



## 13363 - Gauging dust settling in 5-10 Myr old disks with COS

Cycle: 21, Proposal Category: GO

(UV Initiative)

(Availability Mode: SUPPORTED)

### INVESTIGATORS

| <i>Name</i>                            | <i>Institution</i>                             | <i>E-Mail</i>               |
|--|--|-----------------------------|
| <b>Dr. Nuria Calvet (PI) (Contact)</b> | <b>University of Michigan</b>                  | <b>ncalvet@umich.edu</b>    |
| Dr. Laura D. Ingleby (CoI)             | University of Michigan                         | lingleby@umich.edu          |
| Dr. Jesus Hernandez (CoI)              | Centro de Investigaciones de Astronomia        | hernandj@cida.ve            |
| Dr. Cesar Briceno (CoI)                | Centro de Investigaciones de Astronomia        | briceno@cida.ve             |
| Dr. Paola D'Alessio (CoI)              | Universidad Nacional Autonoma de Mexico (UNAM) | p.dalessio@astrosmo.unam.mx |
| Dr. Lee W. Hartmann (CoI)              | University of Michigan                         | lhartm@umich.edu            |
| Dr. Gregory J. Herczeg (CoI)           | Peking University                              | gherczeg1@gmail.com         |

### 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) CVSO58                   | COS/FUV<br>COS/NUV                  | 2                  | 11-Jul-2013 17:16:50.0        | yes                           |
| 02           | (2) CVSO107                  | COS/FUV                             | 2                  | 11-Jul-2013 17:17:01.0        | yes                           |
| 03           | (3) CVSO109                  | COS/FUV                             | 2                  | 11-Jul-2013 17:17:10.0        | yes                           |
| 04           | (4) CVSO90                   | COS/FUV                             | 2                  | 11-Jul-2013 17:17:21.0        | yes                           |
| 05           | (5) OB1A776                  | COS/FUV<br>COS/NUV                  | 2                  | 11-Jul-2013 17:17:31.0        | yes                           |
| 06           | (6) OB1A1192                 | COS/FUV                             | 2                  | 11-Jul-2013 17:17:39.0        | yes                           |

| <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> |
|--------------|------------------------------|-------------------------------------|--------------------|-------------------------------|-------------------------------|
| 07           | (7) OB1A1630                 | COS/FUV<br>COS/NUV                  | 2                  | 11-Jul-2013 17:17:47.0        | yes                           |

14 Total Orbits Used

## **ABSTRACT**

We propose to carry out observations with COS of the FUV emission in 7 disks in the Orion OB1b and 1a subassociations, with ages ~5 and ~ 10 Myr respectively, the age range where disks are actively evolving and dissipating. Our observations will increase by a factor of ~3 the number of disks observed with COS in this critical age range, and encompass the goals of the Ultraviolet Initiative of Cycle 21. The H2 lines excited by Ly alpha present in the COS spectra of our targets, in combination with our ground-based and Spitzer observations, will allow us to estimate the amount of dust settling of the inner disk, providing us with unprecedented insight into the state of evolution of these mature disks.

## **OBSERVING DESCRIPTION**

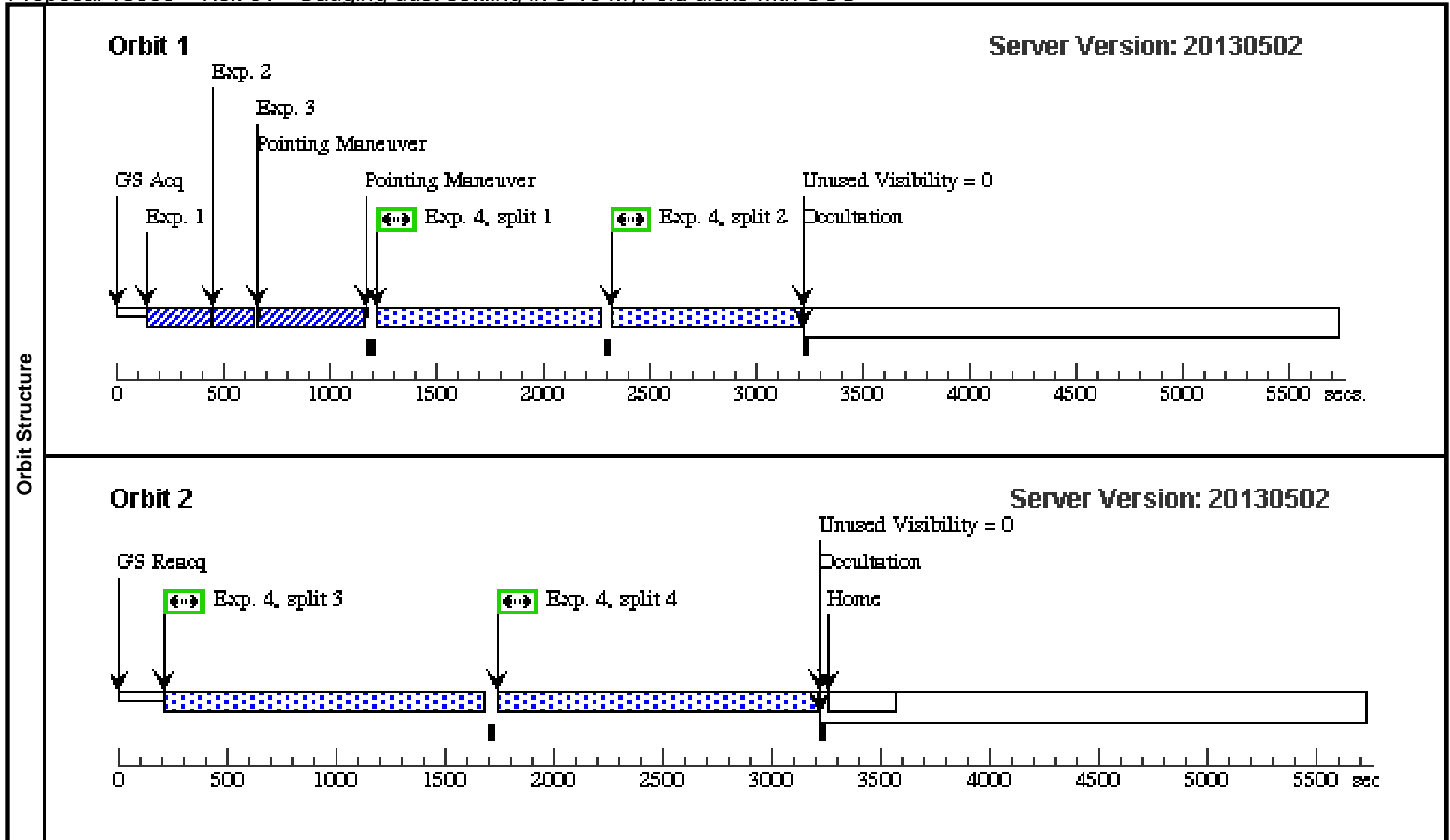
We will acquire the target either using MIRROR A for the dimmer sources or the FUV G160M 1611 grating for the sources which are too bright to observe with MIRROR A. We will follow the acquisition with a brief image in MIRROR A or MIRROR B depending on the source brightness. We will then use the G160M grating set at a central wavelength of 1611 A for the remaining orbit time. Exposure times for all objects were obtained by using COS and STIS FUV through optical observations of other young stars. We chose targets with similar accretion rates (a proxy for the FUV and NUV luminosity) as the input spectrum for the COS ETC, scaled to the distance of our targets and applied extinction values determined from existing optical spectra. We avoid the brightest FUV line (Lyman alpha) by our choice of grating so our targets are safe for the detector. For all targets we ran the ETC using a flux 2X as strong as expected and with no extinction to ensure that the observations are safe.

