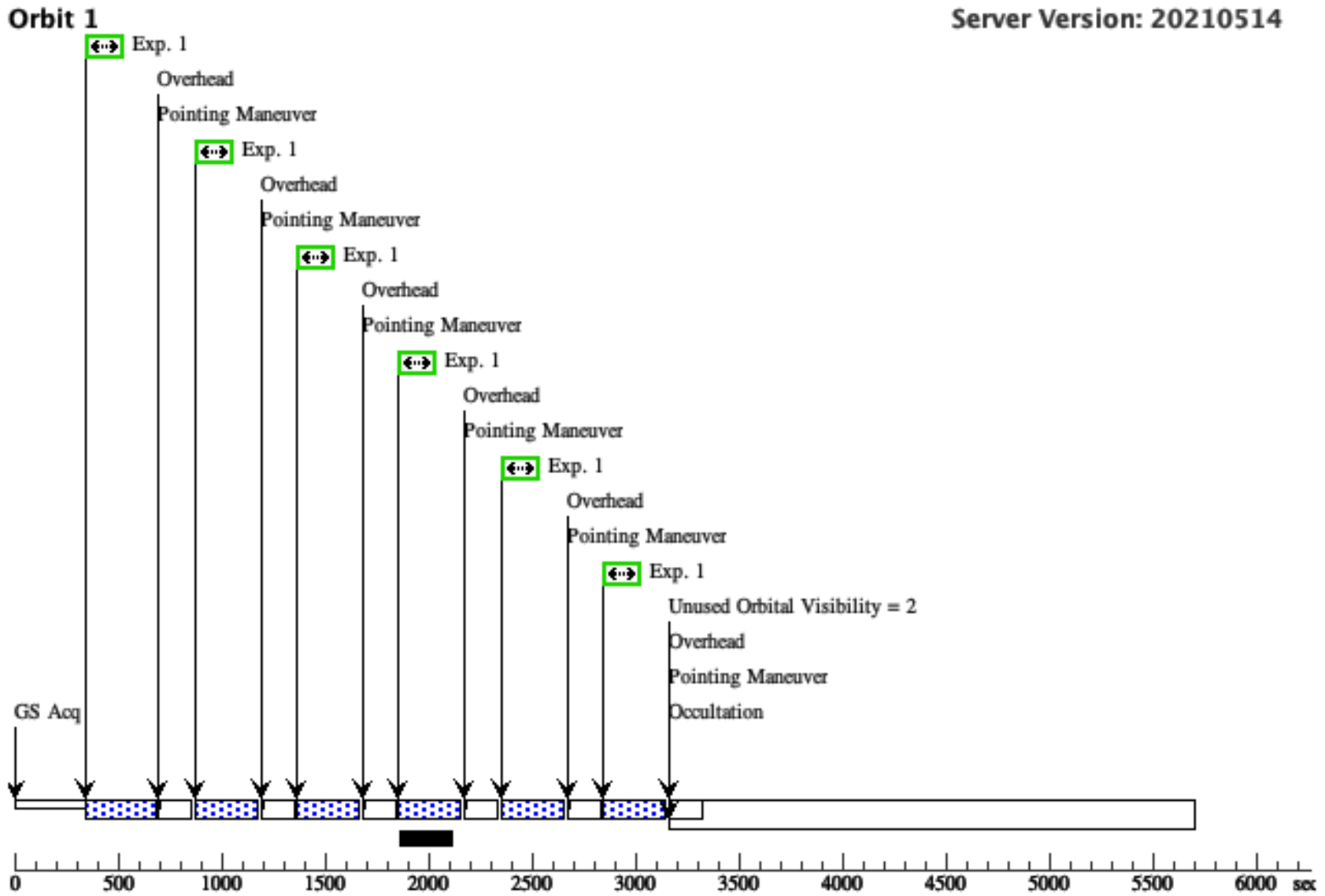
In terms of the possibility of HST going into reduced gyro mode (RGM), the astrometry technique we are using is not the spatial-scan technique, so will not be affected by RGM. In addition, our observations are more affected by systematic errors, not FWHM or SNR, and so nominal changes in these metrics due to RGM will not adversely affect the proposed observations.

