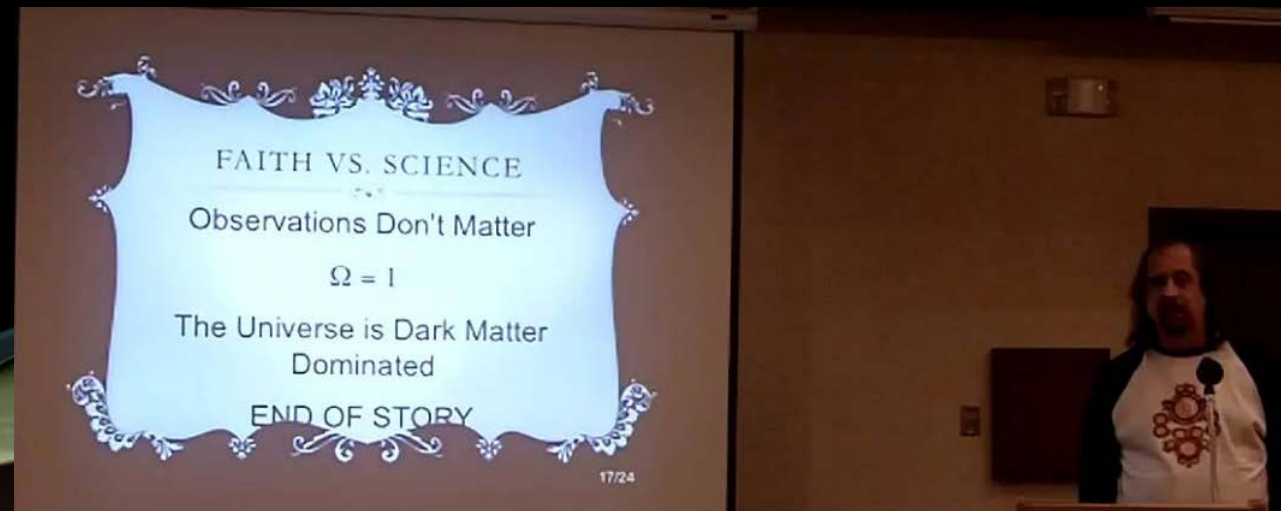


# EMERGENCY KEYNOTE STAND IN GUY WITH STUFF

G. Bothun, University of Oregon



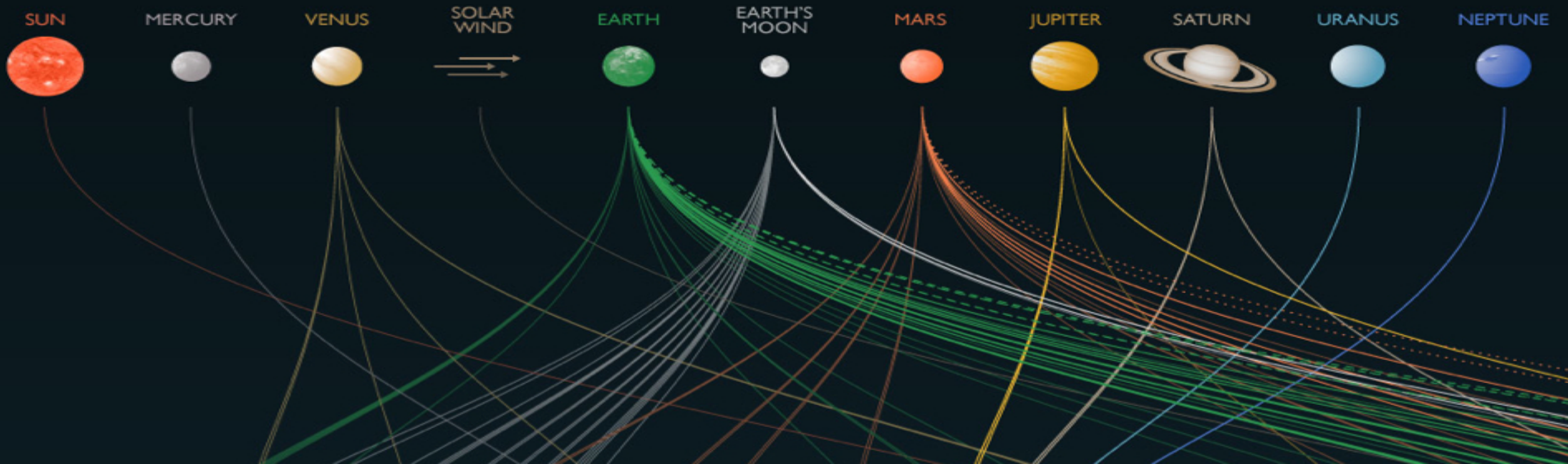
## BASIC OUTLINE OF STUFF

- New Nasa missions and new Big Data
- It's a New World now but still constrained by the old
- Science Literacy and Outreach – the need for a new perspective and approach

# Missions to Earth are becoming important

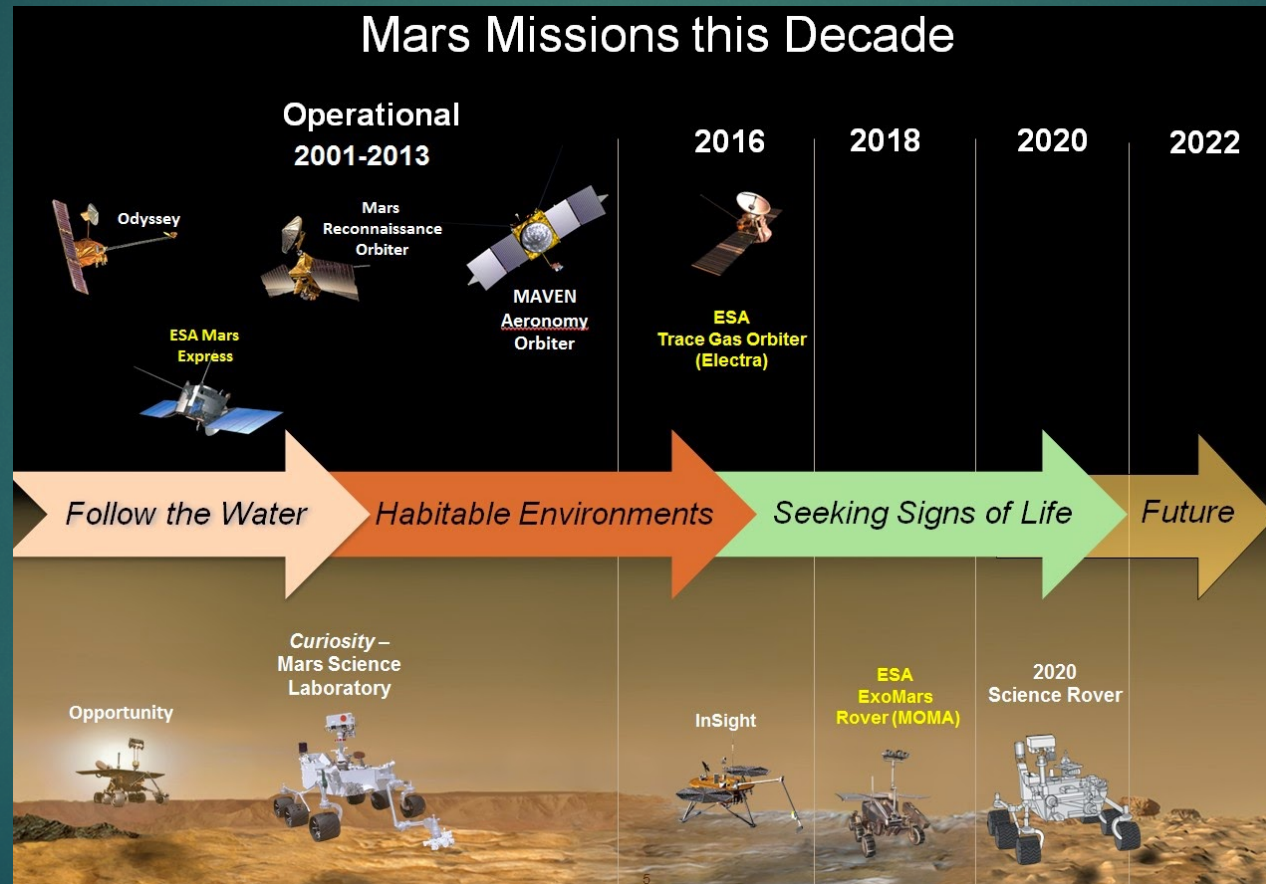
## JPL MISSION HISTORY

over 100 missions launched  
mission launch date x area of study  
past / present / future / proposed