For one source, CVSO 90, which is expected to be a strong accretor and therefore be bright in the UV we will still use the G160M grating but with two different wavelength settings, 1577 and 1623, which will allow us to fill in the gaps in the spectrum while still achieving good S/N.

Proposal 13363 - Visit 01 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:17:54 GMT 2013

| Visit         |   | Proposal 13363, Visit 01<br>Diagnostic Status: No Diagnostics<br>Scientific Instruments: COS/NUV, COS/FUV<br>Special Requirements: (none) |                    |  |                         |   |                       |        |   |       |
|---------------|---|---|--------------------|--|-------------------------|---|-----------------------|--------|---|-------|
| Fixed Targets | # | Name  | Target Coordinates | Targ. Coord. Corrections   | Fluxes                  | Miscellaneous   |                       |        |   |       |
|               |   | (1)   | CVSO58             | RA: 05 29 23.2632 (82.3469300d)<br>Dec: -01 25 15.31 (-1.42092d)<br>Equinox: J2000 | Epoch of Position: 2000 | V=14.8  | Reference Frame: ICRS |        |   |       |
| Exposures     | # | Label (ETC Run)   | Target             | Config,Mode,Aperture   | Spectral Els.           | Opt. Params.  | Special Reqs.         | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit |
|               | 1 | (514144)  | (1) CVSO58         | COS/FUV, ACQ/PEAKXD, PSA   | G160M<br>1611 A         |   |                       |        | 77 Secs (77 Secs)<br>[==>]  | [1]   |
|               | 2 | (514144)  | (1) CVSO58         | COS/FUV, ACQ/PEAKD, PSA  | G160M<br>1611 A         | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9             |                       |        | 9 Secs (9 Secs)<br>[==>]  | [1]   |
|               | 3 | (510483)  | (1) CVSO58         | COS/NUV, ACQ/IMAGE, PSA  | MIRRORB                 |   |                       |        | 15 Secs (15 Secs)<br>[==>]  | [1]   |
|               | 4 | (512188)  | (1) CVSO58         | COS/FUV, TIME-TAG, PSA   | G160M<br>1611 A         | BUFFER-TIME=14<br>267;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |                       |        | 1000 Secs (4503 Secs)<br>[==>832.0 Secs (Split 1)]<br>[==>833.0 Secs (Split 2)]<br>[==>1419.0 Secs (Split 3)]<br>[==>1419.0 Secs (Split 4)] | [2]   |



