Teen AstronomyCafés

High School Students Experiencing Real Research with Scientists


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- **DESIGN:** An outside-of-school education program to excite the interest of talented youth in key science projects with big data.
  - ex. Large Synoptic Survey Telescope (LSST) and the NOAO Data Lab
  - The program cultivates talented youth to enter STEM disciplines
  - Serves as a model to disseminate to the 40+ institutions involved in LSST.

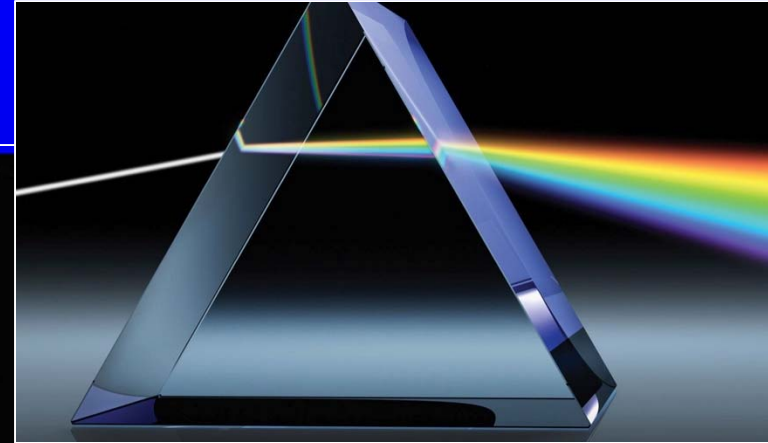- **FUNDING:** 1st year from the LSST Corporation; 2nd year from AURA/NSF.
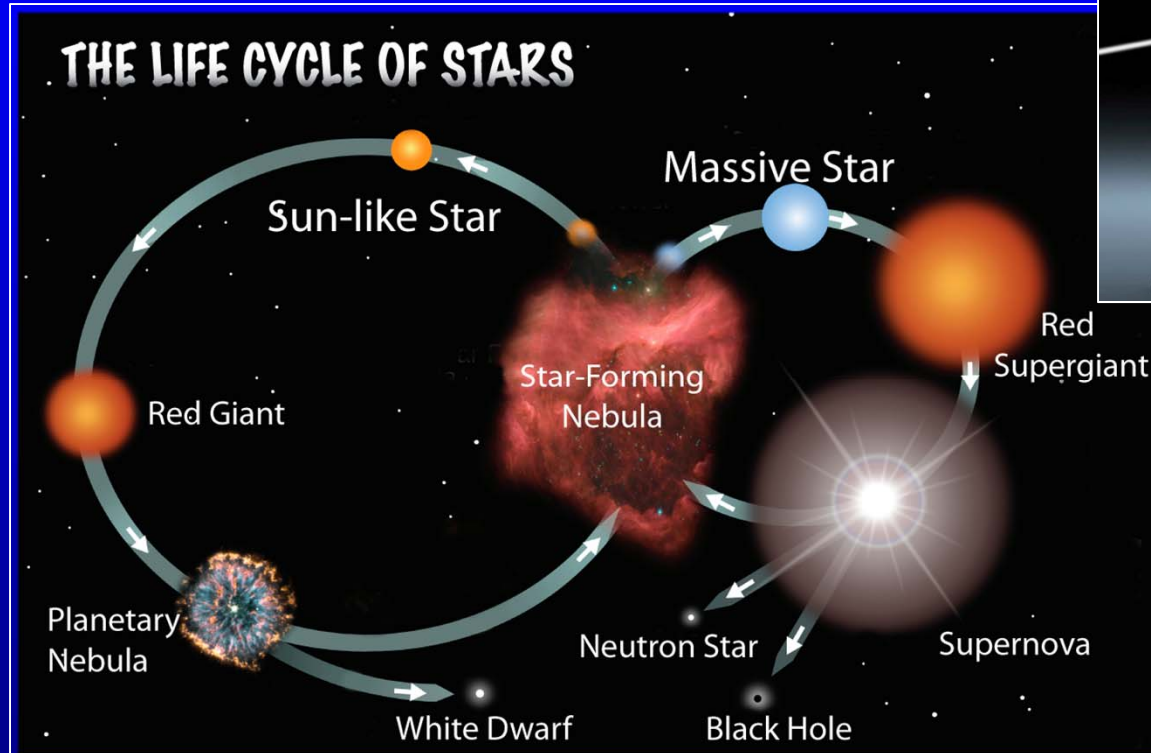

