

INTERSTELLAR PROBE: EXPLOITING THE DARK SKY

Presented to KISS Workshop

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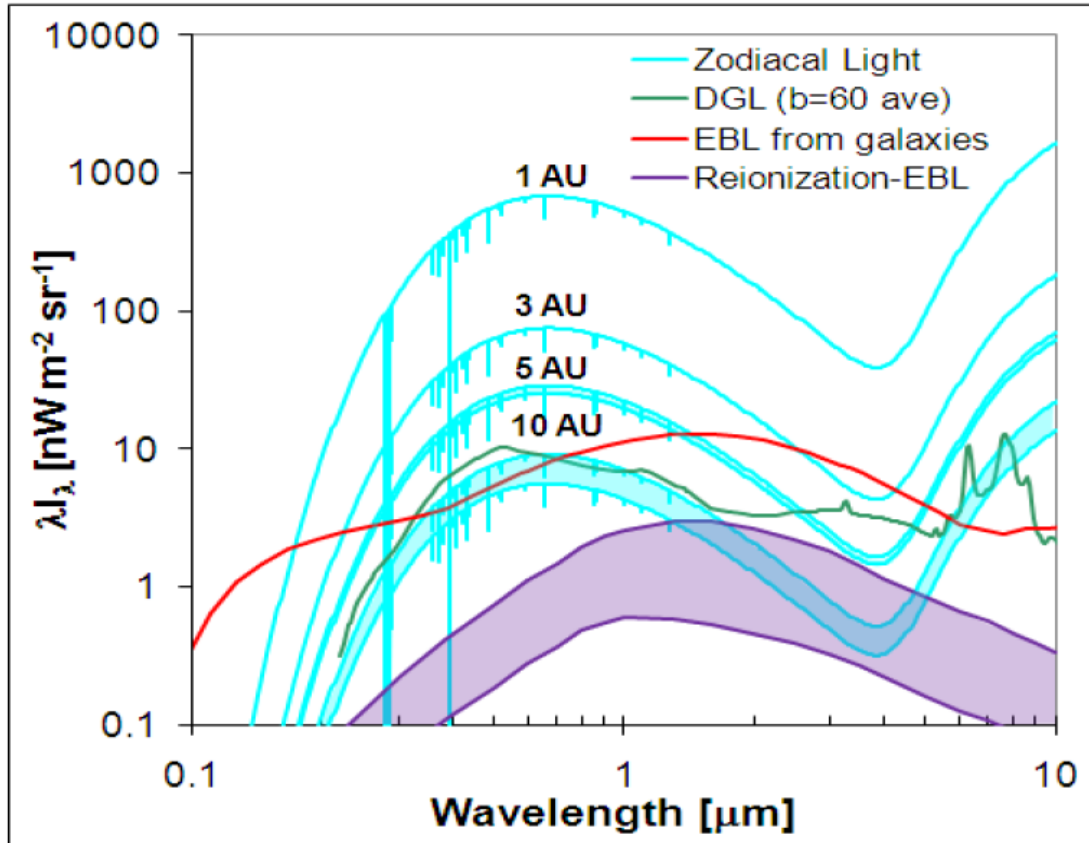
JPL/Caltech

13 January 2015

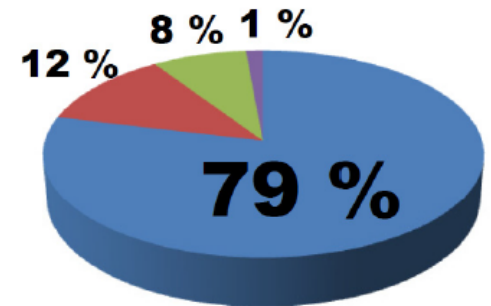
Exploiting the Dark Sky

- At the orbit of Saturn and beyond, the brightness of the zodiacal light from ~ 1 -to- $5\mu\text{m}$ is predicted to drop by $>100\times$
- Enables much more sensitive studies in the near infrared than is possible from ~ 1 au
 - Sky brightness dominated by extragalactic background light
 - May be able to tease out signature of reionization at $z\sim 10$, a subject of intense cosmological interest
 - Observe scattered light from Kuiper Belt dust for comparison with exoplanet systems
- Does not require large telescope; radiative cooling more than adequate

