

# TESS

TRANSITING EXOPLANET SURVEY SATELLITE



AARHUS  
UNIVERSITET  
INSTITUT FOR FYSIK OG ASTRONOMI



STELLAR ASTROPHYSICS CENTRE

**RASMUS HANDBERG**  
ASTRONOM OG SYSTEMUDVIKLER

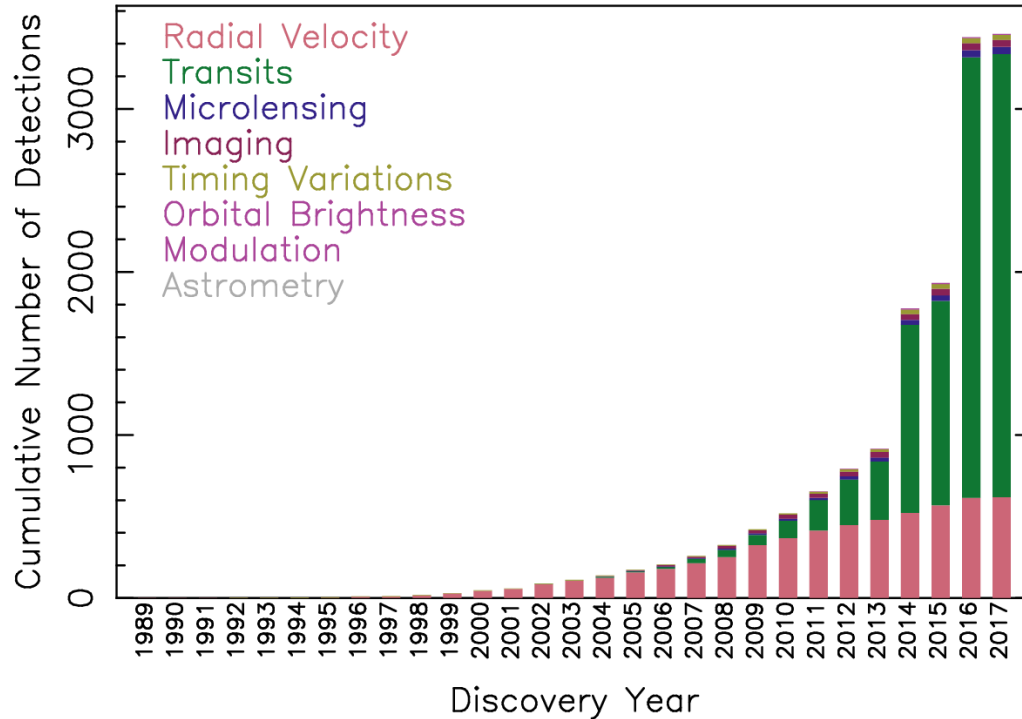


24. MARTS 2017

# ANTAL KENDTE EXOPLANETER

16 Mar 2017

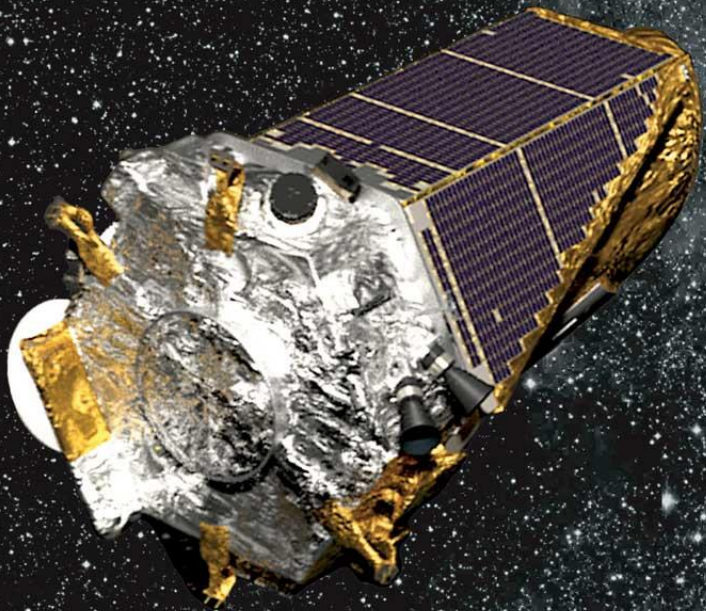
exoplanetarchive.ipac.caltech.edu



# Kepler



NASA + Aarhus!





**Planet-Hunting Kepler Spacecraft Suffers Major Failure, NASA Says**

**Breakdown Imperils NASA's Hunt for Other Earths**

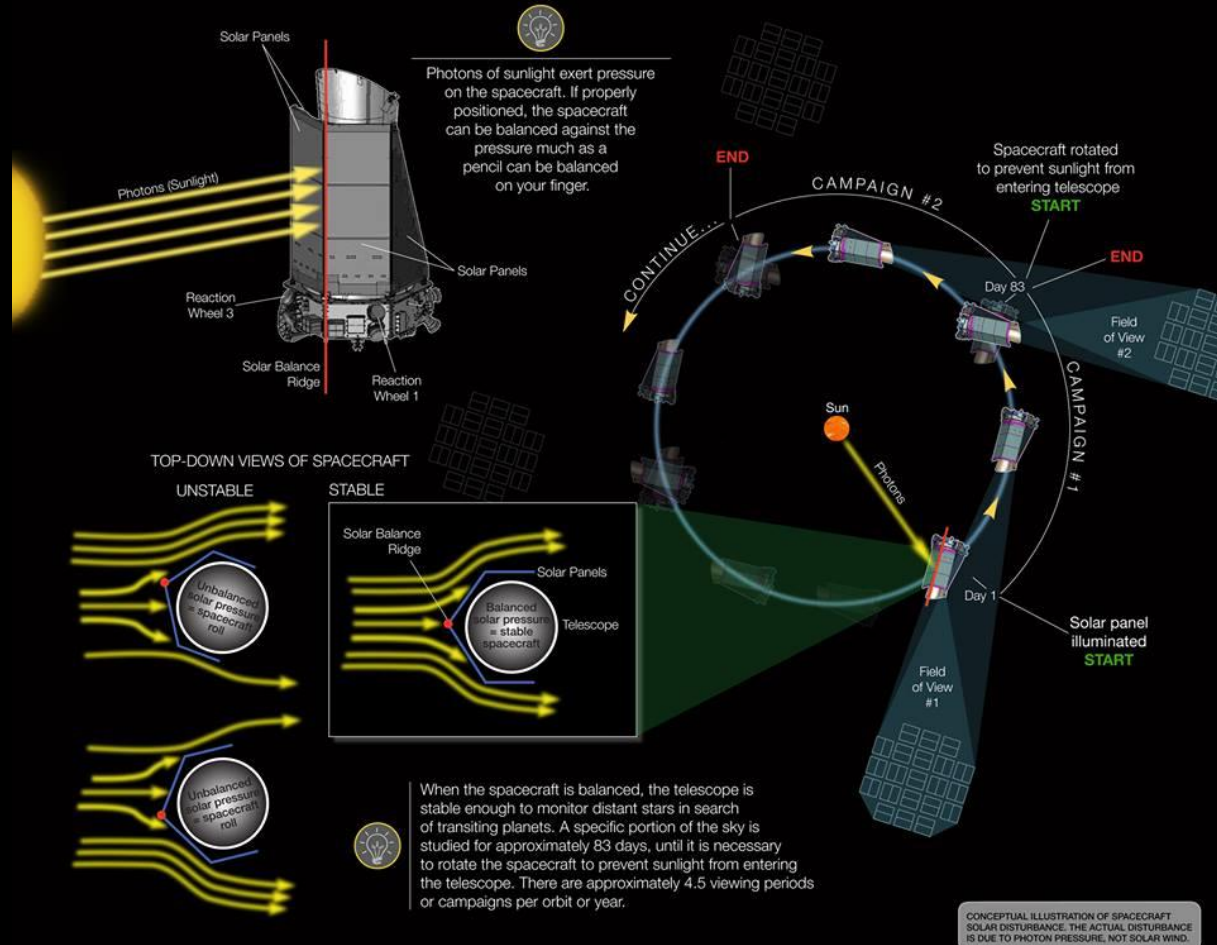
**Kepler Space Telescope Is Beyond Repair, NASA Says**

