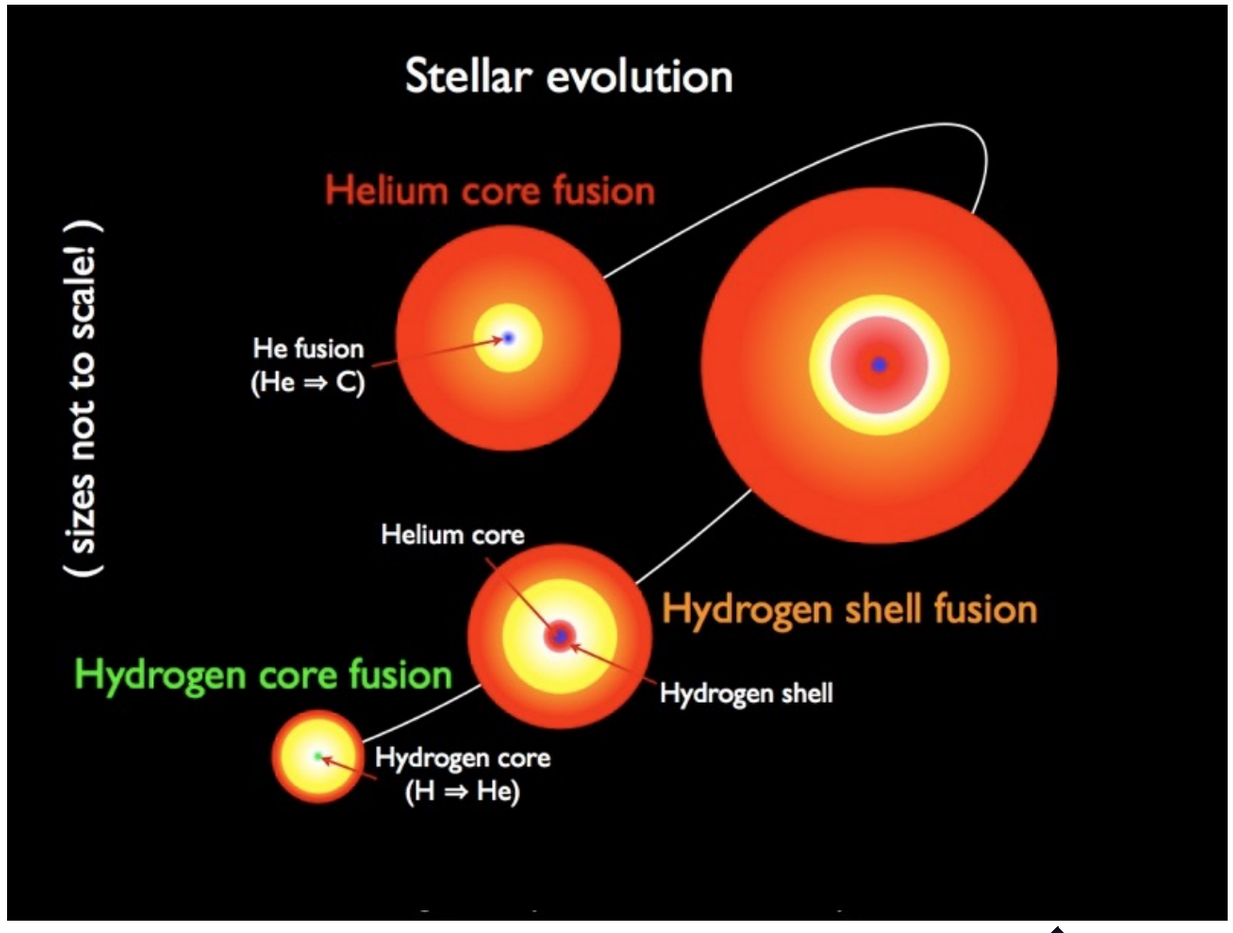
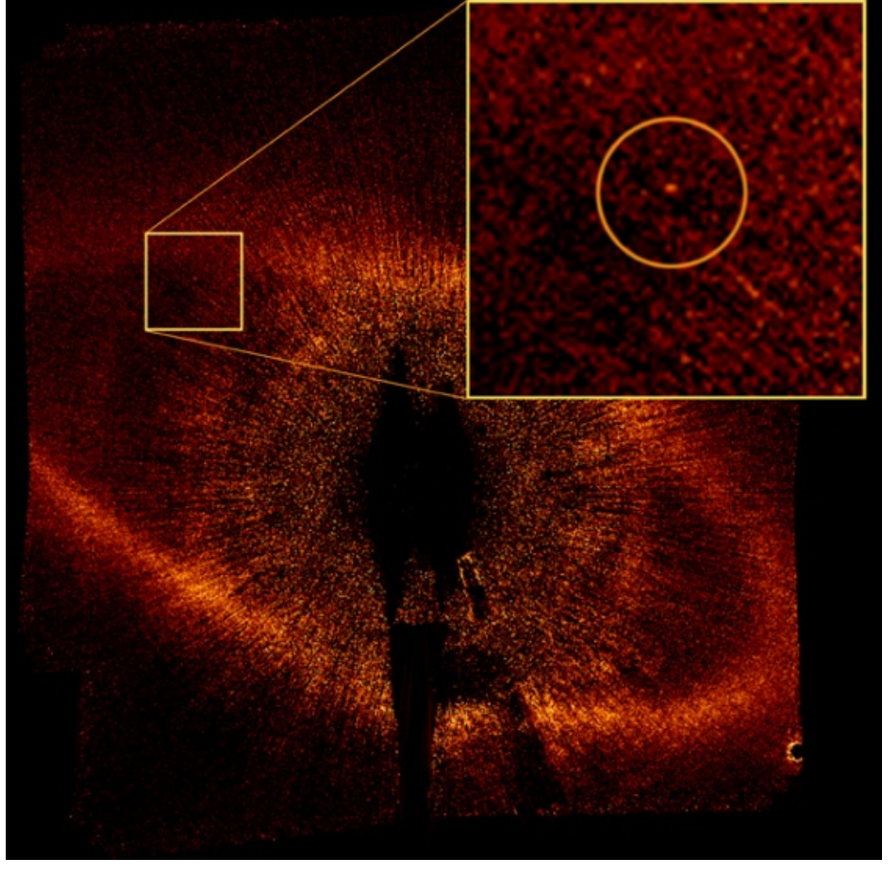
AST31 - Stellar Structure and Evolution

