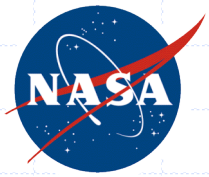
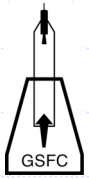


EPOXI

EPOXI (EPOCh)

Drake Deming
Planetary Systems Laboratory
Goddard Space Flight Center



JPL

Ball

EPOXI

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

EPOXI

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.."

EPOXI

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

EPOXI

The EPOCh Science Team

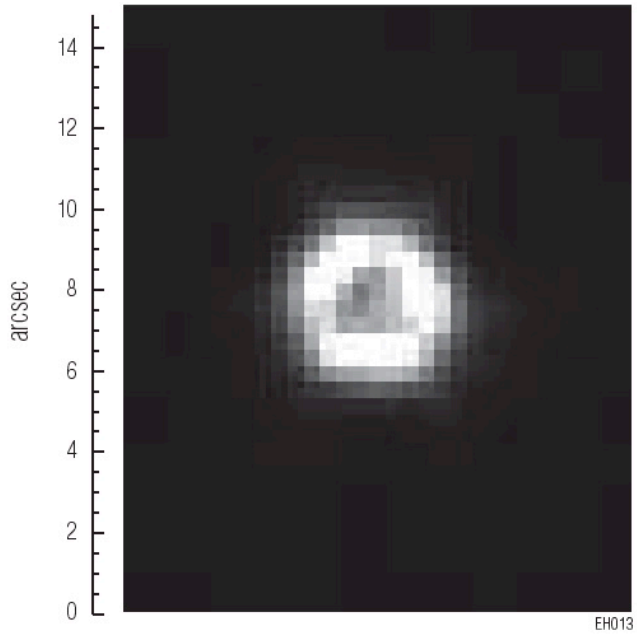
Drake Deming (GSFC), EPOCh Principal Investigator
David Charbonneau (Harvard), Deputy P.I.

Don Hampton (U. Alaska)
Tilak Hewagama (UMD)
Matt Holman (SAO)
Marc Kuchner (GSFC)
Timothy Livengood (NCESSE)
Vikki Meadows (U. Wash)

Alfred Schultz (GSFC)
Sara Seager (M.I.T.)
Joseph Veverka (Cornell)
Dennis Wellnitz (UMD)
Carey Lisse (APL)
Jeffrey Pedelty (GSFC)

