EPOXI (EPOCh)

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History

Origin of EPOXI
(I’ll explain the funny name)
EPOXI transit science
What systems we will observe
How we can achieve high S/N
Opportunities for participation
Announcement of Opportunity for NASA’s Discovery program (April, 2005):

“Under this AO, a science investigation that uses an existing NASA space asset, such as the Deep Impact and Stardust spacecraft, may be proposed as an mission of opportunity..”
Extrasolar Planet Observations and Characterization (EPOCh)

Deep Impact eXtended Investigation (DIXI)

EPOXI = EPOCh + DIXI

M. A’Hearn (UMD) is EPOXI P.I.
Phase-2 selection, July 2007
The EPOCh Science Team

Drake Deming (GSFC), EPOCh Principal Investigator
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Joseph Veverka (Cornell)
Dennis Wellnitz (UMD)
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Jeffrey Pedelty (GSFC)
EPOCh Transit Science

- Photometry using Deep Impact’s 30-cm telescope, 350-950 nm band
- Image de-focus & heliocentric orbit facilitate high precision
- 51 arcsec FOV - 128 x 128 subarray

Observations Jan - May, 2008

Giant planet transiting systems, bright, and mainly not targeted by Kepler
- Reflected light at secondary eclipse
- Search for rings and moons
- Direct search for transits of terrestrial planets
- *Transit timing search* for terrestrial planets
Searching for terrestrial planet transits...

EPOCh searches planetary systems *already known to have giant planets*, with edge-on orbital planes

...theory predicts terrestrial planets trapped in low order mean motion resonances
Another way to detect small planets

Giant planet transit timing provides an indirect search for terrestrial planets - including ones that do not transit
What systems EPOCh will observe...

Three bright (V<13) systems
Update of targets was anticipated
Original (Phase-2) targets (& comment):

- XO-1 (deep transit)
- TrES-2 (in Kepler field)
- HD 189733 (bright)

Updates:

- HD 189733 is dropped
- possible additions: GJ 436, TrES-3, TrES-4, XO-2, etc.
We project 80% of photon-limited S/N

- No specific photometric test during the prime mission
- Heliocentric orbit and defocus help a lot
- One quasi-time series shows photon-limited Gaussian noise
- Principal source of non-photon errors are energetic particles
- There is an on-board stim lamp to monitor flat-fielding
Flat-fielding calibration

- Precision ~ 32 ppm by ground flats
  - Stability monitored by the stim lamp
- Final corrections using the data:
  - ~160,000 images total, ~1600 per spatial position
  - ~1 ppm final corrected flat field precision
  - Any changes are likely to be spatially broad
Star spot correction
Star spots can affect transit timing

A numerical transit-across-spot simulation
Correcting for star spots

spot at the limb is foreshortened

scaling the spot closer to disk center removes the limb spot to within the photon noise
Opportunities for participation

No participating scientist program, but:
  data will be public quickly
  Discovery DAP should provide funding

We are hiring a postdoc
  (at CfA w/Charbonneau)