13691 - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II

Cycle: 22, Proposal Category: GO
(Large Program)
(Availability Mode: SUPPORTED)

INVESTIGATORS

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>E-Mail</th>
</tr>
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<tr>
<td>Dr. Wendy L. Freedman (PI) (Contact)</td>
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<tr>
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<tr>
<td>Dr. S. Eric Persson (Col)</td>
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<tr>
<td>Dr. Andy Monson (Col)</td>
<td>Carnegie Institution of Washington</td>
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<tr>
<td>Dr. Victoria Scowcroft (Col)</td>
<td>Carnegie Institution of Washington</td>
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<tr>
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<td>Carnegie Institution of Washington</td>
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</tr>
<tr>
<td>Ms. Rachael Beaton (Col)</td>
<td>The University of Virginia</td>
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<tr>
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<td><a href="mailto:jak@obs.carnegiescience.edu">jak@obs.carnegiescience.edu</a></td>
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<td>Dr. Mark Seibert (Col)</td>
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<td><a href="mailto:mseibert@obs.carnegiescience.edu">mseibert@obs.carnegiescience.edu</a></td>
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<tr>
<td>Prof. Giuseppe Bono (Col) (ESA Member)</td>
<td>Universita di Roma Tor Vergata</td>
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<tr>
<td>Dr. Gisella Clementini (Col) (ESA Member)</td>
<td>INAF, Osservatorio Astronomico di Bologna</td>
<td><a href="mailto:gisella.clementini@oabo.inaf.it">gisella.clementini@oabo.inaf.it</a></td>
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<tr>
<td>Dr. Soung-Chul Yang (Col)</td>
<td>Korea Astronomy and Space Science Institute (KASI)</td>
<td><a href="mailto:sczoo@kasi.re.kr">sczoo@kasi.re.kr</a></td>
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<tr>
<td>Prof. Myung Gyoon Lee (Col)</td>
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<td><a href="mailto:mglee@astro.snu.ac.kr">mglee@astro.snu.ac.kr</a></td>
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<tr>
<td>Mr. In Sung Jang (Col)</td>
<td>Seoul National University</td>
<td><a href="mailto:isjang@astro.snu.ac.kr">isjang@astro.snu.ac.kr</a></td>
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ABSTRACT
There has been great progress in the measurement of cosmological parameters in recent years, but controversy has arisen over the Planck/WMAP versus the direct measurement of the Hubble constant. The goal of our Carnegie Hubble Program (CHP) is to obtain a direct measure of $H_0$ to 3%. In CHP I, we used Cepheid variables to calibrate the extragalactic distance scale. In the second phase, CHP II, we are establishing a completely independent route to $H_0$ using RR Lyrae variables, the tip of the red giant branch (TRGB) and Type Ia supernovae (SNe Ia). Not only is the RR Lyrae route independent of the Cepheids, but its PL relation has a scatter that is a factor of 2 smaller. Unlike the Cepheids, the RR Lyrae / TRGB distance scale can be applied to both elliptical and spiral galaxies. This is a great systematic advantage, given the small number of galaxies (9 in total) close enough to have measured Cepheid calibrators within the SNIa hosts. By providing a new calibration using a Pop II distance scale, we will immediately double the number of SN Ia distances based on geometry, linking to over 200 SNe in the pure Hubble flow out to $z = 0.7$. Four calibrators containing both Cepheids and TRGB stars provide an important cross-check on systematics. Initially, the accuracy of our value of $H_0$ will be set by four galactic RR Lyrae calibrators with HST/FGS parallaxes. With Gaia, both the RR Lyrae zero point and TRGB method will be independently calibrated with at least an order of magnitude more calibrators, each having precisions of 1% or better. This will allow the highest accuracy measurement of $H_0$ to date using the "Distance Ladder" method.

OBSERVING DESCRIPTION
CHP II
**Visit**

**Proposal 13691, RR Lyr (01)**

**Diagnostic Status:** Error

**Scientific Instruments:** WFC3/IR

**Special Requirements:** DROP TO GYRO IF NECESSARY; SCHED 100%; ORIENT 45D TO 45 D; Period 0.566805 D AND ZERO-PHASE HJD2456574.29999

**Comments:** Need Drop to Gyro after Exposure 9 for drift scan obs.

**Diagnostics**

(Exposure 10 (RR Lyr (01)) special requirements) Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.