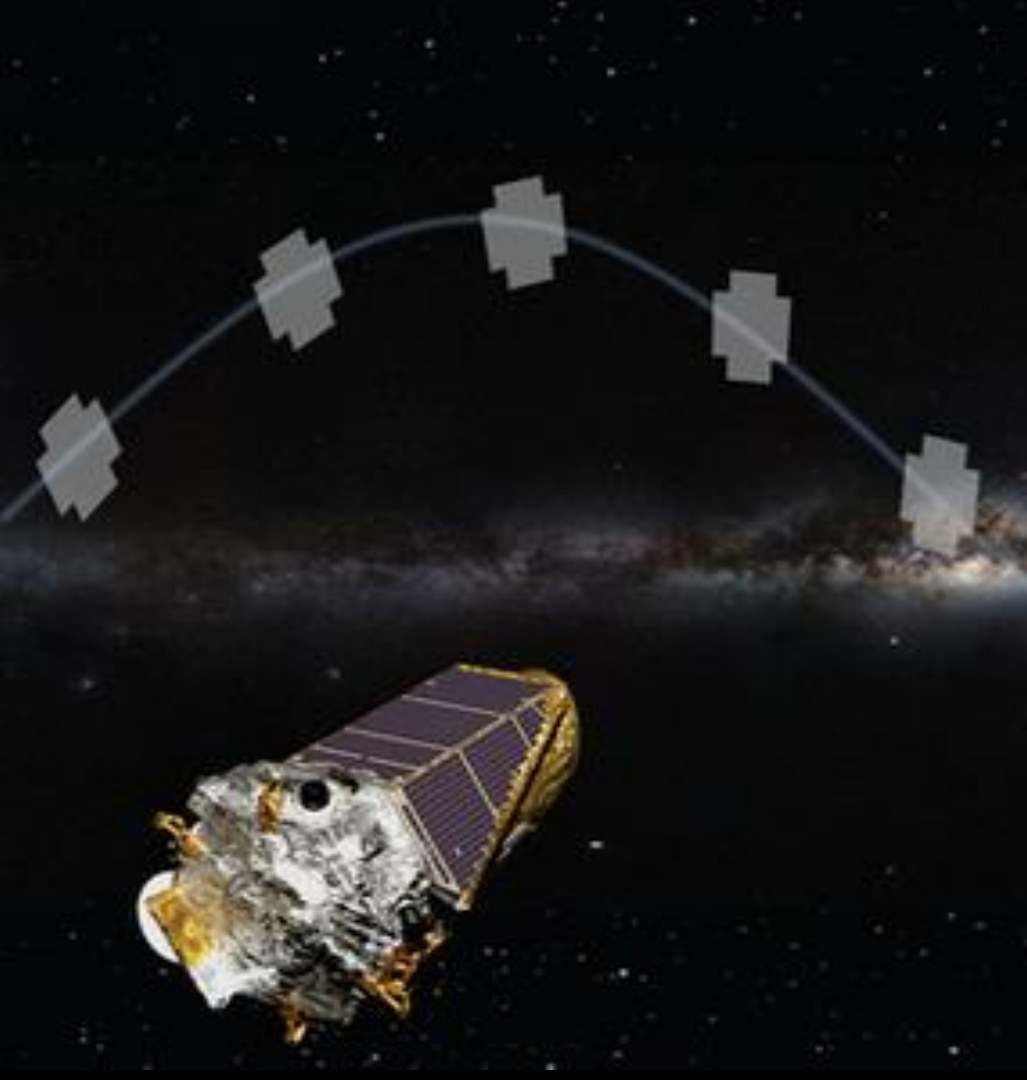
**Kepler's Failure Doesn't Mean the Mission is Over**

**NASA's Exoplanet-Hunting Kepler Space Telescope Gets New Mission**

Kepler Rising: NASA resurrects its planet hunter to great effect

# Kepler's Second Light: How K2 Will Work

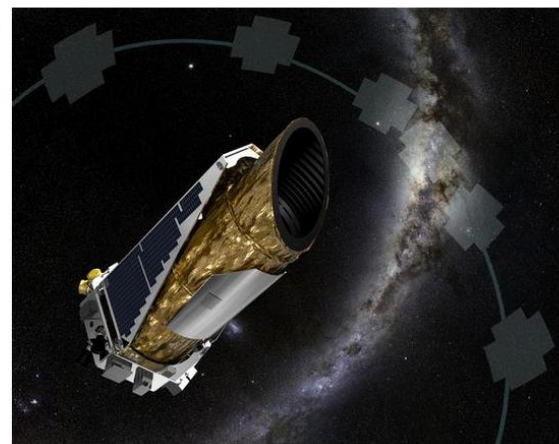




## NASA's Kepler Comes Roaring Back with 100 New Exoplanet Finds

by Sarah Lewin, Staff Writer | January 08, 2016 03:30pm ET

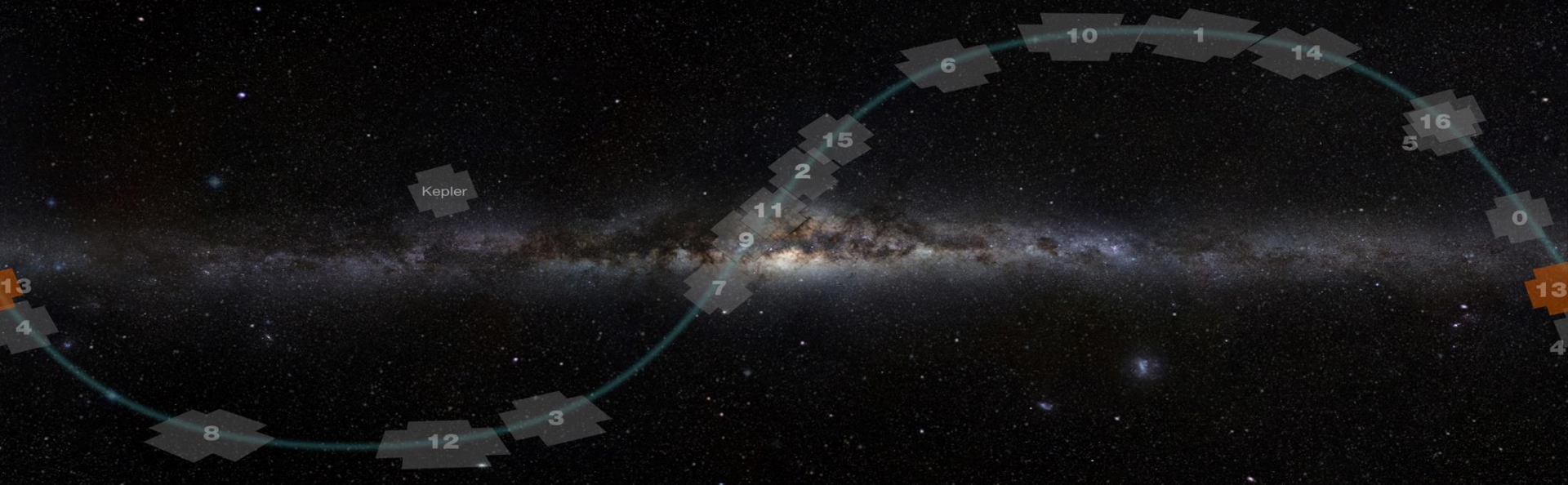
More ▾



The artist's illustration shows NASA's planet-hunting Kepler spacecraft operating in its second-chance K2 mission. [Pin it](#)  
Credit: NASA Ames/JPL-Caltech/T Pyle  
[View full size image](#)

KISSIMMEE, Fla. — NASA's Kepler spacecraft has bounced back nicely from the malfunction that ended its original exoplanet hunt more than two years ago.

Kepler has now discovered more than 100 confirmed [alien planets](#) during its second-chance K2 mission, researchers announced today (Jan. 5) here at the 227th Meeting of the American Astronomical Society (AAS).