EPOCh Transit Science

EPOXI

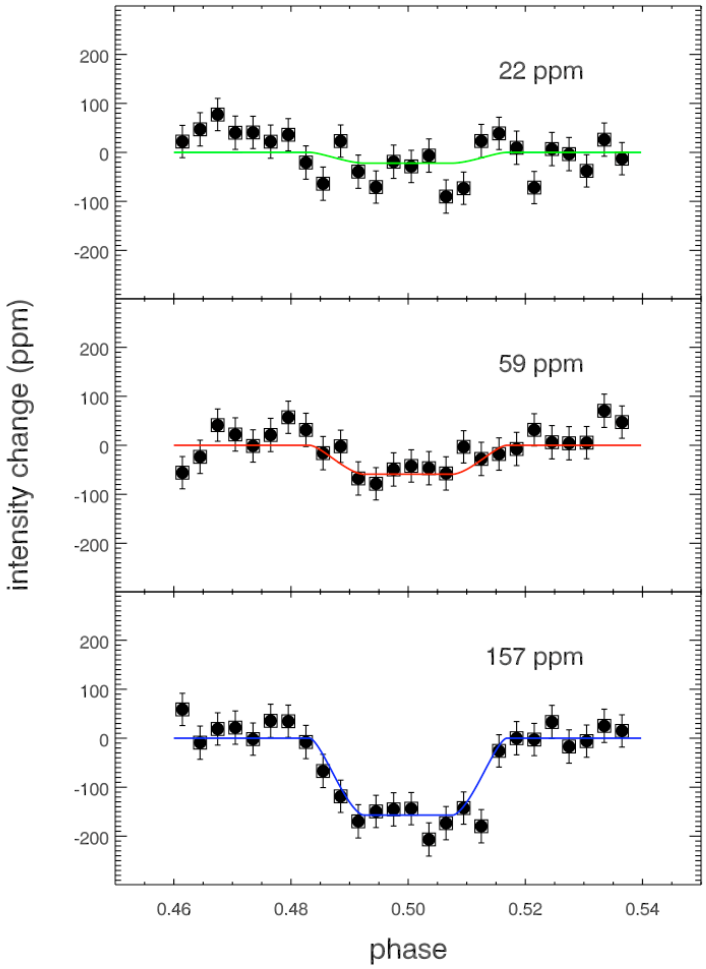


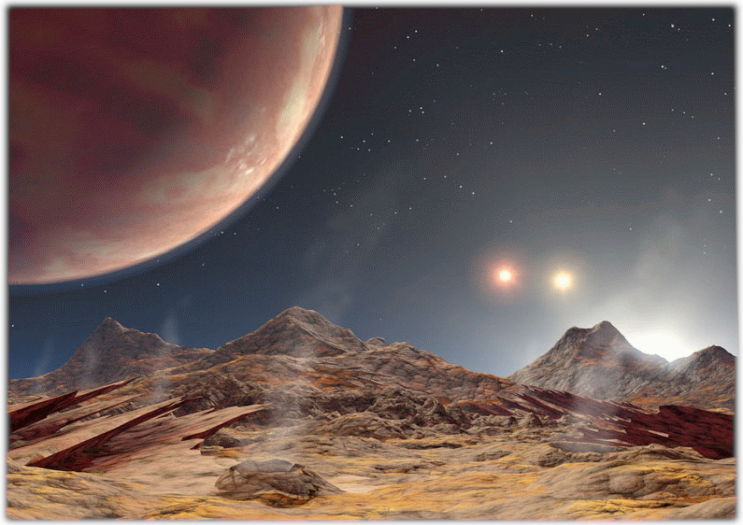
- Photometry using Deep Impact's 30-cm telescope, 350-950 nm band
- Image de-focus & heliocentric orbit facilitate high precision
- 51 arcsec FOV - 128 x 128 subarray

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...