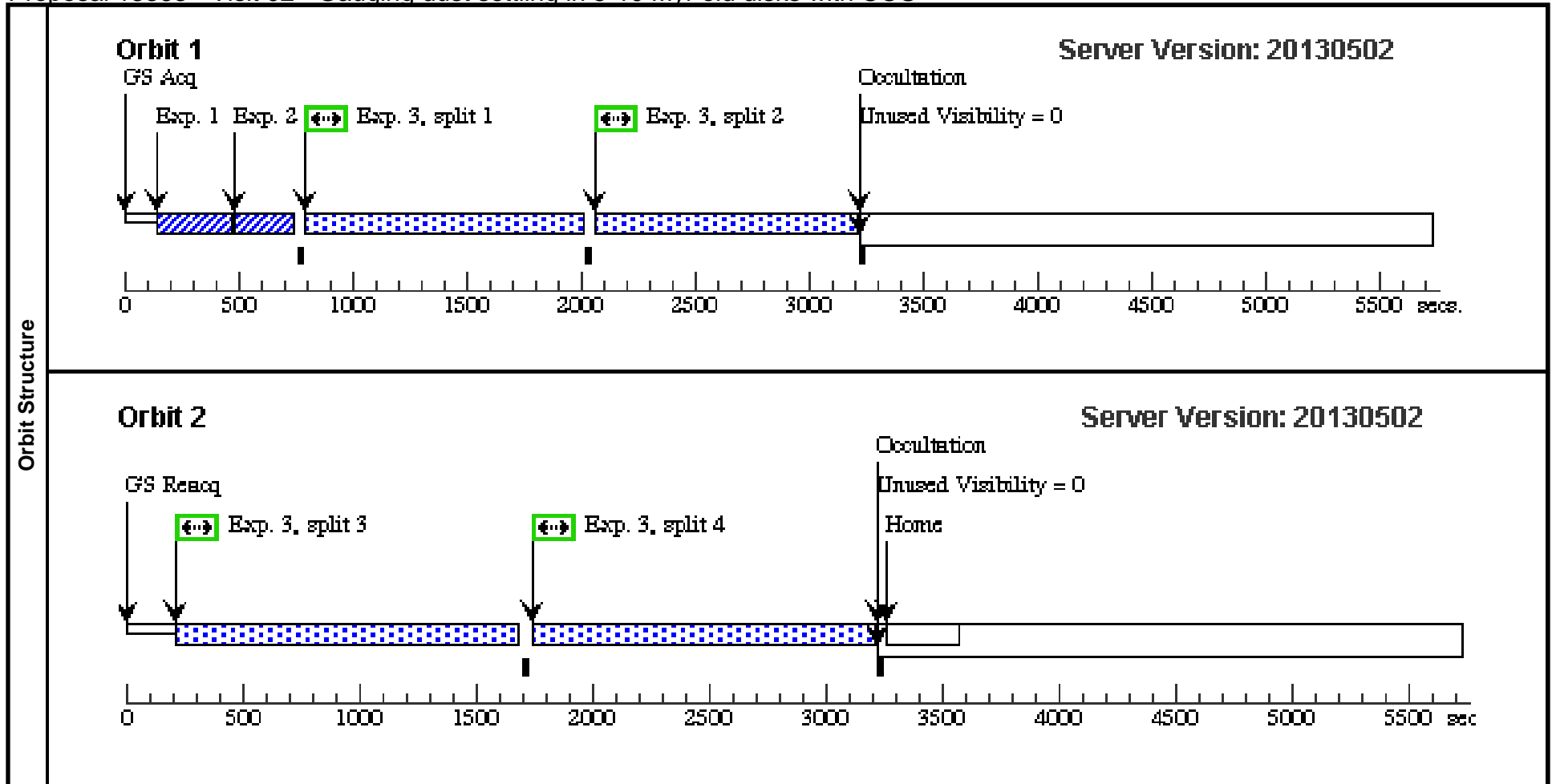
Proposal 13363 - Visit 02 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:17:56 GMT 2013

| Fixed Targets  | # |     | Name    | Target Coordinates  | Targ. Coord. Corrections | Fluxes  | Miscellaneous         |
|--|---|-----|---------|---|--------------------------|---------|-----------------------|
|  |   | (2) | CVSO107 | RA: 05 32 25.7800 (83.1074167d)<br>Dec: -00 36 53.30 (-.61481d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=14.65 | Reference Frame: ICRS |
| <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i> |   |     |         |   |                          |         |                       |