AST-31 is a course **intended for students with a background in physics and/or astronomy and mathematics and a strong interest in astronomy**. The course will cover the following topics: interaction of light and matter, telescopes, stellar structure, stellar evolution, inter-stellar medium, exoplanets, and formation of planetary systems. The course will also include assignments involving the use of computers.

May be used to satisfy the concentration requirements for major and minors in the Department of Physics and Astronomy.

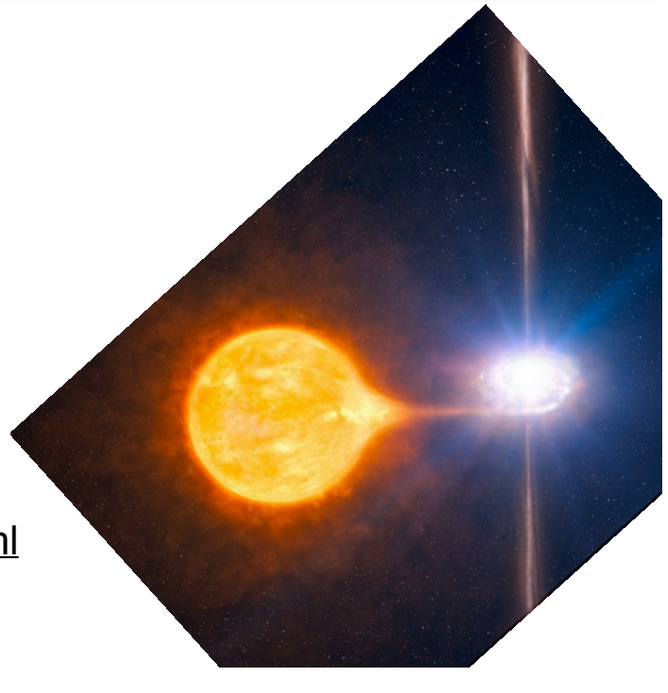
Prerequisites: **PHY11/12 or consent of instructor.**





WHEN: Fall 2020, Block T+: TueThu, 9:00-10:15am
WHERE: Zoom
Contact: Prof. Danilo Marchesini

For more information:
email: danilo.marchesini@tufts.edu
http://cosmos.phy.tufts.edu/~danilo/AST31/AST31.html



Today's class

1. Brief description of the Astronomy group/research @ Tufts

2. Overview of the course, syllabus, schedule

3. Survey (15 min)

4. Q&A

Interested in doing research in Astronomy?

Contact:

Prof. Danilo Marchesini
(Danilo.Marchesini@tufts.edu)
http://cosmos.phy.tufts.edu/~danilo/

Prof. Anna Sajina
(Anna.Sajina@tufts.edu)
http://cosmos2.phy.tufts.edu/~asajina/

Astronomy Group

GRADUATE STUDENTS:
Cemile Marsan — defended Aug. 2017 —> now postdoc in Toronto
Andrea Silva-Bustamante — defended Jan. 2018 —> now postdoc in Tokyo
Nick Martis — defended Apr. 2020 —> now postdoc in Victoria (Canada)