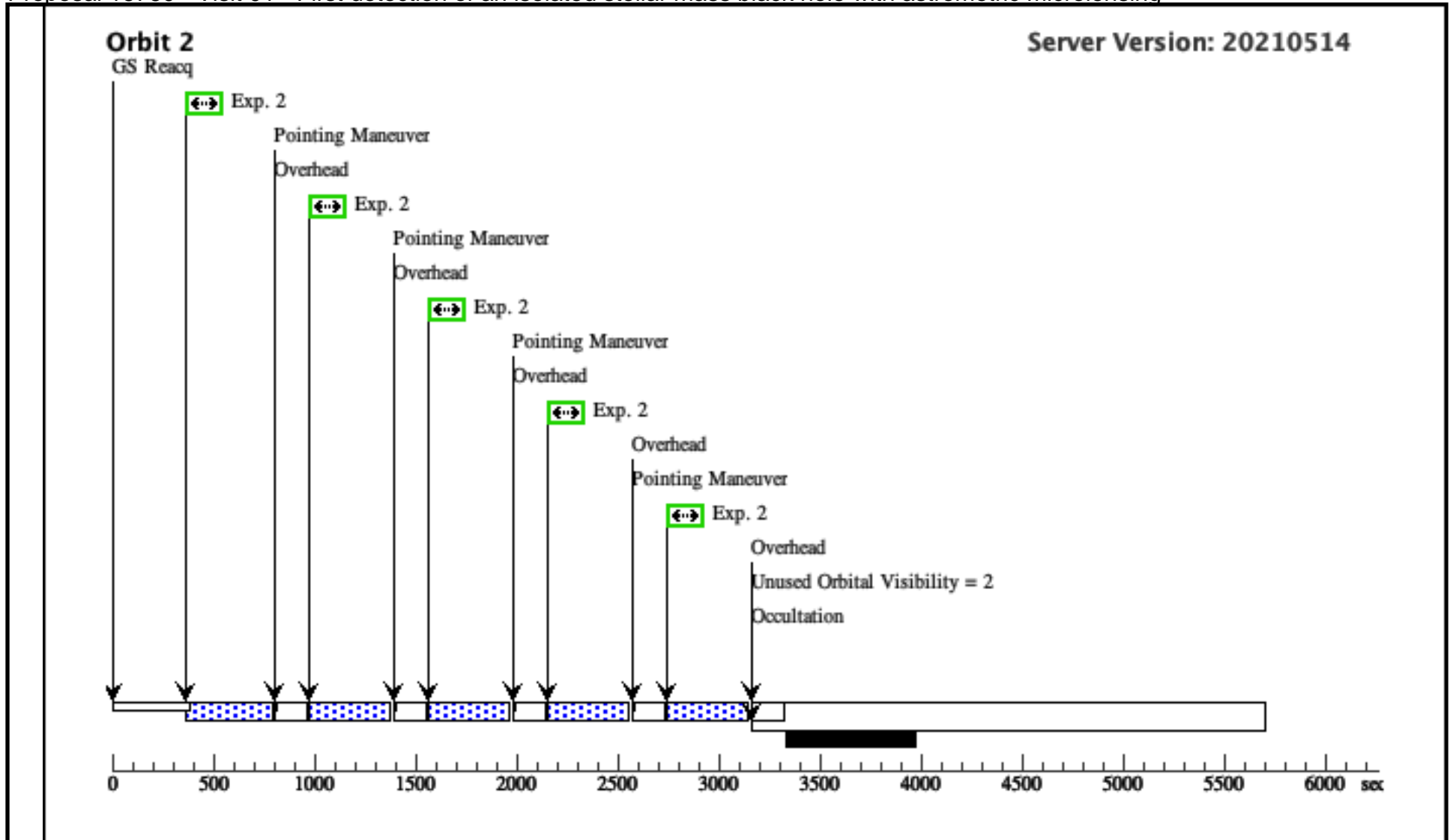
Proposal 16760 - Visit 01 - First detection of an isolated stellar mass black hole with astrometric microlensing