(Exposure 11 (RR Lyr (01)) special requirements) Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.

(Exposure 12 (RR Lyr (01)) special requirements) Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.

(Exposure 13 (RR Lyr (01)) special requirements) Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.

**Patterns**

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### Visit

**Proposal 13691, SU Dra (02)**  
**Diagnostic Status:** Error  
**Special Requirements:** DROP TO GYRO IF NECESSARY; SCHED 100%; ORIENT 45D TO 45 D; Period 0.660419 D AND ZERO-PHASE HJD2456844.8604  
**Comments:** Need Drop to Gyro after Exposure 9 for drift scan obs.

### Diagnostics

- **Exposure 10 (SU Dra (02)) special requirements** Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.
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### Fixed Targets

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<th>Targ. Coord. Corrections</th>
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<th>Miscellaneous</th>
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| (15) | SU-DRA | RA: 11 37 56.6074 (174.4858642d)  
Dec: +67 19 47.06 (67.32974d)  
Equinox: J2000 | | V=9.27 | Reference Frame: SIMBAD |

*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*
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Proposal 13691 - SU Dra (02) - CHP-II: The Carnegie Hubble Program to Measure H₀ to 3% Using Population II
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Proposal 13691 - SU Dra (02) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
Visit Proposal 13691, XZ Cyg (03)  

**Diagnostic Status:** Error  

**Scientific Instruments:** WFC3/IR  

**Special Requirements:** DROP TO GYRO IF NECESSARY; SCHED 100%; ORIENT 45D TO 45 D; Period 0.466579 D AND ZERO-PHASE HJD2456657.65842  

**Comments:** Need Drop to Gyro after Exposure 9 for drift scan obs.  

---  

### Diagnostics  

- **Exposure 10 (XZ Cyg (03)) special requirements** Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.  
- **Exposure 11 (XZ Cyg (03)) special requirements** Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.  
- **Exposure 12 (XZ Cyg (03)) special requirements** Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.  
- **Exposure 13 (XZ Cyg (03)) special requirements** Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.  

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| (16) | XZ-CYG | RA: 19 32 29.3049 (293.1221038d)  
Dec: +56 23 17.49 (56.38819d) | V=9.68 | Reference Frame: SIMBAD |

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

(Exposure 10 (RZ Cep (04)) special requirements) Error (Form): Scan rate: 7.5 is too large. The legal range is >0.0 to 4.999999 under FGS control.

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Proposal 13691 - RZ Cep (04) - CHP-II: The Carnegie Hubble Program to Measure $H_\alpha$ to 3% Using Population II
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<td>12</td>
<td>(21) V-RZ-CEP WFC3/IR, MULTIACCUM, IR F160W SAMP-SEQ=RAPID NSAMP=5 POS TARG 90,-15; SPATIAL SCAN 7.5,180.0 Degrees,Forward</td>
<td>14.661455 Secs (14.661 Secs)</td>
<td>[==&gt;] [I]</td>
<td></td>
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<td>13</td>
<td>(21) V-RZ-CEP WFC3/IR, MULTIACCUM, IR F160W SAMP-SEQ=RAPID NSAMP=5 POS TARG 90,-30; SPATIAL SCAN 7.5,180.0 Degrees,Forward</td>
<td>14.661455 Secs (14.661 Secs)</td>
<td>[==&gt;] [I]</td>
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Proposal 13691 - RZ Cep (04) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
Proposal 13691 - UV Oct-1 (05) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Visit Proposal 13691, UV Oct-1 (05)

Diagnostic Status: Error

Scientific Instruments: WFC3/IR

Special Requirements: DROP TO GYRO IF NECESSARY; SCHED 100%; ORIENT 45D TO 45 D

Comments: Need Drop to Gyro after Exposure 9 for drift scan obs.

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Patterns

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Fixed Targets

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<th>Targ. Coord. Corrections</th>
<th>Fluxes</th>
<th>Miscellaneous</th>
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Proposal 13691 - UV Oct-1 (05) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
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Proposal 13691 - UV Oct-1 (05) - CHP-II: The Carnegie Hubble Program to Measure H₀ to 3% Using Population II
Visit Proposal 13691, UV Oct-2 (06)

Scientific Instruments: WFC3/IR

Special Requirements: DROP TO GYRO IF NECESSARY ; SCHED 100%; ORIENT 45D TO 45 D; AFTER 05 BY 1.5 D TO 1.7 D

Comments: Need Drop to Gyro after Exposure 9 for drift scan obs.