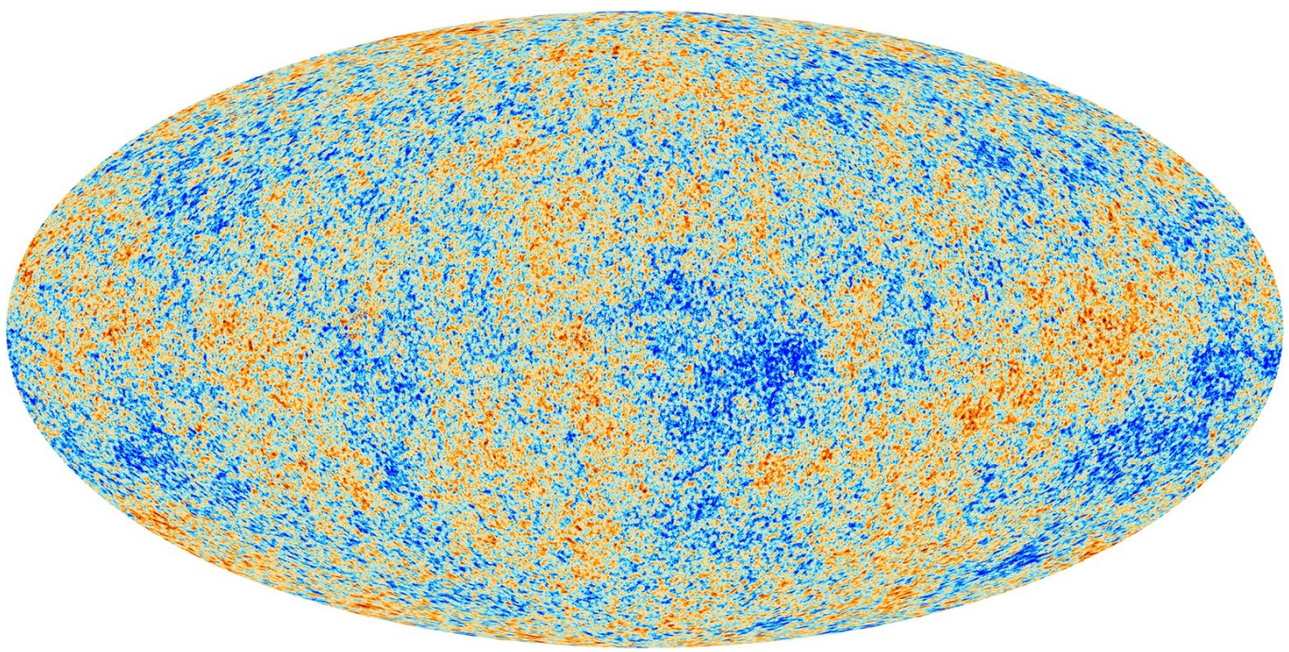
Kalina Nedkova (6th-yr)
Kumail Zaidi (3rd-yr)
Max Kurzner (2nd-yr)
Mudit Garodia (2nd-yr)
Richard Pan (1st-yr)
Valentina La Torre (1st-yr)

UNDERGRADUATE STUDENTS (currently involved in research):

Lilianna Houston
Teddy Peña
Victor Soto-Castro
Jacob Whitney

How did the tiny fluctuations in the distribution of matter we see in the Cosmic Microwave Background Radiation grew into galaxies?

