

# Exoplanetary transit observations with Cassini – VIMS

Christophe Sotin, JPL / Caltech

- Some discussion within the VIMS team (J. Barnes, P. Nicholson, J. Soderblom, R.H. Brown, C. Sotin ...) in 2009 about observing exoplanets with VIMS during XD segments.
- Cassini will start the extended mission in July/October 2010
- Important to show what can be done and the limitations of such instrument. Experience for future instruments
- If we find something interesting, it will be good for both Cassini and the exoplanet community. If we don't, it was worth trying!

But there are several limitations:

- characteristics of the instrument
- Operations (spacecraft is aging and team is reduced)
- Tests on HD189733

# The role of KITP - Exoplanets

- Presentation the first week of March
- Discussion with several people at KITP – Exoplanets
- Conclusions
  - Other targets: HD149026 (8.15); HD 209458 (7.65); HD 17156 (8.17); HAT P2 (8.71)
  - We try to obtain observations for the end of 2010 – need to get them into the pipeline by end of next week (03/12)
- We put the request on time – then we have got some difficulties ... the support from ExoPAG has been appreciated.

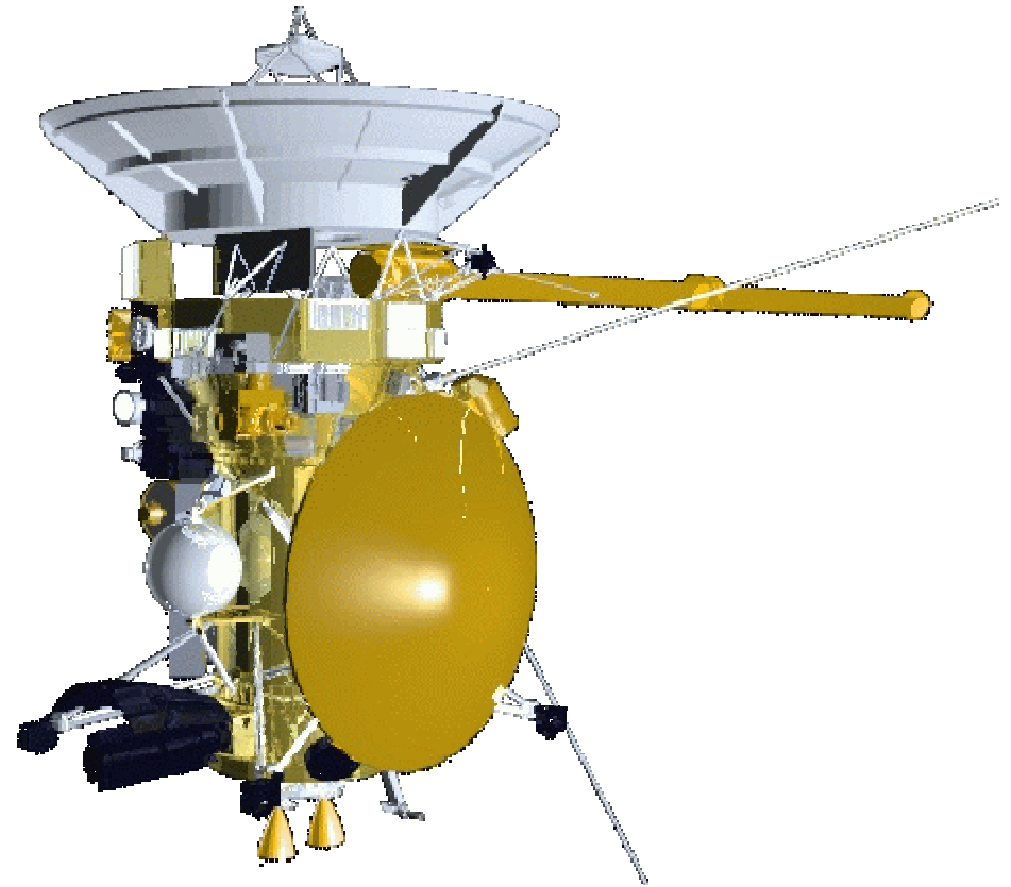
# Cassini

Cassini is a big spacecraft with 12 instruments and 4 main targets:

- Saturn
- Rings
- Icy satellites
- Titan

Each revolution (16 days) has several segments allocated to one main target.

The kind of observations we ask for is not in the approved TM.