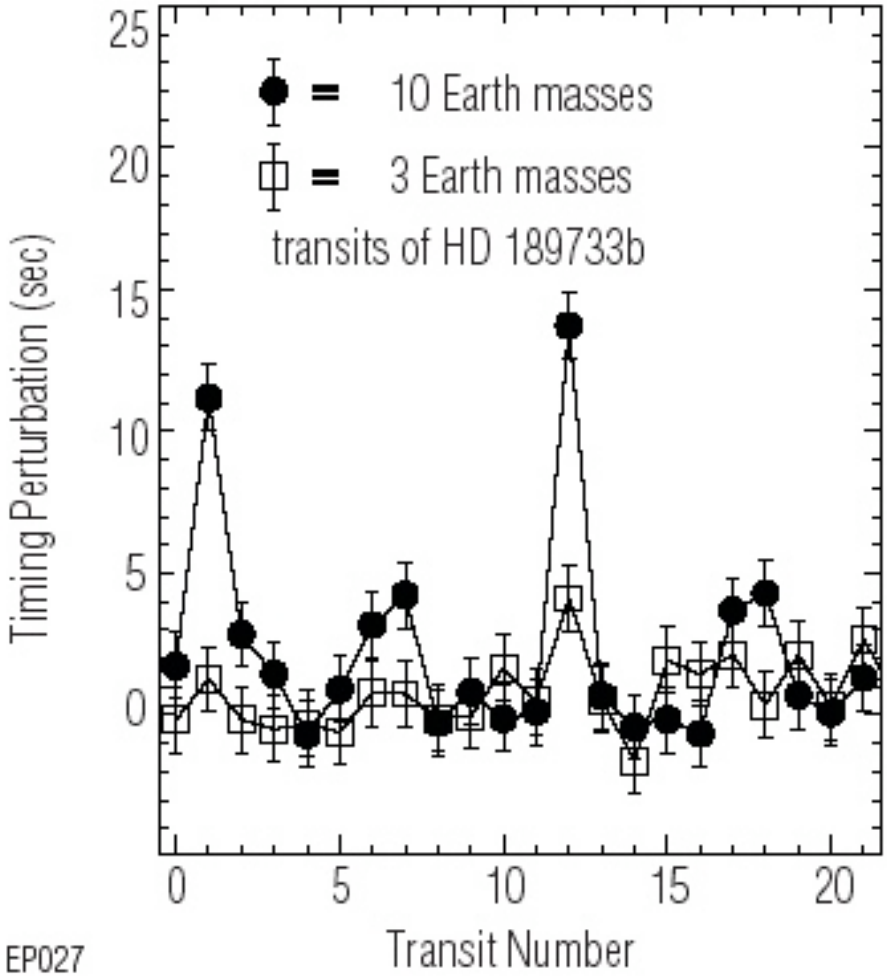




EPOCh searches planetary systems *already known to have giant planets*, with edge-on orbital planes

...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...

EPOXI

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

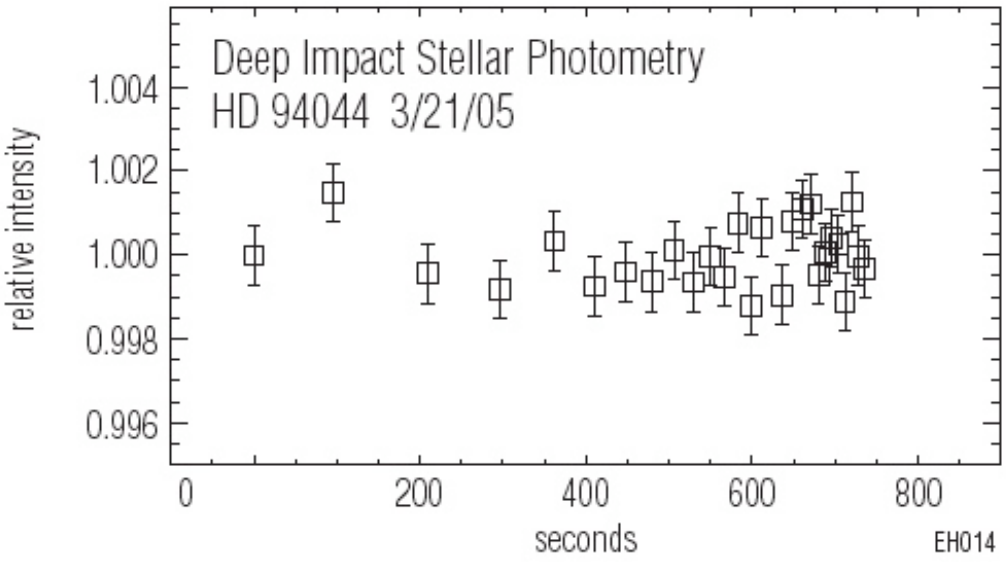
XO-1	(deep transit)
TrES-2	(in Kepler field)
HD 189733	(bright)

Updates:

HD 189733 is dropped
possible additions:
GJ 436, TrES-3, TrES-4, XO-2, etc.

