# 14691 - Unraveling the oscillations of the richest pulsating hydrogen-atmosphere white dwarf

Cycle: 24, Proposal Category: GO

(UV Initiative)

(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?* |
|---|---|---|---|---|---|
| 01 | (1) SDSS-J084055.72+130329.5 | COS/FUV<br>COS/NUV | 3 | 29-Jul-2016 14:53:11.0 | yes |
| 02 | (1) SDSS-J084055.72+130329.5 | COS/FUV<br>COS/NUV | 3 | 29-Jul-2016 14:53:12.0 | yes |

6 Total Orbits Used

**ABSTRACT**

Most stars in our Galaxy will end or have already ended their lives as white dwarf stars, making them important benchmarks for stellar evolution. Here we propose to obtain COS far-ultraviolet spectroscopy of a pulsating hydrogen-atmosphere white dwarf (DAV) with extensive, space-based photometry obtained by the Kepler spacecraft during the K2 mission. The pulsation spectrum is the richest of any DAV collected to date, but to extract any information about the white dwarf interior we must identify the spherical degree (l) of the modes present. Our time-tagged ultraviolet observations will enable us to identify the spherical degree of the highest-amplitude pulsation modes, since the ratios of the ultraviolet-to-optical pulsation amplitudes strongly depend on the geometry of the pulsation modes. This will decisively determine if most of the modes present are a series of l=3 modes, as it appears from the frequency multiplets in the K2 data; however, l=3 modes have never been clearly identified in a pulsating white dwarf. Our far-ultraviolet spectroscopy, covering the H2/H2+ quasi-molecular satellites around 1400 and 1600 AA, will also measure the white dwarf temperature and mass to an accuracy unachievable from the ground. This robust temperature and mass will anchor our detailed asteroseismic investigation of this stellar remnant. The unique combination of HST and Kepler observations will make this white dwarf a benchmark for the unprecedented opportunities for white dwarf archaeology enabled by the original Kepler mission and its extension into the ecliptic, K2.

**OBSERVING DESCRIPTION**

The two main goals of our observations are to measure the atmospheric parameters of this pulsating white dwarf and to measure the far-UV pulsation amplitudes. Using the COS G140L grating centered at 1105 AA, we cover the appropriate spectral features at sufficient spectral resolution to accurately determine the atmospheric parameters. The time-series photometry from the time-tagged data will require slightly more planning. In summary, we request our two three-orbit visits to be separated by 2.2 days (up to no more than 6.0 days separating the visits) in order to fully resolve the pulsations, which in the nearest case are separated by as little as 5.5 microHz. Further information and justification is found in the Description of the Observations section of the accepted proposal.

## Visit

**Proposal 14691, Visit 01** Fri Jul 29 18:53:13 GMT 2016

**Diagnostic Status: Warning**

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: (none)

## Diagnostics

(Visit 01) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.

## Fixed Targets

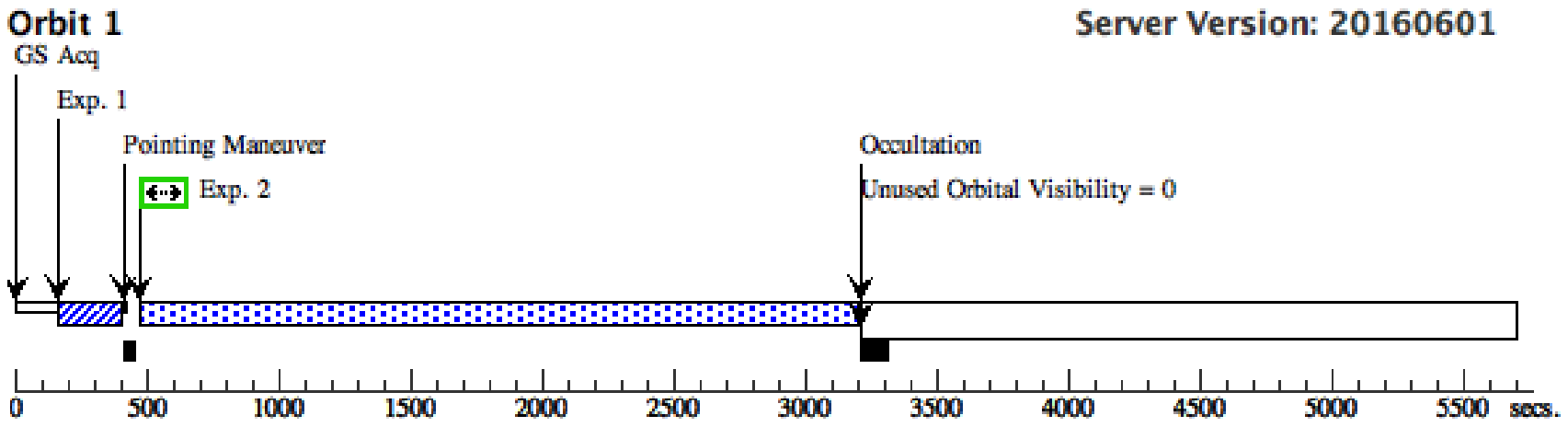
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | SDSS-J084055.72+130329.5 | RA: 08 40 55.7210 (130.2321708d)<br>Dec: +13 03 29.50 (13.05819d)<br>Equinox: J2000 | Proper Motion RA: 11 mas/yr<br>Proper Motion Dec: -9.9 mas/yr<br>Epoch of Position: 2000 | V=17.16+/-0.20<br>g=17.12 | Reference Frame: ICRS |

