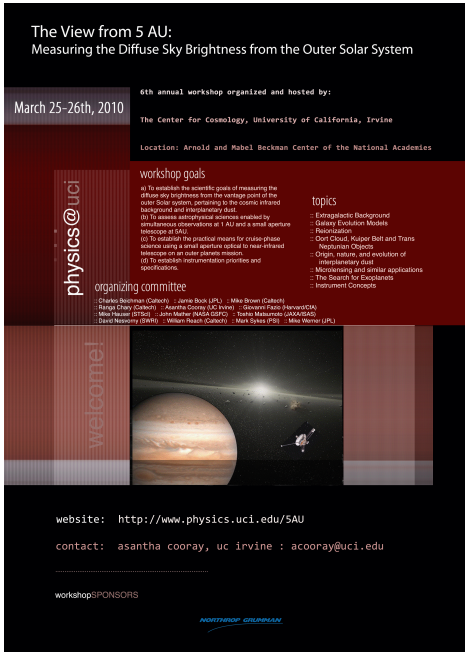
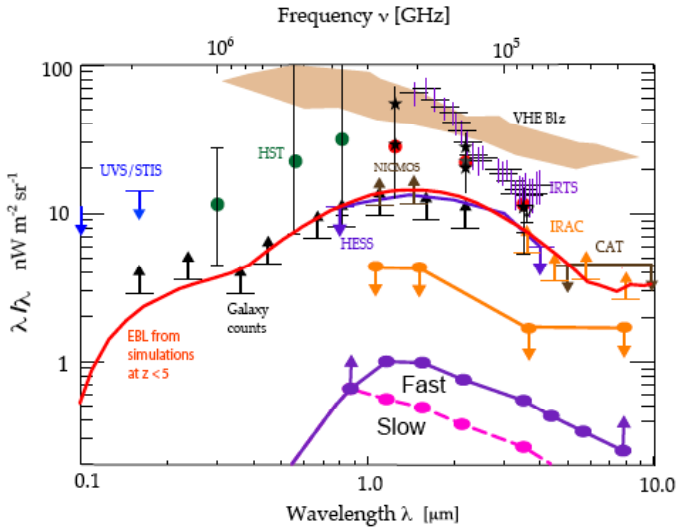
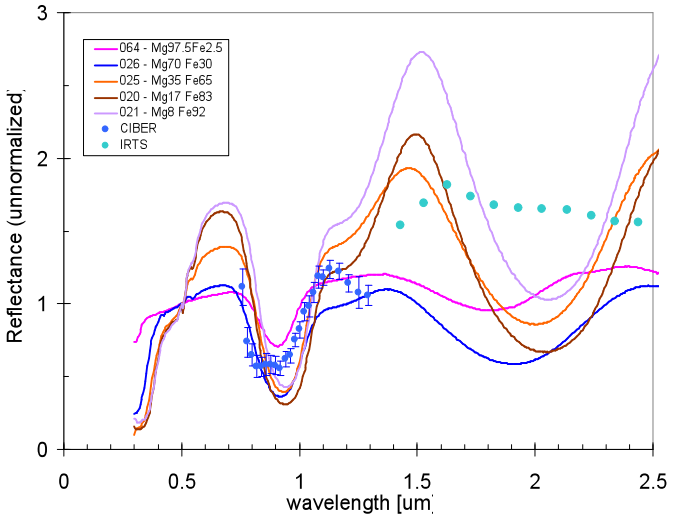




View from 5 AU

Final Discussion

Michael Hauser, STScI
Michael Werner, JPL



Questions for Final Discussion

- What is the desired long term objective we are working towards?
- How can we build support and interest in the astronomy and planetary communities to help achieve that objective?
- Should we pursue a dedicated mission to achieve both the astronomy and planetary science goals?
- Are there programmatic, scientific, or technical currents within the “new” NASA which we ought to catch on to?

Programmatic Questions - I

1. **Desired long term objectives?**
   - **Solar System/ExoPlanet**
     - **Nature/Distribution/Origin of dust in Solar System HZ**
     - **Comet debris vs. asteroid debris –f(R); Size and Composition of dust – f(R)**
     - **Influence of planets on distribution of dust (Jupiter resonances)**
   - **Astrophysics**
     - **Measurement of EBL**
2. **Support in planetary and astrophysics communities?**
   - **Convey criticality to fundamental questions**
   - **Convince there are NO other ways to get the data**
     - **Developing convincing model of instrument[s] performance**
   - **Set up informal web site/list serv to stay in contact**
     - **Usual presentations to AAS; post talks on the web; attend appropriate conferences, etc.**
     - **Informal gatherings/telecons as needed**

- **Don't forget foreign partnerships**
- **Can we link up with EJSM [May workshop]?**

Programmatic Questions - II

3. Visibility at NASA?

- Work closely with Dan Coulter and the ExoPAG
  - Give reports to, or get on agendas of, Solar System PAGs – [Outer planets and Small Bodies]
  - Report to Jon Morse
  - May help us get out of "catch up ball" mode
- Can we can ride the currents of "new NASA"
  - E.g. new RTB's, orbits, etc. which might enable small dedicated 5 AU mission

4. Dedicated mission or piggyback?

- Options:
  - Dedicated mission = Been there, haven't done that. Try again?
  - Hitch a ride with Discovery/New Frontiers/Flagship – hard to arrange a posteriori
  - Form an alliance with Discovery/New Frontiers team – make it a joint zodi cloud/planetary encounter mission
  - "Repurpose" retiring solar system mission* – is 5 au necessary?
- Useful to understand whether same instrument can serve planetary encounter and cruise phase needs
  - *e.g. Epoxi, Target of Opportunity

Session 1: EBL Science Key Questions

- 1. Can galaxy formation and evolution models be constrained with a precise measurement of the EBL spectrum?
- 2. What is the fractional EBL spectrum from sources and cosmologically important diffuse forms of radiation present during reionization?
- 3. With source counts from deep fields with JWST and other large aperture telescopes, can we resolve the EBL from all sources below a certain redshift?
- 4. What are the other astrophysical applications of a small instrument at 5 AU (microlensing, transients)?