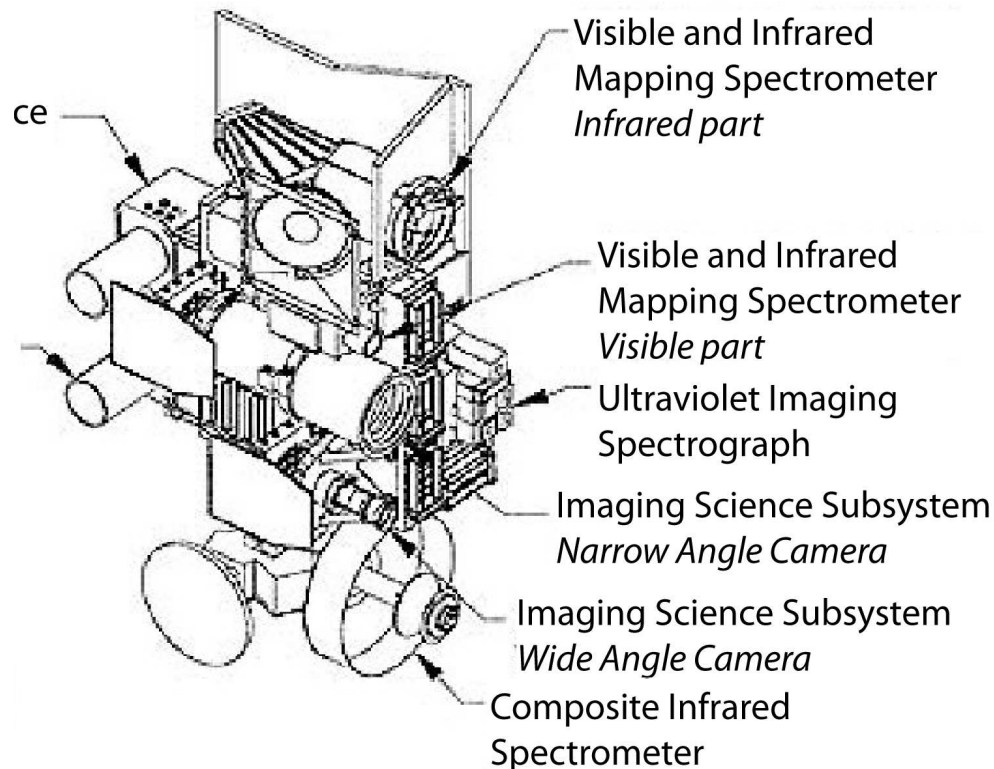
Long observations at apoapsis

# Cassini-VIMS

## Characteristics of the VIMS instrument

(Brown et al., 2004, Space Sci. Rev;  
Belluci et al., 2009, Icarus)

### Remote sensing Pallet



Vis: 96 channels between 300 and 1050 nm

IR: 256 channels between 880 and 5110 nm (spectral resolution from 10 to 20 nm)

IFOV= 0.25 x 0.50 mrad (high res)  
or 0.50 x 0.50 mrad

Two mirrors to get 64 x 64 pixels

Ritchey-Chrétien telescope with a 23 cm diameter and f/3.5 focal.