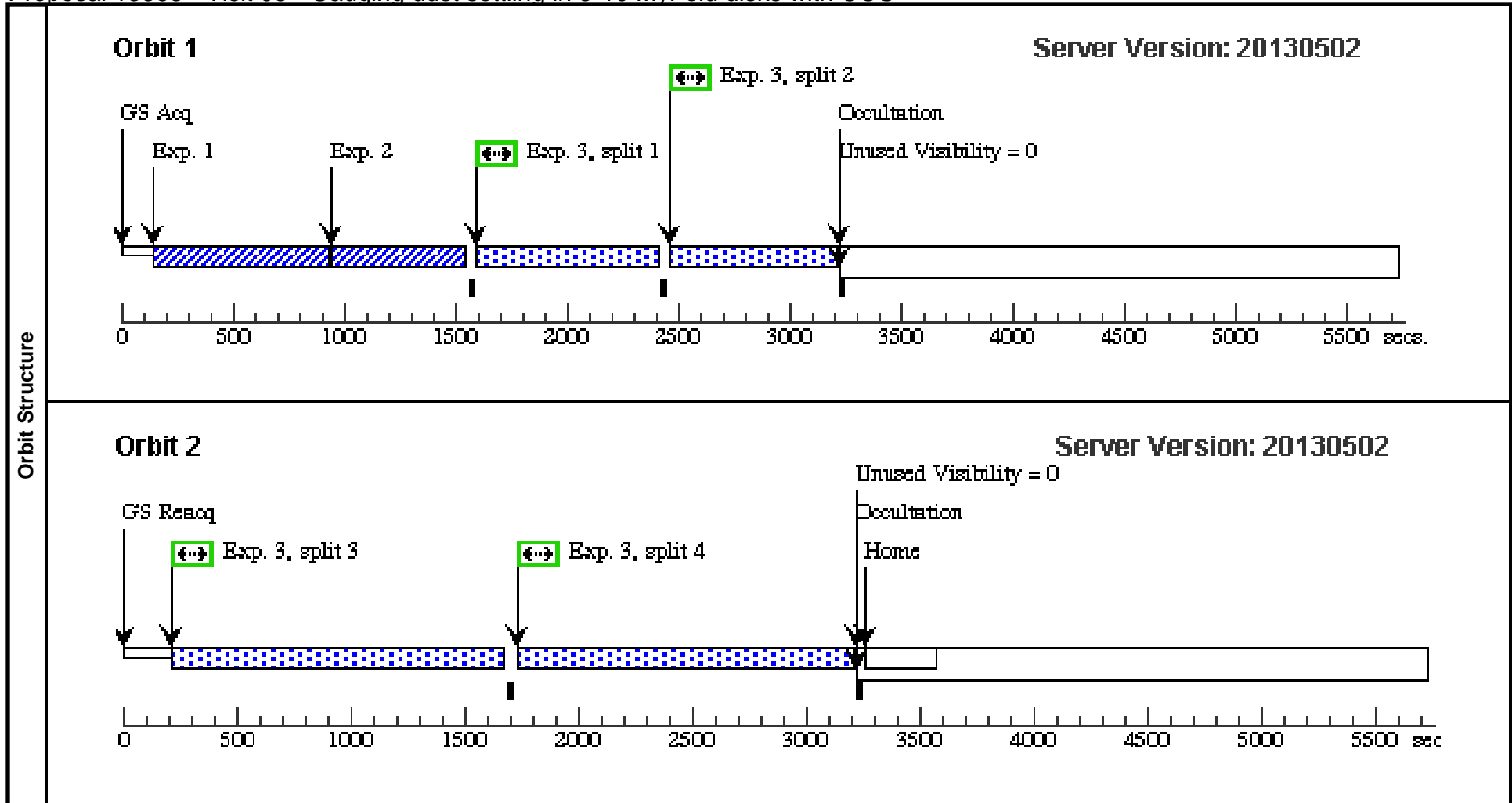
| Exposures | # | Label (ETC Run) | Target      | Config,Mode,Aperture    | Spectral Els.            | Opt. Params.  | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit                        |
|-----------|---|-----------------|-------------|-------------------------|--------------------------|---|---------------|--------|---|------------------------------|
|           |   | 1               | (514172)    | (2) CVSO107             | COS/FUV, ACQ/PEAKXD, PSA | G160M<br>1611 A   |               |        |   | 110 Secs (110 Secs)<br>[==>] |
|           | 2 | (514172)        | (2) CVSO107 | COS/FUV, ACQ/PEAKD, PSA | G160M<br>1611 A          | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9             |               |        | 22 Secs (22 Secs)<br>[==>]  | [1]                          |
|           | 3 | (514184)        | (2) CVSO107 | COS/FUV, TIME-TAG, PSA  | G160M<br>1611 A          | BUFFER-TIME=14<br>267;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (5031 Secs)<br>[==>1096.0 Secs (Split 1)]<br>[==>1097.0 Secs (Split 2)]<br>[==>1419.0 Secs (Split 3)]<br>[==>1419.0 Secs (Split 4)] | [1]<br>[2]                   |



Proposal 13363 - Visit 03 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:17:57 GMT 2013

| Visit     | Proposal 13363, Visit 03<br>Diagnostic Status: No Diagnostics<br>Scientific Instruments: COS/FUV<br>Special Requirements: (none) |                 |  |                          |                          |   |               |        |   |            |
|-----------|--|-----------------|--|--------------------------|--------------------------|---|---------------|--------|---|------------|
|           | Fixed Targets  | #               | Name   | Target Coordinates       | Targ. Coord. Corrections | Fluxes  | Miscellaneous |        |   |            |
|           | (3)  | CVSO109         | RA: 05 32 32.6570 (83.1360708d)<br>Dec: -01 13 46.12 (-1.22948d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=13.89                  | Reference Frame: ICRS   |               |        |   |            |
|           | <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>                         |                 |  |                          |                          |   |               |        |   |            |
| Exposures | #  | Label (ETC Run) | Target   | Config,Mode,Aperture     | Spectral Els.            | Opt. Params.  | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit      |
|           | 1  | (517341)        | (3) CVSO109  | COS/FUV, ACQ/PEAKXD, PSA | G160M<br>1611 A          |   |               |        | 570 Secs (570 Secs)<br>[==>]  | [1]        |
|           | 2  | (517341)        | (3) CVSO109  | COS/FUV, ACQ/PEAKD, PSA  | G160M<br>1611 A          | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9             |               |        | 90 Secs (90 Secs)<br>[==>]  | [1]        |
|           | 3  | (517349)        | (3) CVSO109  | COS/FUV, TIME-TAG, PSA   | G160M<br>1611 A          | BUFFER-TIME=21<br>507;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (4231 Secs)<br>[==>697.0 Secs (Split 1)]<br>[==>696.0 Secs (Split 2)]<br>[==>1410.0 Secs (Split 3)]<br>[==>1428.0 Secs (Split 4)] | [1]<br>[2] |