Gautham Narayan

Kagoshima, Japan, 30 March 2018

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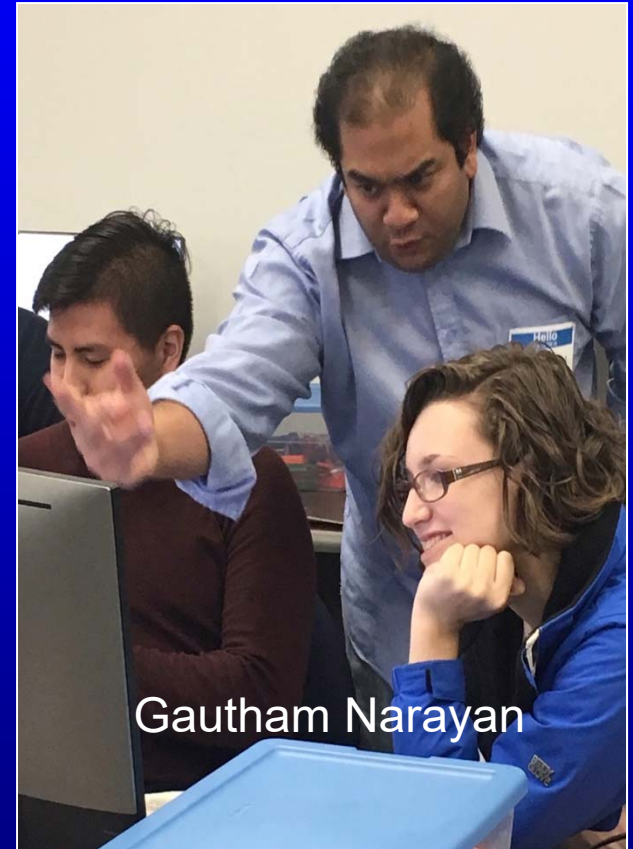
- **FREE SATURDAY SCIENCE CAFÉS:** Once a month during the academic year, high school students interacted with expert astronomers working with large astronomical data sets.

- **ORGANIZERS:** a group of interested local high school students, an undergraduate student coordinator, the astronomers, the program director (and an evaluator).