We project 80% of photon-limited S/N

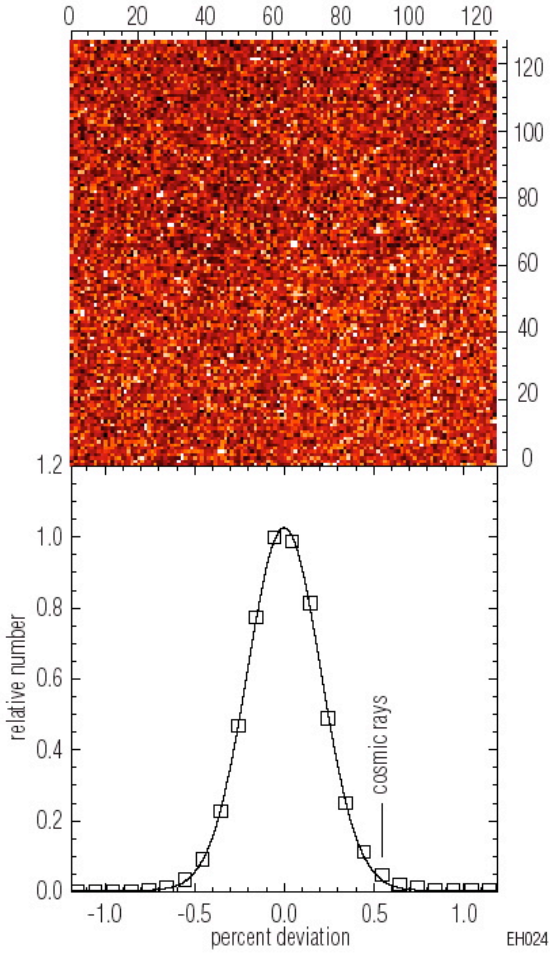
- No specific photometric test during the prime mission
- Heliocentric orbit and defocus help a lot
- One quasi- time series shows photon-limited Gaussian noise
- Principal source of non-photon errors are energetic particles
- There is an on-board stim lamp to monitor flat-fielding