## Diagnostics

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## Fixed Targets

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Visit Proposal 13691, IC 1613-1 (07)
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 83D TO 87 D

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<td>599.231134 Secs (1198.462 Secs)</td>
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### Proposal 13691 - IC 1613-1 (07) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

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Orbit 1

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Pointing Maneuver
Pointing Maneuver
Pointing Maneuver

GS AcqExp. 1
Exp. 1
Exp. 3
Exp. 3

Unused Orbital Visibility = 2
Occultation

Exp. 2
Exp. 2
Exp. 4
Exp. 4
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Proposal 13691 - IC 1613-2 (08) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
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Proposal 13691 - IC 1613-2 (08) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II
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| Sequence 21-24 Non-Int in IC 1613-2 (08) | Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in IC 1613-2 (08) (1) | Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in IC 1613-2 (08) | 419 Secs (1006 Secs) |
Proposal 13691 - IC 1613-2 (08) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
Proposal 13691 - IC 1613-2 (08) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
## Visit
**Proposal 13691, M31-1 (09)**

**Diagnostic Status:** No Diagnostics

**Scientific Instruments:** WFC3/IR, ACS/WFC

**Special Requirements:** SCHED 100%; ORIENT 188D TO 192 D

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- **(2)**
- **(3)**
- **(29)**

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Proposal 13691 - M31-1 (09) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
Orbit 4

GS Reacq

Exp. 13

Exp. 13

Exp. 15

Exp. 15

Pointing Maneuver

Pointing Maneuver

Pointing Maneuver

Unused Orbital Visibility = 115

Pointing Maneuver

Occultation

Exp. 14

Exp. 14

Exp. 16

Exp. 16

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.
Proposal 13691 - M31-1 (09) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II

Orbit 5

Server Version: 20140605

GS Reacq

Exp. 17

Pointing Maneuver

Exp. 17

Pointing Maneuver

Exp. 19

Pointing Maneuver

Exp. 19

Unused Orbital Visibility = 115

Pointing Maneuver

Occultation

Exp. 18

Exp. 18

Exp. 20

Exp. 20
### Patterns

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

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**Comments:** This object was generated by the targetselector and retrieved from the NED database.
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**Proposal 13691 - M31-2 (10) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II**

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
- **Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**

- NSAMP=10; SAMP-SEQ=STEP2

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
- **Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**

- NSAMP=10; SAMP-SEQ=STEP2

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
- **Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**

- NSAMP=10; SAMP-SEQ=STEP2

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
- **Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**

- NSAMP=10; SAMP-SEQ=STEP2

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
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- NSAMP=10; SAMP-SEQ=STEP2

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- NSAMP=10; SAMP-SEQ=STEP2

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- NSAMP=10; SAMP-SEQ=STEP2

- **Sequence 21-24 Non-Int in M31-2 (10)**
- **Pattern 1, Exps 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**
- **Prime + Parallel Group 21-22 in Pattern 1, Exps 21-22 in Sequence 21-24 Non-Int in M31-2 (10)**

- NSAMP=10; SAMP-SEQ=STEP2
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Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 223D TO 227 D

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Orbit 1

GS AcqExp. 1
Exp. 1
Exp. 3
Exp. 3
Exp. 2
Exp. 2
Exp. 4
Exp. 4

Pointing Maneuver
Pointing Maneuver
Pointing Maneuver
Pointing Maneuver

Unused Orbital Visibility = 3
Occultation

Server Version: 20140605
Orbit 6

GS Reacq

Exp. 21

Pointing Maneuver

Pointing Maneuver

Pointing Maneuver

Reconfig

Unused Orbital Visibility = 114

Occultation

Exp. 22

Exp. 22

Exp. 24

Exp. 24

Exp. 21

Exp. 23

Exp. 23
Visit Proposal 13691, M32-2 (12) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II  
Diagnostic Status: No Diagnostics  
Scientific Instruments: WFC3/IR, ACS/WFC  
Special Requirements: SCHED 100%; ORIENT 223D TO 227D; AFTER 11 BY 1.5D TO 1.7D

