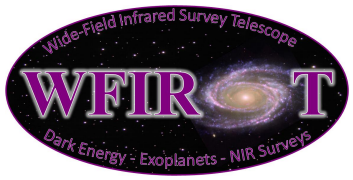

Galactic Bulge Time On Target

May 10 2011

Viewing Time of the Galactic Bulge

- These charts examine the compatibility of a 500 day microlensing program with a 6 month SNe observing program (distributed over ~1.8 calendar years) within a 5 year mission period.

- There is a rich mission science and engineering trade space for accommodating the WFIRST science investigations and creating a robust observing program that provides flexible operations concepts.

- It may be that the SNe investigation would prefer its observing time to be spread over ~2 years, with a 30-hour observing period scheduled every 5th day.

- These charts do not provide a definitive analysis of observing time. They provide an informal assessment of the potential for extending the ops concept of the JDEM Omega template for the WFIRST DRM in a cost-neutral fashion.

Microlensing – Sne Observations Point Design

- Assumptions for these charts:
  - The 500 day microlensing program is carried out over seven viewing seasons of the galactic bulge consisting of 72 continuous days each. This will be carried out over ~500 days out of ~3.2 years of the mission in combination with other non-SNe programs.
  - The SNe program is carried out in parallel with a ~1.8 year period of the mission.

- The JDEM Omega observatory that is the template for WFIRST observatory was not designed with microlensing observations as part of the operations concept or requirements.

- Among the considerations that limit the duration of the JDEM observatory's observation of the galactic bulge are:
  - Stray Light
  - Observatory Electric Power
  - Observatory Thermal Control

- Prospects for each of these to support a 72 day observing season of the galactic bulge for the WFIRST DRM are examined on the following charts

Stray Light

- The off-axis unobscured telescope geometry under development for WFIRST offers some advantages with regard to stray light control relative to the on axis obscured telescope design.

- It has also been indicated that microlensing observations can tolerate more stray light than dark energy observations.

➢ The unobscured design may present a design space with enough room to pursue an observatory pitch angle of 36 degrees toward the sun.

  – This could potentially provide a basis for a 72 day season of pointing at the Galactic bulge from a stray light standpoint.

- Engineering design and analysis are necessary to validate this concept.

- Detailed stray light analysis would routinely be categorized as Phase A design work. Roughly a third of an FTE by a specialist would be necessary to validate the design when the payload reaches an appropriate level of maturity.

- A first order analysis will be performed in the upcoming interim WFIRST DRM design cycle.

- <u>Considerations</u>
- The telescope barrel or scarf would need to grow while being compatible with the launch vehicle fairing constraints.

- A larger barrel or scarf will entail a mass increase that will need to be reconciled against the lower mass to orbit margin of the Falcon 9 launch vehicle relative to the Atlas V.

Observatory Electrical Power

- In order to sustain viewing of the galactic bulge for 72 days, additional margin in the solar array power needs to be created or identified.

- A capability for supporting +/- 36 degree pitch away from the sun would validate a 72 day viewing season from an electrical power standpoint.

- The JDEM Omega Ops concept calls for allowing a 10 degree tilt away from the ecliptic poles while also sustaining a 45 degree roll away from a maximum power solar angle. However, the ecliptic latitude of the Galactic Center is very low.

- If the microlensing observing ops concept can be performed without the 45 degree roll requirement, that should enable the capability for the solar arrays to sustain a 36 degree pitch away from the sun. This will affect the degrees of freedom of placing the orientation of the FOV on the Galactic Bulge.

Liens

- Update to WFIRST DRM solar array configuration with the unobscured telescope packaged to fit inside the launch vehicle fairing.

- Validate that the microlensing program can be performed with no significant roll off of the maximum power angle.

Observatory Thermal Control

- JDEM Omega Observatory was designed for the thermal environment associated with the dark energy science pointing envelope.

- The microlensing pointing envelope is different from the dark energy pointing envelope, so thermal modeling needs to be performed to determine the impacts that the microlensing envelope has on the design.

- No show stopping issues are known of at this time, and the Project is optimistic a thermal design solution can be found that will allow a 72 day microlensing viewing season.

- The upcoming design cycle on the Interim WFIRST DRM will provide an opportunity to validate the thermal design for pointing at the Galactic bulge for 72 days.

Conclusions

- The WFIRST DRM has good prospects for being able to support a point design for 72 day observing seasons of the galactic bulge.
- Engineering analysis and modeling in the coming design cycle for the Interim WFIRST DRM should increase confidence in this.
- A good deal more development of the flexibility of the mission operations concept is necessary to mature the design of a low risk mission.
- This will require the development of a good deal more insight into the interplay of the science and engineering requirements.