# There is a good story here about exploration and instrumentation

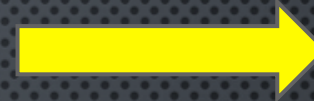




# Exoplanet Missions

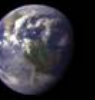


The Story of Life may indeed be Universal (as scientifically expected)



LITERACY TEST

## Potentially Habitable Exoplanets



Earth



Gliese 667C c



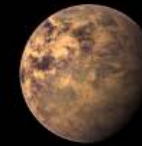
Kepler-62 e



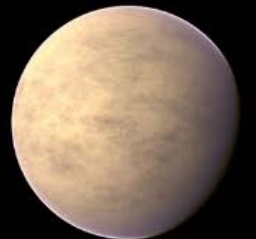
Tau Ceti e\*



Gliese 581 g\*



Gliese 667C f



HD 40307 g



Gliese 163 c



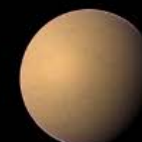
Kepler-61 b



Kepler-22 b



Kepler-62 f



Gliese 667C e



Gliese 581 d



# Actual Launch was Jan 17, 2016 – data now starting to come in

## Jason 3



**LAUNCH DATE**  
2015

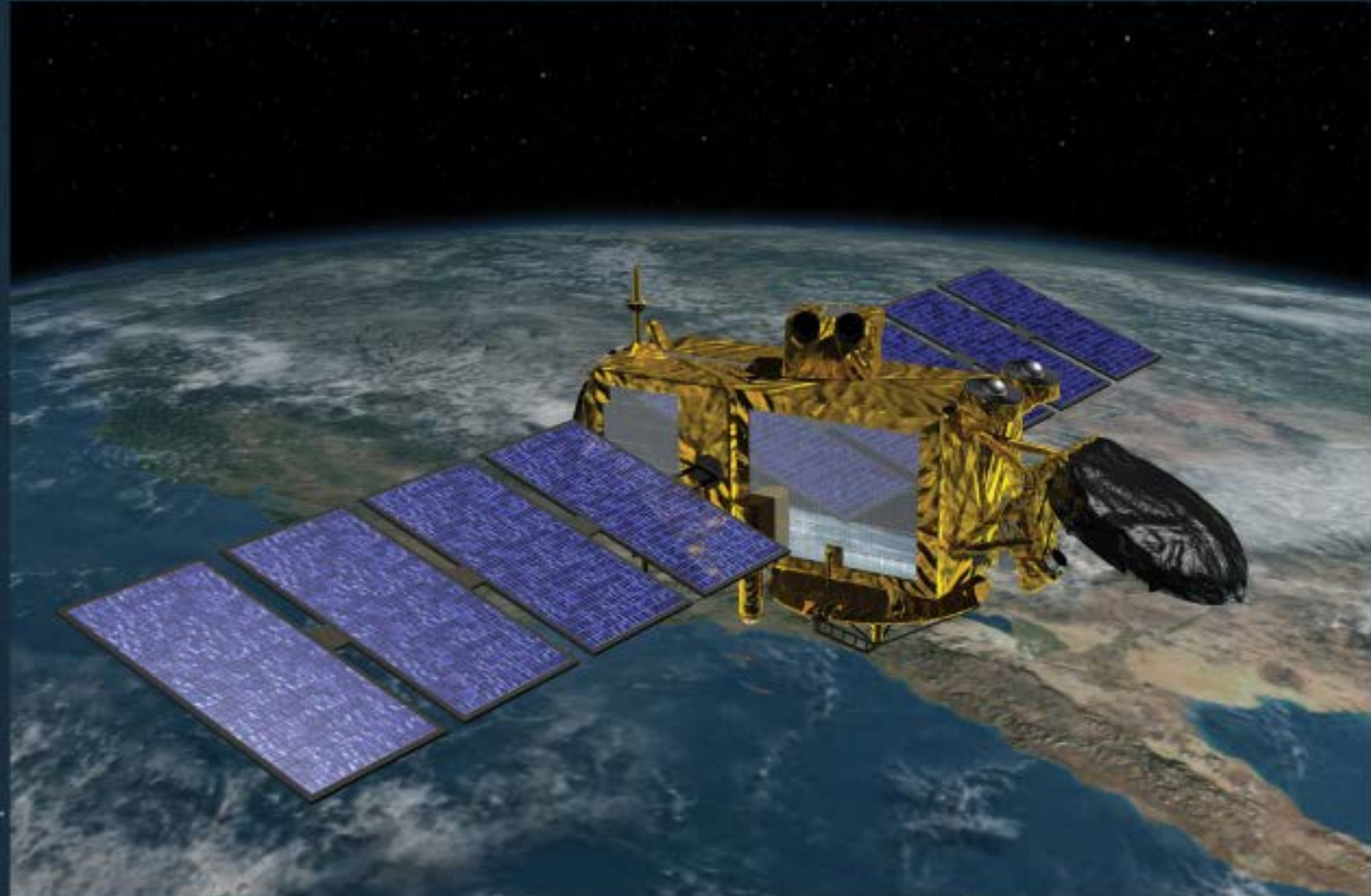


**DESTINATION**  
Earth Orbit



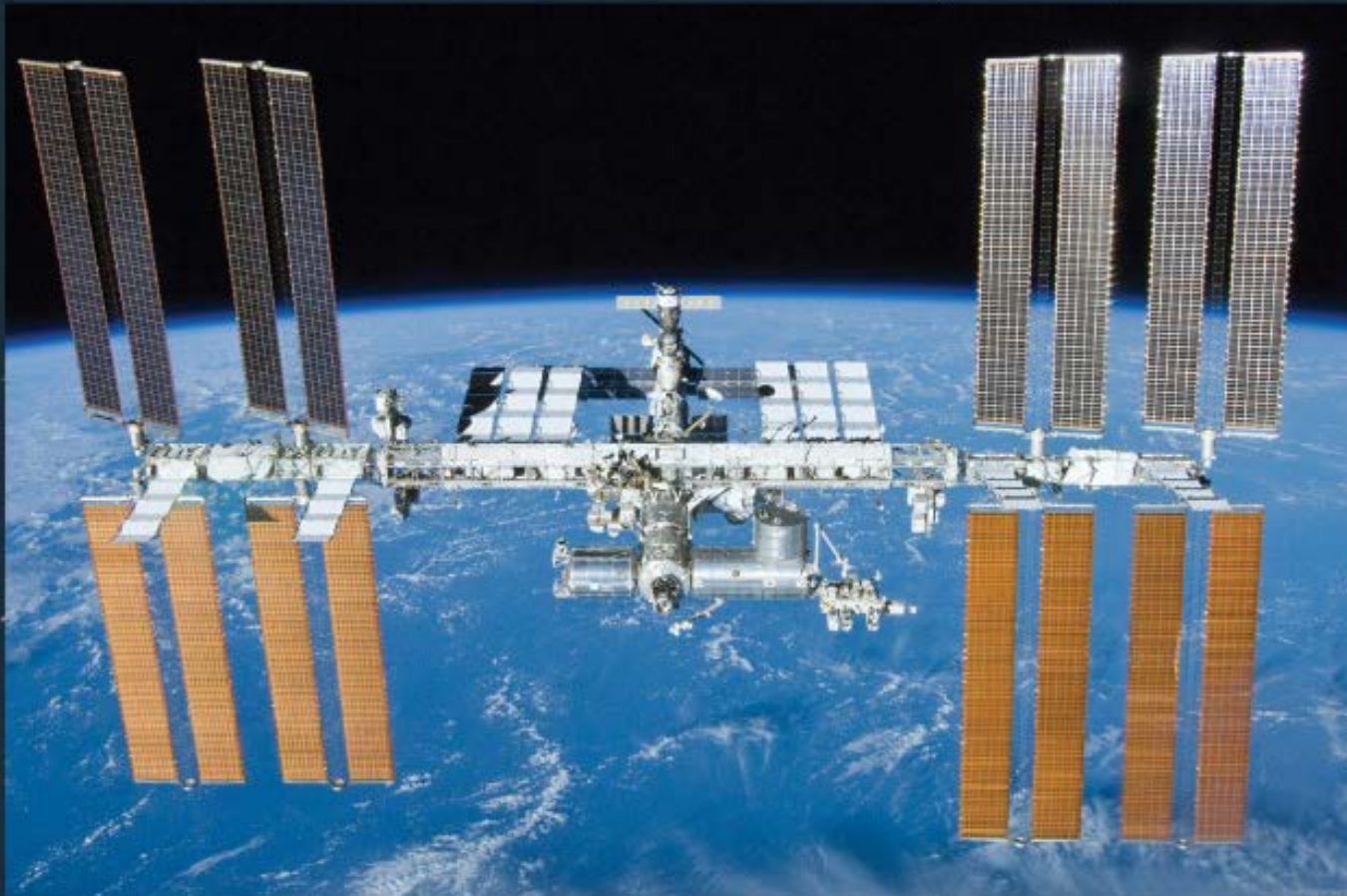
### MISSION

Extending the timeline of ocean surface topography measurements begun by the Topex/Poseidon and Jason 1 and 2 satellites, Jason 3 will make highly detailed measurements of sea-level on Earth to gain insight into ocean circulation and climate change.





