14773 - A Direct Distance to an Ancient Metal-Poor Star Cluster

Cycle: 24, Proposal Category: GO

(Availability Mode: SUPPORTED)

INVESTIGATORS

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VISITS

Visit	*Targets used in Visit*	*Configurations used in Visit*	*Orbits Used*	*Last Orbit Planner Run*	*OP Current with Visit?*
05	(1) NGC6397	WFC3/UVIS	1	29-Jul-2016 15:36:14.0	yes

1 Total Orbits Used

ABSTRACT

We propose spatial-scanning observations of NGC 6397, an ancient metal-poor globular cluster, in order to obtain a high-precision measurement of its annual trigonometric parallax. Using comprehensive preparations and simulations, we have found that the uncertainty on this direct distance measurement will be approximately 2%. Although dozens of open clusters within 1 kpc have measured parallaxes, to date there has been no measured parallax for a globular cluster. All globular clusters lie further than 1 kpc, and so there are no stellar population anchors at old ages (> 10 Gyr) and low metallicities ([Fe/H] < -1) with direct high-precision distances. Our program will provide the first anchor in this ancient metal-poor regime, with implications for a wide variety of stellar population studies, particularly in the realm of star formation histories.

OBSERVING DESCRIPTION

Note that GO-14773 is contructed to reproduce GO-14336 and GO-13817, which executed successfully. GO-13817 represents epochs 1 and 2 of this 5-epoch program. GO-14336 represents epochs 3 and 4 of this 5-epoch program. GO-14773 represents epoch 5 of this 5-epoch program. The only changes made here, with respect to GO-14366, are:

Visit timing requirements have been adjusted one year later.

There is only a single epoch in this cycle.

The filters F336W, F467M, F547M, and F850LP are all used in this single epoch.

The 10 warnings reported by APT for GO-14773 are the same as those reported for GO-13817 and GO-14336.
Program GO-14773 should use the same guide stars as those for GO-13817 and GO-14336.

Here is the original observing description, with updates to the dates mentioned:

Our proposal obtains a high-precision distance to the metal-poor GC NGC6397 using the spatial-scanning capability of WFC3/UVIS. Our preparations include selection of the best field location and orientation, taking into account the number of cluster and field stars with useful scans (uncontaminated by neighbors), appropriate sampling of the parallax ellipse, schedulability, and scan position angle relative to the parallactic motion at the time of each observation. In each single-orbit epoch, we can execute 4 spatial scans in the F606W filter (forward, reverse, forward, reverse) of 3600-pixel length, plus 8 unscanned images binned 2x2. These binned images will employ the F336W, F467M, F547M and F850LP filters. The resulting 4-filter photometry, when combined with ground-based spectroscopy of the field stars, will enable the required constraints on the absolute parallax reference frame. We will obtain multiple images in each filter for the entire scanned area, enabling cosmic-ray rejection and increased dynamic range. The program will eventually obtain five single-orbit epochs, at six month intervals (September and March) that sample the times of maximum parallactic motion. We should have at least a week of schedule availability for each epoch, at the appropriate orientation and date. We leave a few minutes of unused visibility to ensure scheduling. The orientation and cadence are constrained, but a single orbit within a 1-week period, repeated every 6 months with exact 180 degree flips in orientation, should not present a burden to the HST scheduling system. Each spatial scan is nearly along the y-axis of the detector (0.05 degree offset), minimizing the effect of charge transfer inefficiency, but providing subsampling of the point spread function in the resolution direction (perpendicular to the scan).

Ideally, we would observe on Sep 18 2016, which would be the time of maximum offset on the parallax ellipse, but observations within a week of these dates have little impact on the fidelity of the measurement.

Ideally, we would scan at a position angle of 2.9 degrees (perpendicular to the semi-major axis of the parallax ellipse), corresponding to an orientation of 138 degrees for WFC3. However, that roll angle is unavailable at the appropriate dates, and the roll angle must also be chosen to obtain clean scans of the desired stars. So, 110.5 and 290.5 degrees are used.