Kepler

13  
4

8

12

3

7

9

11

2

15

6

10

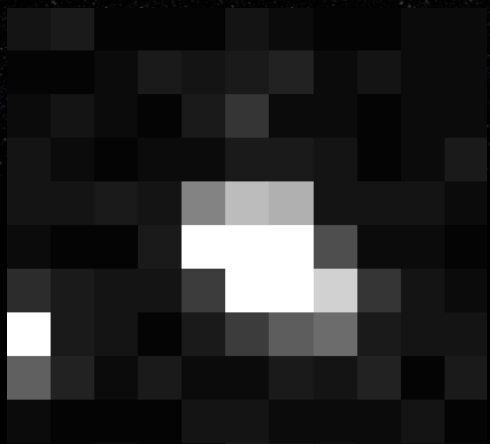
1

14

16  
5

0

13  
4



EPIC 200164267

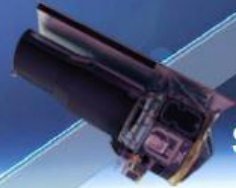
2017-02-23 14:40:59



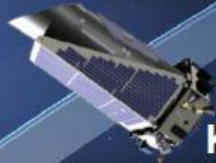
# Exoplanet Missions



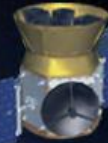
Hubble



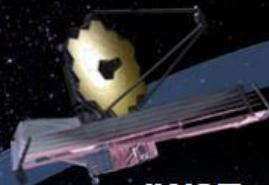
Spitzer



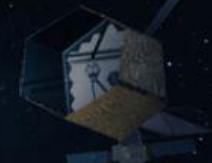
Kepler &  
K2



TESS



JWST



*New Worlds  
Telescope*

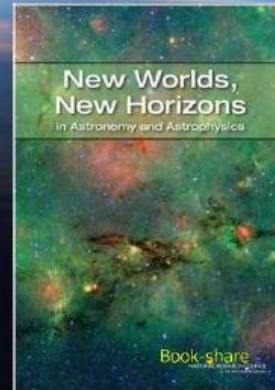


WFIRST

Ground-based  
Observatories

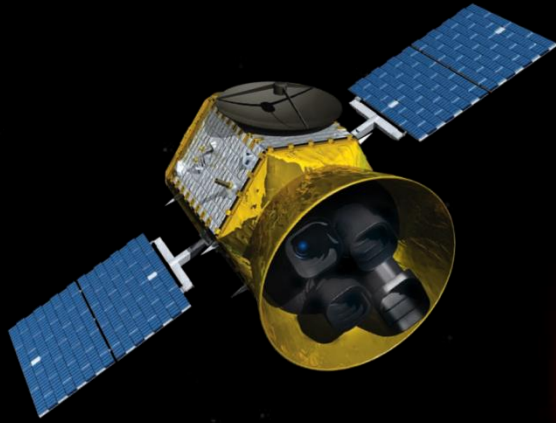


2001  
Decadal  
Survey



2010  
Decadal  
Survey

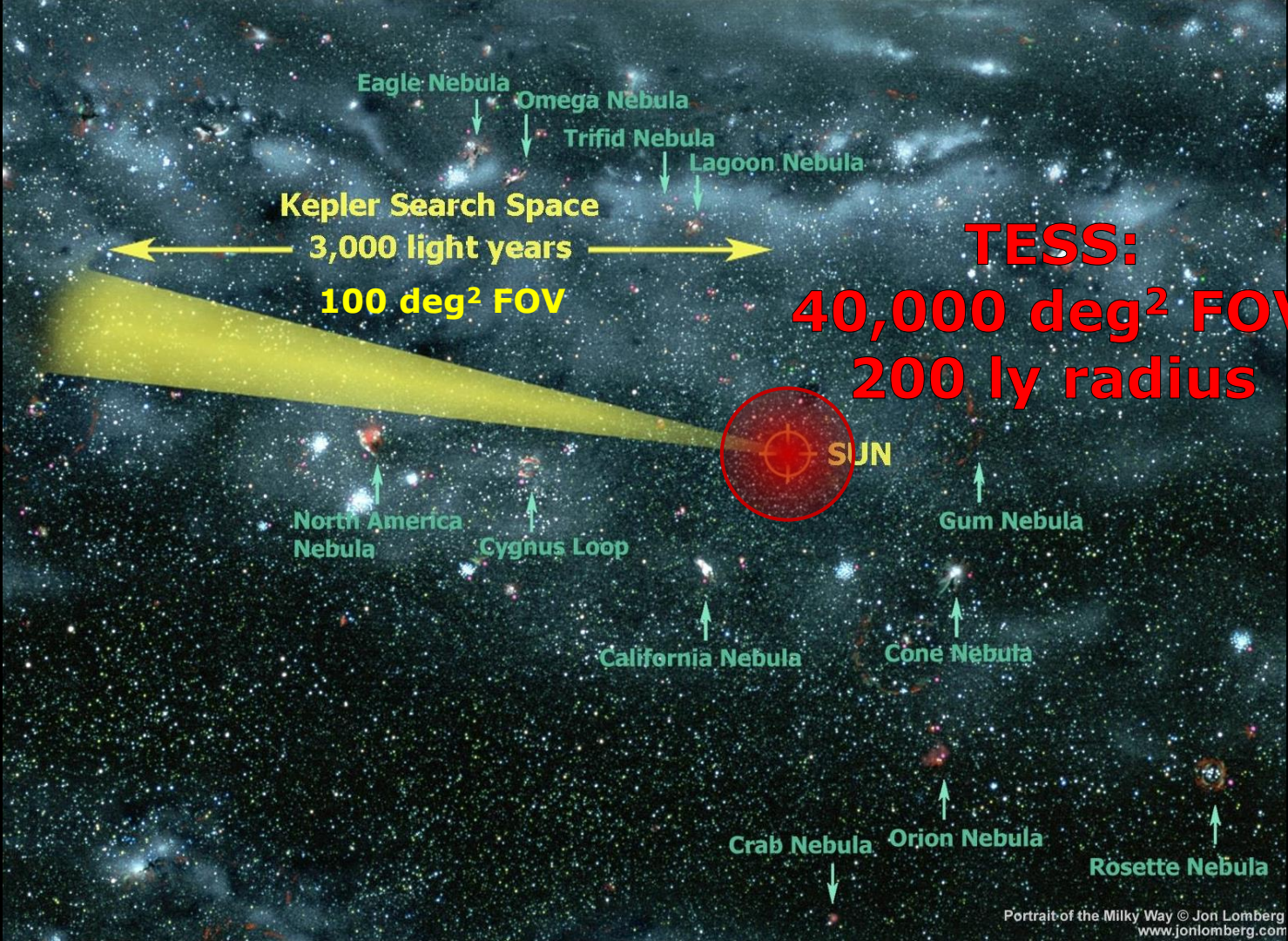




# TRANSITING EXOPLANET SURVEY SATELLITE

DISCOVERING NEW EARTHS AND SUPER-EARTHS  
IN THE SOLAR NEIGHBORHOOD

Op sendes marts 2018



Eagle Nebula  
Omega Nebula  
Trifid Nebula  
Lagoon Nebula

Kepler Search Space

3,000 light years

100 deg<sup>2</sup> FOV

**TESS:**

**40,000 deg<sup>2</sup> FOV**

**200 ly radius**

SUN

North America  
Nebula

Cygnus Loop

California Nebula

Cone Nebula

Gum Nebula

Crab Nebula

Orion Nebula

Rosette Nebula

# Transiting Exoplanets

- Non-Kepler
- Kepler
- Predicted TESS

0h  
September

21h

18h  
June



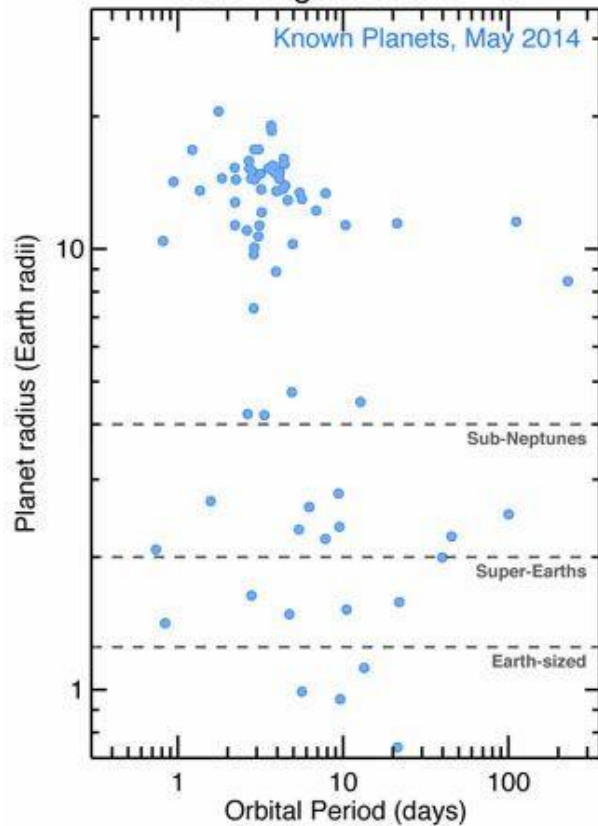
6h  
December

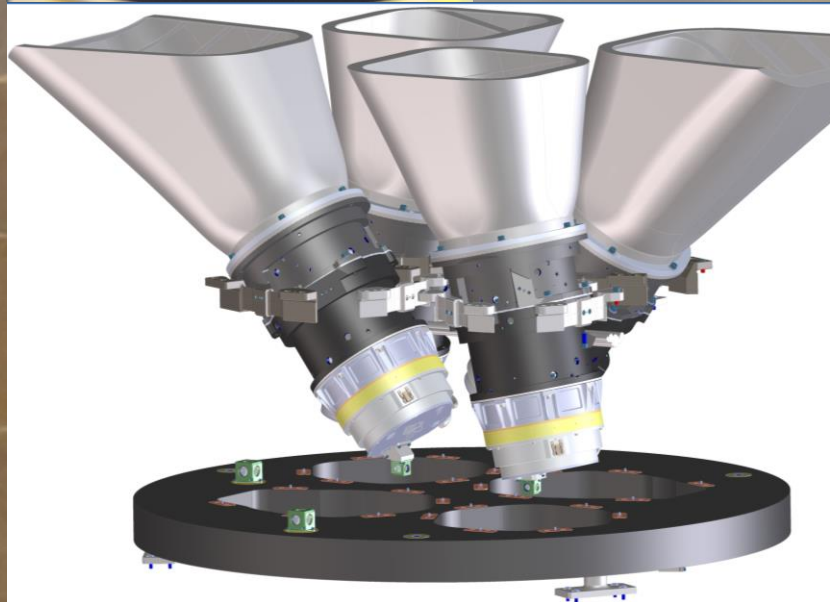
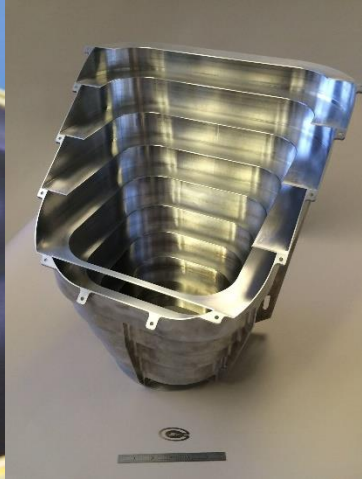
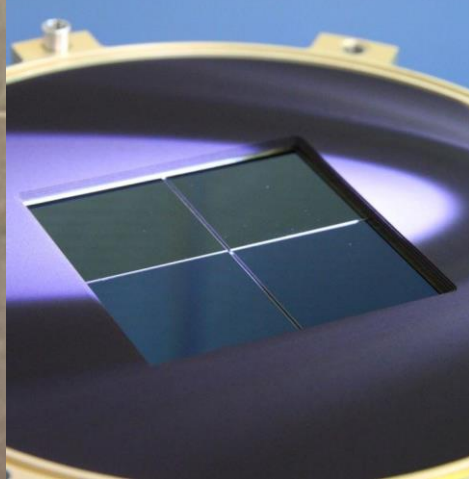
15h