# Expected Launch June 2017 – instruments still being calibrated



## Cold Atom Laboratory (CAL)



### LAUNCH DATE

April 21, 2016



### DESTINATION

International Space Station



### LAUNCH LOCATION

Cape Canaveral Air Force Station,  
Florida

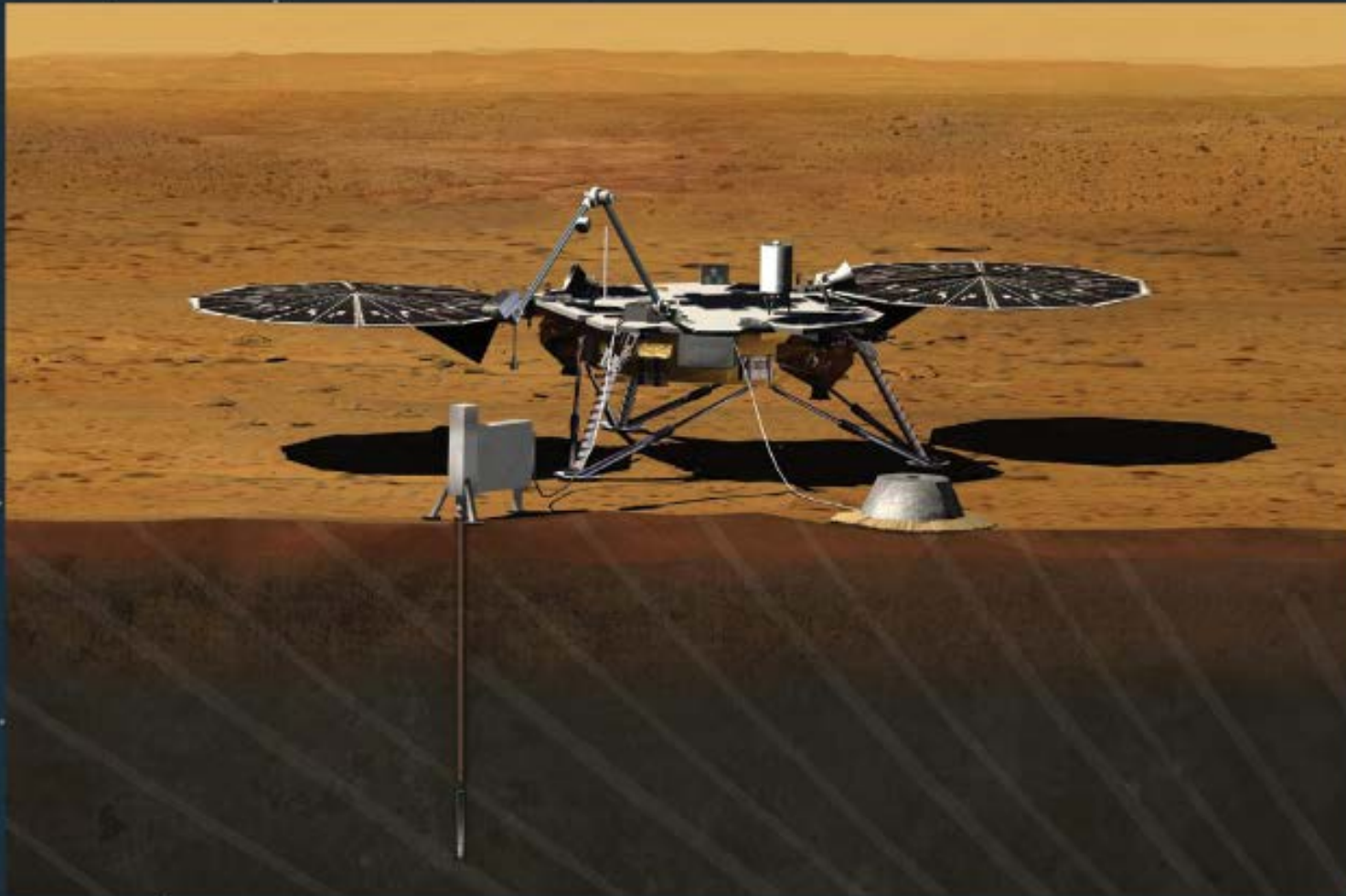


### MISSION

A facility designed to fly aboard the International Space Station, the Cold Atom Laboratory, or CAL, will make use of the space station's unique microgravity environment to observe quantum phenomena that would otherwise be undetectable from Earth.



# Now suspended to May 2018



## InSight



### LAUNCH DATE

March 2016



### DESTINATION

Mars



### MISSION

The InSight mission (formerly called GEMS), will place a lander on Mars designed to drill beneath the surface and investigate the planet's deep interior to better understand Mars' evolution as a rocky planet. As part of its investigation, InSight will use a seismometer and a heat-flow probe to study the interior structure of the Red Planet.