The binned imaging needs to provide photometry that does not saturate the ADC (65,000 DN) in 4 pixels while providing good signal-to-noise. At a gain of 1.5, that means the central 4 pixels should have less than 100,000 e-. The ensquared energy in the central 2x2 pixels of the PSF is 2.8x higher than that in the central pixel, according to the handbook. To be conservative, assume the central unbinned pixel should have ~<30,000 e- (note full well is ~70,000 e-). Using Stromgren photometry of reference stars in the field, the range of most interest can be represented by two stars at ~4500K and ~5000K, with V=11.5 mag and V=15.6 mag.

Count rate in central unbinned pixel (e-/s)
Filter 4500K/11.5mag 5000K/15.6mag
F336W 1307 67
F467M 9425 219
F547M 39435 825
F850LP 33202 508

Exposure times of 40, 20, 10, & 10 sec for the F336W, F467M, F547M, and F850LP should have good SNR and will match exposures obtained in previous epochs.

Visit

Proposal 14773, Epoch 5 of 5 (05), implementation Fri Jul 29 19:36:15 GMT 2016

Diagnostic Status: Warning

Scientific Instruments: WFC3/UVIS

Special Requirements: ORIENT 110.5D TO 110.5 D; BETWEEN 11-SEP-2016:00:00:00 AND 25-SEP-2016:00:00:00

Comments: Note that SAME OBSET is required to keep the 12 exposures within a single visibility period and avoid multiple GS ACQs.

The use of "GS ACQ Scenario" in the first exposure has been used in previous spatial scanning programs but was not used here. If it is needed to execute properly, please contact the PI.

Diagnostics

(Epoch 5 of 5 (05)) Warning (Orbit Planner): MERGING RULE VIOLATED DURING AUTOMATIC MERGING

(Epoch 5 of 5 (05)) Warning (Orbit Planner): MERGING RULE VIOLATED DURING AUTOMATIC MERGING

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(Epoch 5 of 5 (05)) Warning (Orbit Planner): MERGING RULE VIOLATED DURING AUTOMATIC MERGING

(Epoch 5 of 5 (05)) Warning (Orbit Planner): MERGING RULE VIOLATED DURING AUTOMATIC MERGING