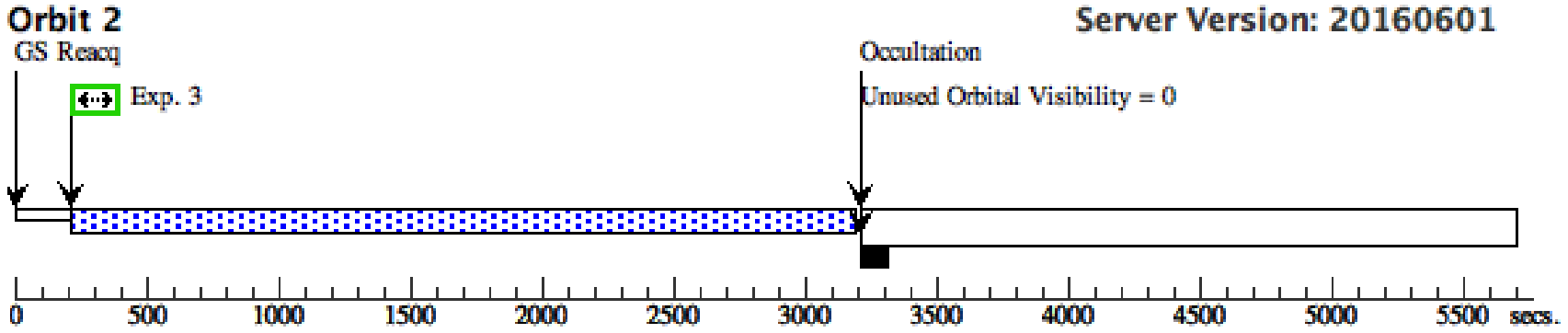
*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*
*Extended=NO*

