14688 - Extended Star Formation or a Range of Stellar Rotation Velocities? The Nature of Extended Main Sequence Turnoffs in Intermediate-Age Star Clusters

Cycle: 24, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

Name	*Institution*	*E-Mail*
Dr. Paul Goudfrooij (PI) (Contact)	**Space Telescope Science Institute**	**goudfroo@stsci.edu**
Dr. Matteo Correnti (CoI)	Space Telescope Science Institute	correnti@stsci.edu
Dr. Leo Girardi (CoI) (ESA Member)	Osservatorio Astronomico di Padova	leo.girardi@oapd.inaf.it
Dr. Thomas H. Puzia (CoI)	Pontificia Universidad Catolica de Chile	tpuzia@astro.puc.cl

VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
01	(1) NGC-1831 ANY	ACS/WFC WFC3/UVIS	2	29-Jul-2016 14:51:19.0	yes

2 Total Orbits Used

ABSTRACT

Recently, deep color-magnitude diagrams (CMDs) from HST data revealed that several massive intermediate-age star clusters in the Magellanic Clouds exhibit extended main-sequence turn-offs (eMSTOs), and in some cases also dual red clumps. This poses serious questions regarding the mechanisms responsible for the formation of massive star clusters and their well-known light-element abundance variations. The nature of eMSTOs is currently a hotly debated topic of study. Several recent studies indicate that the eMSTOs are caused by an age spread of about 100-500 Myr among cluster stars, while other studies indicate that eMSTOs can be caused by a coeval population in which the relevant stars span a range of rotation velocities. Formal evidence to (dis-)prove either scenario still remains at large, mainly because the available stellar tracks that incorporate the effects

of rotation are only available for masses > 1.7 Msun whereas the stars in the known eMSTOs of intermediate-age clusters are less massive. To circumvent this issue, we identified a massive star cluster in the Large Magellanic Cloud (LMC) that has the right dynamical properties to host an eMSTO along with an age at which the effects of age spreads to CMD morphology are substantially different from those of spreads of rotation rates: the ~600 Myr old cluster NGC 1831. We propose to obtain deep WFC3/UVIS imaging with filters F336W and F814W to analyze the morphologies of the MSTO and upper MS regions of NGC 1831 at high precision and compare with model predictions. This will have a lasting impact on our understanding of the eMSTO phenomenon and of star cluster formation in general.

OBSERVING DESCRIPTION

The target star cluster is observed with WFC3 using the F336W and F814W broad-band filters. We make sure we include one F814W exposure that does not saturate the brightest stars expected from its age mentioned in the literature. On the other hand, we need color uncertainties less than 0.05 mag down to well beyond the estimated magnitude of the main sequence turnoff to achieve an accurate age determination and to enable a robust identification of multiple or broad turnoff structures. Hence we also include at least two longer exposures per filter to achieve deep photometry. At least two dither positions are used for each filter to allow a robust elimination of hot pixels and cosmic ray hits during the analysis. ACS is used in parallel to the primary WFC3 exposures, using the filters F435W and F814W. This will allow a robust determination of the field population contribution to the star cluster pointing, both in terms of the star distribution in the color-magnitude diagram and the overall radial distribution of cluster stars. Used the ORIENT special requirement to avoid bright stars just outside the WFC3 and ACS fields of view, which would cause scattered light issues.

Visit

Proposal 14688, NGC 1831 visit (01) Fri Jul 29 18:51:20 GMT 2016

Diagnostic Status: No Diagnostics

Scientific Instruments: WFC3/UVIS, ACS/WFC

Special Requirements: SCHED 30%; ORIENT 332D TO 346 D; ORIENT 319D TO 328 D; ORIENT 303D TO 313 D; ORIENT 285D TO 291 D; ORIENT 269D TO 279 D; ORIENT 227D TO 245 D; ORIENT 214D TO 218 D; ORIENT 193D TO 201 D; ORIENT 168D TO 180 D; ORIENT 110D TO 130 D; ORIENT 81D TO 93 D; ORIENT 72D TO 75 D; ORIENT 32D TO 43 D; ORIENT 9D TO 11 D; ORIENT 0D TO 3 D; ORIENT 357D TO 359.9 D