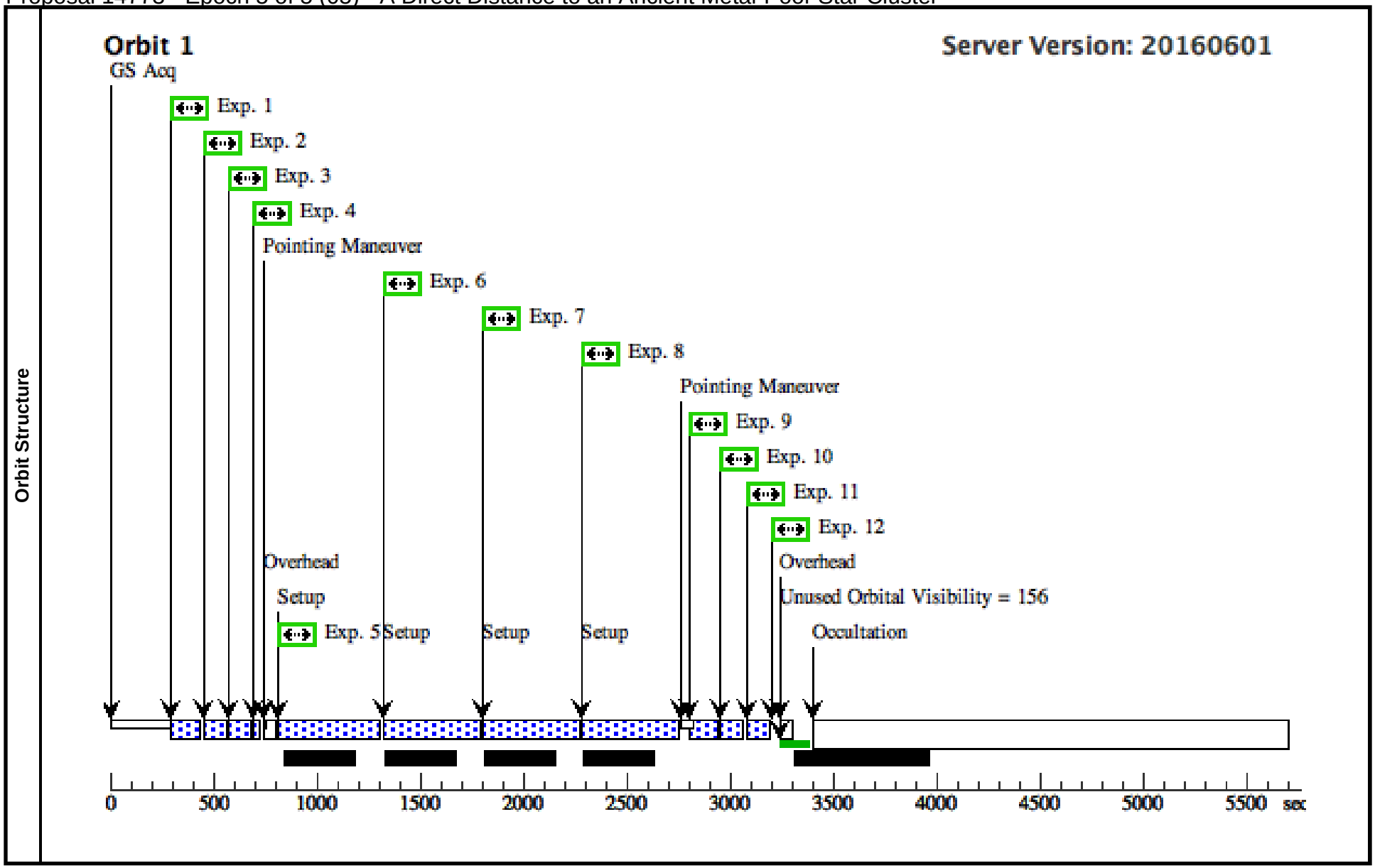
Fixed Targets

#	Name	Target Coordinates	Targ. Coord. Corrections	Fluxes	Miscellaneous
(1)	NGC6397	RA: 17 40 50.3975 (265.2099896d) Dec: -53 31 48.00 (-53.53000d) Equinox: J2000		V=5.7+/-0.1	Reference Frame: ICRS

Exposures

#	Label	Target	Config,Mode,Aperture	Spectral Els.	Opt. Params.	Special Reqs.	Groups	Exp. Time (Total)/[Actual Dur.]	Orbit
1		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,-72; GSPAIR S7CC0003 52F1S7CC000506F2	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	40 Secs (40 Secs) *[==>]*	***[1]***
2		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F467M	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,-72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	20 Secs (20 Secs) *[==>]*	***[1]***
3		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F547M	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,-72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	10 Secs (10 Secs) *[==>]*	***[1]***
4		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F850LP	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,-72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	10 Secs (10 Secs) *[==>]*	***[1]***
5		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-72; SPATIAL SCAN 0.4 1,90.05 Degrees,Forward	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	350 Secs (350 Secs) *[==>]*	***[1]***
6		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-72; SPATIAL SCAN 0.4 1,90.05 Degrees,Reverse	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	350 Secs (350 Secs) *[==>]*	***[1]***
7		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-72; SPATIAL SCAN 0.4 1,90.05 Degrees,Forward	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	350 Secs (350 Secs) *[==>]*	***[1]***
8		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F606W		POS TARG 0,-72; SPATIAL SCAN 0.4 1,90.05 Degrees,Reverse	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	350 Secs (350 Secs) *[==>]*	***[1]***
9		(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F336W	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	40 Secs (40 Secs) *[==>]*	***[1]***

	10	(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F467M	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	20 Secs (20 Secs) *[==>]*	***[1]***
	11	(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F547M	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	10 Secs (10 Secs) *[==>]*	***[1]***
	12	(1) NGC6397	WFC3/UVIS, ACCUM, UVIS-CENTER	F850LP	CR-SPLIT=NO; BIN=2; FLASH=12	POS TARG 0,72	Sequence 1-12 Non-Int in Epoch 5 of 5 (05) Same Obset in Sequence 1-12 Non-Int in Epoch 5 of 5 (05)	10 Secs (10 Secs) *[==>]*	***[1]***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Server Version: 20160601
Orbit Structure
GS Acq
Exp. 1
Exp. 2
Exp. 3
Exp. 4
Pointing Maneuver
Exp. 6
Exp. 7
Exp. 8
Pointing Maneuver
Exp. 9
Exp. 10
Exp. 11
Exp. 12
Overhead
Setup
Exp. 5
Setup
Setup
Setup
Overhead
Unused Orbital Visibility = 156
Occultation
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500
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3000
3500
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5500
sec