- **FORMAT:** a short presentation, discussion (plus food), computer lab activity and more discussion for 2.5 hours.

- **TOPICS:** killer asteroids, the birth and death of stars, colliding galaxies, the structure of the universe, gravitational lensing, dark energy, dark matter and more
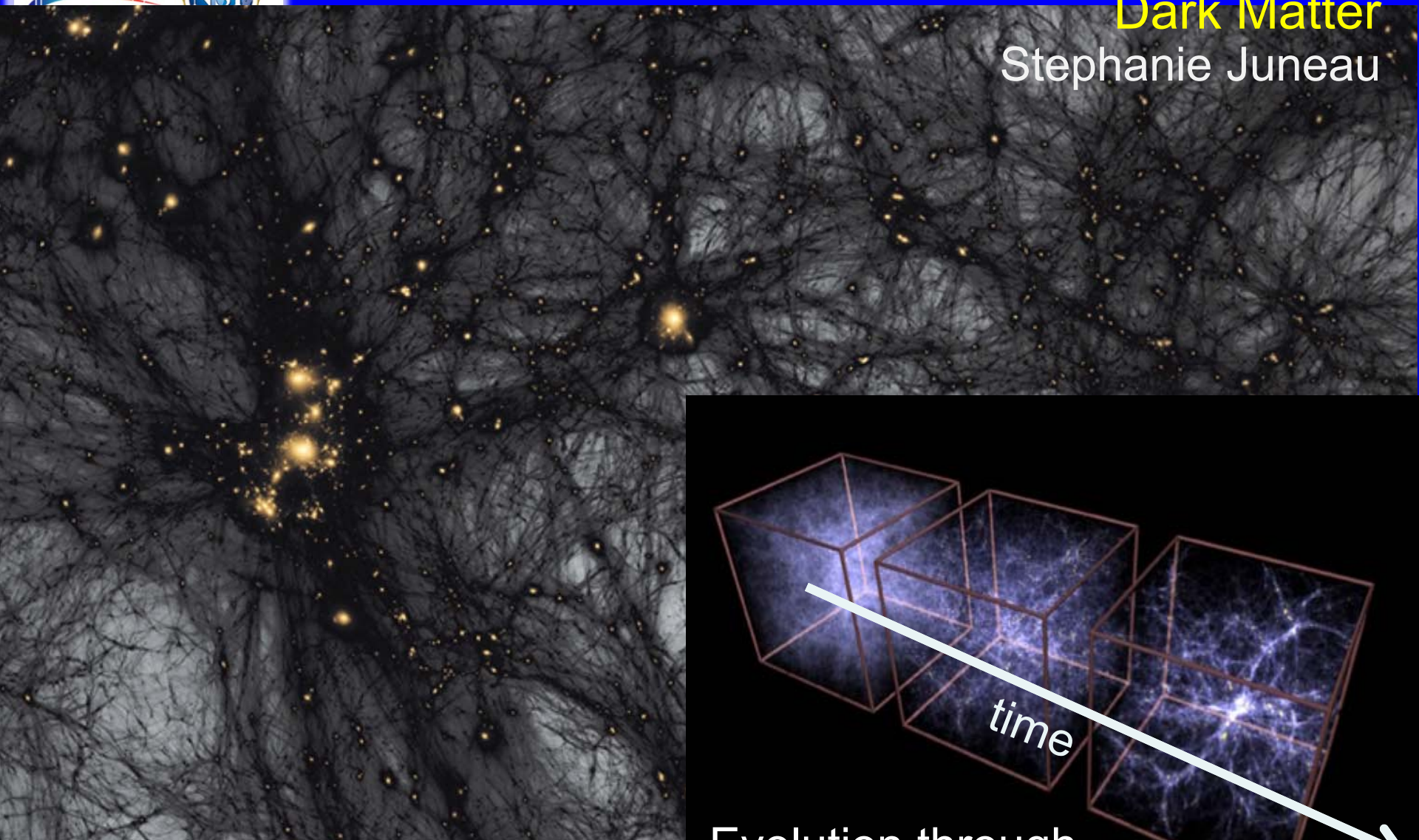
Birth and Death of Stars
Gautham Narayan