9h

12h  
March

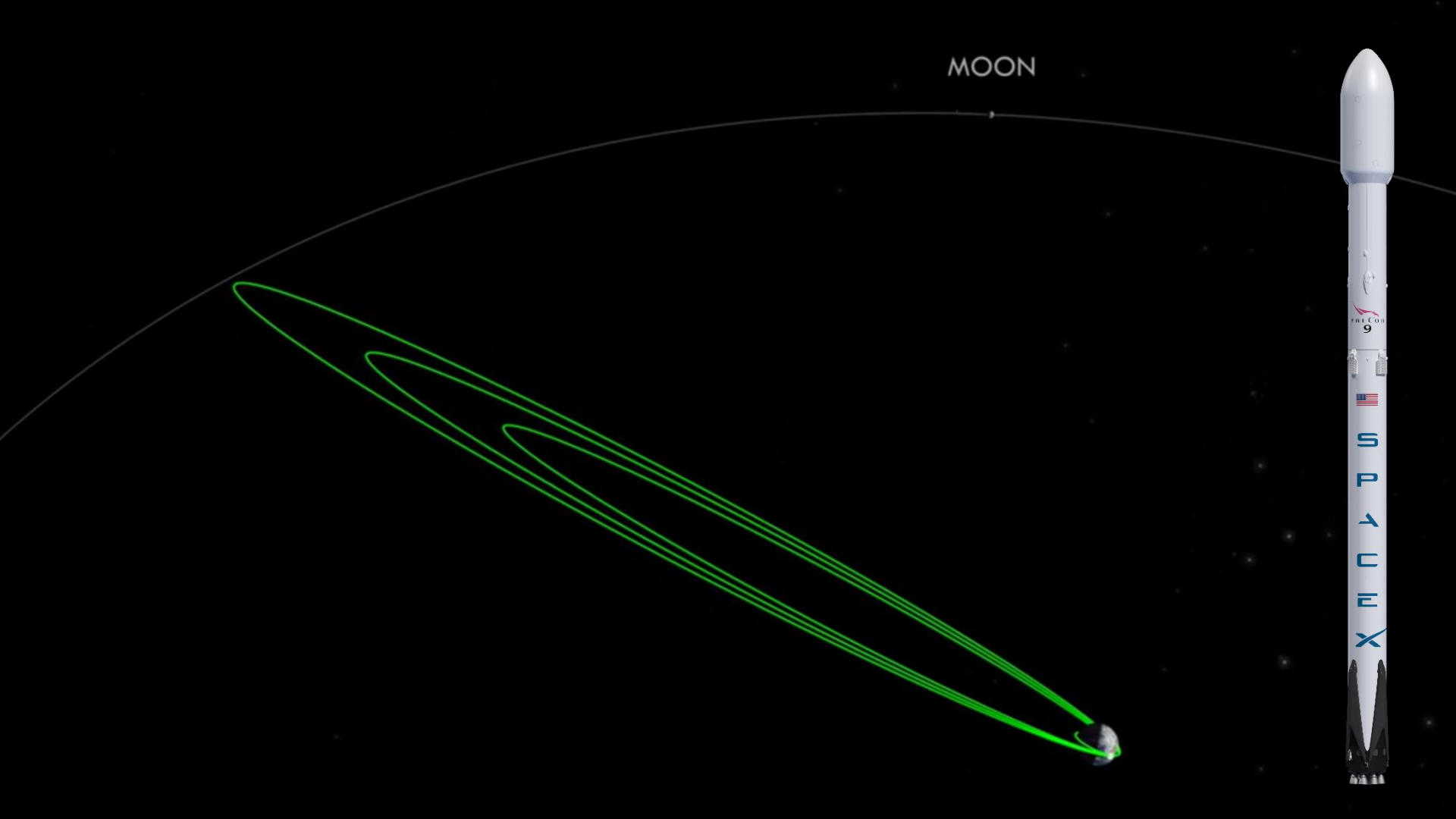
# Stars Brighter than J=10







MOON



FALCON  
9



S  
P  
A  
C  
E  
X

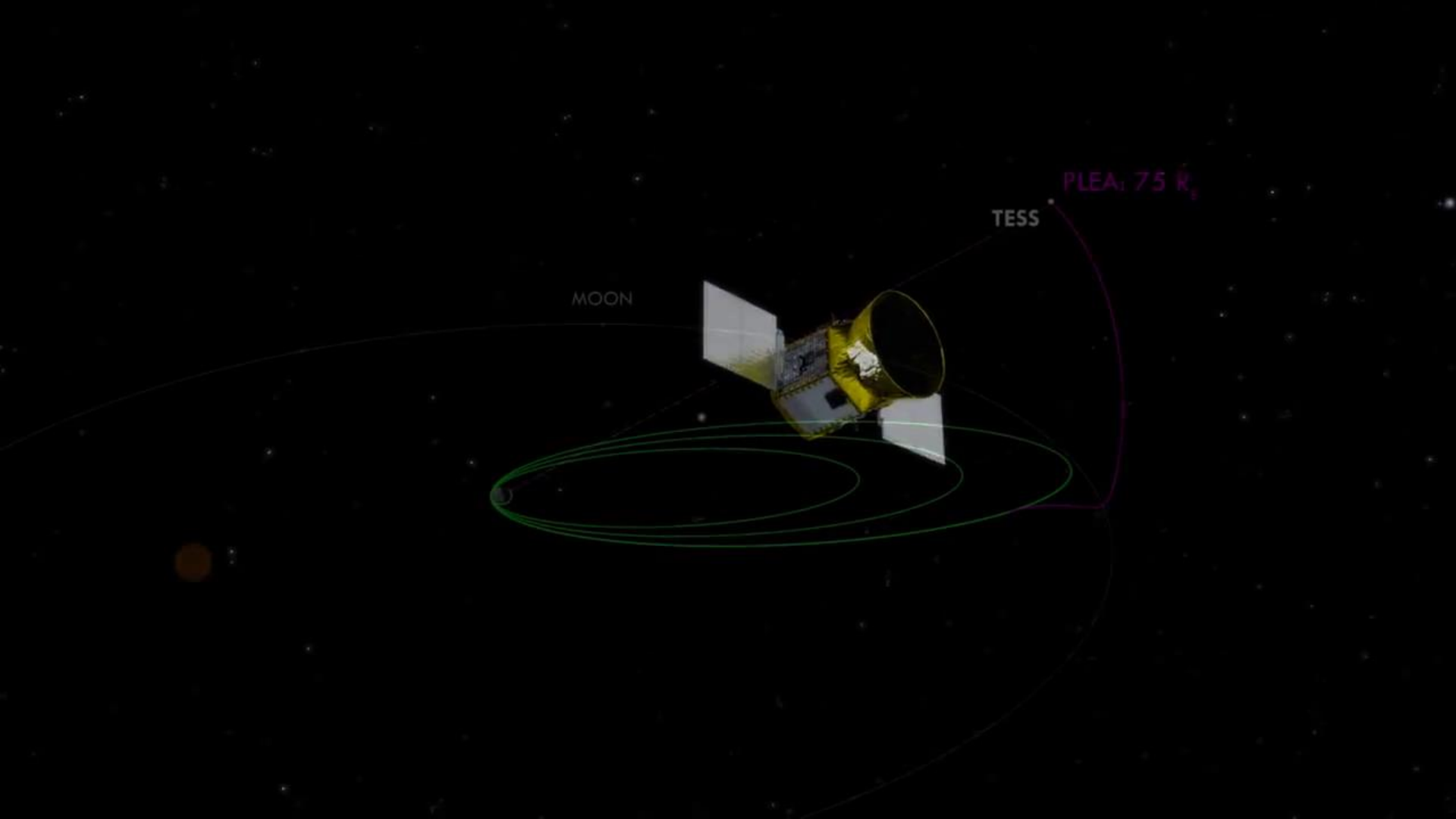
PLEA:  
POST-LUNAR-ENCOUNTER APOGEE

The diagram illustrates the orbital paths of the Transiting Exoplanet Survey Satellite (TESS) and the Moon. A thin grey arc represents the Moon's orbit around Earth. A green curve shows the TESS transfer orbit, which starts from Earth and reaches a point labeled 'TESS'. A purple curve shows the post-lunar-encounter apogee (PLEA) orbit, which is a higher orbit that extends further into space. The background is black with some faint star-like speckles.