380,000 years after the Big Bang



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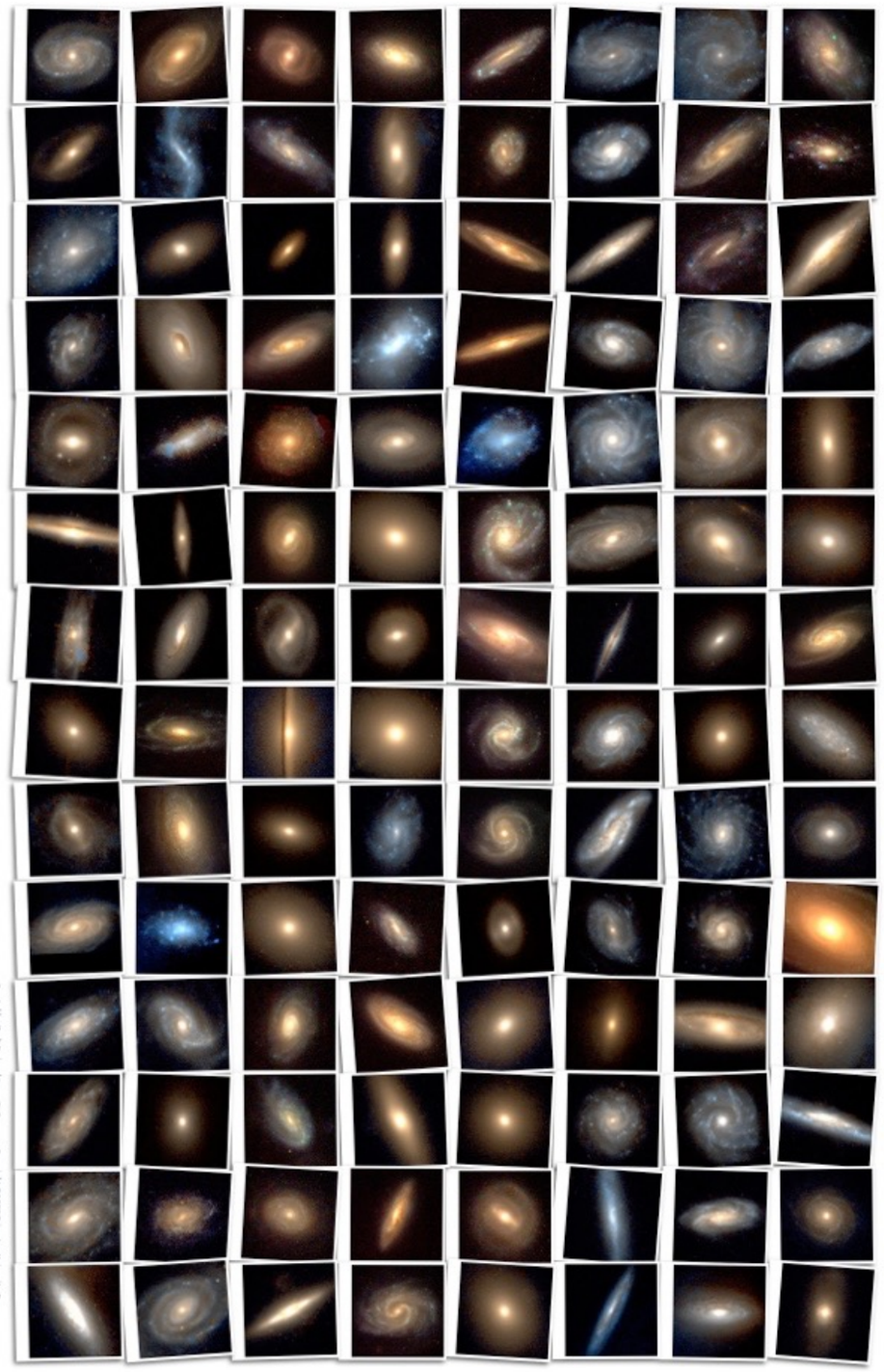


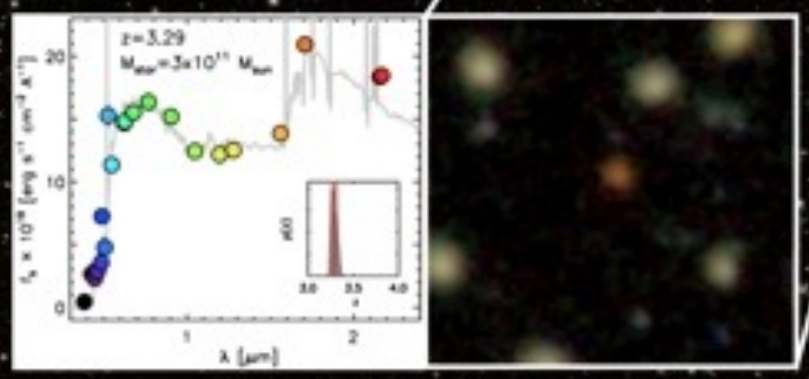
Today

Co-evolution of SMBH and host galaxy ?

Prof. Marchesini

Understanding how galaxies formed shortly after the Big Bang, and how they evolved with cosmic time.

To do this I search for and study the most distant galaxies in the universe...