THE LIFE CYCLE OF STARS

Sun-like Star

Massive Star

Red Giant

Star-Forming Nebula

Red Supergiant

Planetary Nebula

Neutron Star

Supernova

White Dwarf

Black Hole

How do we study stars?
Astronomers chase rainbows.

The Universe Recycles
(and you should too!)

Large Scale Structure of the Universe: Dark Matter

Stephanie Juneau

time

Evolution through cosmic time: A computer model

Stephanie Juneau

Large Scale Structure: Python Notebook Activities

Step 1.3: Measure Redshifts

The next step here is to overlay a reference spectrum (called a template) onto the galaxy spectra from above.

```python
In [7]:  # redshift value (0 for a star, and upward for distant galaxies e.g.:
         # z = 0.01, 0.02, 0.05, ... 0.1, 0.2, ... 1.0)
         # First run this cell with zero redshift, and then adjust the value.
         z1 = 0.

         # now, we can plot the reference spectrum (at redshift=0)
         figure()
         plot(spec1.wavelength(), spec1.spectrum/40., color='black')
         plot(spec.wavelength()*(1.+z1), spec.spectrum/spec.spectrum.max()/1.5, color='red')
         xlabel('Wavelength')
         ylabel('Brightness')
         xlim(3800,6000)
         ylim(-0.1, 1.2)
```
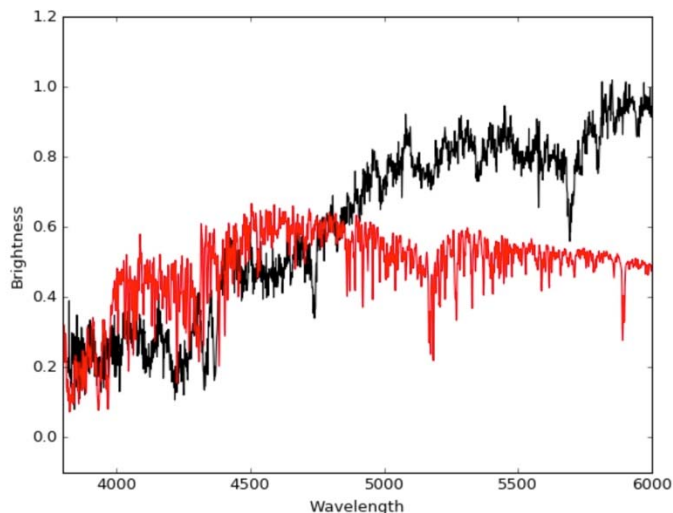
Now, let's step back and plot galaxies over a large region of the sky!

```python
In [114]:  # ZOOMING OUT

           #Fetch the sample from the Sloan data
           data = fetch_sdss_specgals()
           print 'Done retrieving the galaxy sample'

           #define the variables for plotting
           RA = data['ra']
           DEC = data['dec']

           # convert RA range to [-180,+180] instead of [0,360]
           RA -= 180

           #plot the RA/DEC positions
           figure()
           s=1.0    #symbol size
           plt.scatter(RA, DEC,s=s,c=data['z'], lw=0,cmap=plt.cm.rainbow,
                       vmin=0, vmax=0.2)
           plt.title('SDSS Galaxies (Zoom Out)')
           xlabel('RA (degrees)')
           ylabel('DEC (degrees)')

           #range for the x axis (horizontal) and y axis (vertical)
           xlim(-15,15)
           ylim(0,30)

           #color bar
           plt.colorbar()
```
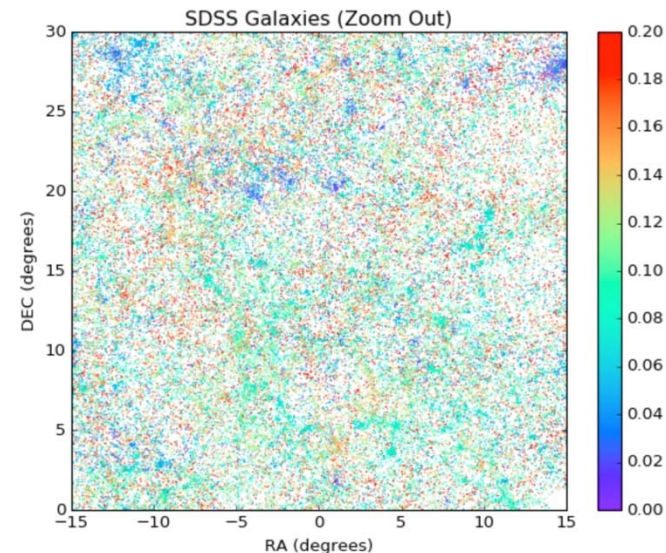
Done retrieving the galaxy sample

```
Out[114]:  <matplotlib.colorbar.Colorbar at 0x16d5d8b90>
```

What do you see now on the zoomed out view? Are those structures smaller or larger?

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How galaxies collide and merge gravitationally