TESS TRANSFER ORBIT LUNAR INCLINATION  
IS NOMINALLY  $37^\circ$

TESS





MOON

TESS

PLEIADES, 75 R<sub>E</sub>



### Transiting Exoplanet Survey Satellite 1:1 model

**FORMÅL**  
At lave asteroseismologi på klare stjerner  
At finde tusinder af flere exoplaneter

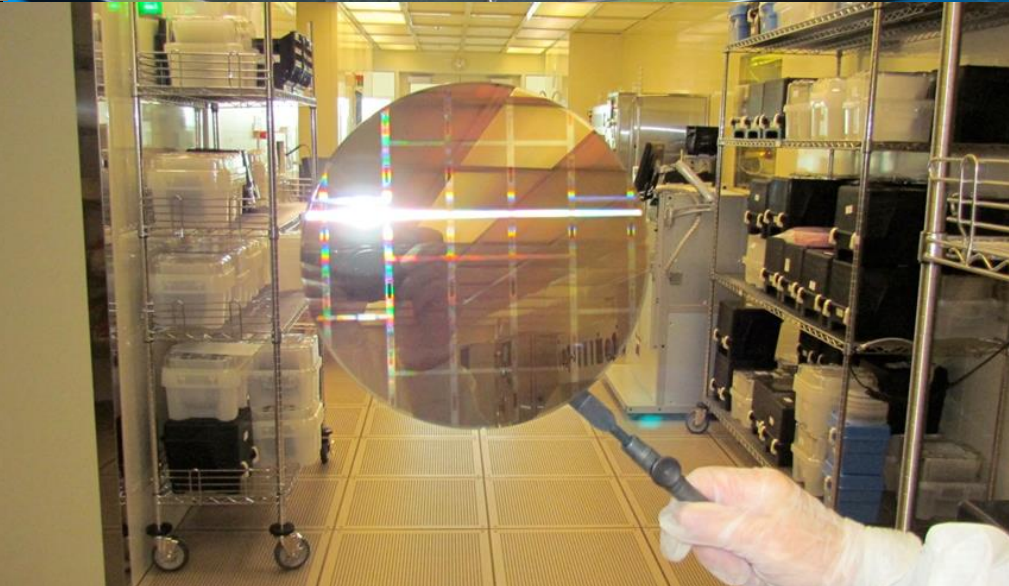
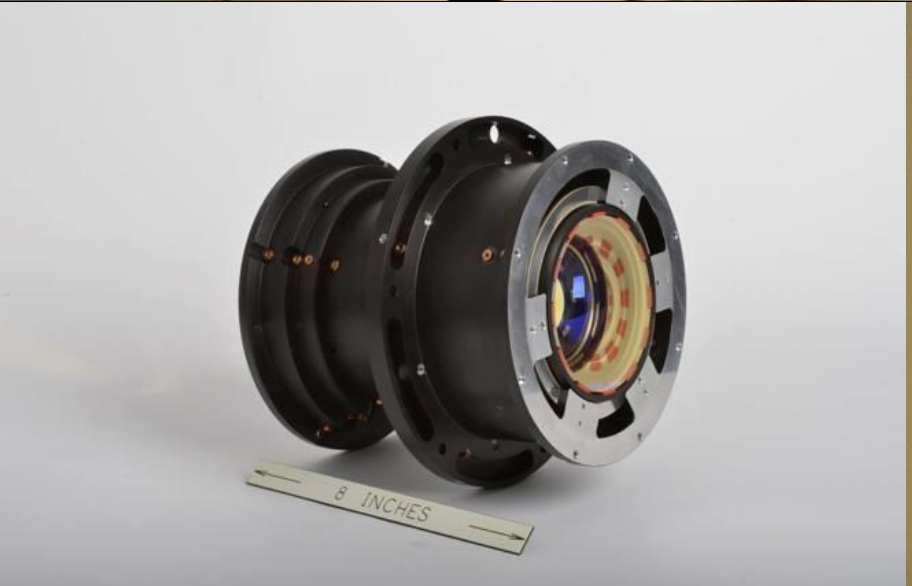
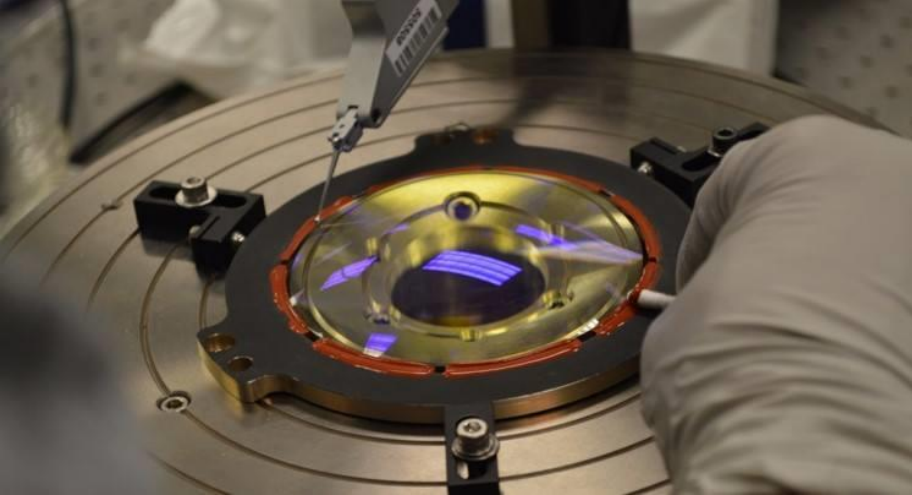
**OBSERVATIONER**  
Klare stjerner  $> 5,0^m$  til asteroseismologi  
20 millioner stjerner ned til  $12^m$  til planetykt  
Hele himlen gennemses og flere gange