# Timeline will likely be pushed back a couple more years

## Mars 2020



**LAUNCH DATE**  
2020

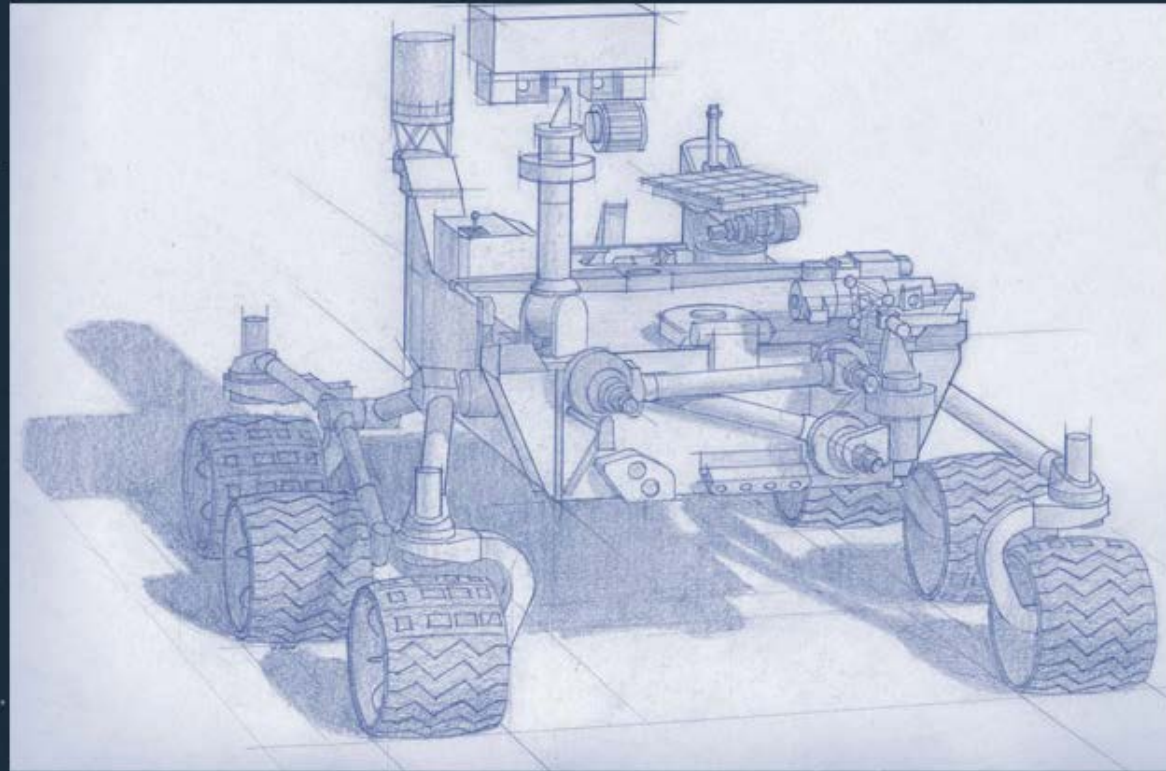


**DESTINATION**  
Mars



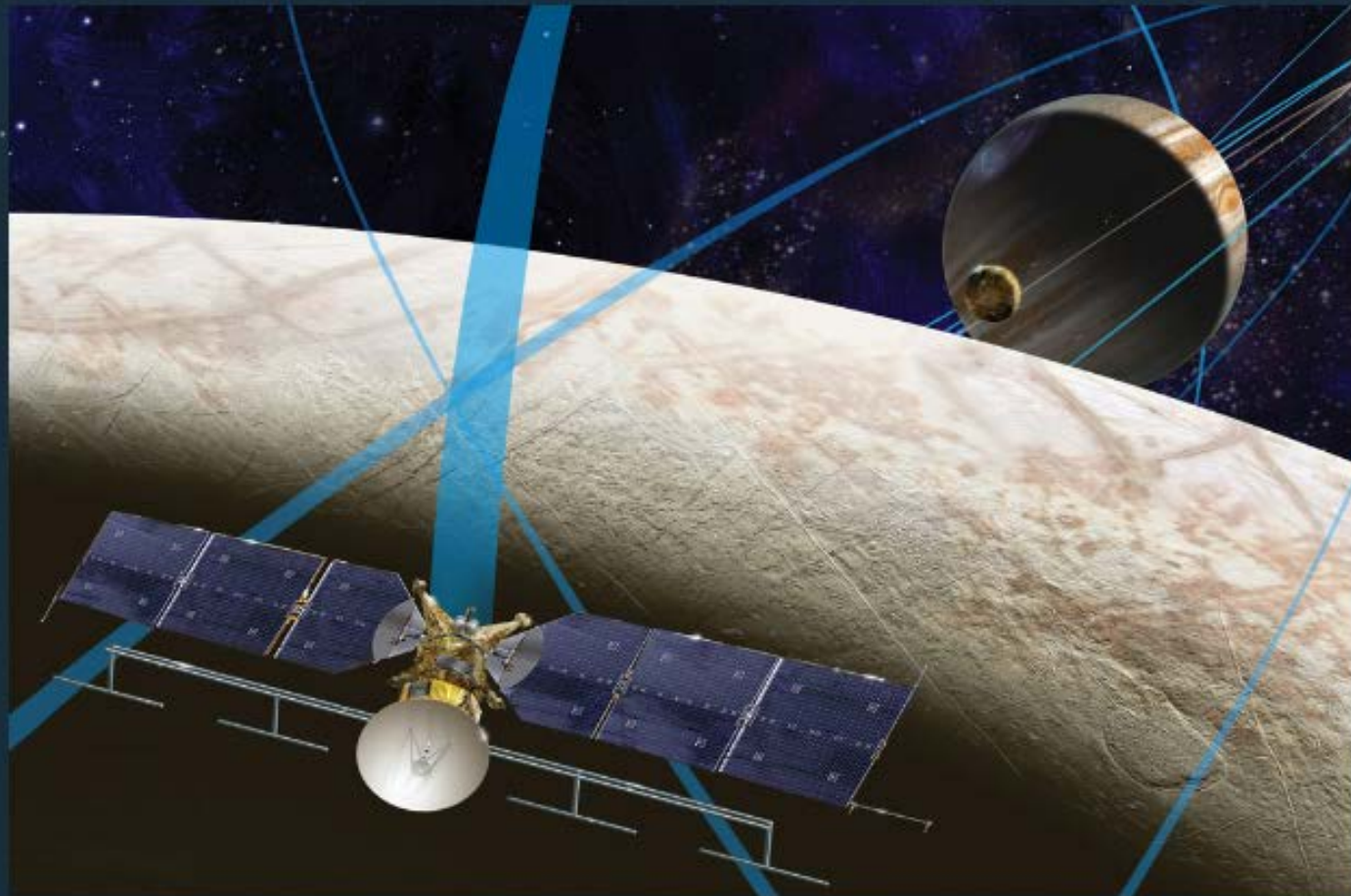
### MISSION

The Mars 2020 mission is a future rover designed to investigate key questions about the habitability of Mars, and assess natural resources and hazards in preparation for future human expeditions to the Red Planet.





# Part of the Discovery of Life Pathway



## Europa Mission



**LAUNCH DATE**  
TBD 2020's



**DESTINATION**  
Europa



### MISSION

The Europa mission will conduct detailed reconnaissance of Jupiter's moon Europa and investigate whether the icy moon could harbor conditions suitable for life.



# Earth Monitoring Mission

## Orbiting Carbon Observatory 3 (OCO-3)



**LAUNCH DATE**  
TBD



**DESTINATION**  
Earth Orbit



### MISSION

The Orbiting Carbon Observatory 3, or OCO-3, is a future space instrument designed to investigate important questions about the distribution of carbon dioxide on Earth as it relates to growing urban populations and changing patterns of fossil fuel combustion.





