



14886 - The unusual lensing BCG in Abell 1201: A steep IMF gradient, or an ultra-massive central black hole?

Cycle: 24, Proposal Category: GO
(Availability Mode: SUPPORTED)

INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
Dr. Russell Julian Smith (PI) (ESA Member) (Contact)	Durham Univ.	russell.smith@durham.ac.uk
Dr. John Lucey (CoI) (ESA Member)	Durham Univ.	john.lucey@durham.ac.uk
Dr. Alastair C. Edge (CoI) (ESA Member)	Durham Univ.	alastair.edge@durham.ac.uk
Dr. Mark Swinbank (CoI) (ESA Member)	Durham Univ.	a.m.swinbank@durham.ac.uk
Dr. James William Nightingale (CoI) (ESA Member)	Durham Univ.	james.w.nightingale@durham.ac.uk

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>
02	(1) ABELL1201-BCG	WFC3/UVIS	3	04-Jan-2017 21:04:12.0	yes

3 Total Orbits Used

ABSTRACT

Abell 1201 is a cluster of galaxies at $z=0.17$, with a brightest cluster galaxy (BCG) which acts as a gravitational lens to a background source at $z=0.45$. The lensing configuration is unusual, with a single bright arc formed at small radius (~ 5 kpc), where the stars are expected to contribute substantially to the total lensing mass.

Using VLT/MUSE data, we have recently discovered a faint counter-image to the main arc, located just $0.6''$ from the lens centre. This image is not

predicted at all in lensing models which incorporate the mass contributions from stars (following the observed light profile) and dark matter. Modelling shows that the formation of the counter-image requires additional mass at small radius.

Possible solutions include (a) imposing a gradient of the stellar-mass-to-light ratio, reflecting a heavier initial mass function (IMF) in the galaxy centre, or (b) adding a central black hole with mass above ten billion solar masses, comparable to the largest dynamical measurements. The first scenario would be relevant to ongoing controversies concerning possible non-standard IMFs in massive elliptical galaxies. The second explanation would be the first lensing-based detection of a central black hole, with implications for the still sparsely-populated upper end of the black hole scaling relations.

The two alternative models yield different predictions for the morphology of the counter-image. Our proposed WFC3/UVIS observations will establish whether the image is (a) a radial arc, supporting the IMF gradient interpretation, or (b) a compact counter-image, confirming the ultra-massive black hole scenario. HST resolution is essential for this measurement.

OBSERVING DESCRIPTION

The target is a $z=0.17$ cluster-dominant elliptical galaxy, with an unusual gravitational-lensing arc system.

The particular aim of these observations is to get improved information on a very faint inner counter-image to the main arc, buried behind the bright elliptical.

We observe in a blue bandpass (F390W), to improve contrast between the star-forming background galaxy and the red foreground galaxy. We also take imaging in a red bandpass (F814W), to help model the stellar mass distribution in the lens.

The observation should be fairly straightforward, with a simple five-point small-dither pattern in each band for cosmic ray and detector defect rejection. The dither is a typical $N+1/2$ pixel "box", with an additional "central" position. But since the observations get split over three orbits, pointing offset errors probably introduce their own significant random dither at similar level.

We elected to use post-flash to mitigate CTE losses in the F814W where the exposures are short; we also use the C1K1C-CTE aperture to keep target close to the amplifier.

Proposal 14886 - A1201BCG (02) - The unusual lensing BCG in Abell 1201: A steep IMF gradient, or an ultra-massive central black h...

Thu Jan 05 02:04:13 GMT 2017

Visit	Proposal 14886, A1201BCG (02), implementation Diagnostic Status: No Diagnostics Scientific Instruments: WFC3/UVIS Special Requirements: (none)									
	Fixed Targets	#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous			
	(1)	ABELL1201-BCG	RA: 11 12 54.5022 (168.2270925d) Dec: +13 26 8.98 (13.43583d) Equinox: J2000		V=16.5+/-0.1	Reference Frame: SIMBAD				
	<i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>									
Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
	1	A1201BCG-RED-A	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F814W	FLASH=4	POS TARG +0.185, +0.197		336 Secs (336 Secs) [==>]	[1]
	2	A1201BCG-RED-B	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F814W	FLASH=4	POS TARG 0,0		336 Secs (336 Secs) [==>]	[1]
	3	A1201BCG-BLUE-A	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390W		POS TARG 0,0		1430 Secs (1430 Secs) [==>]	[1]
	4	A1201BCG-RED-C	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F814W	FLASH=4	POS TARG +0.092, 0.098		337 Secs (337 Secs) [==>]	[1]
	5	A1201BCG-BLUE-B	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390W		POS TARG -0.09,-0.09		1430 Secs (1430 Secs) [==>]	[2]
	6	A1201BCG-BLUE-C	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390W		POS TARG -0.09,+0.09		1430 Secs (1430 Secs) [==>]	[2]
	7	A1201BCG-BLUE-D	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390W		POS TARG +0.09,-0.09		1430 Secs (1430 Secs) [==>]	[3]
	8	A1201BCG-BLUE-E	(1) ABELL1201-BCG	WFC3/UVIS, ACCUM, UVIS2-C1K1C-CTE	F390W		POS TARG +0.09,+0.09		1430 Secs (1430 Secs) [==>]	[3]