InSb detectors

Star tracker mode for occultations

The rms-noise level in each interval is

$6.2 \times 10^{-3}$  in [0.88–1.60]  $\mu\text{m}$

$3.6 \times 10^{-3}$  in [1.67–2.95]  $\mu\text{m}$

$7.5 \times 10^{-3}$  in [3.03–3.83]  $\mu\text{m}$

$27.1 \times 10^{-3}$  in [3.90–4.79]  $\mu\text{m}$

$81.1 \times 10^{-3}$  in [4.80–5.12]  $\mu\text{m}$

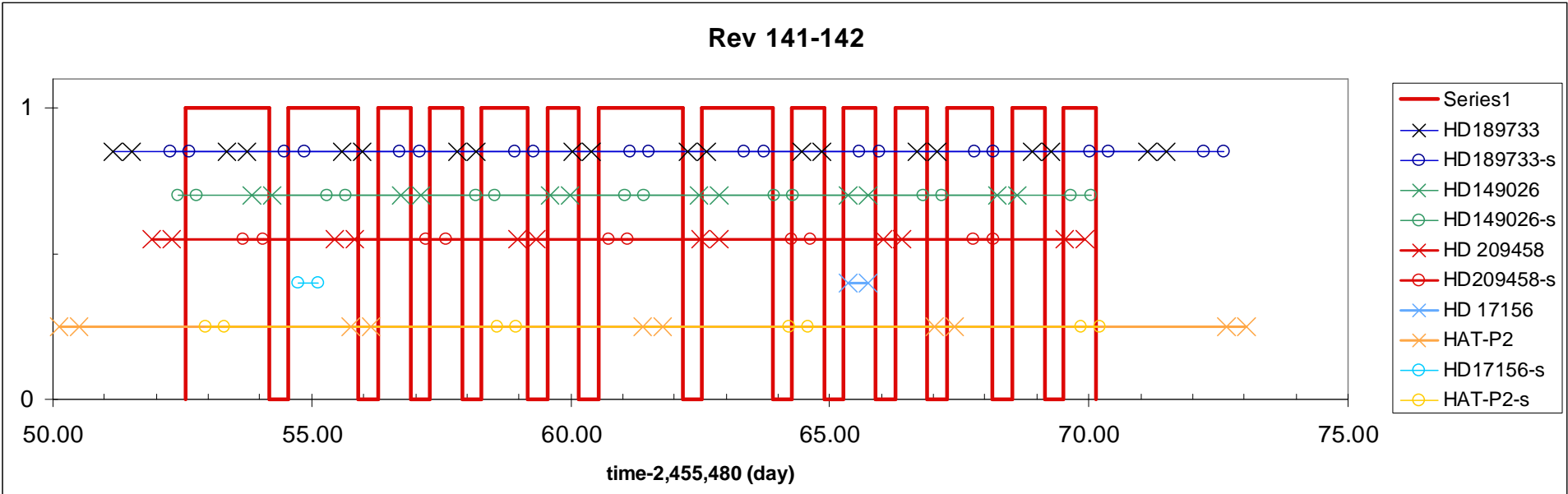
# First proposed observation of an exoplanet HD189733

IRTF observations of the secondary eclipse of extrasolar planet HD189733b show atmospheric fluorescence of methane (Swain et al., 2010). The only other planets where this process has been observed are Jupiter, Saturn, and Titan (discovered by Cassini/VIMS, Baines et al., 2006).

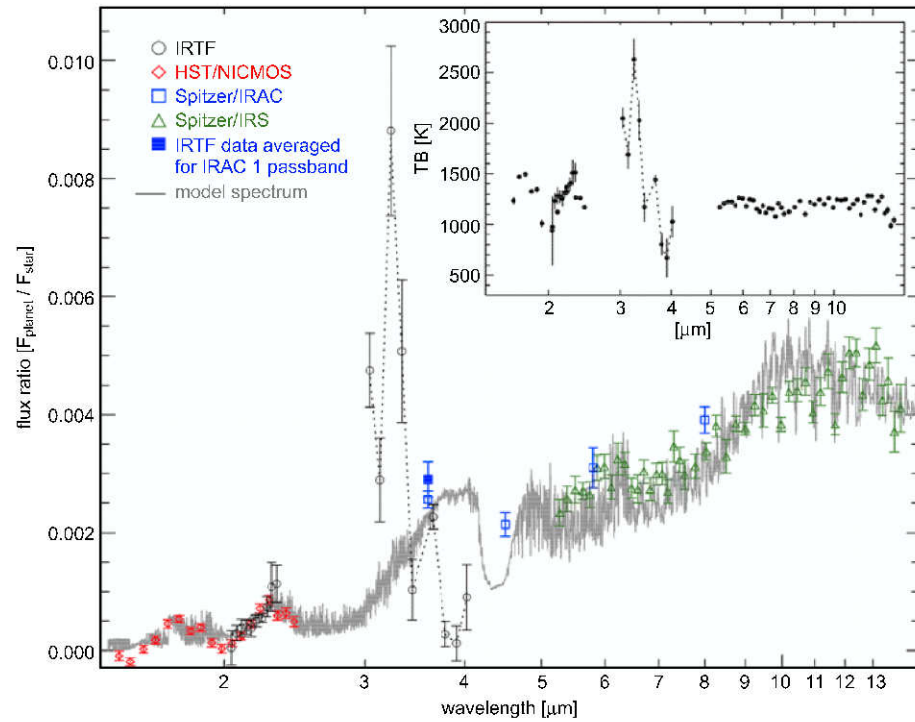
The emission occurs at 3.3 microns. That spectral range is beyond NICMOS on HST, which cuts off at 2.5 microns, but was too short for the spectrometers on Spitzer.