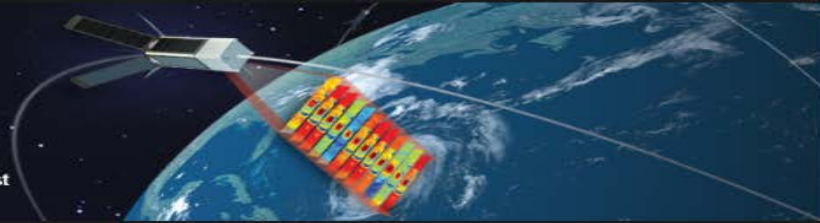
# CubeSat Array - key to understanding hurricane evolution



**Time-Resolved Observations of  
Precipitation structure and storm  
Intensity with a Constellation of Smallsats**

**MIT Lincoln Laboratory** (proposing organization)

William J. Blackwell, Principal Investigator. Scott Braun (NASA GSFC), Project Scientist



## Resources

[Mission Overview](#)

[Science Objectives and  
Significance to NASA/NOAA](#)

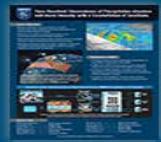
[The MicroMAS-2 CubeSat](#)

[TROPICS Mission  
Implementation](#)

[Latest News and Updates](#)

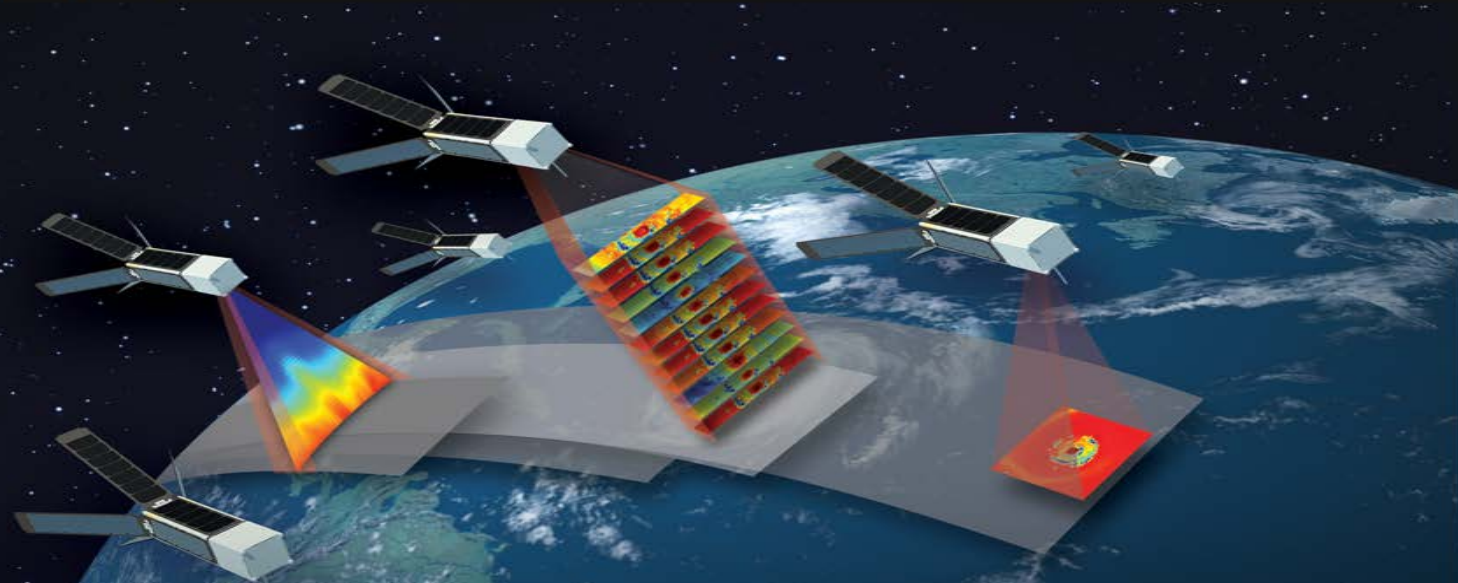
[References](#)

## Summary



Fact Sheet

## Mission Overview



12 identical 3U CubeSats provide sounding (left CubeSat has a temperature profile of a simulated Tropical Cyclone (TC) from a numerical weather prediction (NWP) model) and 12-channel radiometric imagery (center CubeSat has simulated radiances from NWP model and radiative transfer model and the near right CubeSat has a single-channel radiance image of a TC) with 30-minute median revisit rate to meet most PATH requirements.



# Launch for sure – also key to understanding tropical storm evolution – can take data similar to scale of simulations

## CYGNSS Mission

### NASA's Weather Prediction Project

The Cyclone Global Navigation Satellite System (CYGNSS) aims to improve extreme weather prediction.

CYGNSS will use a constellation of eight small satellites carried to orbit on a single launch vehicle. In orbit, CYGNSS's eight micro-satellite observatories will receive both direct and reflected signals from Global Positioning System (GPS) satellites. The direct signals pinpoint CYGNSS observatory positions, while the reflected signals respond to ocean surface roughness, from which wind speed is retrieved.

The mission will study the relationship between ocean surface properties, moist atmospheric thermodynamics, radiation and convective dynamics to determine how a tropical cyclone forms and whether or not it will strengthen, and if so by how much. This will advance forecasting and tracking methods.

### Count Down to CYGNSS Launch

**52** | **15** | **35** | **45**  
DAYS | HOURS | MINUTES | SECONDS

November 21, 2016

Launch Window Open at 06:00 EST on 21 Nov 2016

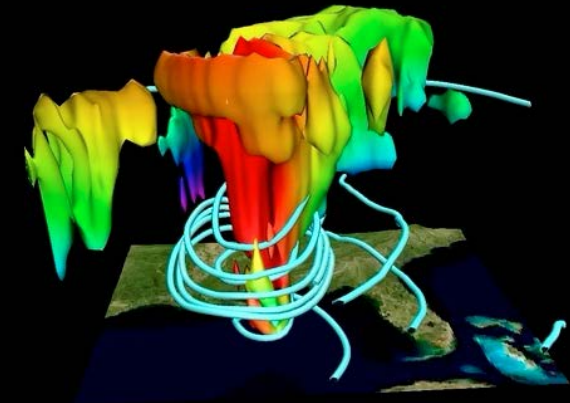
### CYGNSS Team

University of Michigan Department of Atmospheric,  
Oceanic & Space Sciences  
Principal Investigator: C. Ruf

Constellation Scientist: A. Ridley  
Southwest Research Institute  
Project Manager: J. Scherrer  
Project Systems Engineer: R. Rose  
Spacecraft Lead: J. Eterno  
Mission Operations Lead: J. Redfern