Thu Jul 29 19:03:53 GMT 2021

<b>Visit</b>	<b>Proposal 16760, Visit 01, implementation</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 88D TO 96 D; ORIENT 278D TO 282 D <i>Comments: It would be strongly preferred that this visit be scheduled in October 2021 if possible, when ORIENT is between 88 and 96 degrees.</i>									
	(Exposure 1 (Pattern 1, Exps 1-1 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 2 (Pattern 2, Exps 2-2 in Visit 01)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser									
<b>Diagnos</b>										
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>	<b>Secondary Pattern</b>	<b>Exposures</b>						
	(1)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=6 Point Spacing=0.13 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=45 Angle Between Sides= Center Pattern=false		(1)					
(2)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=5 Point Spacing=0.13 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=45 Angle Between Sides= Center Pattern=false		(2)						
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>	<b>Fluxes</b>	<b>Miscellaneous</b>				
	(1)	OGLE-2011-BLG-0462	RA: 17 51 40.1900 (267.9174583d) Dec: -29 53 26.30 (-29.89064d) Equinox: J2000		V=20.25+/-0.1	Reference Frame: ICRS				
<i>Comments:</i> Category=STAR Description=[BULGE]										
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1	(1) OGLE-2011-BL G-0462	(1) OGLE-2011-BL G-0462	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=15	POS TARG 0,0	Pattern 1, Exps 1-1 in Visit 01 (1)	307 Secs (1842 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)] [=>(Pattern 6)]	[1]
2	(1) OGLE-2011-BL G-0462	(1) OGLE-2011-BL G-0462	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=5	POS TARG 0,0	Pattern 2, Exps 2-2 in Visit 01 (2)	407 Secs (2035 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)]	[2]	

Orbit Structure





Proposal 16760 - Visit 02 - First detection of an isolated stellar mass black hole with astrometric microlensing

Thu Jul 29 19:03:53 GMT 2021

<b>Visit</b>	<b>Proposal 16760, Visit 02, implementation</b> <b>Diagnostic Status: Warning</b> Scientific Instruments: WFC3/UVIS Special Requirements: ORIENT 88D TO 96 D; ORIENT 278D TO 282 D; AFTER 01 BY 180 D TO 360 D <i>Comments: It would be strongly preferred that this visit be scheduled August 2022 or after, if possible, when ORIENT is between 88 to 96 degrees.</i>									
	<b>Diagnosics</b> (Exposure 1 (Pattern 1, Exps 1-1 in Visit 02)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser (Exposure 2 (Pattern 2, Exps 2-2 in Visit 02)) Warning (Form): FLASH level may be too high for this exposure or a long subexposure. See extended explanation in the diagnostic browser									
<b>Patterns</b>	<b>#</b>	<b>Primary Pattern</b>				<b>Secondary Pattern</b>			<b>Exposures</b>	
	(1)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=6 Point Spacing=0.13 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=45 Angle Between Sides= Center Pattern=false						(1)	
(2)	Pattern Type=SPIRAL Purpose=DITHER Number Of Points=5 Point Spacing=0.13 Line Spacing=	Coordinate Frame=POS-TARG Pattern Orientation=45 Angle Between Sides= Center Pattern=false						(2)		
<b>Fixed Targets</b>	<b>#</b>	<b>Name</b>	<b>Target Coordinates</b>	<b>Targ. Coord. Corrections</b>		<b>Fluxes</b>	<b>Miscellaneous</b>			
	(1)	OGLE-2011-BLG-0462	RA: 17 51 40.1900 (267.9174583d) Dec: -29 53 26.30 (-29.89064d) Equinox: J2000			V=20.25+/-0.1	Reference Frame: ICRS			
<i>Comments:</i> Category=STAR Description=[BULGE]										
<b>Exposures</b>	<b>#</b>	<b>Label</b>	<b>Target</b>	<b>Config,Mode,Aperture</b>	<b>Spectral Els.</b>	<b>Opt. Params.</b>	<b>Special Reqs.</b>	<b>Groups</b>	<b>Exp. Time (Total)/[Actual Dur.]</b>	<b>Orbit</b>
	1	(1) OGLE-2011-BL G-0462	(1) OGLE-2011-BL G-0462	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F814W	FLASH=15	POS TARG 0,0	Pattern 1, Exps 1-1 in Visit 02 (1)	307 Secs (1842 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)] [=>(Pattern 6)]	[1]
2	(1) OGLE-2011-BL G-0462	(1) OGLE-2011-BL G-0462	WFC3/UVIS, ACCUM, UVIS2-2K2C-SUB	F606W	FLASH=5	POS TARG 0,0	Pattern 2, Exps 2-2 in Visit 02 (2)	407 Secs (2035 Secs) [=>(Pattern 1)] [=>(Pattern 2)] [=>(Pattern 3)] [=>(Pattern 4)] [=>(Pattern 5)]	[2]	

Orbit Structure

Orbit 1