How the effects of collision depend on properties of galaxies

Dara Norman

Kagoshima, Japan, 30 March 2018

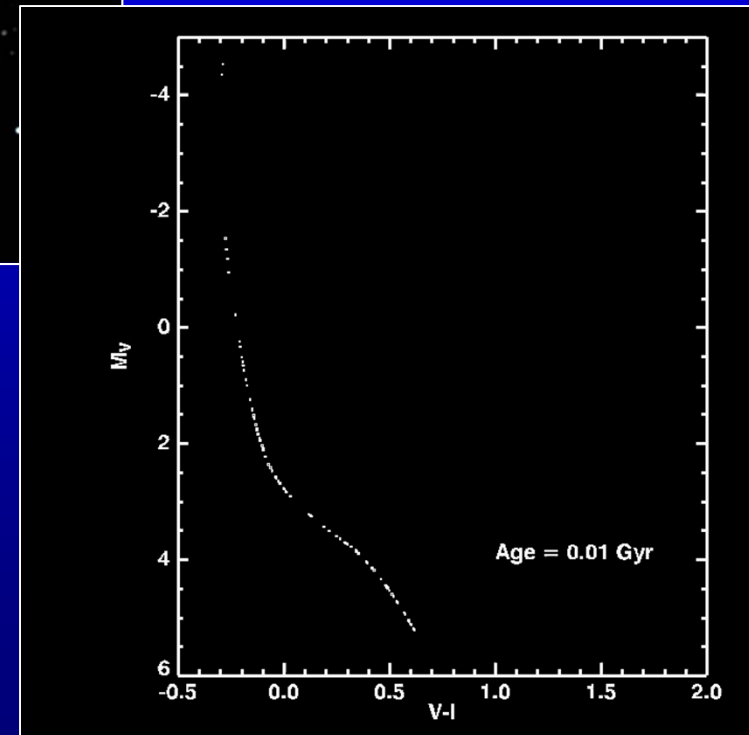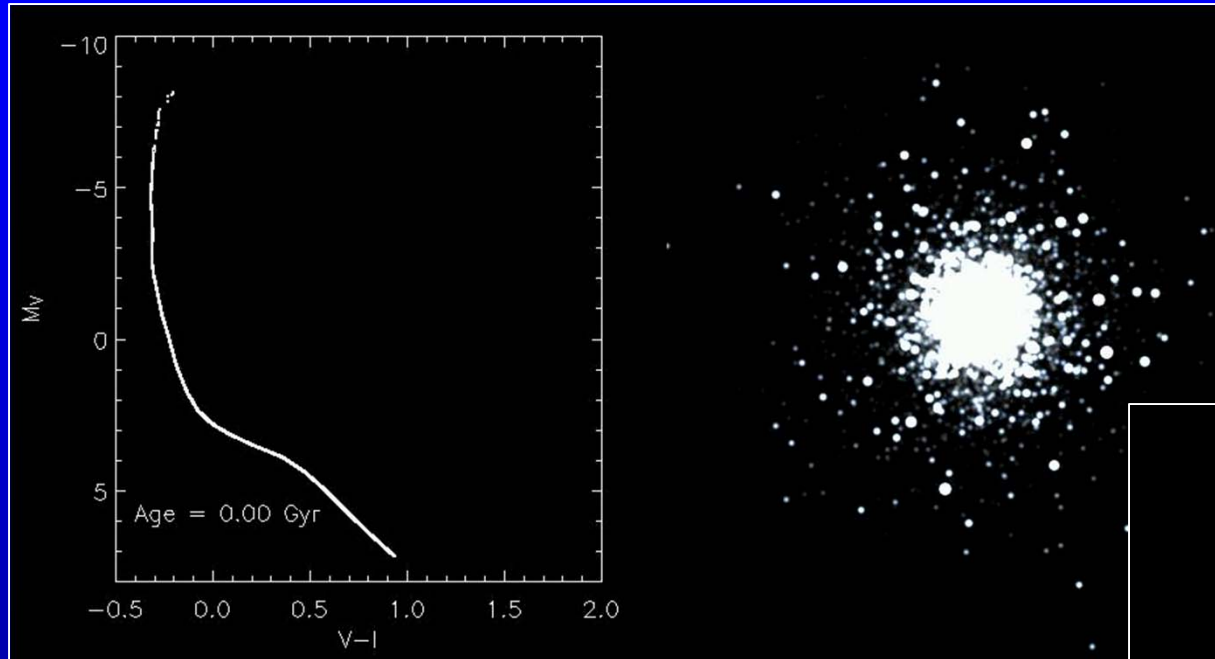SMASH