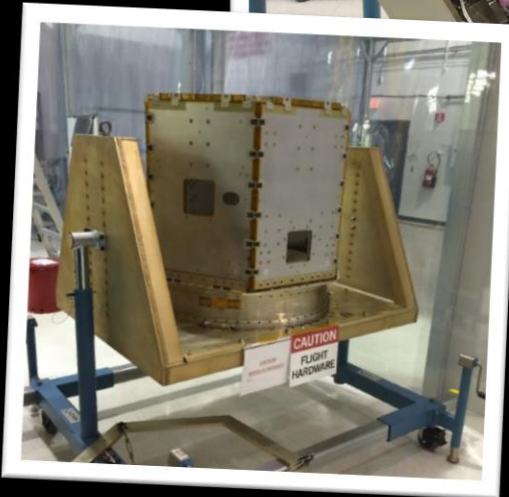
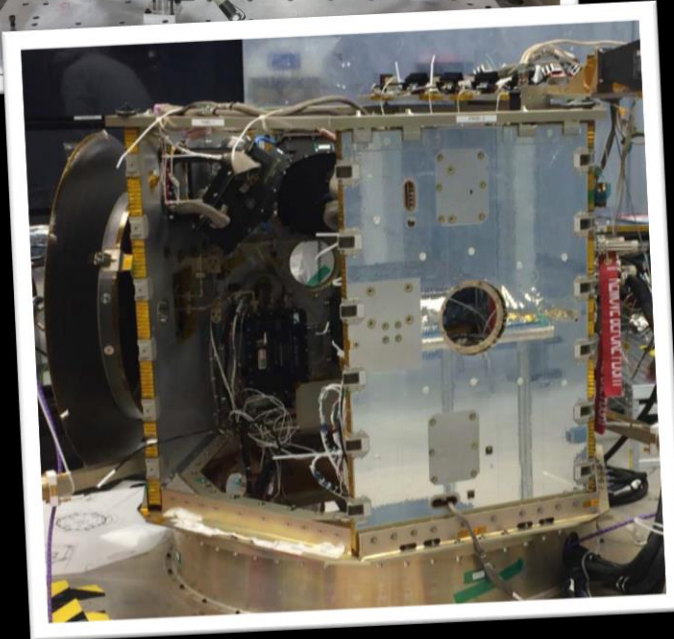
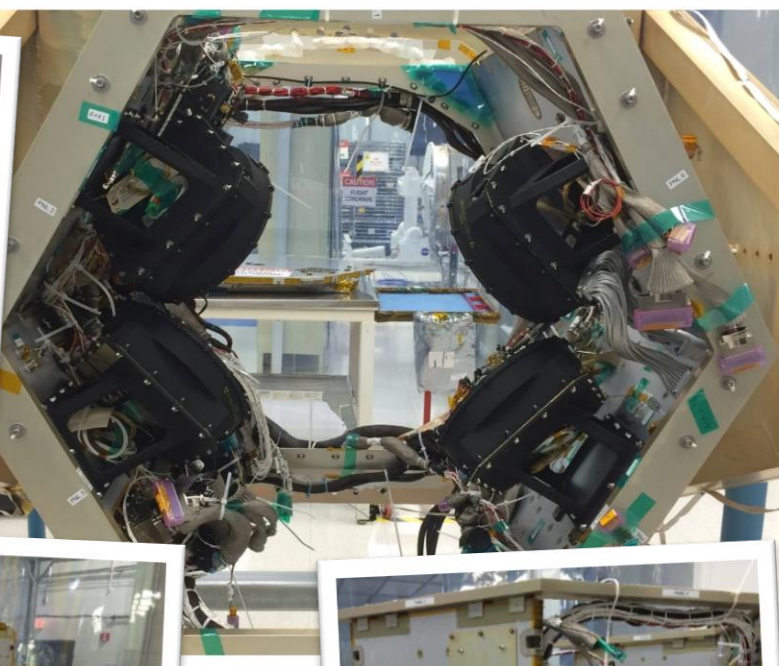
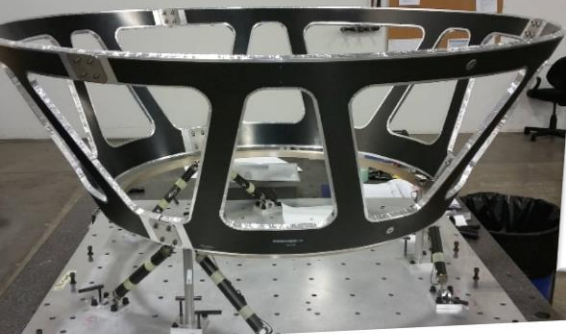
**METODE**  
Målinger af meget små lysstyrkevariationer  
forårsaget af stjernesvingninger eller transit