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Dec: +40 51 30.00 (40.85833d)  
Equinox: J2000 | | V=9.72 | |
| | | | | | Reference Frame: NED |
| Comments: This object was generated by the targetselector and retrieved from the NED database. |

| (31) | MESSIER-032-FIELD2 | RA: 00 42 50.7000 (10.7112500d)  
Dec: +40 50 10.00 (40.83611d)  
Equinox: J2000 | | V=9.72 | |
<p>| | | | | | Reference Frame: NED |
| Comments: This object was generated by the targetselector and retrieved from the NED database. |
|----|-----------|---------------------|------------------------|---------------|-------------|---------------|--------|---------------------------------|-------|
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|    |           |                     |                        |               |             | Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M32-2 (12) | | | | | |
| 2  |           |                     | ACS/WFC, ACCUM, WFC    | F606W         |             | Sequence 1-4 Non-Int in M32-2 (12) | Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M32-2 (12) | 419 Secs (922 Secs) | [I]   |
|    |           |                     |                        |               |             | Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M32-2 (12) | | | | | |
| 3  |           |                     | WFC3/IR, MULTIACCUM, IR-FIX | F160W         | NSAMP=10; SAMP-SEQ=STEP2 | Sequence 1-4 Non-Int in M32-2 (12) | Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M32-2 (12) | 599.231134 Secs (1198.462 Secs) | [I]   |
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| 4  |           |                     | ACS/WFC, ACCUM, WFC    | F606W         |             | Sequence 1-4 Non-Int in M32-2 (12) | Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M32-2 (12) | 419 Secs (1006 Secs) | [I]   |
|    |           |                     |                        |               |             | Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M32-2 (12) | | | | | |
| 5  |           |                     | WFC3/IR, MULTIACCUM, IR-FIX | F160W         | NSAMP=10; SAMP-SEQ=STEP2 | Sequence 5-8 Non-Int in M32-2 (12) | Pattern 1, Exps 5-6 in Sequence 5-8 Non-Int in M32-2 (12) | 599.231134 Secs (1198.462 Secs) | [2]   |
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Non-Int in M32-2 (12)
Prime + Parallel Grp
up 15-16 in Pattern 1
Exps 15-16 in Sequence 13-16 Non-Int in M32-2 (12) | 419 Secs (1006 Secs)
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Non-Int in M32-2 (12)
Prime + Parallel Grp
up 17-18 in Pattern 1
Exps 17-18 in Sequence 17-20 Non-Int in M32-2 (12) | 599.231134 Secs (1198.462 Secs)
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Non-Int in M32-2 (12)
Prime + Parallel Grp
up 17-18 in Pattern 1
Exps 17-18 in Sequence 17-20 Non-Int in M32-2 (12) | 419 Secs (1006 Secs)
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Non-Int in M32-2 (12)
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up 19-20 in Pattern 1
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Non-Int in M32-2 (12)
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up 19-20 in Pattern 1
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Proposal 13691 - M33-1 (13) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Visit
Proposal 13691, M33-1 (13)
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 265D TO 275 D

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Proposal 13691 - M33-1 (13) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
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**Proposal 13691 - M33-2 (14) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II**

**Visit**

Proposal 13691, M33-2 (14)