### Two modes

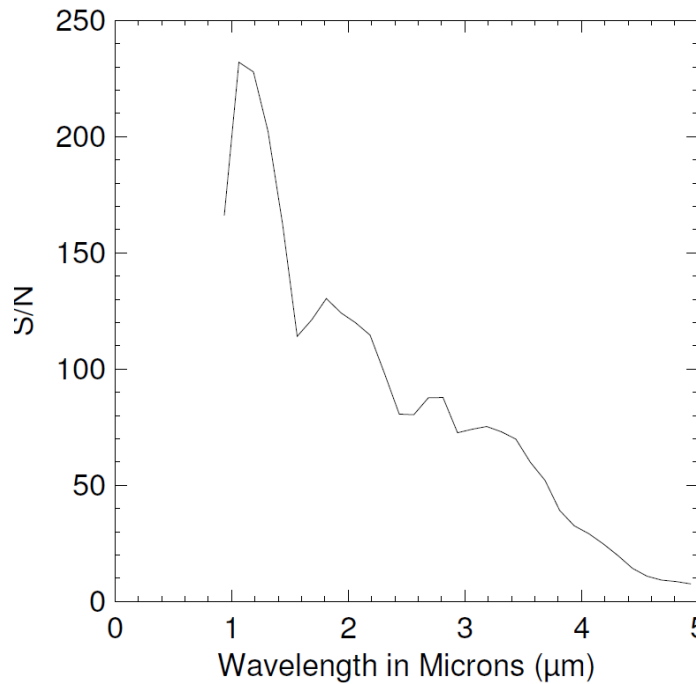
VIMS' occultation mode to maximize the integration time on the star  
small (2-4 pixels wide) images of the region around the star.