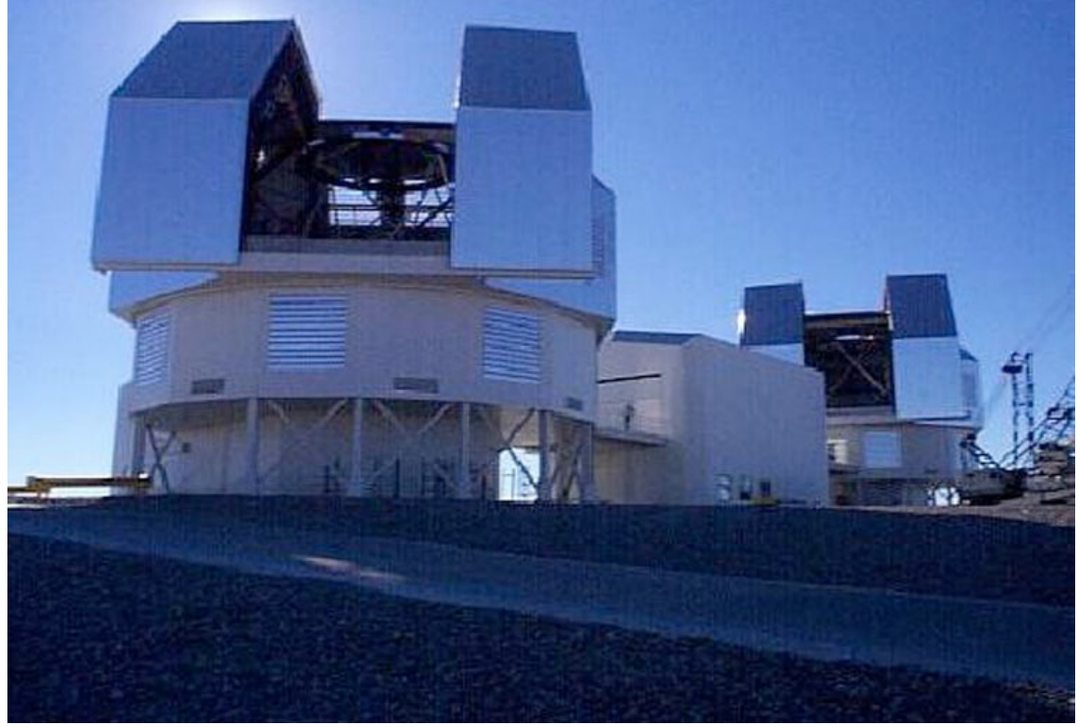


Hunting monsters:
searching for Very Massive Galaxies when the Universe was younger than 2 billion years old (Marchesini+2010)

Image credits: Danilo Marchesini (Tufts University)

KECK TELESCOPES: HAWAII

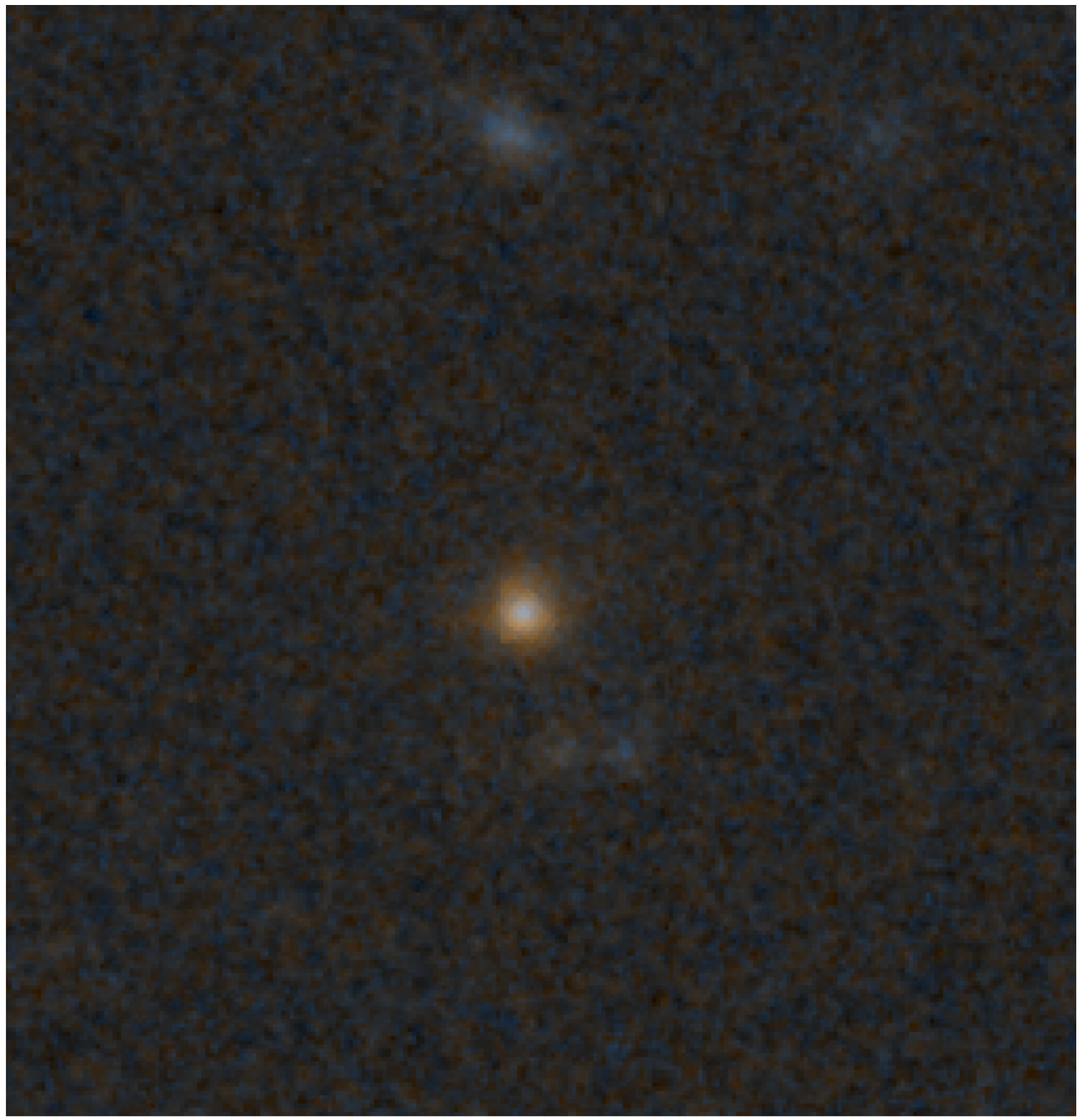
MAGELLAN TELESCOPE: CHILE



VERY LARGE TELESCOPES: CHILE

GRANTECAN: CANARY ISL., SPAIN

Confirmation of the Existence of Very Massive Galaxies in the Early Universe (Marsan+2015/2017)