**TIDSPLAN**  
Opstart august 2017  
2 års observationer planlagt

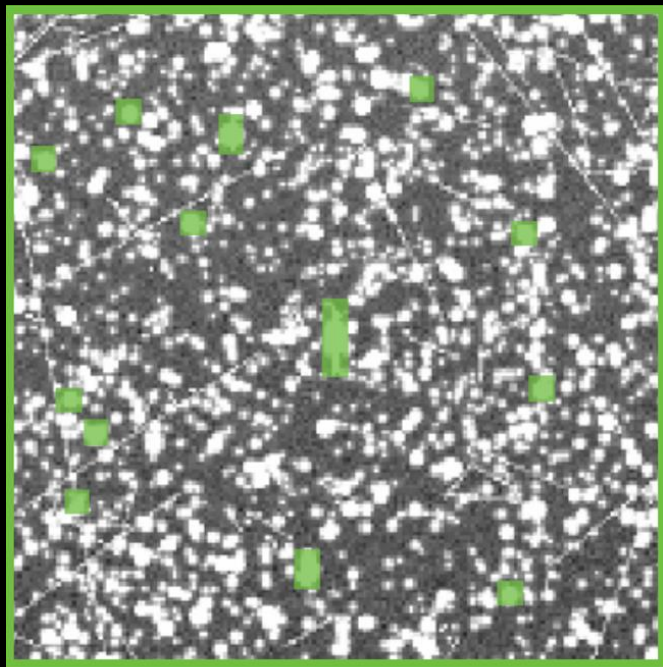
**PARTNERE**  
NASA  
MPE  
SAC, et al



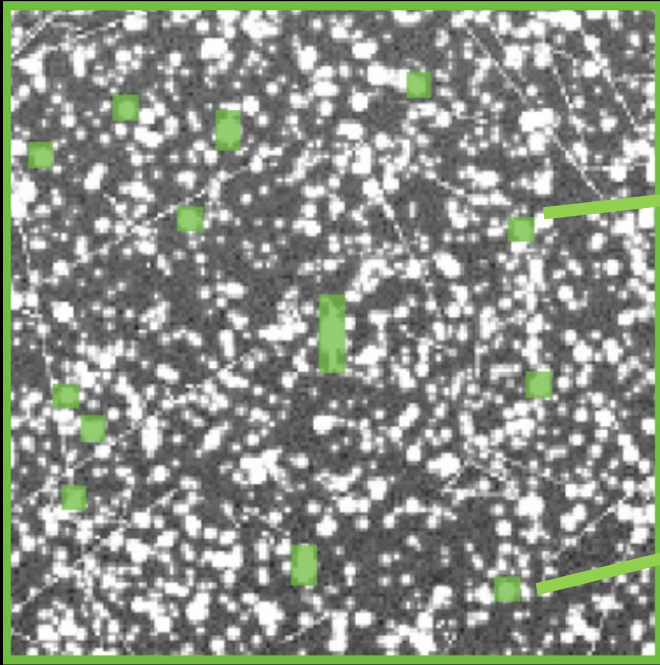




@NASA\_TESS



1 degree

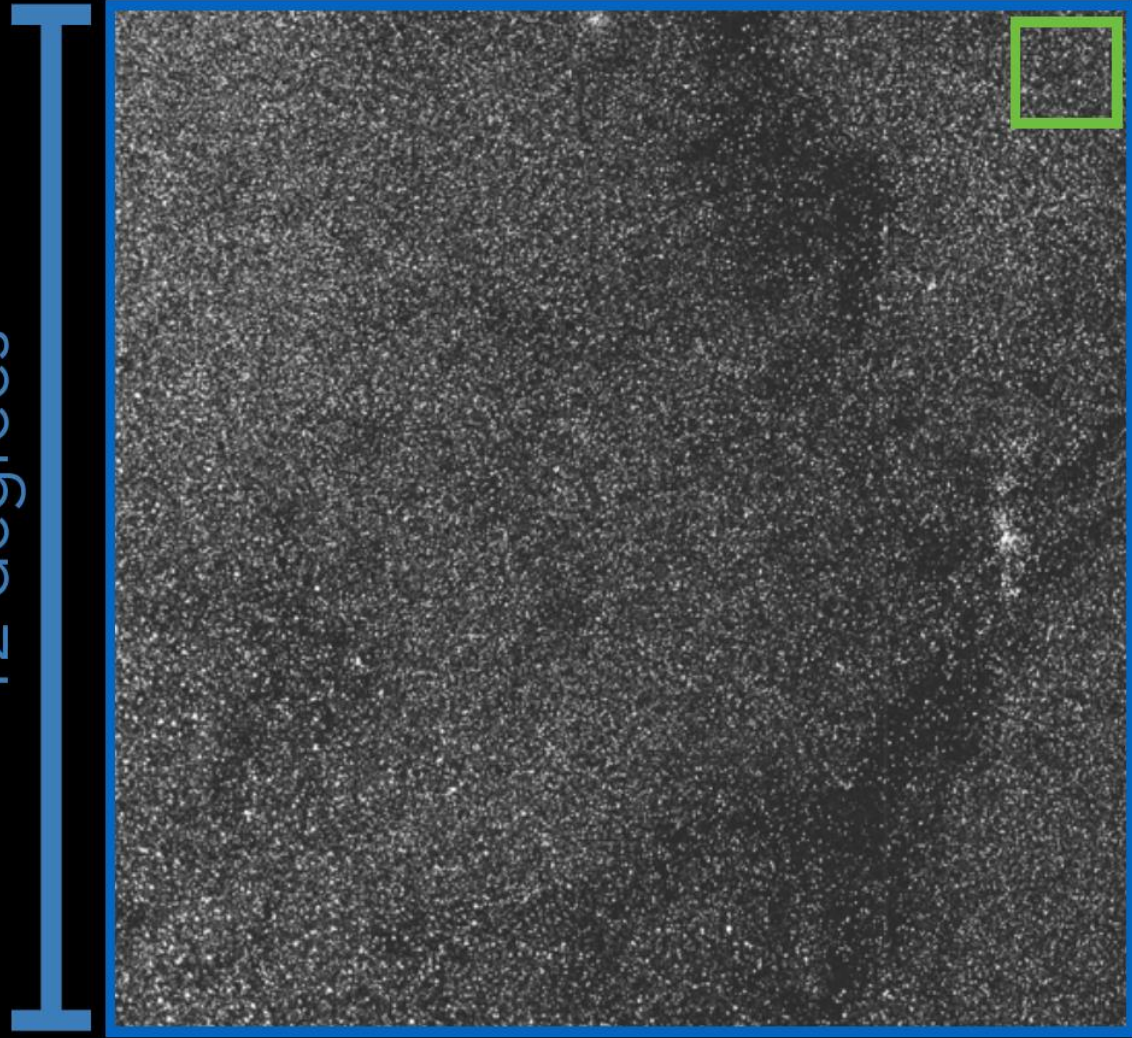


Udlæses hver 2 min  
> 200.000 stjerner

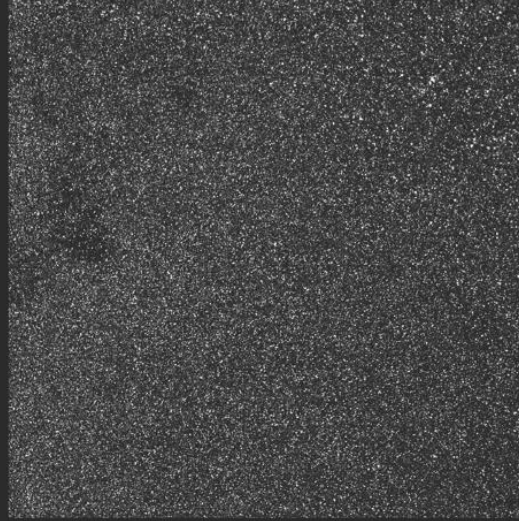
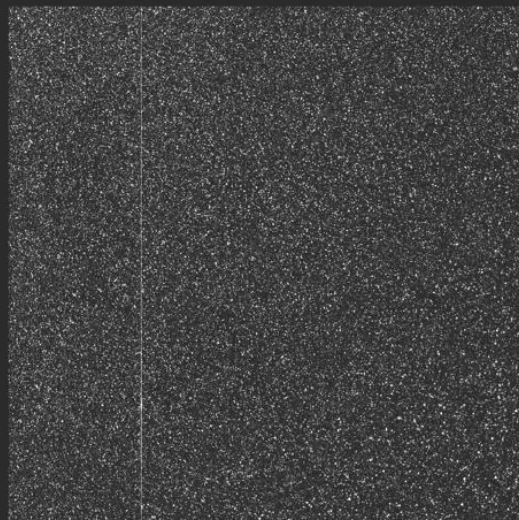
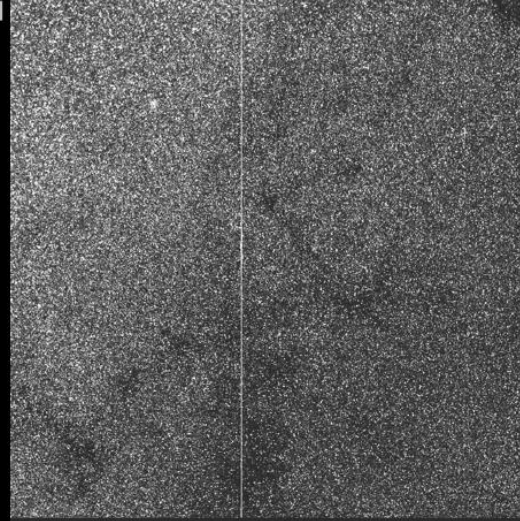
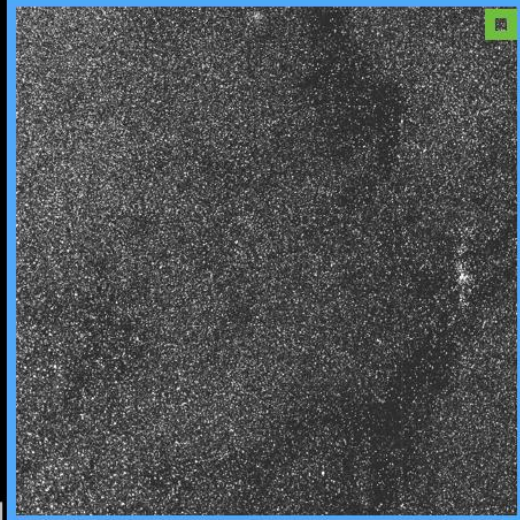
Udlæses hver 20 sek

