



# 13011 - Searching for the H-alpha 'Smoking Gun' of Prolonged Star Cluster Formation

Cycle: 20, Proposal Category: GO  
(Availability Mode: SUPPORTED)

## INVESTIGATORS

<i>Name</i>	<i>Institution</i>	<i>E-Mail</i>
<b>Dr. Thomas H. Puzia (PI) (Contact)</b>	<b>Pontificia Universidad Catolica de Chile</b>	<b>tpuzia@gmail.com</b>
Dr. Paul Goudfrooij (CoI) (AdminUSPI)	Space Telescope Science Institute	goudfroo@stsci.edu
Dr. Selma E. de Mink (CoI)	Space Telescope Science Institute	demink@stsci.edu

## 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) NGC-1856 ANY	ACS/WFC WFC3/UVIS	2	11-Jul-2012 01:12:42.0	yes

2 Total Orbits Used

## ABSTRACT

Recently, deep HST images provided conclusive evidence that several massive intermediate-age star clusters (SC) in the LMC and SMC present extended main-sequence turn-offs (eMSTOs), and in some cases also dual red clumps. This poses serious questions regarding the mechanisms responsible for SC formation. While most recent studies indicate that the eMSTOs are caused by a range in stellar age of about 150-500 Myr among cluster stars, the obvious and important question is: Why has this not been observed yet in SCs in that age range? Our calculations show that prolonged star formation in SCs requires a cluster escape velocity in excess of about 10 km/s, and there really is only one SC in the Local Group that has the right mass and size to be able to retain mass loss in slow winds of the first stellar generation and be young enough to have some of its second stellar generation being still on the pre-main sequence (PMS) and showing emission-line signatures: the 300 Myr old cluster NGC 1856 in the LMC.

Since this SC has no adequate HST imaging in the archive to detect an eMSTO, we propose to obtain deep broad-band imaging in F438W, F555W, F814W with WFC3/UVIS to analyze the MSTO and use F656N to search for Balmer-line emission signatures from PMS stars of the secondary stellar generation. The detection of the PMS phase in this cluster (or lack thereof) will have a lasting impact on our understanding of the eMSTO phenomenon. This SC represents a unique opportunity to render insights on the relative importance of various types of polluter stars of the first generation that have been proposed to be responsible for the chemical enrichment of second-generation stars in star clusters.

### **OBSERVING DESCRIPTION**

The target star cluster is observed with WFC3 using the F438W, F555W, and F814W broad-band filters and the F656N narrow-band H $\alpha$  filter. For the broad-band filters, we make sure we include one 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 if the target cluster in question is indeed found to host multiple stellar populations. Hence we also include at least two longer exposures per filter to achieve deep photometry. At least two dither positions are used for each target star cluster 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 F555W, F658N, and F814W. This will allow a robust determination of the field population contribution to the star cluster pointing.

Proposal 13011 - NGC1856 (01) - Searching for the H-alpha 'Smoking Gun' of Prolonged Star Cluster Formation

<b>Visit</b>	<p><b>Proposal 13011, NGC1856 (01)</b> <span style="float: right;">Wed Jul 11 05:12:53 GMT 2012</span></p> <p><b>Diagnostic Status: No Diagnostics</b></p> <p>Scientific Instruments: WFC3/UVIS, ACS/WFC</p> <p>Special Requirements: SCHED 30%; ORIENT 0D TO 87 D; ORIENT 205D TO 359.9 D</p> <p><i>Comments: The visit orientation requirements are set to avoid a bright star in the WFC3 field of view.</i></p>																
	<b>Fixed Targets</b>	<table border="1"> <thead> <tr> <th>#</th> <th>Name</th> <th>Target Coordinates</th> <th>Targ. Coord. Corrections</th> <th>Fluxes</th> <th>Miscellaneous</th> </tr> </thead> <tbody> <tr> <td>(1)</td> <td>NGC-1856</td> <td>RA: 05 09 30.3900 (77.3766250d) Dec: -69 07 45.40 (-69.12928d) Equinox: J2000</td> <td></td> <td>V=10.06</td> <td>Reference Frame: ICRS</td> </tr> </tbody> </table> <p><i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i></p>					#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous	(1)	NGC-1856	RA: 05 09 30.3900 (77.3766250d) Dec: -69 07 45.40 (-69.12928d) Equinox: J2000		V=10.06
#		Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous											
(1)	NGC-1856	RA: 05 09 30.3900 (77.3766250d) Dec: -69 07 45.40 (-69.12928d) Equinox: J2000		V=10.06	Reference Frame: ICRS												

Proposal 13011 - NGC1856 (01) - Searching for the H-alpha 'Smoking Gun' of Prolonged Star Cluster Formation

Exposures	#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time/[Actual Dur.]	Orbit
	1		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F814W		POS TARG -0.3,-0.3		51 Secs [==>]	[1]
	2		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F438W		SAME POS AS 1		430 Secs [==>]	[1]
	3		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F438W		POS TARG 0.18,2.4 14		430 Secs [==>]	[1]
	4		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F814W		POS TARG .18,2.4 4	Prime + Parallel Gro up 4-5 in NGC1856 (01)	360 Secs [==>]	[1]
	5		ANY	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Gro up 4-5 in NGC1856 (01)	280 Secs [==>]	[1]
	6		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F656N		POS TARG 0.0,null	Prime + Parallel Gro up 6-7 in NGC1856 (01)	735 Secs [==>]	[1]
	7		ANY	ACS/WFC, ACCUM, WFC	F555W			Prime + Parallel Gro up 6-7 in NGC1856 (01)	630 Secs [==>742.0 Secs ]	[1]
	8		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F814W		POS TARG 0.0,null	Prime + Parallel Gro up 8-9 in NGC1856 (01)	450 Secs [==>]	[1]
	9		ANY	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Gro up 8-9 in NGC1856 (01)	350 Secs [==>]	[1]
	10		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F438W		POS TARG 0.0,null		185 Secs [==>]	[2]
	11		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F555W				350 Secs [==>]	[2]
	12		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F555W		POS TARG 0.18,2.4 14	Prime + Parallel Gro up 12-13 in NGC1856 (01)	350 Secs [==>]	[2]
	13		ANY	ACS/WFC, ACCUM, WFC	F814W			Prime + Parallel Gro up 12-13 in NGC1856 (01)	280 Secs [==>339.0 Secs ]	[2]
	14		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F656N		POS TARG 0.18,2.4 14	Prime + Parallel Gro up 14-15 in NGC1856 (01)	940 Secs [==>]	[2]
	15		ANY	ACS/WFC, ACCUM, WFC	F658N			Prime + Parallel Gro up 14-15 in NGC1856 (01)	850 Secs [==>]	[2]
	16		(1) NGC-1856	WFC3/UVIS, ACCUM, UVIS1	F656N		POS TARG -0.3,-0.3	Prime + Parallel Gro up 16-17 in NGC1856 (01)	940 Secs [==>]	[2]
17		ANY	ACS/WFC, ACCUM, WFC	F658N			Prime + Parallel Gro up 16-17 in NGC1856 (01)	850 Secs [==>]	[2]	