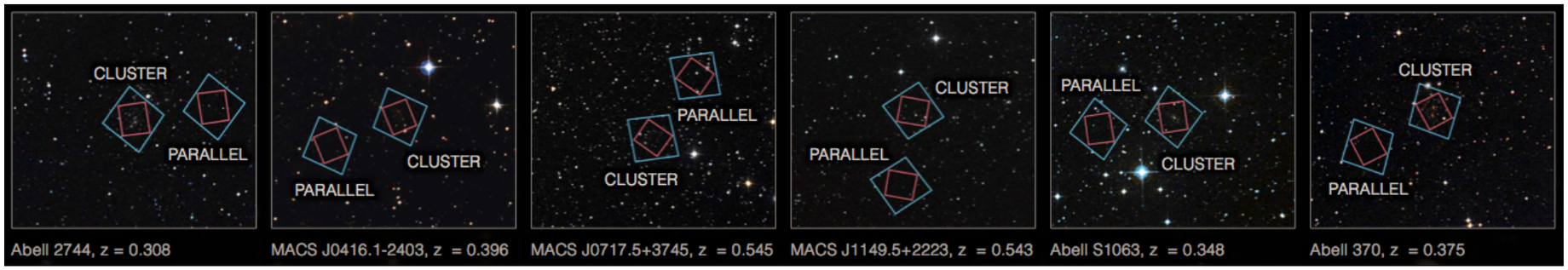
Stellar mass ~ 300 billion M_{Sun}
(4x more massive than MW)
when the Universe is only
~1.8 billion years old.

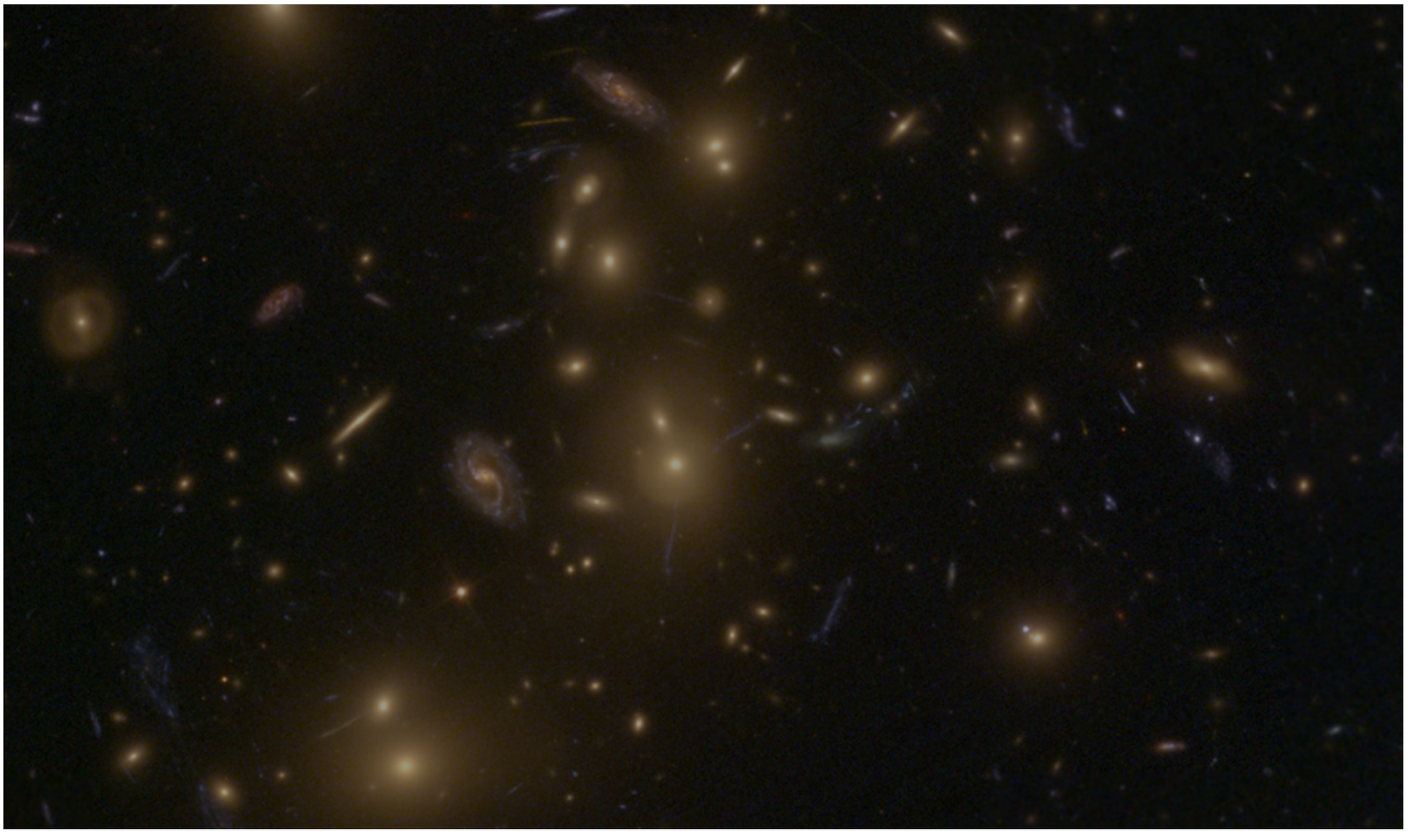
Age of stars in this galaxy
~ 400 million years