Fixed Targets

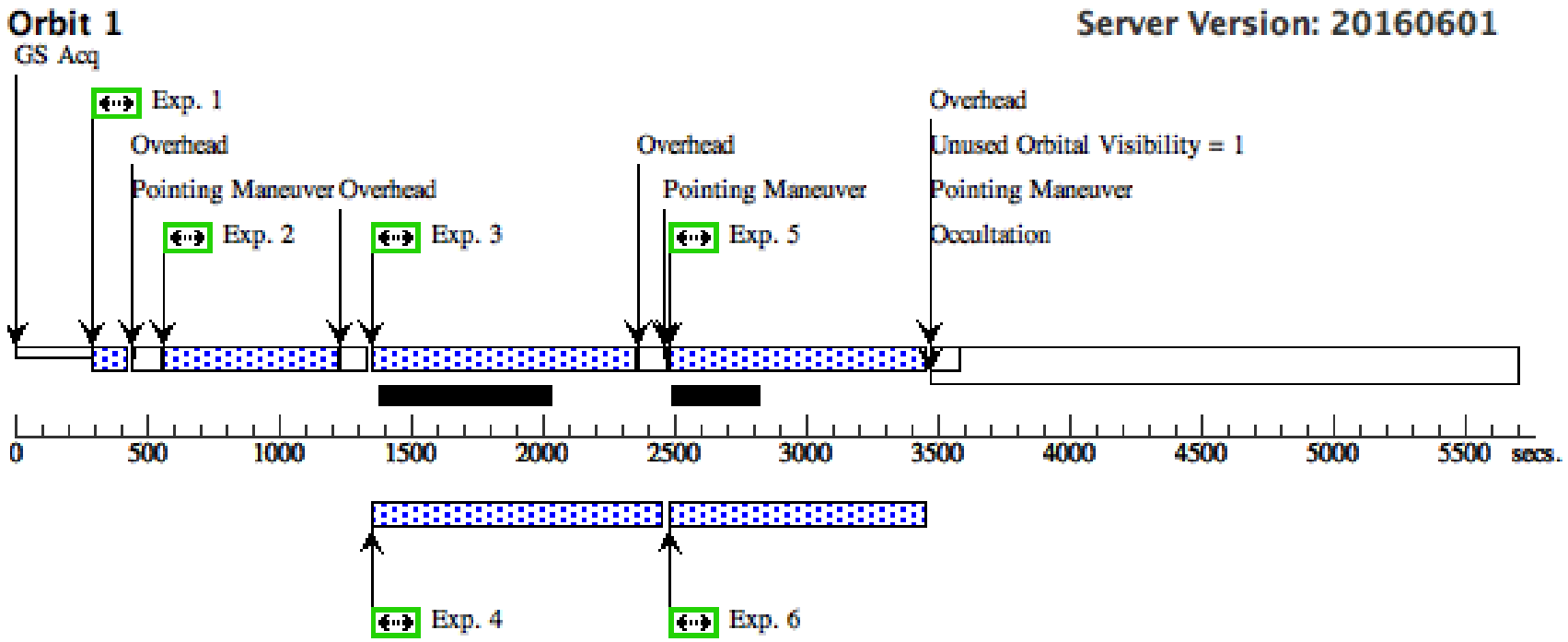
#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC-1831	RA: 05 06 16.2934 (76.5678892d) Dec: -64 55 5.92 (-64.91831d) Equinox: J2000		V=11.18	Reference Frame: SIMBAD