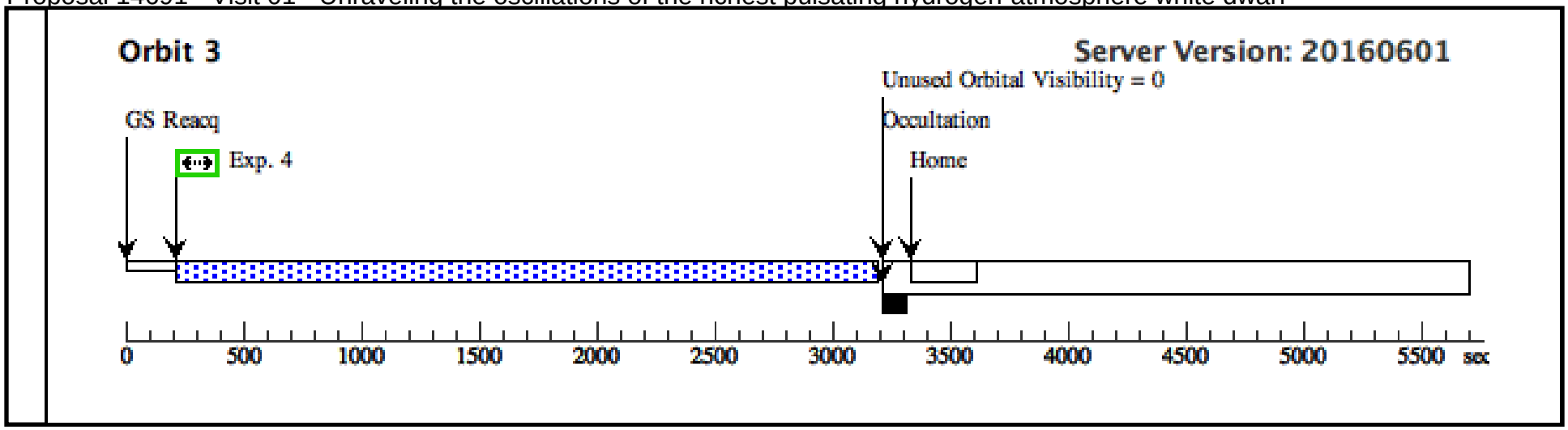
## Exposures

| # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (COS.ta.822409) | (1) SDSS-J084055.72+130329.5 | COS/NUV, ACQ/IMAGE, PSA | MIRRORA | | | | 5 Secs (5 Secs)<br>*[==>]* | *[1]* |
| 2 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=1;<br>BUFFER-TIME=2549 | | | 2549 Secs (2549 Secs)<br>*[==>]* | *[1]* |
| 3 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=2;<br>BUFFER-TIME=2932 | | | 2932 Secs (2932 Secs)<br>*[==>]* | *[2]* |
| 4 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=3;<br>BUFFER-TIME=2932 | | | 2932 Secs (2932 Secs)<br>*[==>]* | *[3]* |

Orbit Structure

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Occultation
Exp. 4
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1000
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3000
3500
4000
4500
5000
5500
sec

## Visit

**Proposal 14691, Visit 02** Fri Jul 29 18:53:13 GMT 2016

**Diagnostic Status: Warning**

Scientific Instruments: COS/FUV, COS/NUV

Special Requirements: AFTER_01 BY 2.2 D TO 6.0 D

## Diagnostics

(Visit 02) Warning (Form): For the best data quality, it is strongly recommended that all four FP-POS positions be used when observing at a given COS CENWAVE setting.

## Fixed Targets

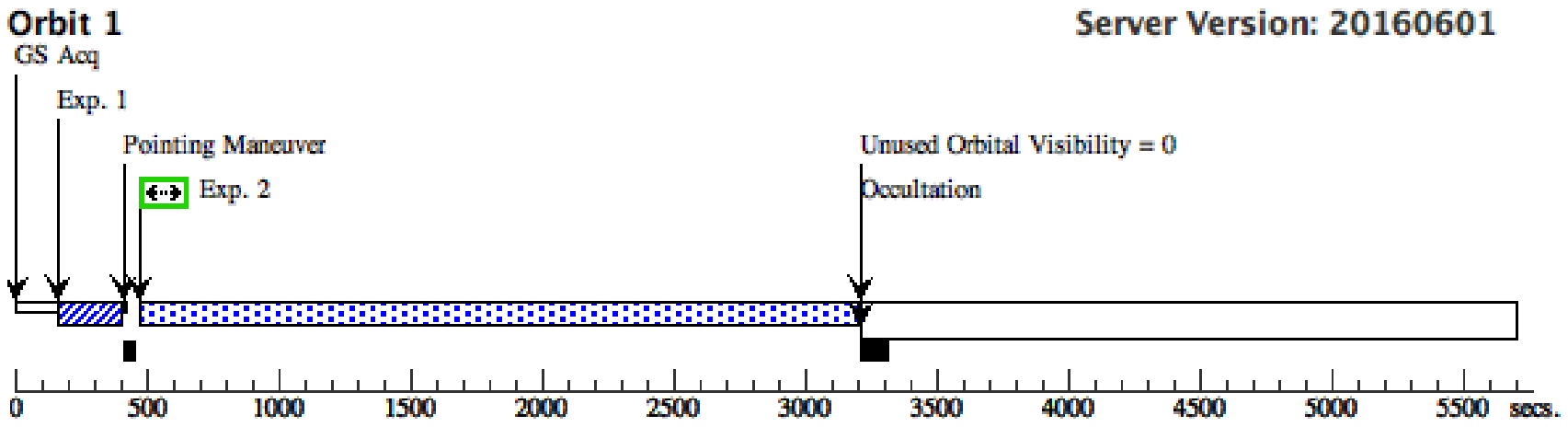
| # | Name | Target Coordinates | Targ. Coord. Corrections | Fluxes | Miscellaneous |
|---|---|---|---|---|---|
| (1) | SDSS-J084055.72+130329.5 | RA: 08 40 55.7210 (130.2321708d)<br>Dec: +13 03 29.50 (13.05819d)<br>Equinox: J2000 | Proper Motion RA: 11 mas/yr<br>Proper Motion Dec: -9.9 mas/yr<br>Epoch of Position: 2000 | V=17.16+/-0.20<br>g=17.12 | Reference Frame: ICRS |