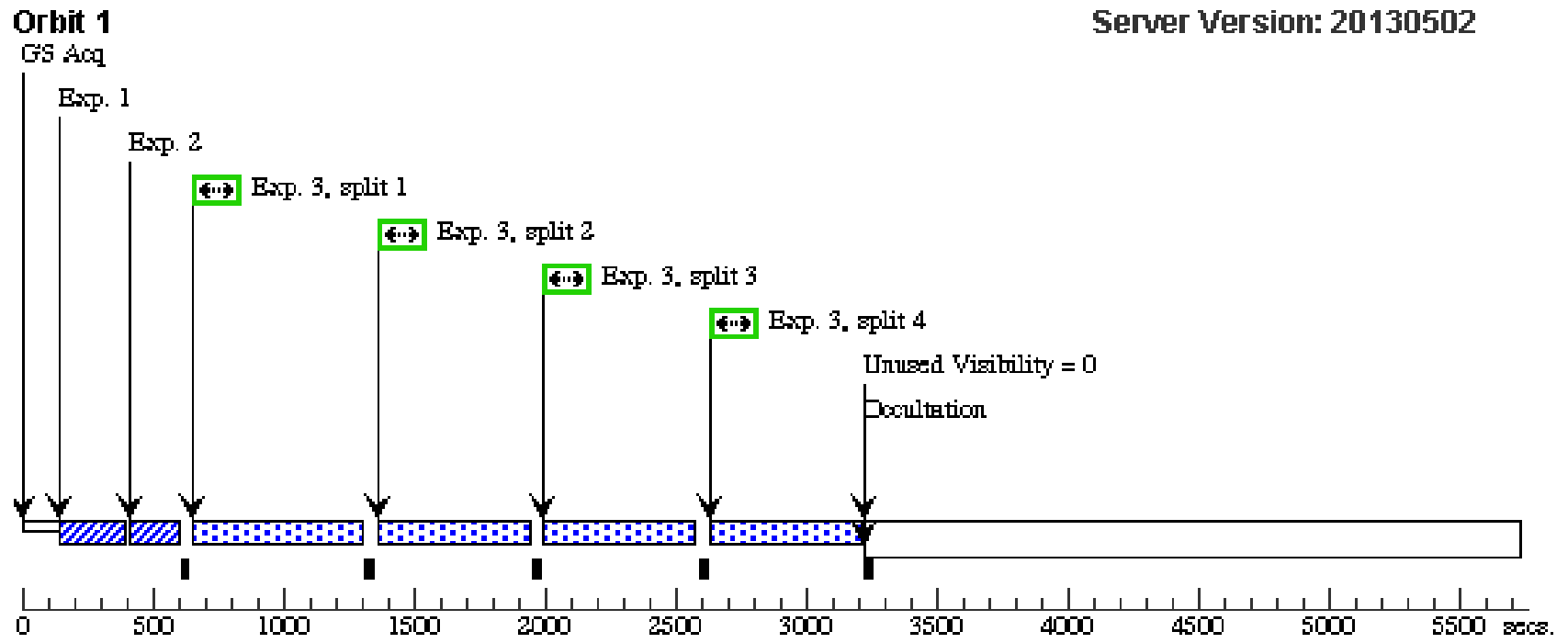


Proposal 13363 - Visit 04 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:17:59 GMT 2013

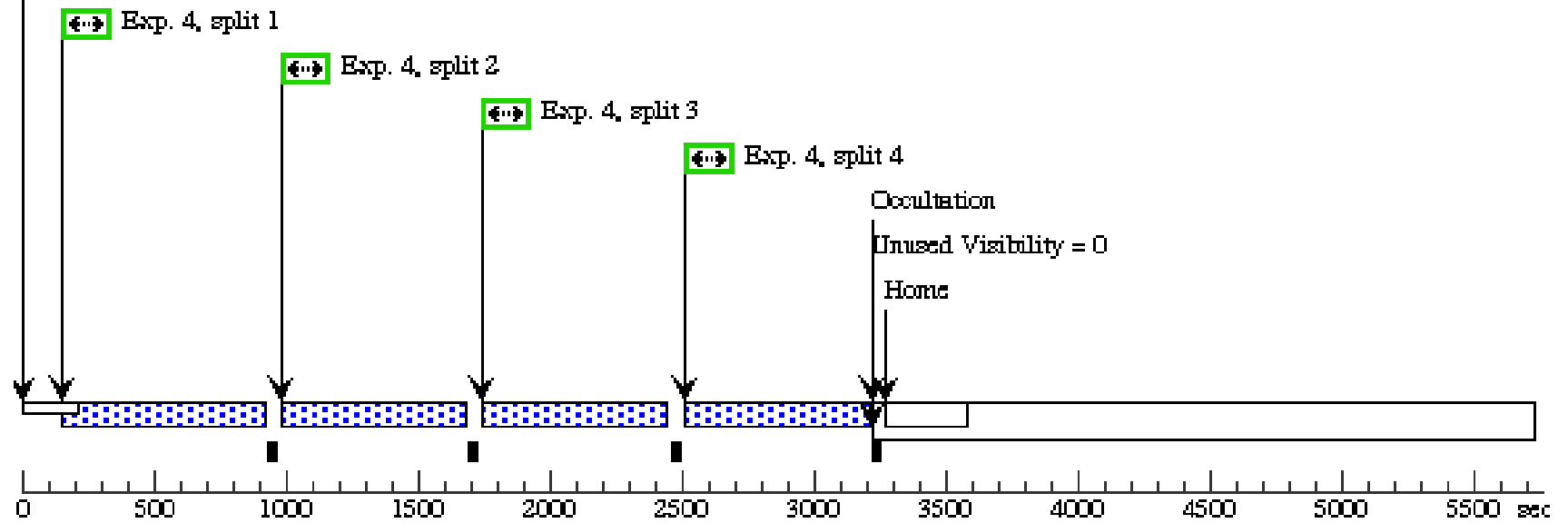
| Fixed Targets | Visit  |                 |   |                          |                 |  |               |        |   |       |  |
|---------------|--|-----------------|---|--------------------------|-----------------|--|---------------|--------|---|-------|--|
|               | #  | Name            | Target Coordinates  | Targ. Coord. Corrections | Fluxes          | Miscellaneous  |               |        |   |       |  |
|               | Proposal 13363, Visit 04<br>Diagnostic Status: No Diagnostics<br>Scientific Instruments: COS/FUV<br>Special Requirements: (none) |                 |   |                          |                 |  |               |        |   |       |  |
|               | (4)  | CVSO90          | RA: 05 31 20.6300 (82.8359583d)<br>Dec: -00 49 19.80 (-.82217d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=14.72         | Reference Frame: ICRS  |               |        |   |       |  |
|               | <i>Comments: This object was generated by the targetselector and retrieved from the SIMBAD database.</i>                         |                 |   |                          |                 |  |               |        |   |       |  |
| Exposures     | #  | Label (ETC Run) | Target  | Config,Mode,Aperture     | Spectral Els.   | Opt. Params.   | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit |  |
|               | 1  | (515273)        | (4) CVSO90  | COS/FUV, ACQ/PEAKXD, PSA | G160M<br>1611 A |  |               |        | 33 Secs (33 Secs)<br>[==>]  | [1]   |  |
|               | 2  | (515273)        | (4) CVSO90  | COS/FUV, ACQ/PEAKD, PSA  | G160M<br>1611 A | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9            |               |        | 8 Secs (8 Secs)<br>[==>]  | [1]   |  |
|               | 3  | (515355)        | (4) CVSO90  | COS/FUV, TIME-TAG, PSA   | G160M<br>1577 A | BUFFER-TIME=26<br>36;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (2098 Secs)<br>[==>526.0 Secs (Split 1)]<br>[==>524.0 Secs (Split 2)]<br>[==>524.0 Secs (Split 3)]<br>[==>524.0 Secs (Split 4)] | [1]   |  |
|               | 4  | (515353)        | (4) CVSO90  | COS/FUV, TIME-TAG, PSA   | G160M<br>1623 A | BUFFER-TIME=29<br>33;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 500 Secs (2598 Secs)<br>[==>649.0 Secs (Split 1)]<br>[==>649.0 Secs (Split 2)]<br>[==>649.0 Secs (Split 3)]<br>[==>651.0 Secs (Split 4)]  | [2]   |  |