(Survey of the MAgellanic Stellar History)
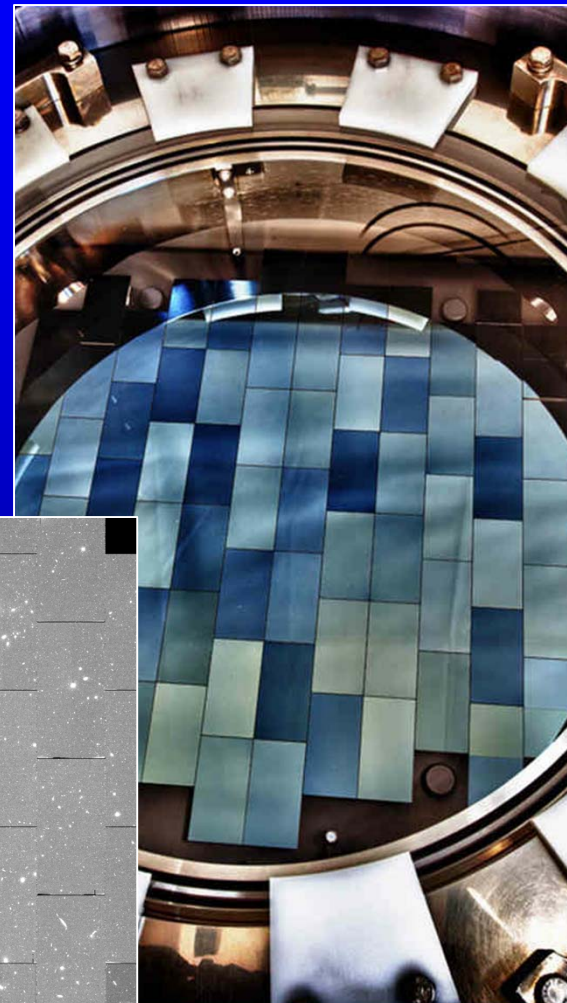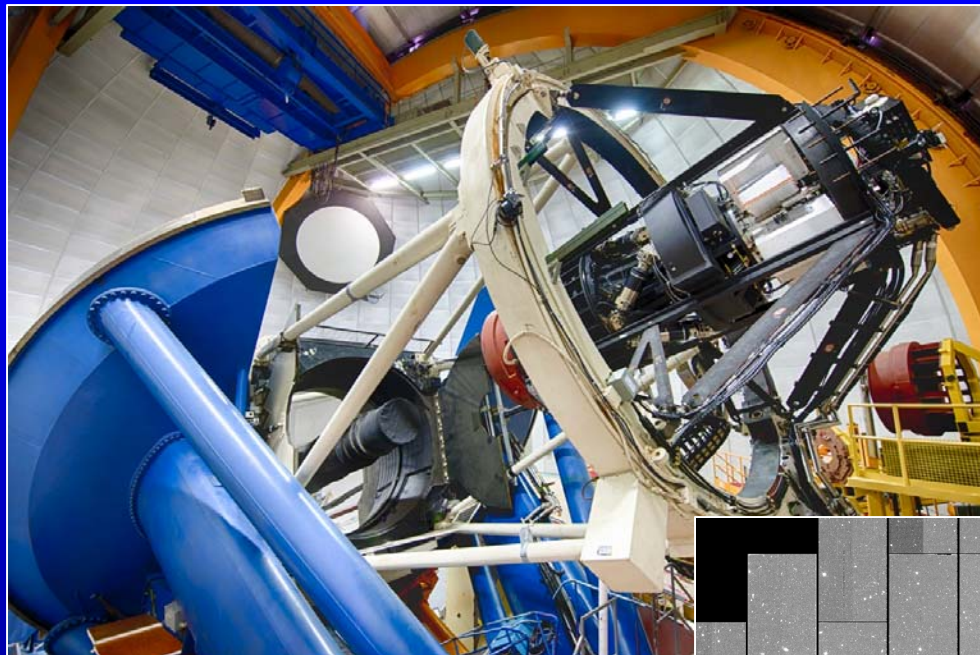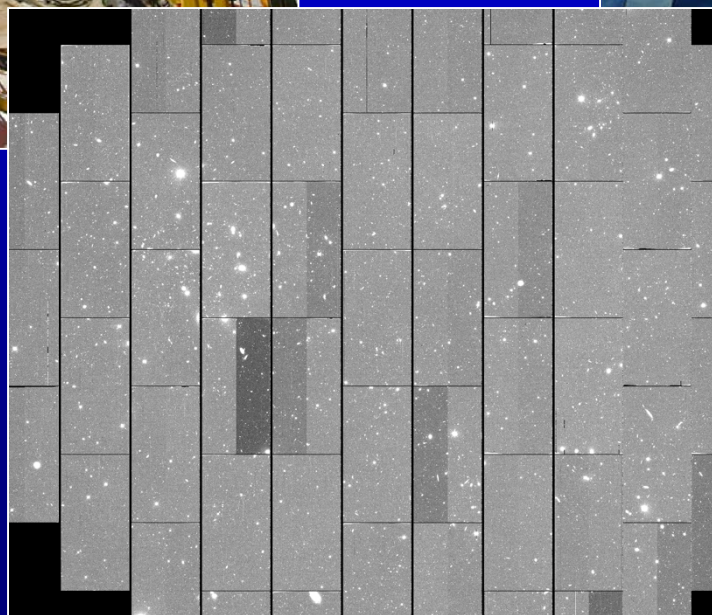DECam survey of the Magellanic Clouds.