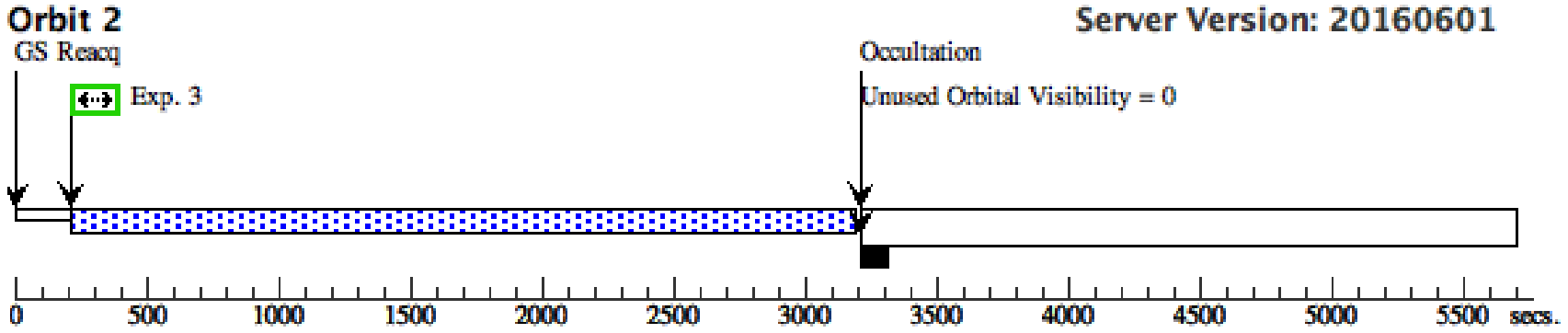
*Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.*
*Extended=NO*

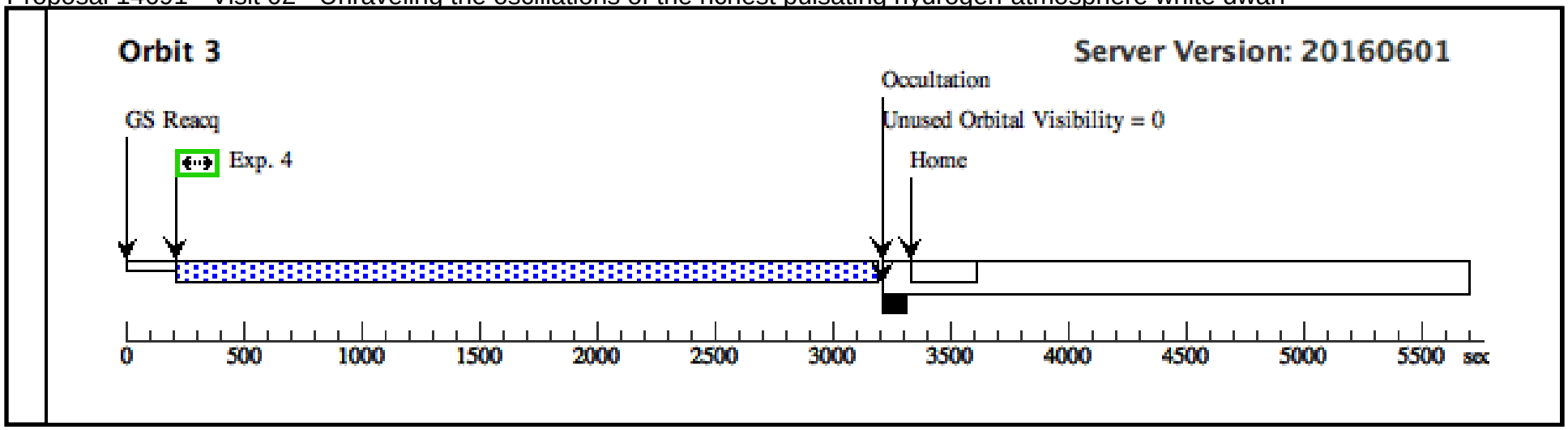
## Exposures

| # | Label (ETC Run) | Target | Config,Mode,Aperture | Spectral Els. | Opt. Params. | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.] | Orbit |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (COS.ta.822409) | (1) SDSS-J084055.72+130329.5 | COS/NUV, ACQ/IMAGE, PSA | MIRRORA | | | | 5 Secs (5 Secs)<br>*[==>]* | *[1]* |
| 2 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=1;<br>BUFFER-TIME=2549 | | | 2549 Secs (2549 Secs)<br>*[==>]* | *[1]* |
| 3 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=2;<br>BUFFER-TIME=2932 | | | 2932 Secs (2932 Secs)<br>*[==>]* | *[2]* |
| 4 | (COS.sp.822415) | (1) SDSS-J084055.72+130329.5 | COS/FUV, TIME-TAG, PSA | G140L<br>1105 A | FP-POS=3;<br>BUFFER-TIME=2932 | | | 2932 Secs (2932 Secs)<br>*[==>]* | *[3]* |

Orbit Structure

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