**Diagnostic Status:** No Diagnostics

**Scientific Instruments:** WFC3/IR, ACS/WFC

**Special Requirements:** SCHED 100%; ORIENT 265D TO 275 D; AFTER 13 BY 1.5 D TO 1.7 D

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<p>| Fixed Targets | |
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
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| | | Equinox: J2000 | | | |
| | Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. | |
| (32) | M-33-FIELD2 | RA: 01 33 35.3000 (23.3970833d) Dec: +30 29 7.00 (30.48528d) | | V=6.27 | Reference Frame: SIMBAD |
| | | Equinox: J2000 | | | |
| | Comments: This object was generated by the targetselector and retrieved from the SIMBAD database. | |
|----|-------------|-------------------------|--------------------------|---------------|----------------------------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------|-------|
| 1  | F160W       | (2) M-33-FIELD1         | WFC3/IR, MULTIACCUM, IR-FIX | F160W         | NSAMP=10; SAMP-SEQ=STEP2 00     | Sequence 1-4 Non-Int in M33-2 (14) Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M33-2 (14) (1) Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M33-2 (14) | [==&gt;(Pattern 1)] [==&gt;(Pattern 2)] [Sequence 1-4 Non-Int in M33-2 (14)] [Prime + Parallel Group 1-2 in Pattern 1, Exps 1-2 in Sequence 1-4 Non-Int in M33-2 (14)] | 599.231134 Secs (1198.462 Secs) | [I]   |
| 2  | F160W       | (32) M-33-FIELD2        | WFC3/IR, MULTIACCUM, IR-FIX | F160W         | NSAMP=10; SAMP-SEQ=STEP2 00     | Sequence 1-4 Non-Int in M33-2 (14) Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) | [==&gt;(Pattern 1)] [==&gt;(Pattern 2)] [Sequence 1-4 Non-Int in M33-2 (14)] [Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14)] | 599.231134 Secs (1198.462 Secs) | [I]   |
| 3  | F160W       | (32) M-33-FIELD2        | ACS/WFC, ACCUM, WFC      | F606W         |                             | Sequence 1-4 Non-Int in M33-2 (14) Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) | [==&gt;(Pattern 1)] [==&gt;(Pattern 2)] [Sequence 1-4 Non-Int in M33-2 (14)] [Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14)] | 419 Secs (922 Secs) | [I]   |
| 4  | F160W       | (32) M-33-FIELD2        | ACS/WFC, ACCUM, WFC      | F606W         |                             | Sequence 1-4 Non-Int in M33-2 (14) Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) (1) Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14) | [==&gt;(Pattern 1)] [==&gt;(Pattern 2)] [Sequence 1-4 Non-Int in M33-2 (14)] [Prime + Parallel Group 3-4 in Pattern 1, Exps 3-4 in Sequence 1-4 Non-Int in M33-2 (14)] | 419 Secs (1006 Secs) | [I]   |
| 5  | F160W       | (2) M-33-FIELD1         | WFC3/IR, MULTIACCUM, IR-FIX | F160W         | NSAMP=10; SAMP-SEQ=STEP2 00     | Sequence 5-8 Non-Int in M33-2 (14) Pattern 1, Exps 5-6 in Sequence 5-8 Non-Int in M33-2 (14) (1) Prime + Parallel Group 5-6 in Pattern 1, Exps 5-6 in Sequence 5-8 Non-Int in M33-2 (14) | [==&gt;(Pattern 1)] [==&gt;(Pattern 2)] [Sequence 5-8 Non-Int in M33-2 (14)] [Prime + Parallel Group 5-6 in Pattern 1, Exps 5-6 in Sequence 5-8 Non-Int in M33-2 (14)] | 599.231134 Secs (1198.462 Secs) | [2]   |</p>
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Proposal 13691 - M33-2 (14) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
### Visit

**Proposal 13691, Fornax-1a (15)**

- **Diagnostic Status:** No Diagnostics
- **Scientific Instruments:** WFC3/IR, ACS/WFC
- **Special Requirements:** SCHED 100%; ORIENT 313D TO 317 D

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Visit Proposal 13691, Fornax-1b (16)  
Diagnostic Status: No Diagnostics  
Scientific Instruments: WFC3/IR, ACS/WFC  
Special Requirements: SCHED 100%; ORIENT 313D TO 317 D; AFTER 15 BY 1.1 D TO 1.3 D

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Orbit Structure

Proposal 13691 - Fornax-1b (16) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
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### Exposures

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Proposal 13691 - Sculptor-2 (19) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Visit Proposal 13691, Sculptor-2 (19)
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 43D TO 47 D; AFTER 18 BY 1.1 D TO 1.3 D

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Orbit Structure

**Orbit 1**
- GS Acq
- Exp. 1
- Pointing Maneuver
- Exp. 1
- Pointing Maneuver
- Unused Orbital Visibility = 1
- Occultation

**Orbit 2**
- GS Reacq
- Exp. 3
- Pointing Maneuver
- Exp. 3
- Pointing Maneuver
- Unused Orbital Visibility = 1
- Occultation
### Patterns