Knut Olsen
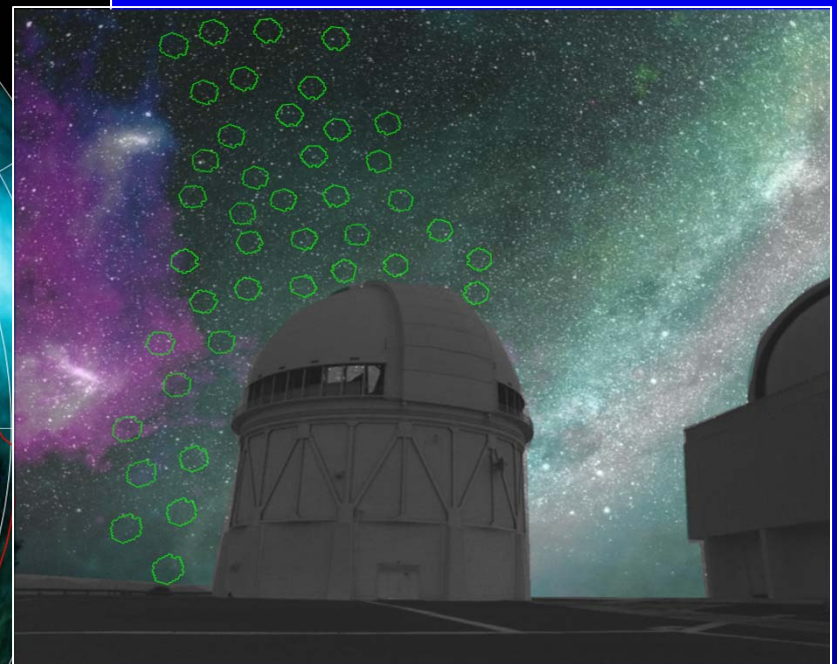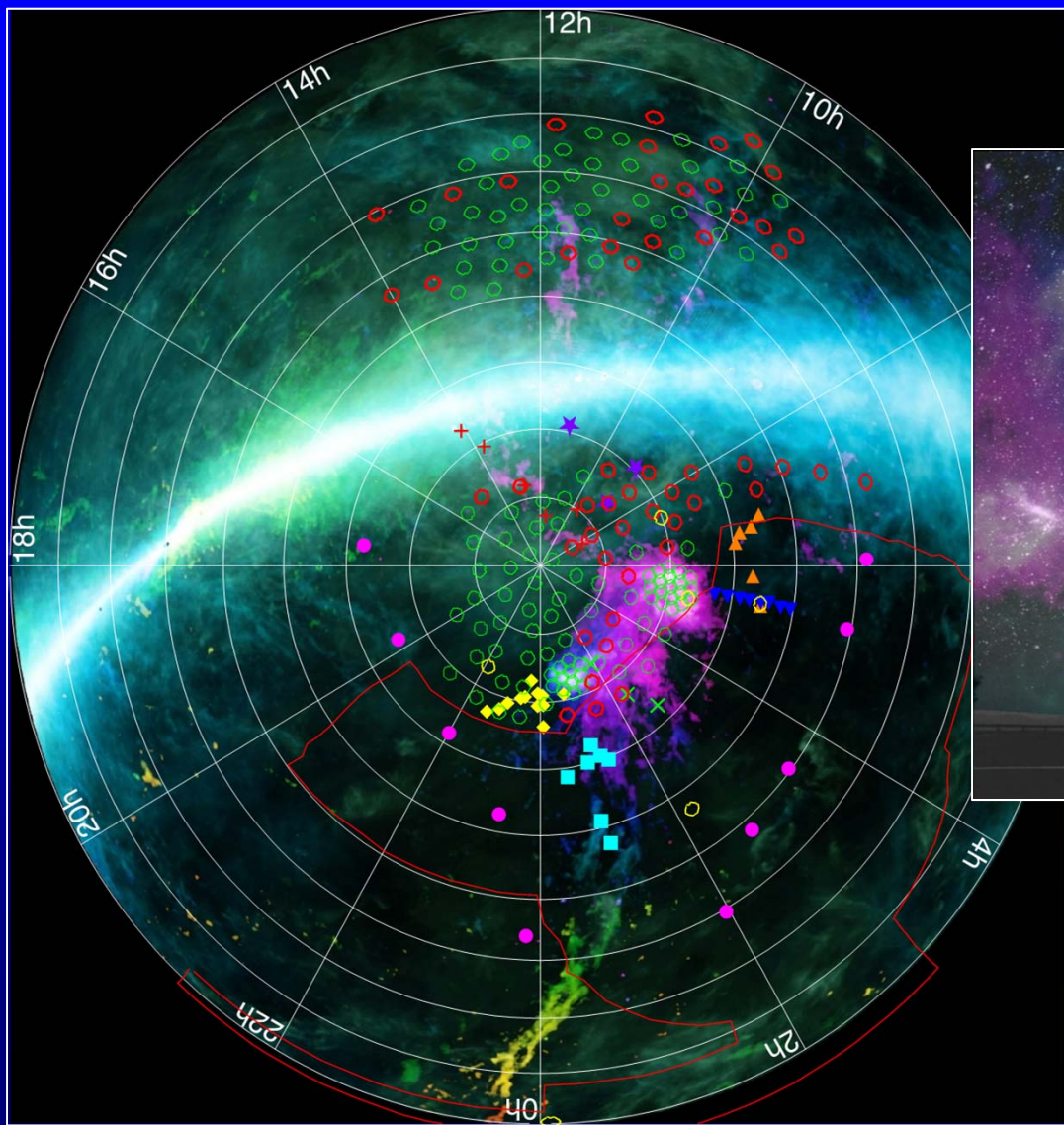
How does a star cluster H-R diagram evolve? A galaxy H-R diagram evolve?