1 degree

**one CCD:**  
12 degrees



**one  
camera:  
24 degrees**

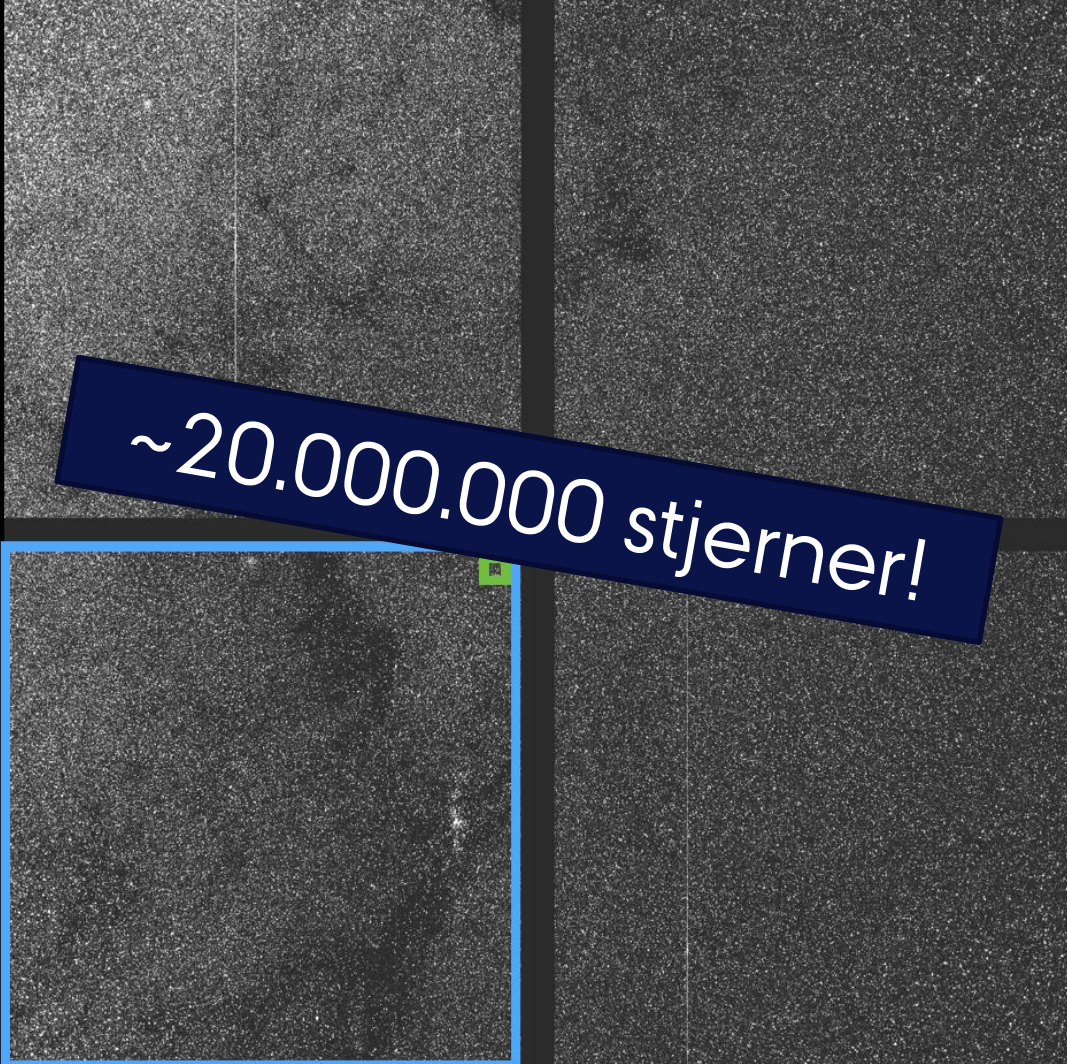




**one  
camera:  
24 degrees**



one  
camera:  
24 degrees



~20.000.000 stjerner!

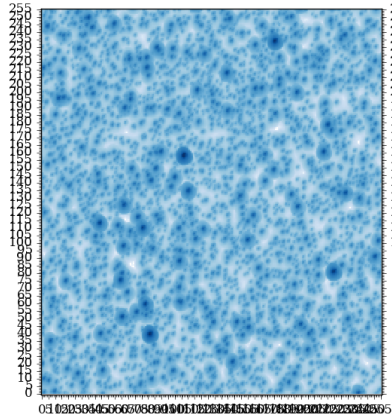
x4

# FØRSTE TESTS AF AUTOMATISK SOFTWARE

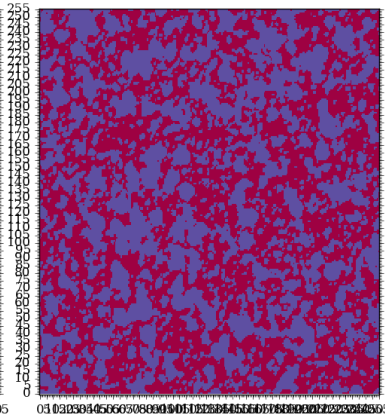


# FØRSTE TESTS AF AUTOMATISK SOFTWARE

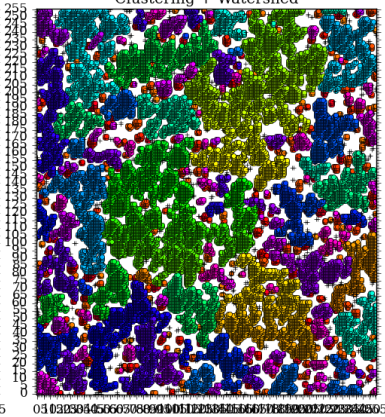
Sum-image



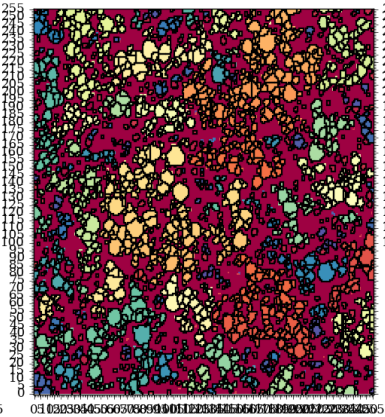
Significant flux



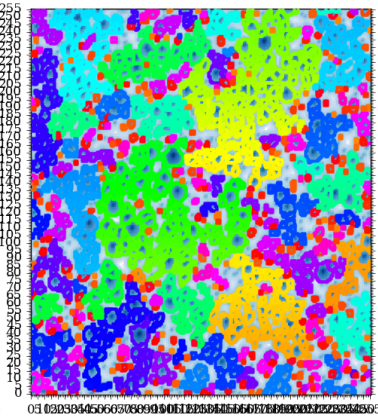
Clustering + Watershed



Extracted clusters



Final masks





# MARTS 2018

SpaceX Falcon 9





AARHUS  
UNIVERSITET