Surrey Satellite Technology, U.S.  
DDMI Program Manager: G. Hockenberry

Sierra Nevada Corporation  
Deployment Module Lead: W. Boyd





100



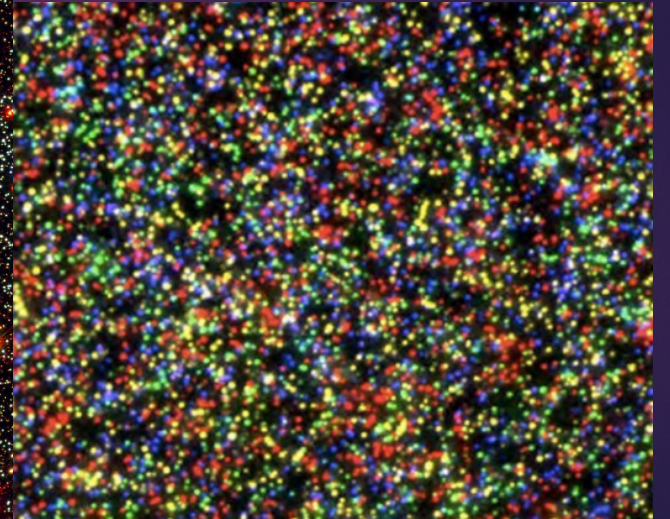
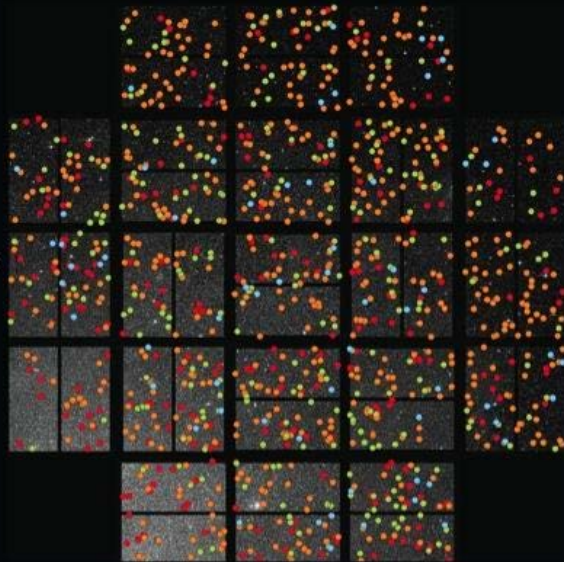


# Big data, discovery and new kinds of Astronomy – are we prepared?

## MOVING TO THE TEMPORAL DOMAIN

### Locations of Kepler Planet Candidates

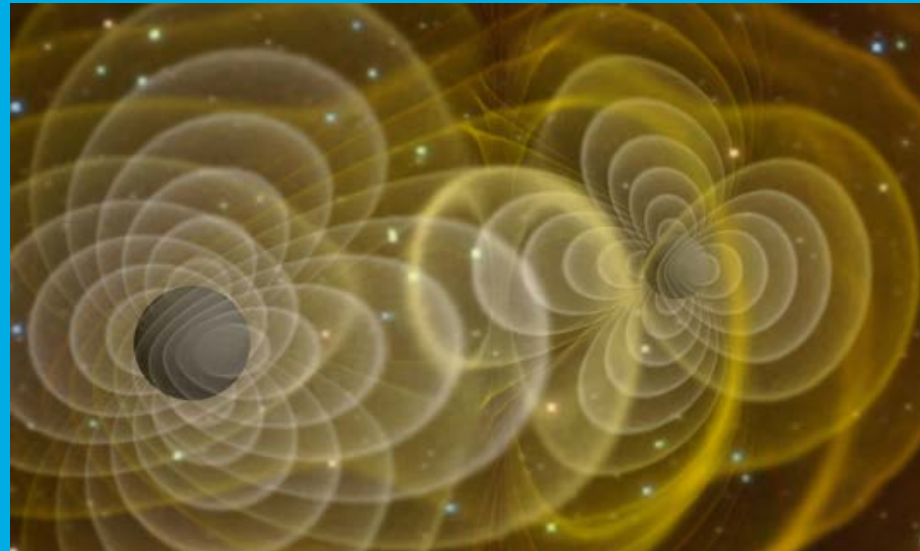
- Earth-size
- Super-Earth size  
1.25 - 2.0 Earth-size
- Neptune-size  
2.0 - 6.0 Earth-size
- Giant-planet size  
6.0 - 22 Earth-size



# DISCOVERY IN ASTRONOMY

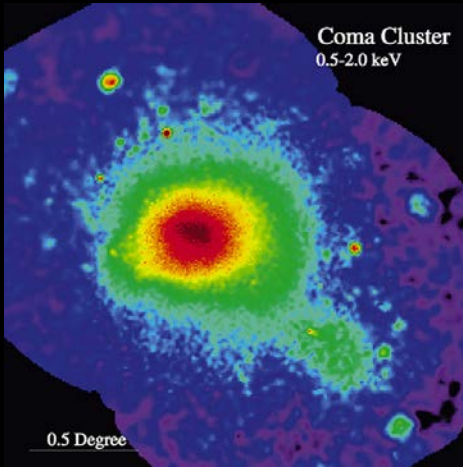
- Has almost always progressed by building new Detectors (Not Necessarily Large Apertures!) and opening up new wavelengths to survey the Universe.
- The Universe reveals most of its interesting physics in wavelengths other than the optical regime
- The New Gravitational Wave Source Discovered in 9/2015 is an excellent example

Unforeseen objects now exist In this “known” Universe – outreach has emphasized the triumph but not the discovery of these new objects