Orbit Structure



**Orbit 2**

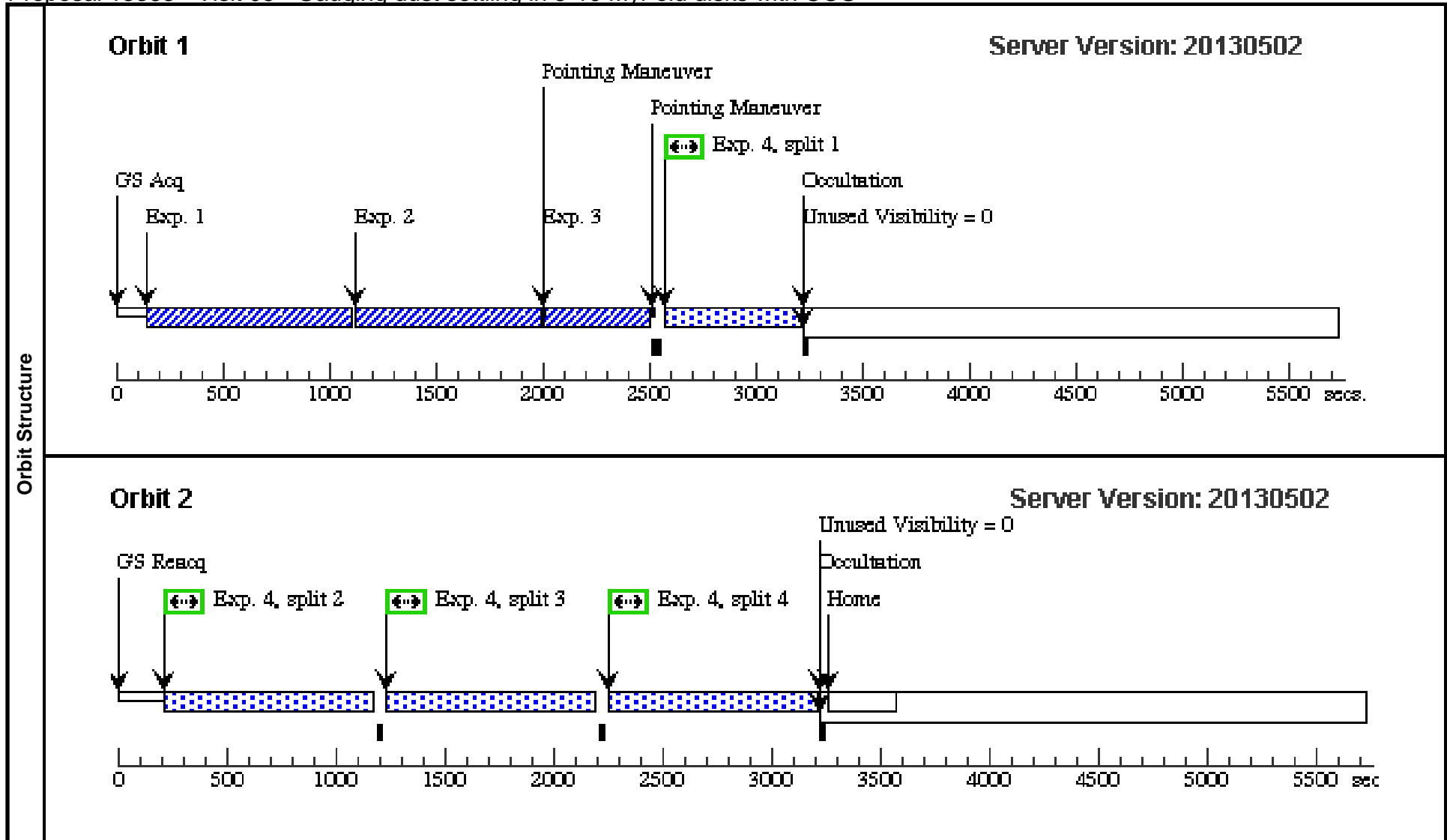
GS Req



Proposal 13363 - Visit 05 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:18:00 GMT 2013

| Visit     | Proposal 13363, Visit 05<br>Diagnostic Status: No Diagnostics<br>Scientific Instruments: COS/NUV, COS/FUV<br>Special Requirements: (none) |                 |   |                          |                          |   |               |        |   |       |
|-----------|---|-----------------|---|--------------------------|--------------------------|---|---------------|--------|---|-------|
|           | Fixed Targets   | #               | Name  | Target Coordinates       | Targ. Coord. Corrections | Fluxes  | Miscellaneous |        |   |       |
|           | (5)   | OB1A776         | RA: 05 24 41.0390 (81.1709958d)<br>Dec: +01 54 38.56 (1.91071d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=14.9                   | Reference Frame: ICRS   |               |        |   |       |
| Exposures | #   | Label (ETC Run) | Target  | Config,Mode,Aperture     | Spectral Els.            | Opt. Params.  | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit |
|           | 1   | (515246)        | (5) OB1A776   | COS/FUV, ACQ/PEAKXD, PSA | G160M<br>1611 A          |   |               |        | 744 Secs (744 Secs)<br>[==>]  | [1]   |
|           | 2   | (515246)        | (5) OB1A776   | COS/FUV, ACQ/PEAKD, PSA  | G160M<br>1611 A          | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9             |               |        | 144 Secs (144 Secs)<br>[==>]  | [1]   |
|           | 3   | (515247)        | (5) OB1A776   | COS/NUV, ACQ/IMAGE, PSA  | MIRRORB                  |   |               |        | 16 Secs (16 Secs)<br>[==>]  | [1]   |
|           | 4   | (515248)        | (5) OB1A776   | COS/FUV, TIME-TAG, PSA   | G160M<br>1611 A          | BUFFER-TIME=18<br>634;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (3159 Secs)<br>[==>426.0 Secs (Split 1)]<br>[==>911.0 Secs (Split 2)]<br>[==>911.0 Secs (Split 3)]<br>[==>911.0 Secs (Split 4)] | [2]   |



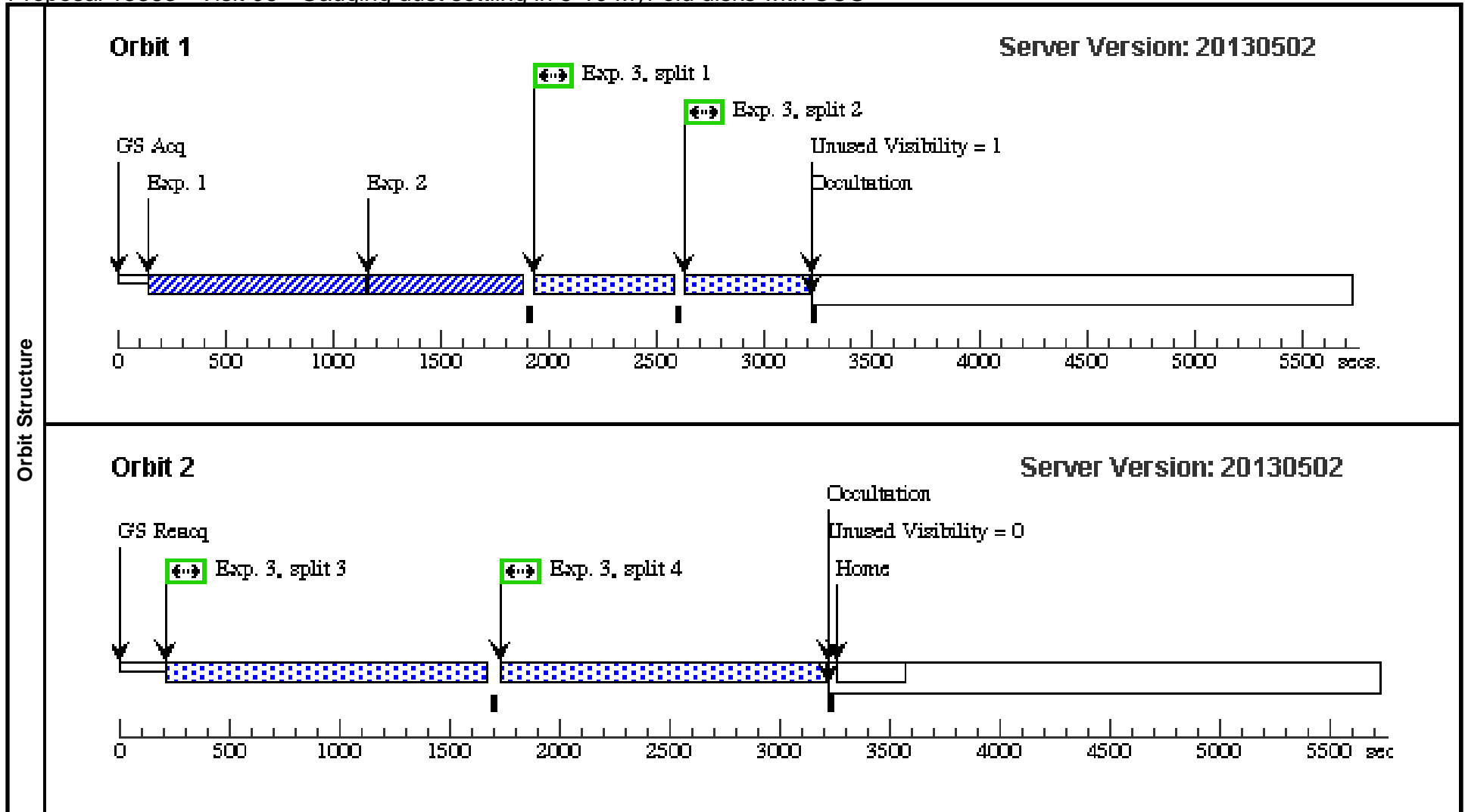
Proposal 13363 - Visit 06 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:18:01 GMT 2013