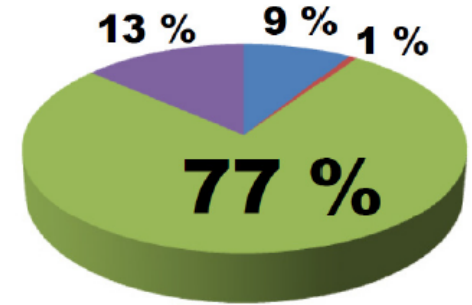
Surveying the Sky at 10au



■ Zodi ■ Stars ■ DGL ■ EBL



DIRBE Sky at 1 AU



ZEBRA Sky at 10 AU

Data supplied by Jamie Bock, Principal Investigator of ZEBRA mission concept proposed as Explorer Mission of Opportunity

Possible Implementations

As an example, ZEBRA instrument came in two flavors:

1. Each uses H2RG JWST-developed HgCdTe array
2. Each uses radiative cooling to $T \sim 50\text{K}$

Sensitivity and Operations: ZEBRA was to complete observations in 180 days out of a ~ 9 yr mission, observing periodically at different radial positions. High signal/noise achieved in observations only one hour in duration.

ZEBRA-lite

3 cm telescope

9 kg, 12 watts

Volume = $.5\text{m}^3$

Extragalactic, Zodi, Kuiper
Belt Science

ZEBRA-max

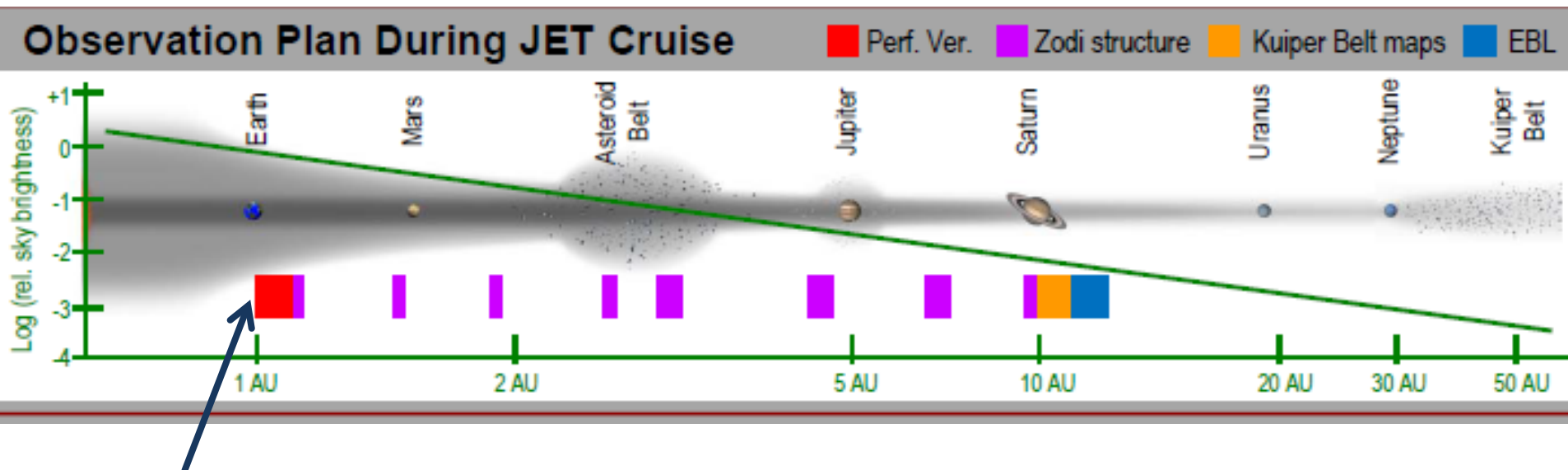
Adds 15 cm telescope

16kg, 12 watts

Volume = 1.1m^3

Adds Epoch of
Reionization Science

Observation Scenario



Scenario above proposed when ZEBRA was piggybacking on outer Solar System mission. The approach used for the interstellar explorer might be somewhat different, perhaps adding additional observations beyond Saturn

Conclusions

- Low sky brightness of outer solar system enables truly exciting studies of vis-ir backgrounds
- Studies of diffuse emission do not require large apertures
- Proof of concept for modest-sized instrument in hand based on ZEBRA study
 - Could be implemented as part of a general purpose imaging capability
 - Smaller version[s] might be developed in context of the present study
- Recommend including this capability in further studies with implementation mode TBD