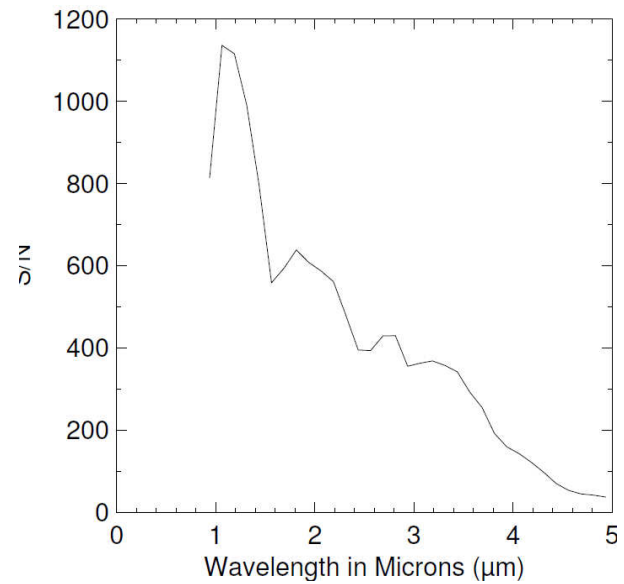
# First challenge: the VIMS detectors



S/N HD189733 in 5min



S/N HD189733 in 2hours



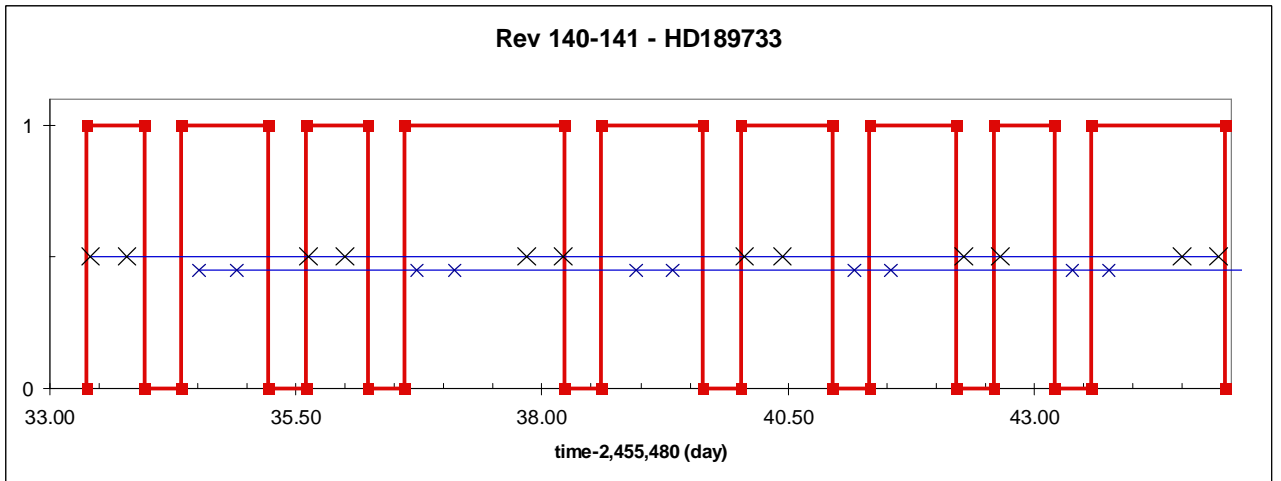
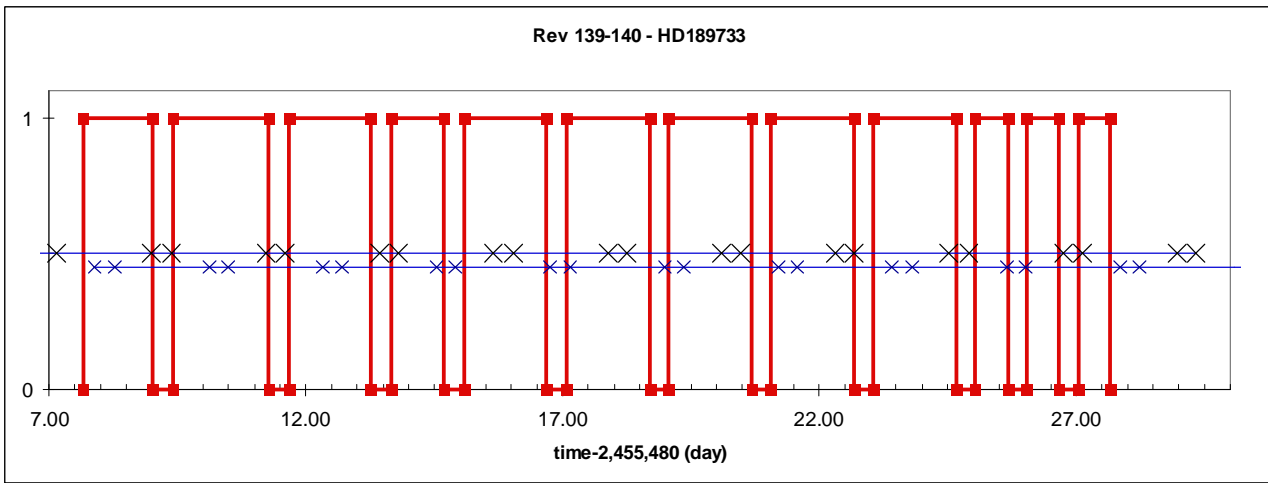
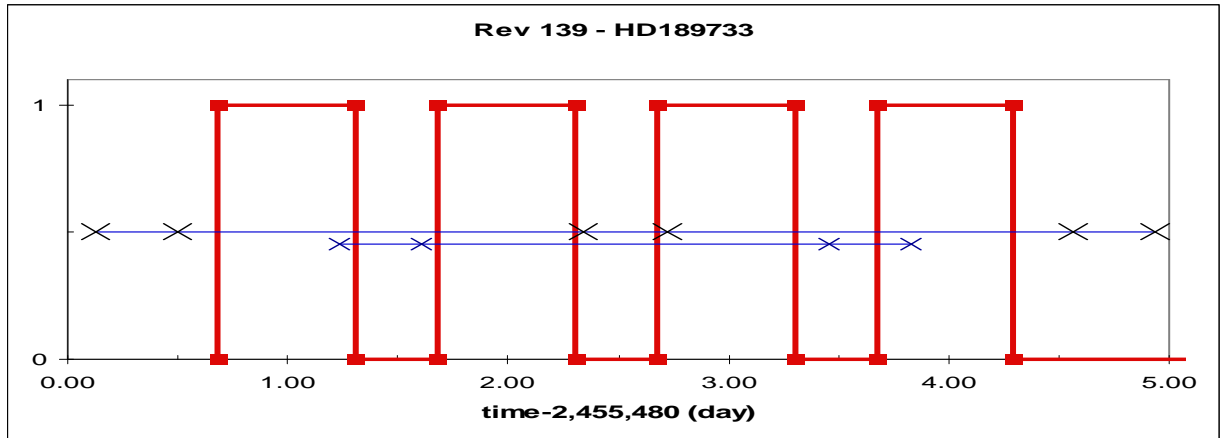
## Second challenge: Very large field of view



VIMS: FoV = 0.5 mrad

The sky is full of stars !!  
Tracking the good one is  
challenging

Cassini is very stable at  
VIMS FoV





## Conclusions

Test of star tracking in June

First observation hopefully in October 2010 – results will drive the implementation for other opportunities

Other targets: HD149026 (8.15); HD 209458 (7.65); HD 17156 (8.17); HAT P2 (8.71)

Good exercise for future collaboration between planetary missions and astrophysical observations