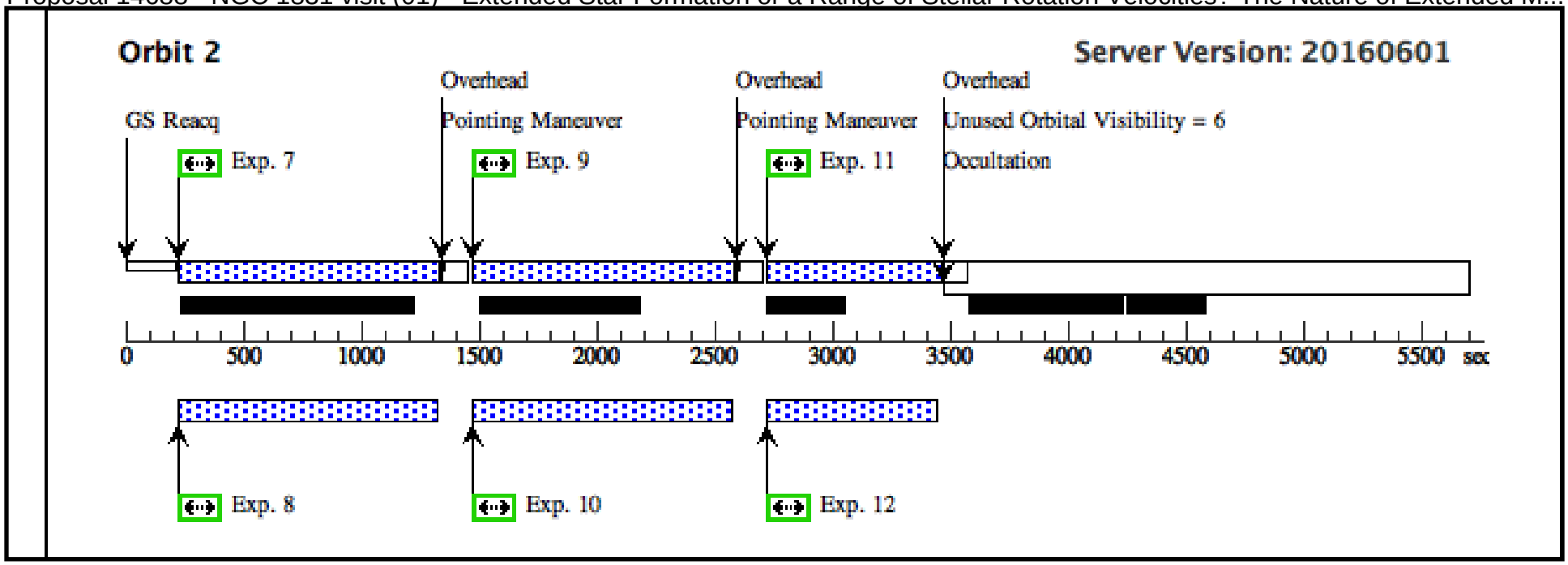
Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1	Short F814W	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F814W	FLASH=12	POS TARG 0.18,0.18		100 Secs (100 Secs) *[==>]*	*[1]*
2	F814W	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F814W		POS TARG 0.,0.		660 Secs (660 Secs) *[==>]*	*[1]*
3	F336W	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=10		Prime + Parallel Group 3-4 in NGC 1831 visit (01)	975 Secs (975 Secs) *[==>]*	*[1]*
4	ACS F435W	ANY	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 3-4 in NGC 1831 visit (01)	830 Secs (890 Secs) *[==>890.0 Secs]*	*[1]*
5	F336W dith 1	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=10	POS TARG 0.18,-2.414	Prime + Parallel Group 5-6 in NGC 1831 visit (01)	975 Secs (975 Secs) *[==>]*	*[1]*
6	ACS F435W	ANY	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 5-6 in NGC 1831 visit (01)	850 Secs (850 Secs) *[==>]*	*[1]*
7	F336W dith 2	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=9	POS TARG 0.18,0.18	Prime + Parallel Group 7-8 in NGC 1831 visit (01)	1115 Secs (1115 Secs) *[==>]*	*[2]*
8	ACS F435W	ANY	ACS/WFC, ACCUM, WFC	F435W			Prime + Parallel Group 7-8 in NGC 1831 visit (01)	980 Secs (980 Secs) *[==>]*	*[2]*
9	F336W dith 3	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F336W	FLASH=9	POS TARG 0.36,-2.234	Prime + Parallel Group 9-10 in NGC 1831 visit (01)	1115 Secs (1115 Secs) *[==>]*	*[2]*
10	ACS F814W	ANY	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 9-10 in NGC 1831 visit (01)	950 Secs (950 Secs) *[==>]*	*[2]*
11	F814W dith 1	(1) NGC-1831	WFC3/UVIS, ACCUM, UVIS2	F814W		POS TARG 0.18,-2.414	Prime + Parallel Group 11-12 in NGC 1831 visit (01)	720 Secs (720 Secs) *[==>]*	*[2]*
12	ACS F814W	ANY	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Group 11-12 in NGC 1831 visit (01)	600 Secs (600 Secs) *[==>]*	*[2]*

Orbit Structure




Orbit 2
Server Version: 20160601
GS Reacq
Overhead
Pointing Maneuver
Overhead
Pointing Maneuver
Overhead
Unused Orbital Visibility = 6
Occultation
Exp. 7
Exp. 9
Exp. 11
Exp. 8
Exp. 10
Exp. 12
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
sec