Most of the stars formed in a very short and intense burst of star formation

Collaboration expanded to include University of California - Riverside/Irvine + York University (Toronto, CA); tens of Keck nights awarded (Forrest+2020a/b)

The Hubble Frontier Fields program

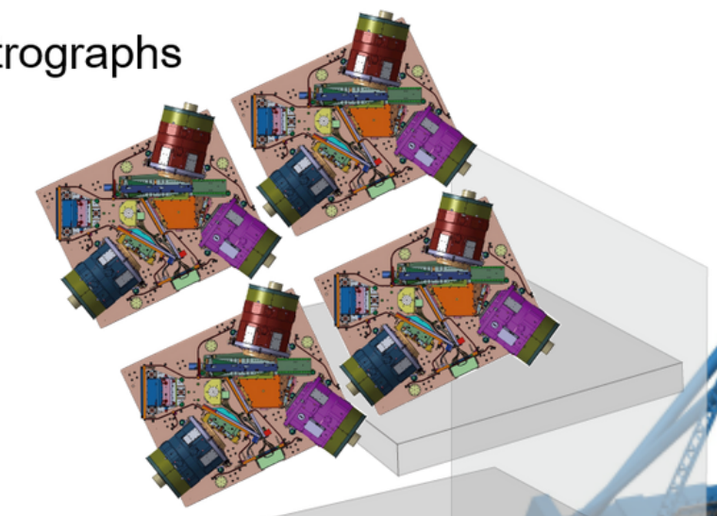




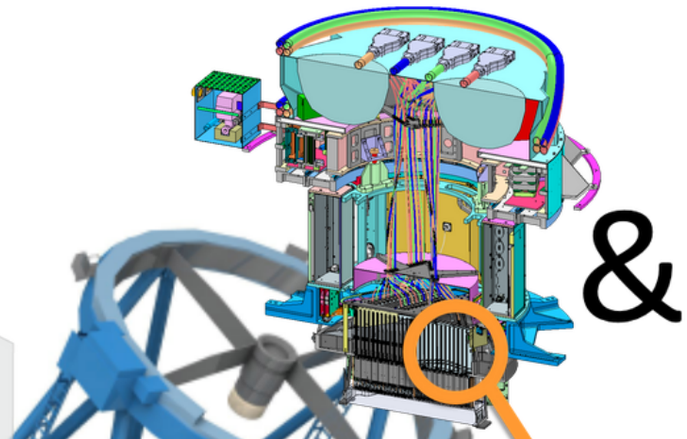
Catalogs published in Shipley et al. (2018) and used by Kalina+Victor for their projects

Prime Focus Spectrograph (PFS)