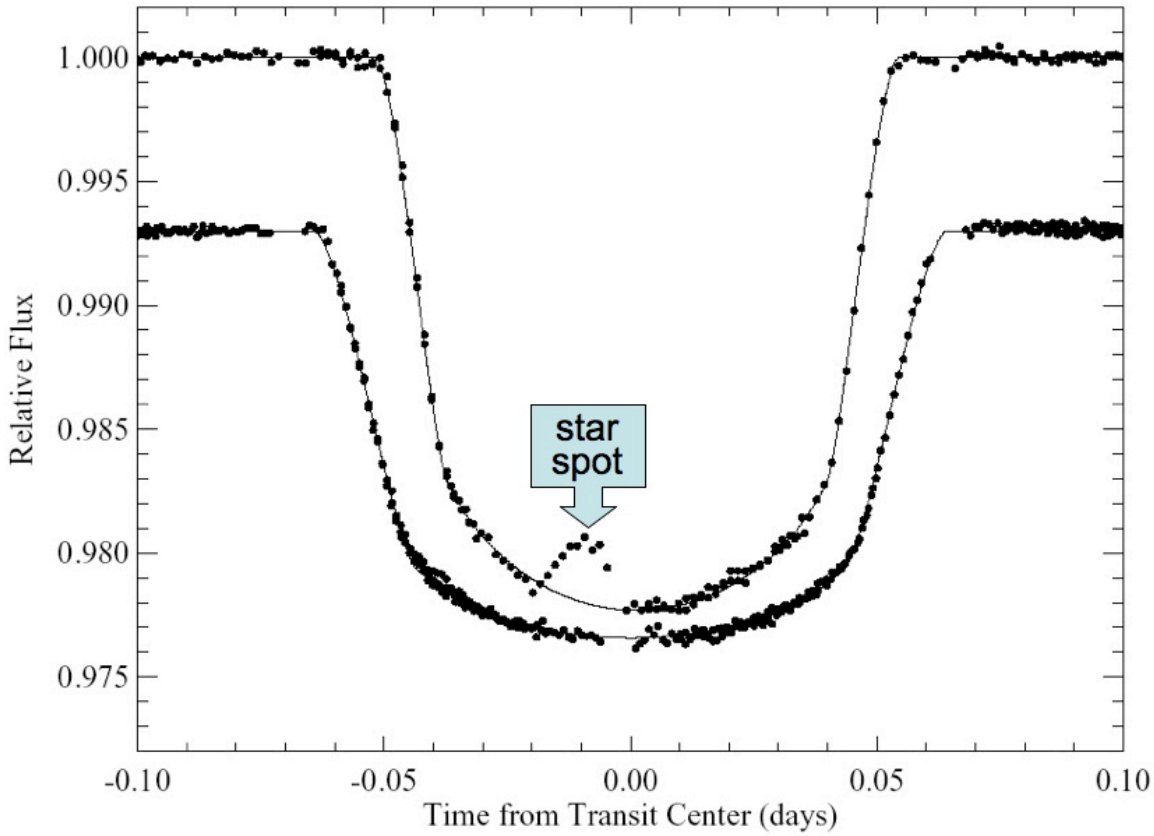
EPOXI

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

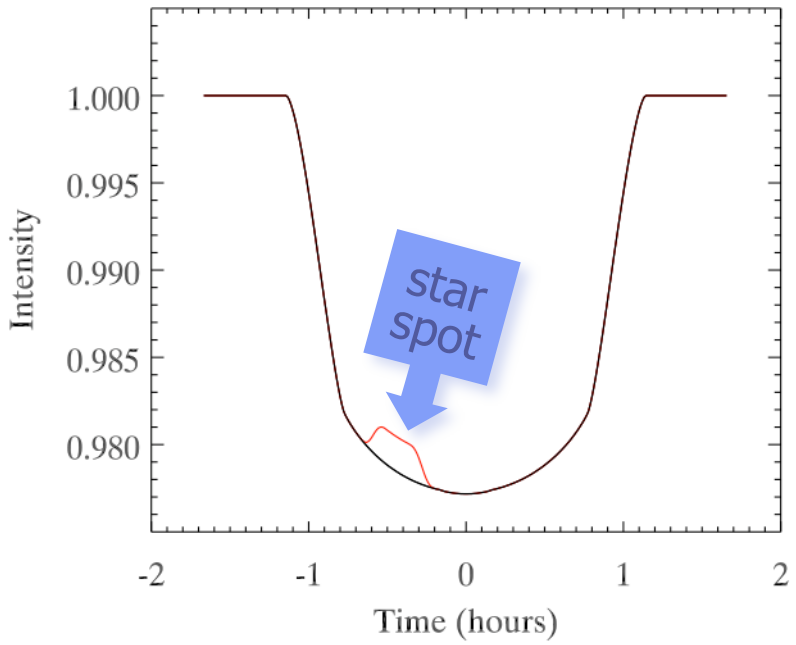


Star spot correction



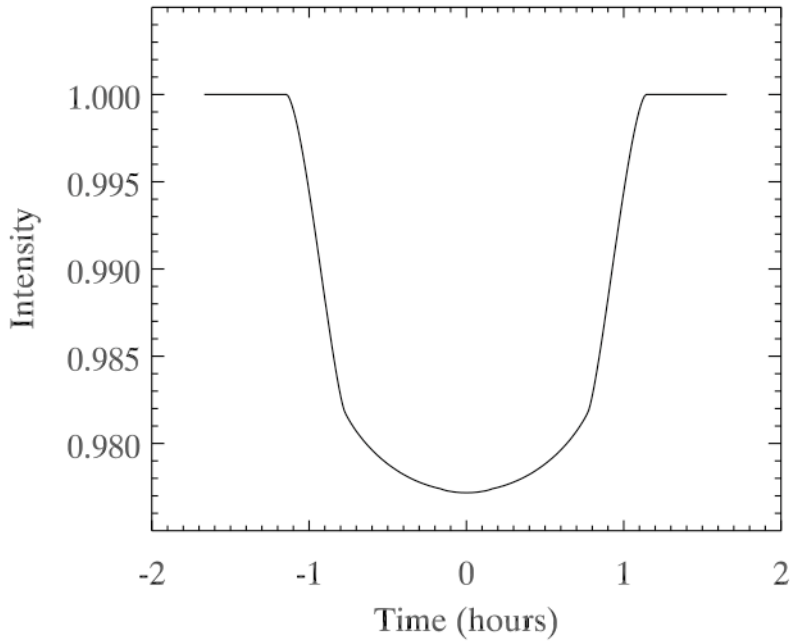
Star spots can affect transit timing

EPOXI



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

EPOXI

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)