Killer Asteroids: Dark Energy Camera on Blanco Telescope (Chile)

Lori Allen and Frank Valdes

E. Compute a column to interpret as approximate distances.

Go to the table column window again. Click on the first icon which is a green plus. This brings up a window which allows calculations on columns to make a new column for our table. Enter the information shown in the figure below. After entering this click OK to produce the new column. Select the new column in the table column window **and deselect the previous one**. Finally click the histogram icon in the main window as before. Also, as before, make the plot be log-log and play around with the presentaion (adjust the bins, shift the region shown, and maybe add a title.

- **5 f**abulous high school youth leaders
  - Ensure an enjoyable & successful program for fellow students.
  - Help students with computer activities.
  - Evaluate how well the science café went.
  - Help shape the next science café and improve the program.

- The experience offers youth leaders
  - Ownership of the program.
  - Opportunities to take on responsibilities.
  - Learn leadership and communication skills.
  - Foster their continued interests in STEM.

Lori Allen

- "**I don't really learn it until I teach it to others**...I liked seeing how all the learning I do in school applies to this and the world. It made me look at school content in a different way. I saw it as more applicable, meaningful. I took initiative to learn more on my own."

- "**The practice session gives us the opportunity to learn the science/research better** so we can understand what is going on and teach it to others."

- "During the lecture, I saw a picture of people working on the same computer programs we used and I thought, **wow, we're doing what scientists do!**"

- Working with the astronomer, peer-recruiters, peer-educators, behind the scenes, leadership skills, more confidence & social skills, how to be an educator, talking in front of groups, how to work with students, freedom to make their own planning decisions, etc

Teen Astronomy Cafés Program: STUDENT DEMOGRAPHICS

- 83 students signed up this academic year (more than 2x Spring 2017)

- This spring, 53 per café (2/3-3/4 attend)

- 50% female

- 22 schools; 4 students homeschooled

- 1/3 of the schools are underperforming

- 2/5 of the high school students attending

- 18 years old (7%)

- 17 year olds (20%)

- 16 year olds (33%)

- 15 year olds (14%)

- 14 year olds (16%)

- middle school (10%)

Will be focusing on more underperforming schools

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For all cafés, average scores are > 3.5 out of 4 on the following:

- The scientist raised my curiosity about their research.

- I understood the science in the presentation.

- I felt comfortable asking the scientist questions.

- We had enough time to ask the scientist questions.

- I got a sense of who the scientist is as a person.

- The scientist helped me see how their research connects with issues important to society.

- The scientist made connections between their research and my daily life.

- I learned more about science by doing the activities.

- I have a better understanding of how science research is done.

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From the feedback, we have improved:

- **Advertising to schools** more effectively to recruit more attendees. Figuring out how to maintain communication effectively with students.

- **Shortening the presentations** to between 20-30 minutes. Focusing more on a few "Big Ideas"/breakthrough-science.

- Getting students to feel more **comfortable asking questions**. Providing them with more one on one time with the presenters.

- **Designing the computer activities** so students understand the purposes for analyzing data, the types of data represented by the computer programs, and are correctly reading and interpreting data.

- Clearly and explicitly **linking the ideas** in the presentation to the data analysis activities students conduct in the second half of a session.

Kagoshima, Japan, 30 March 2018

Contact Information

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Websites of NOAO EPO Programs

- Teen Astronomy Cafés:
  www.teenastronomycafe.org

- Globe at Night campaign: www.globeatnight.org

- Quality Lighting Teaching Kit:
  www.noao.edu/education/qltkit.php

- Dark Skies Rangers activities:
  www.globeatnight.org/dsr/