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Orbit Structure

Orbit 1

GS Acq  Exp. 1

Pointing Maneuver  Exp. 1

Unused Orbital Visibility = 0
Occultation
Pointing Maneuver

Exp. 2

Exp. 2

Orbit 2

GS Reacq  Exp. 3

Pointing Maneuver  Exp. 3

Unused Orbital Visibility = 3
Pointing Maneuver
Occultation

Exp. 4

Exp. 4
### Patterns

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Proposal 13691 - M 96 (22) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

**Orbit 1**
- GS Acq → Exp. 1
- Pointing Maneuver → Exp. 1
- Pointing Maneuver
  - Occultation
  - Unused Orbital Visibility = 0

**Orbit 2**
- GS Reacq → Exp. 3
- Pointing Maneuver → Exp. 3
- Pointing Maneuver
  - Unused Orbital Visibility = 1
  - Occultation
## Proposal 13691 - NGC 4536 (23) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II

**Visit**

Proposal 13691, NGC 4536 (23)

**Diagnostic Status:** No Diagnostics

**Scientific Instruments:** WFC3/IR, ACS/WFC

**Special Requirements:** SCHED 100%; ORIENT 304D TO 306 D

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Proposal 13691 - NGC 4536 (23) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II

Orbit Structure

**Orbit 1**

- GS Acq
- Exp. 1
- Exp. 3

Unused Orbital Visibility = 1
Occultation

- Exp. 2
- Exp. 4

**Orbit 2**

- GS Reacq
- Exp. 5
- Pointing Maneuver
- Exp. 5

Unused Orbital Visibility = 0
Occultation
Pointing Maneuver

- Exp. 6
- Exp. 6
Proposal 13691 - NGC 4536 (23) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

**Orbit 3**
- GS Reacq
- Exp. 7
- Pointing Maneuver
- Exp. 7
- Unused Orbital Visibility = 0
- Pointing Maneuver
- Exp. 8

**Orbit 4**
- GS Reacq
- Exp. 9
- Pointing Maneuver
- Exp. 9
- Unused Orbital Visibility = 3
- Occultation
- Exp. 10

Server Version: 20140605
Proposal 13691 - NGC 4526 (24) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II

Visit Details:
- Proposal 13691, NGC 4526 (24)
- Diagnostic Status: No Diagnostics
- Scientific Instruments: WFC3/IR, ACS/WFC
- Special Requirements: SCHED 100%; ORIENT 108° TO 110°

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### Proposal 13691 - NGC 4526 (24) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

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- GS Acq
- Exp. 1
- Exp. 2
- Exp. 3
- Exp. 4

Orbit 2
- GS Reacq
- Exp. 5
- Exp. 5
- Pointing Maneuver
- Exp. 6
- Exp. 6

Server Version: 20140605
Unused Orbital Visibility = 0
Occultation

Server Version: 20140605
Unused Orbital Visibility = 4
Pointing Maneuver
Occultation
Orbit 5

GS Reacq

Exp. 11

Pointing Maneuver

Exp. 11

Unused Orbital Visibility = 4

Pointing Maneuver

Occultation

Exp. 12

Exp. 12

Orbit 6

GS Reacq

Exp. 13

Pointing Maneuver

Exp. 13

Reconfig

Unused Orbital Visibility = 4

Occultation

Exp. 14

Exp. 14
Visit Proposal 13691, NGC 4424 (25)  
Diagnostic Status: No Diagnostics  
Scientific Instruments: WFC3/IR, ACS/WFC  
Special Requirements: SCHED 100%; ORIENT 277D TO 279 D

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Proposal 13691 - NGC 1448-1 (26) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Visit
Proposal 13691, NGC 1448-1 (26)
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 134D TO 136 D

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GS Acq Exp. 1

Exp. 1

Exp. 3

Unused Orbital Visibility = 0
Occultation

Exp. 2

Exp. 4

Orbit 2

GS Reacq Exp. 5

Exp. 5

Pointing Maneuver

Pointing Maneuver
Unused Orbital Visibility = 0
Occultation

Exp. 6

Exp. 6

Server Version: 20140605
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Orbit Structure