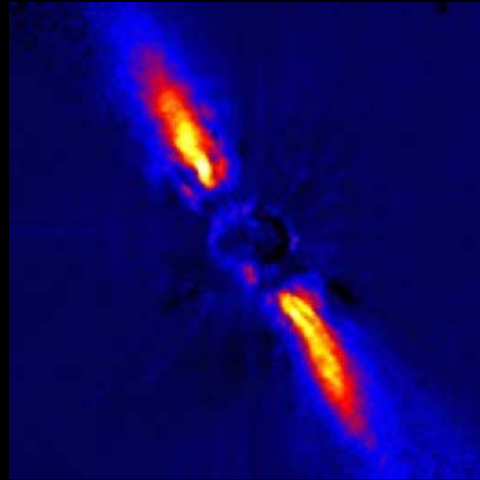




# DISCOVERY MILESTONES



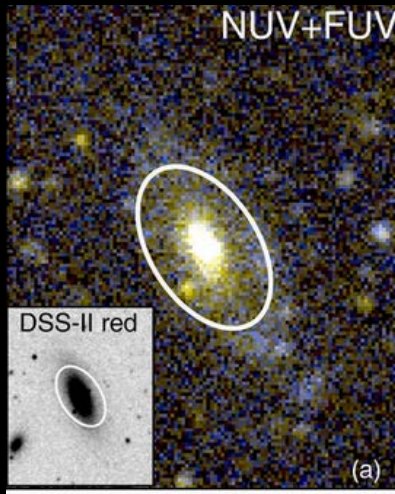
X-Ray Clusters



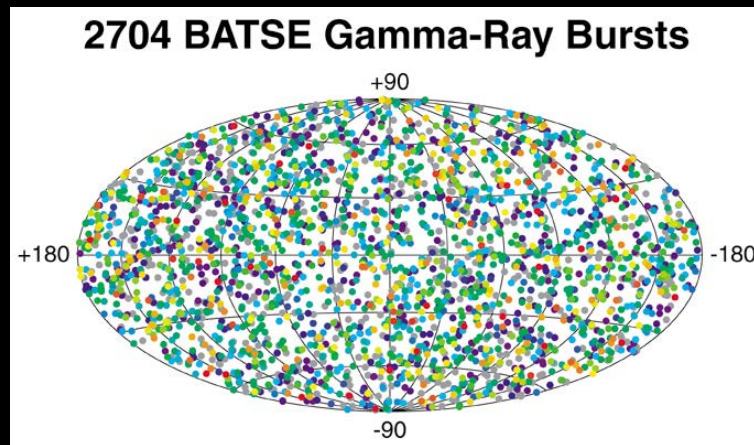
Dusty Proto-planet  
Disks



New Kinds of  
Galaxies



XUV Disks

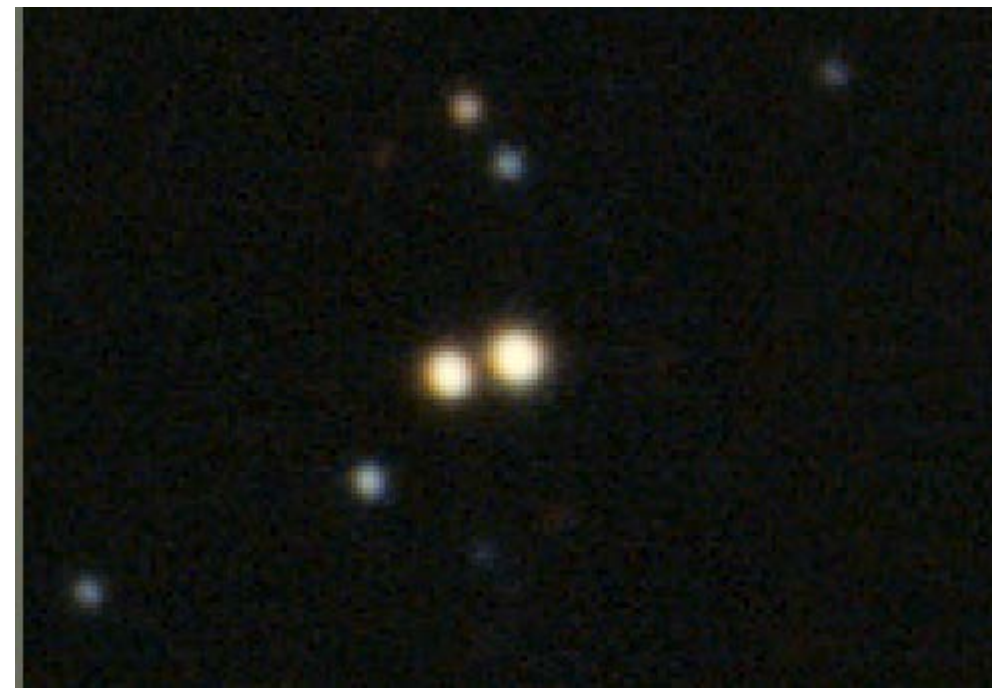


The Gamma Ray Universe



# Too many pixels, too little Screens

- ▶ A 36 million pixel image (displayed here on 1 million pixels)





35 Million Pixel Native Resolution – 1 cm per pixel





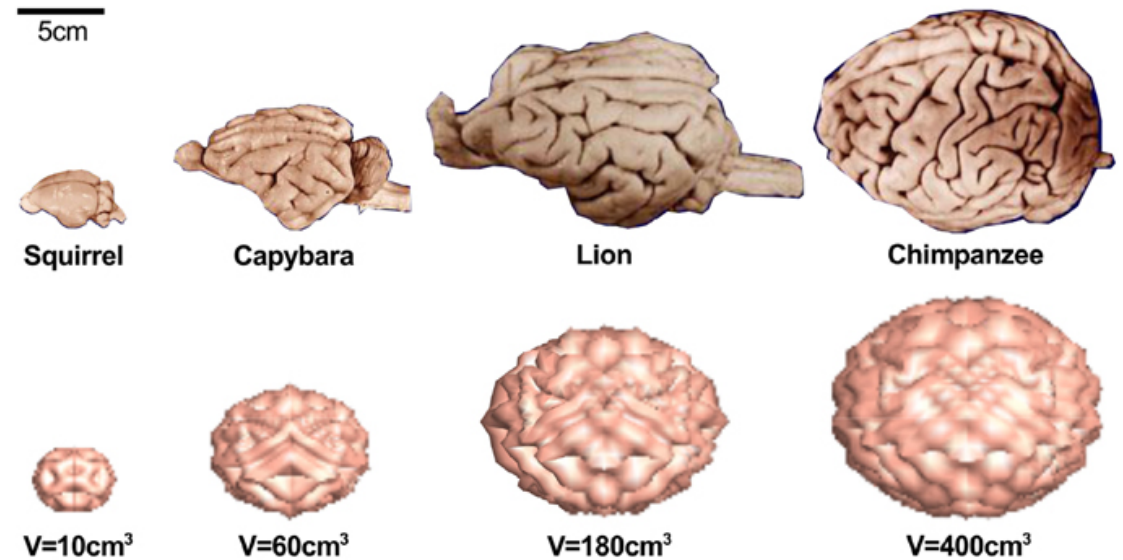
# Coming to the UO



50  
Million  
pixels



# Okay Great, Can I get a bigger Brain? – This is the principal limitation with Big Data

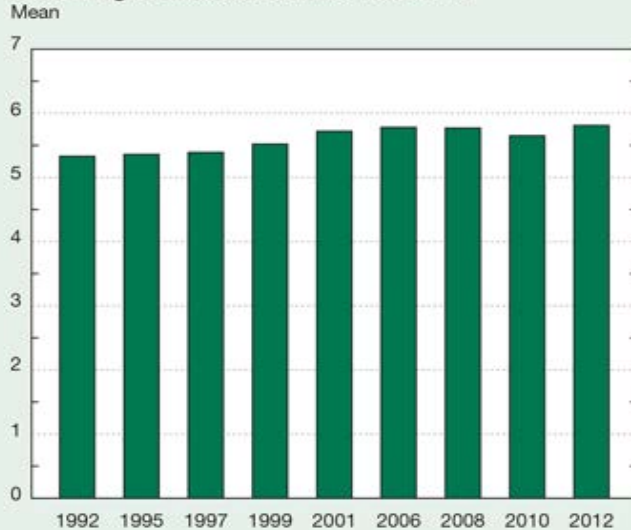




# Science Literacy – what is it? How do we improve it?

PRINT CLOSE

Figure 7-6  
Mean number of correct answers to trend factual knowledge of science scale: 1992–2012



NOTES: Mean number of correct answers to the nine questions that are included in the trend factual knowledge of science scale; see appendix table 7-8 for explanation, list of questions, and percentage of questions answered correctly. See appendix tables 7-9 and 7-10 for responses to individual questions.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, Survey of Public Attitudes Toward and Understanding of Science and Technology (1992–2001); University of Chicago, National Opinion Research Center, General Social Survey (2006–12).

Science and Engineering Indicators 2014

## Overview of Knowledge Questions Related to Earth Sciences and Energy Issues

% answering each item correctly

	U.S. adults	HS or less	Some college	College grad	Postgrad degree	Men	Women	Source
<b>Science in the news/daily life</b>								
The most electricity in the U.S. comes which source: coal	49	36	52	61	69	59	40	ATP (wave 5) 2014
Which natural resource is extracted in fracking: natural gas	51	39	53	61	75	58	45	Mar. 7-10, 2013
U.S. energy output has been ... increasing (2014)	54	44	54	63	74	61	47	Dec. 3-7, 2014
Gas believed to cause rising temperatures: carbon dioxide	71	64	69	80	89	83	60	Aug. 15-25, 2014
Ocean tides are created by ... gravitational pull of moon	76	65	79	90	91	83	71	ATP (wave 6) 2014
Which may cause a tsunami: an earthquake under the ocean	77	67	83	88	88*	80	74	June 18-21, 2009
Element needed for nuclear energy/weapons is uranium	82	73	85	93	94	90	75	ATP (wave 6) 2014
<b>Textbook knowledge</b>								
Which gas makes up most of the Earth's atmosphere: nitrogen	20	12	22	28	36	27	14	Mar. 7-10, 2013
The continents have been moving over millions of years and will continue to move (true)	77	68	83	83	87	83	72	Mar. 7-10, 2013
Identify hottest layer of Earth as the core (with labeled image)	86	79	89	93	93	89	84	ATP (wave 6) 2014