| Fixed Targets | Visit  |   |                          |        |                       |  |
|---------------|--|---|--------------------------|--------|-----------------------|--|
|               | Proposal 13363, Visit 06<br>Diagnostic Status: No Diagnostics<br>Scientific Instruments: COS/FUV<br>Special Requirements: (none) |   |                          |        |                       |  |
| #             | Name   | Target Coordinates  | Targ. Coord. Corrections | Fluxes | Miscellaneous         |  |
| (6)           | OB1A1192   | RA: 05 25 45.8928 (81.4412200d)<br>Dec: +01 45 50.08 (1.76391d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=14.7 | Reference Frame: ICRS |  |

| Exposures | # | Label (ETC Run) | Target       | Config,Mode,Aperture     | Spectral Els.   | Opt. Params.  | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit      |
|-----------|---|-----------------|--------------|--------------------------|-----------------|---|---------------|--------|---|------------|
|           | 1 | (517546)        | (6) OB1A1192 | COS/FUV, ACQ/PEAKXD, PSA | G160M<br>1611 A |   |               |        | 790 Secs (790 Secs)<br>[==>]  | [1]        |
|           | 2 | (517546)        | (6) OB1A1192 | COS/FUV, ACQ/PEAKD, PSA  | G160M<br>1611 A | CENTER=FLUX-W<br>T-FLR;<br>NUM-POS=5;<br>SEGMENT=BOTH;<br>STEP-SIZE=0.9             |               |        | 114 Secs (114 Secs)<br>[==>]  | [1]        |
|           | 3 | (517562)        | (6) OB1A1192 | COS/FUV, TIME-TAG, PSA   | G160M<br>1611 A | BUFFER-TIME=19<br>085;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (3890 Secs)<br>[==>526.0 Secs (Split 1)]<br>[==>526.0 Secs (Split 2)]<br>[==>1410.0 Secs (Split 3)]<br>[==>1428.0 Secs (Split 4)] | [1]<br>[2] |



Proposal 13363 - Visit 07 - Gauging dust settling in 5-10 Myr old disks with COS

Thu Jul 11 21:18:02 GMT 2013

| Fixed Targets | #   |  | Name     | Target Coordinates  | Targ. Coord. Corrections | Fluxes | Miscellaneous         |  |  |
|---------------|-----|--|----------|---|--------------------------|--------|-----------------------|--|--|
|               | (7) |  | OB1A1630 | RA: 05 26 55.3752 (81.7307300d)<br>Dec: +01 40 22.48 (1.67291d)<br>Equinox: J2000 | Epoch of Position: 2000  | V=15.5 | Reference Frame: ICRS |  |  |

| Exposures | # | Label (ETC Run) | Target       | Config,Mode,Aperture     | Spectral Els.   | Opt. Params.  | Special Reqs. | Groups | Exp. Time (Total)/[Actual Dur.]   | Orbit |
|-----------|---|-----------------|--------------|--------------------------|-----------------|---|---------------|--------|---|-------|
|           | 1 | (515367)        | (7) OB1A1630 | COS/NUV, ACQ/SEARCH, PSA | MIRRORB         | CENTER=FLUX-W<br>T-FLR;<br>SCAN-SIZE=3;<br>STEP-SIZE=1.767                          |               |        | 186 Secs (186 Secs)<br>[==>]  | [1]   |
|           | 2 | (515367)        | (7) OB1A1630 | COS/NUV, ACQ/IMAGE, PSA  | MIRRORB         |   |               |        | 186 Secs (186 Secs)<br>[==>]  | [1]   |
|           | 3 | (515370)        | (7) OB1A1630 | COS/FUV, TIME-TAG, PSA   | G160M<br>1611 A | BUFFER-TIME=21<br>984;<br>EXTENDED=NO;<br>FLASH=YES;<br>FP-POS=ALL;<br>SEGMENT=BOTH |               |        | 1000 Secs (2866 Secs)<br>[==>133.0 Secs (Split 1)]<br>[==>911.0 Secs (Split 2)]<br>[==>911.0 Secs (Split 3)]<br>[==>911.0 Secs (Split 4)] | [2]   |