Orbit 1

GS Acq → Exp. 1

Pointing Maneuver

Unused Orbital Visibility = 1
Pointing Maneuver
Occultation

Exp. 2
Exp. 2

Orbit 2

GS Reacq → Exp. 3

Pointing Maneuver

Unused Orbital Visibility = 0
Occultation
Pointing Maneuver

Exp. 4
Exp. 4
Proposal 13691 - NGC 1448-2 (27) - CHP-II: The Carnegie Hubble Program to Measure H₀ to 3% Using Population II

Orbit 5

GS Reacq

Exp. 9

Pointing Maneuver

Exp. 9

Occultation

Reconfig

Unused Orbital Visibility = 0

Exp. 10

Exp. 10

Server Version: 20140605
**Proposal 13691 - NGC 1365-1 (28) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II**

Visit Proposal 13691, NGC 1365-1 (28)
Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 311D TO 313 D

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Orbit Structure

**Orbit 1**
- GS Acq Exp. 1
- Pointing Maneuver Exp. 1
- Unused Orbital Visibility = 1
- Pointing Maneuver
- Occultation

**Orbit 2**
- GS Reacq Exp. 3
- Pointing Maneuver Exp. 3
- Unused Orbital Visibility = 2
- Pointing Maneuver
- Occultation

---

Proposal 13691 - NGC 1365-1 (28) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
**Proposal 13691 - NGC 1365-2 (29) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II**

**Visit** Proposal 13691, NGC 1365-2 (29)  
**Diagnostic Status:** No Diagnostics  
**Scientific Instruments:** WFC3/IR, ACS/WFC  
**Special Requirements:** SCHED 100%; ORIENT 311D TO 313 D; AFTER 28 BY 1 D TO 10 D

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Proposal 13691 - NGC 1365-2 (29) - CHP-II: The Carnegie Hubble Program to Measure \(Ho\) to 3% Using Population II
**Proposal 13691 - NGC 1365-3 (30) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II**

**Visit**
- **Proposal 13691, NGC 1365-3 (30)**
- Diagnostic Status: No Diagnostics
- Scientific Instruments: WFC3/IR, ACS/WFC
- Special Requirements: SCHED 100%; ORIENT 311D TO 313D; AFTER 28 BY 1 D TO 10 D

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Proposal 13691 - NGC 1365-3 (30) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
Orbit Structure

Orbit 1
- GS Acq
- Exp. 1
- Pointing Maneuver
- Exp. 1
- Unused Orbital Visibility = 1
- Pointing Maneuver
- Occultation

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.

Exp. 2

Orbit 2
- GS Reacq
- Exp. 3
- Pointing Maneuver
- Exp. 3
- Unused Orbital Visibility = 2
- Pointing Maneuver
- Occultation

0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 secs.

Exp. 4

Server Version: 20140605

Proposal 13691 - NGC 1365-3 (30) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
### Visits

**Proposal 13691, NGC 1316-1 (37)**

**Visit Details:**
- **Diagnostic Status:** No Diagnostics
- **Scientific Instruments:** WFC3/IR, ACS/WFC
- **Special Requirements:** SCHED 100%; ORIENT 229D TO 231 D

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| | | | [==>(Pattern 1)] [==>(Pattern 2)] |

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Diagnostic Status: No Diagnostics
Scientific Instruments: WFC3/IR, ACS/WFC
Special Requirements: SCHED 100%; ORIENT 229D TO 231 D; AFTER  37 BY 1 D TO 10 D

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Proposal 13691 - NGC 1316-2 (32) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II
### Proposal 13691 - NGC 1316-3 (36) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

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Orbit Structure

Proposal 13691 - NGC 1316-3 (36) - CHP-II: The Carnegie Hubble Program to Measure $H_0$ to 3% Using Population II
Proposal 13691 - OMEGA CEN-1 (34) - CHP-II: The Carnegie Hubble Program to Measure Ho to 3% Using Population II

Visit

Proposal 13691, OMEGA CEN-1 (34)
Diagnostic Status: Warning
Scientific Instruments: WFC3/IR
Special Requirements: SCHED 100%; ORIENT 43D TO 47 D; ORIENT 133D TO 137 D

(Exposure 3 (Pattern 9, Exps 3-3 in OMEGA CEN-1 (34)) special requirements) Warning (Form): Be very careful mixing POS TARG and Center_Pattern = Yes

Patterns

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