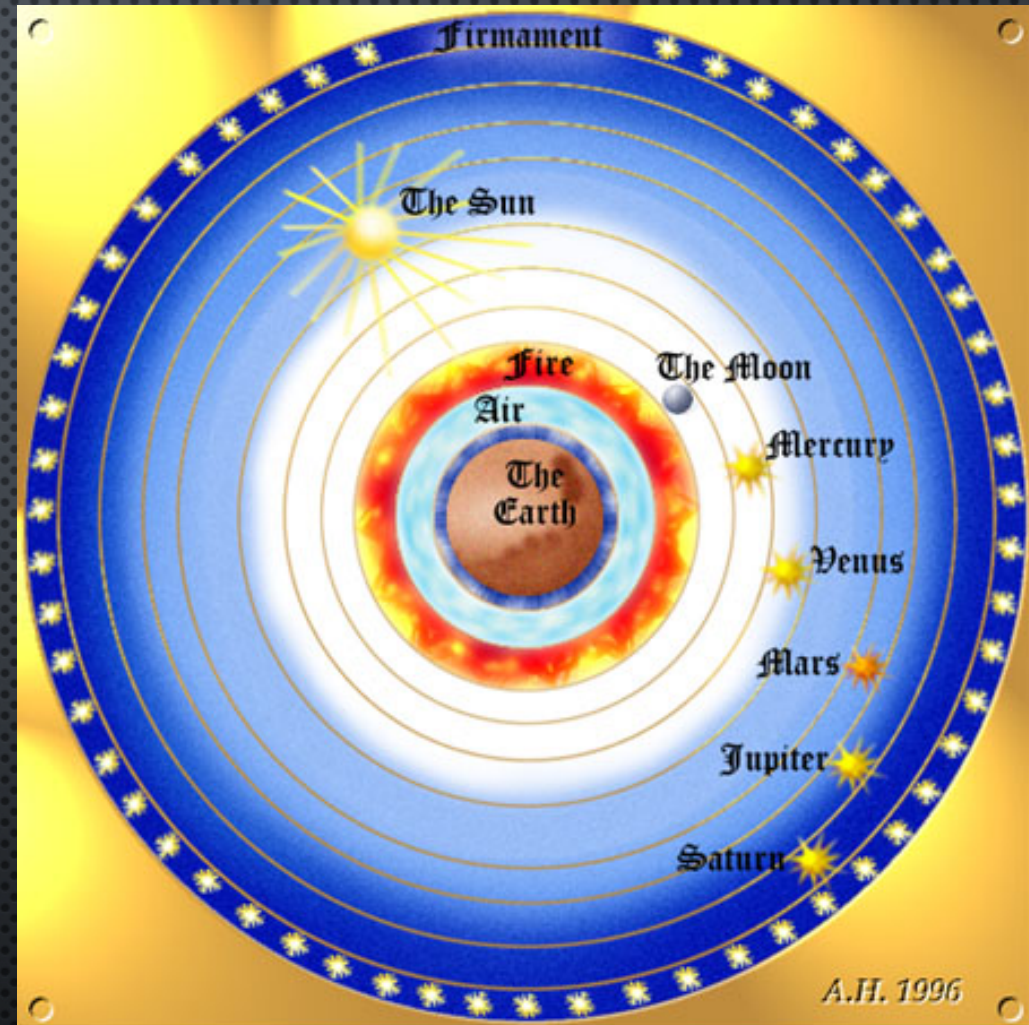
# Outreach Oregon "O" Style





Once upon a Time:

- Everything Was Known
- Every thing was Simple
- Every thing was logical and ordered
- Uncertainty DID NOT EXIST
- Tell the people the Known Truth
- Impress people with how clever we are And how impressive science is, since we have figured it all out

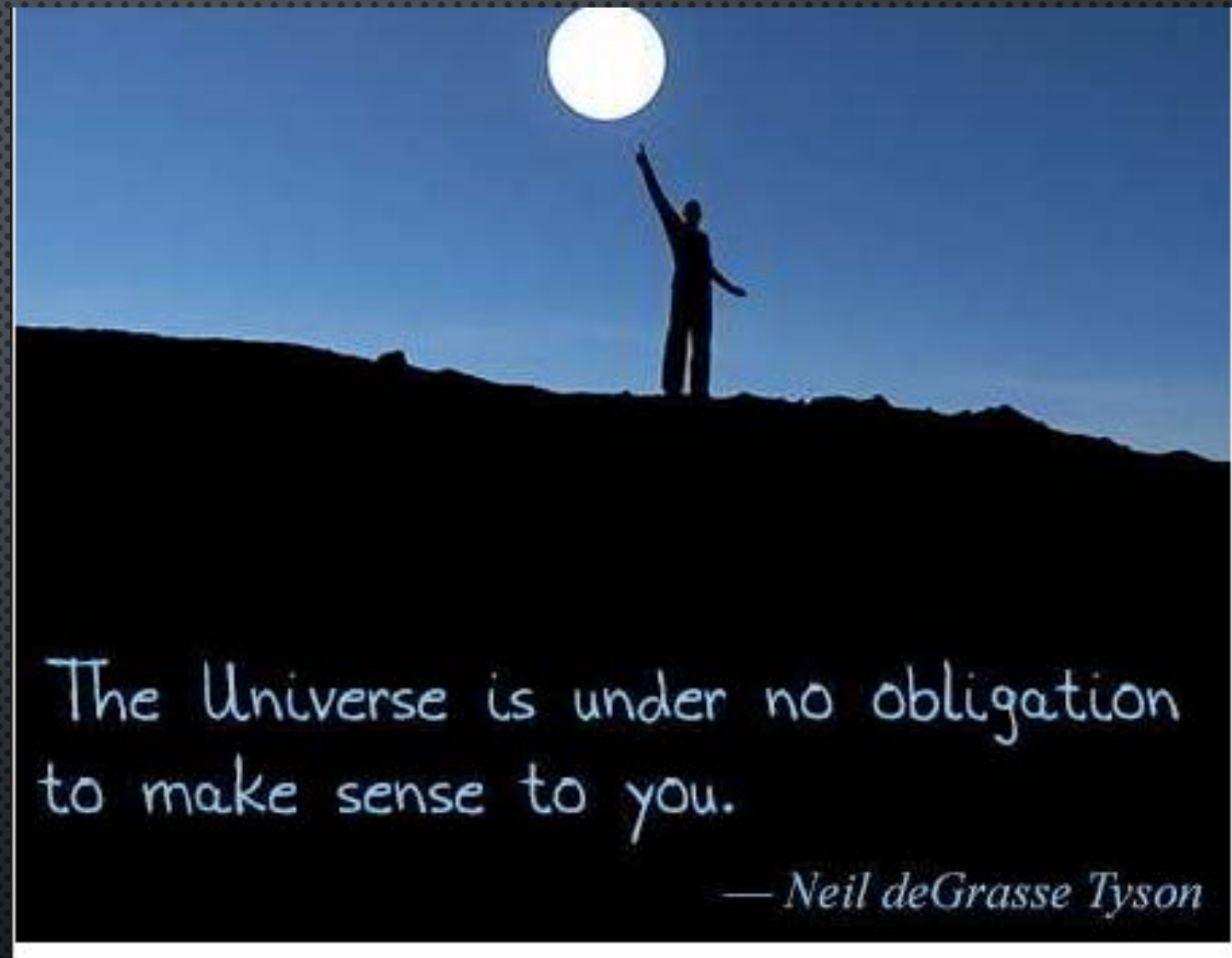




Yet Science is NOT a pathway to the truth – in fact, just the opposite – Science is a process that maps out everything which is unknown.

Science is a process that should produce humility not a process that produces arrogance because we think we understand everything

The current management of the planet is very arrogant – this needs to change – this is the big picture of science literacy



The Universe is under no obligation to make sense to you.

— Neil deGrasse Tyson





Most people when they visit the beach look out upon the vast ocean and reflect.

Is this an ocean of Truth or an ocean of the unknown; is it an ocean of opportunity? - certainly it is an ocean of exploration

Science is the process of exploration that maps out the uncertainty - Science literacy is the understand of that as the mission of Science

Outreach should stress this at all times