Spectrographs



Prime Focus Instrument

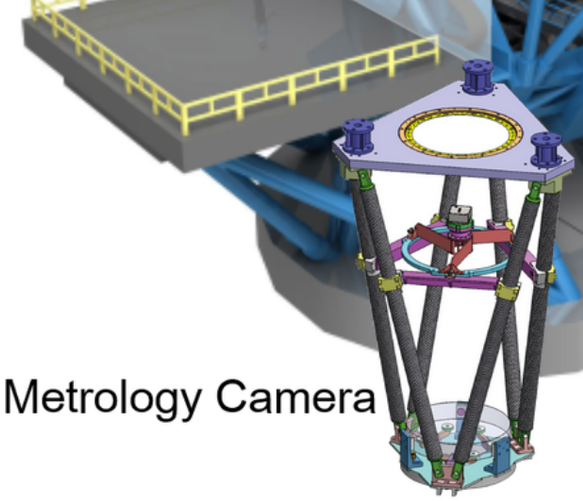


&

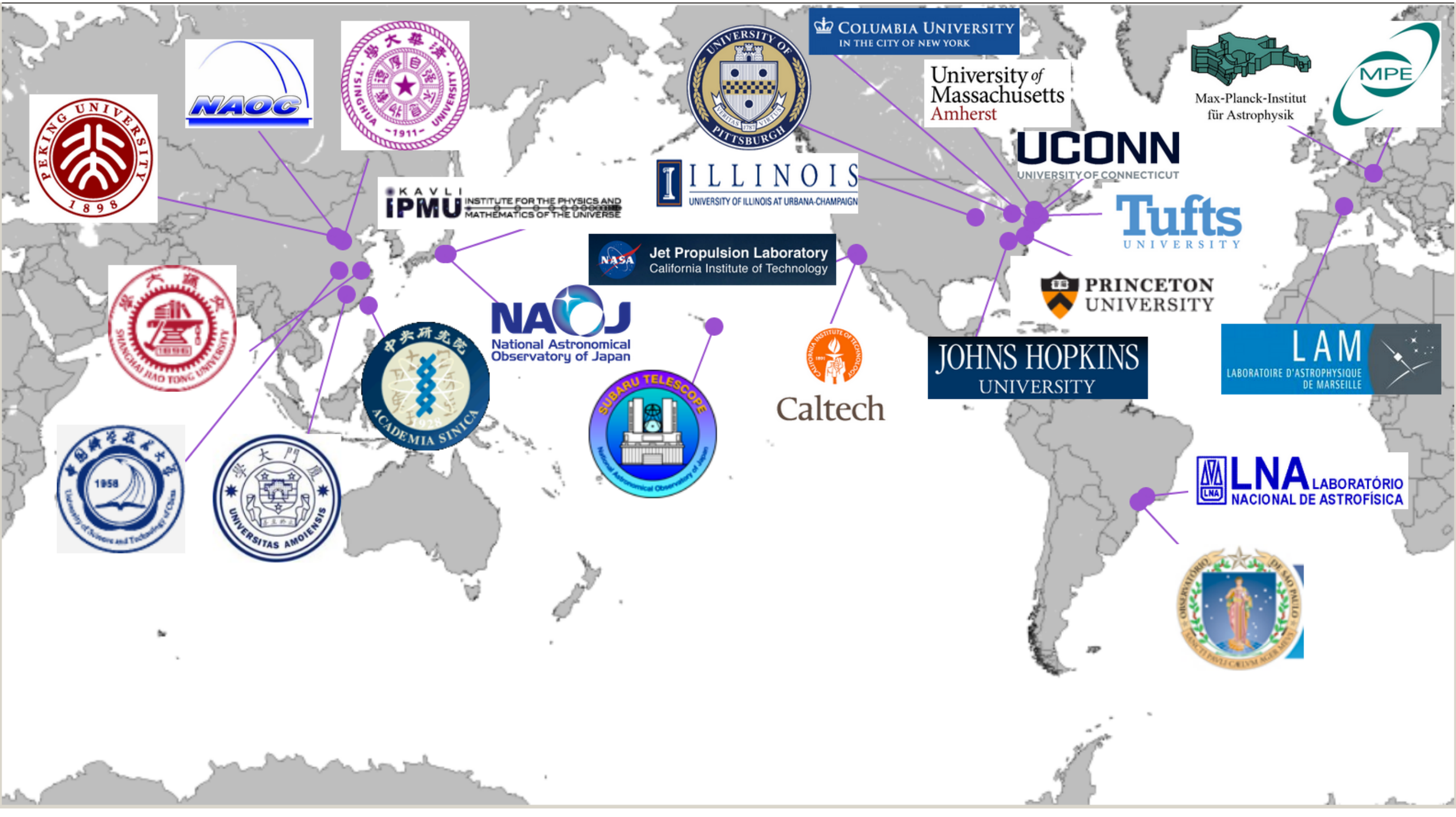
Wide Field Corrector

Fiber Positioner “Cobra”

Metrology Camera



Prime Focus Spectrograph



PFS Website: https://pfs.ipmu.jp/intro.html

Professor Anna Sajina
Astrophysics

My research involves studies of distant, dusty IR-bright galaxies. Galaxies like that often also host active galactic nuclei which are growing supermassive black holes. This research gives insight into how galaxies formed and evolved from the Big Bang to the present and what is the role of the supermassive black holes in the centers of galaxies.

Here are the tools I use in my research.....

Infrared telescopes like
the Spitzer Space Telescope

Radio telescopes, like the VLA
in New Mexico

Simulated observations based
on N-body galaxy simulations

And couldn't do without my trusty
laptop — astrophysics research
involves plenty of coding!

Interested in doing research in Astronomy?

Contact:

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(Danilo.Marchesini@tufts.edu)
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Prof. Anna Sajina
(Anna.Sajina@tufts.edu)
http://cosmos2.phy.tufts.edu/~asajina/

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ASSIGNMENT for Lecture 2 (Thursday, September 10):

Read and understand Ch. 2 (2.1, 2.2, and 2.3; skip 2.4) - this may take 2-3 hours if done properly, although you should have seen all of this before (PHY11). The demonstration in Example 2.2.1 is facultative. Try to understand all other demonstrations, although we will also discuss them during the lectures.