EBL Science

- **1. Can galaxy formation and evolution models be constrained with a precise measurement of the EBL spectrum?**

- **2. What is the fractional EBL spectrum from sources and cosmologically important diffuse forms of radiation present during reionization?**

- **1. Yes, but it's very hard to get it! There are possibly more important model parameters than there are things to measure in the EBL, so the EBL measurements are not enough by themselves. JWST data will also be helpful with constraining the simulations even if some sources are too faint even for JWST.**
  2. We don't know yet, but the spectrum could be helpful if it shows sharp features, and shows a sharp UV cutoff to give a redshift. The total relates to the integrated SFR. Bumps in the EBL spectrum could signify particle decay, though much of that is supposed to decay almost instantaneously after the Big Bang. The summary chart shows minimal models based on reionization but these curves are way below the current measurements. So at the moment we can't answer the question about the multiple sources of diffuse radiation.

EBL Science (2)

- **3. With source counts from deep fields with JWST and other large aperture telescopes, can we resolve the EBL from all sources below a certain redshift?**

- **4. What are the other astrophysical applications of a small instrument at 5AU? (microlensing, transients)?**

- **3. From Cooray models: No. Even JWST is not likely to see deep enough because apparently many sources will be very faint. At the recent 'First Stars and Galaxies' conference, it was predicted that the typical first galaxy would have a flux of 0.25 nJy, well below the advertised 10 sigma sensitivity of the JWST.**

Chary Session Summary

- **** Gould**
  Sampling stellar light curves once a week is a useful tool for detecting exoplanets at separations/masses parameter space which is different from radial velocity - see imprint of exoplanet signatures in the light curve. Will require observations in the Galactic plane which is mutually exclusive from high latitude diffuse emission study.
  **** Henry**
  What is the origin of the UV emission of ~300 units intensity seen by Voyager ? Clearly correlated with the Galaxy. Why is there a plunge shortward of Lyman-alpha (Holberg effect).
  ****Windhorst**
  Faint end slope of galaxy LF is a useful tracer of feedback mechanisms.
  By stacking, find evidence for disky profiles for dwarfs which can increase the total IGL.

  Lots of straylight and flat fielding issues at the faintest flux densities. Also sources which appear in the wings of brighter sources which may or may not be real but can bias your LF towards steeper faint end slopes.
  ****Beauchamp**
  OPAG supports JEO as a flagship. Titan-Cassini could follow. LIFE is a Enceladus sample return mission which will be proposed for 2015 launch. Opportunities for both NIR and MIR imager/spectrometers.

Session 2: Planetary Science Key Questions

- 1. What is the origin of interplanetary dust in the outer solar system?

  2. How does interplanetary dust interact with the outer planets?

  3. What is the composition of inner and outer solar system material?

  4. How does the solar system dust cloud relate to exoplanetary systems?

Planetary Science

- **Brown:**
  * Kuiper Belt dynamics exceptionally messy; can measuring dust production give meaningful input?
  * if we need to "throw away" current knowledge about collisional models for KBOs, how will it ever be possible to tie observations of dust back to the parent bodies?

  Dermott:
  * based on Lisse's question: is there a prediction of significant density in the Jovian trojan points that could be important as a zody signal (conversele, to be avoided for background experiments)?

  Nesvorny:
  * imaging requirements: latitude profiles are diagnostic of parent populations, how much unique imaging data is required (just one profile?)?

  Murray-Clay:
  * mentioned 3 relevant design issues, i got one for sure:
  * we should measure dust properties versus latitude, because sample different parent populations in the Kuiper Belt

- **Beichman:**
  * getting NASA to care about our project: site survey at 5 AU, understanding local zody as template for exo-zody

  Greaves, Wyatt:
  * solar system is exceptionally un-dusty (lowest 10th percentile); so how representative would our studies be in order to make inferences about other disks?

  Messenger:
  * listed possible goals and processes for outer solar system dust, including:
  * try to measure change in dust propertues (aqueous alteration, crystallinity)
  * serach for distinct populations of dust, tracing compositional diversity in the Kuiper Belt

  Lisse:
  * mineralogy studies refer to small grains where features prominent, including solar system and debris disks. other systems are templates for ours "if the solar system zodiacal light has small grains, which it doesn't"....how can we make direct analogies if the sizes of particles are so different?

Session 3: Instrument Design Drivers Key Questions

- 1. What instrument parameters are needed to remove foregrounds? e.g., spatial resolution (aperture), Fraunhofer line spectrometer?
- 2. What are the instrument parameters most useful for planetary science, e.g., how much spectral information for composition studies, spatial resolution, wide-field, thermal infrared imaging?
- 3. What cadence of observations during cruise is needed for understanding the dust cloud?
- 4. What is the potential of a planetary instrument making these measurements?