

# "BUILDING THE FOUNDATIONS FOR STUDENT OBSERVATIONS USING NASA'S DEEP IMPACT SPACECRAFT"

By Jamie Vargas  
California State University,  
Fresno  
Mentor: Rich Rieber



# Educational Purpose of this Project

- In the classroom students are often given classical physics problems.
- Students want and deserve to work on real world problems.

# The proposed program

- There are 3 phases for implementation of the student run observation using the DI equipment.
- Each Phase gets progressively more complex and becomes more independent in regards to student participation.

# Phase 1: “Eye Candy”

- Public is allowed access to raw data.
- Students are encouraged to **compile the images** and **communicate** with other aspiring scientists via a public mission site and/or blog.



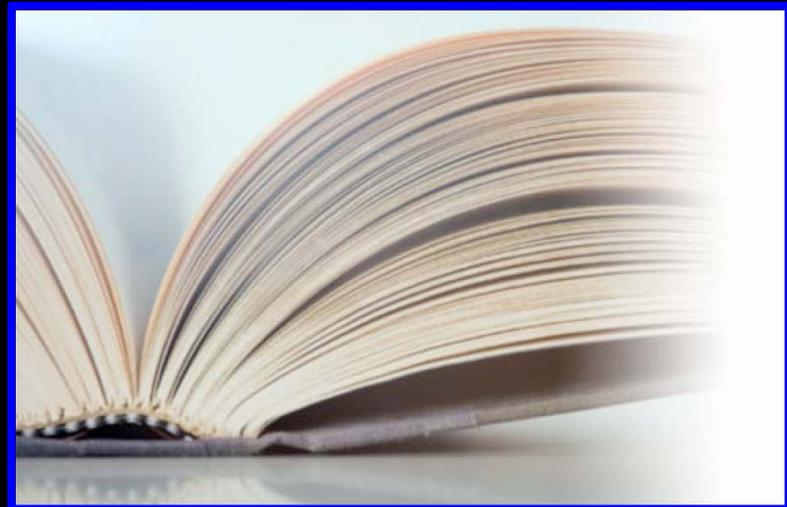
Member: machi



Member: NGC3314

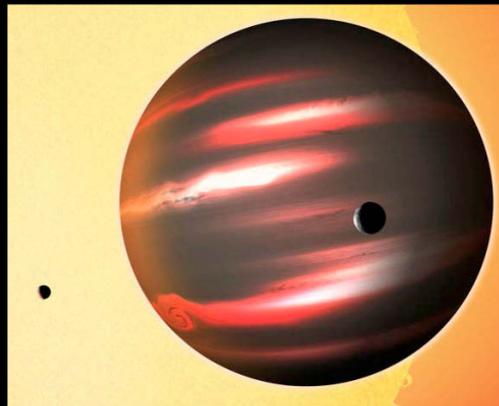
# Phase 2: Target Selection

- Public (Students) are given several targets to choose from.
- Discussion between students occurs for 2 – 4 weeks.
- DI Team will make selection based on survey results of targets.
- Students will then conduct a process similar to Phase 1.
- Student will produce a brief summary of their findings on the public website.



# Phase 3: Field Proposals from Students

- Students write a proposal for conducting scientific observations of exoplanets and other deep space objects.
- DI Team will select one of the proposed missions.
- Team selected will receive the data from this observation 6 months before it is made public.
- Students will have the opportunity to publish their results as a CO-1 researcher in a journal ( i.e. Astronomy Education Review or *The Astronomical Review*)



# Making the Connection



# Lesson Plans for Phases 1 and 2

- There were two routes in terms of using the archived images provided by the science team.
- Image processing (making a color photo)
- Image analysis (generating light curves)

# Image Processing

- Not just pretty pictures. ( Composition Maps)
- All images produced by the spacecraft are in a 16 bit FITS format

Colored image processing requires

- Stacking software capable of opening and manipulating 16 bit FITS
- Software that is capable of reducing the noise from cosmic rays
- Example Software: GIMP, Registax, FITS Liberator, Photoshop, Nebulosity

# Image Analysis

Good:

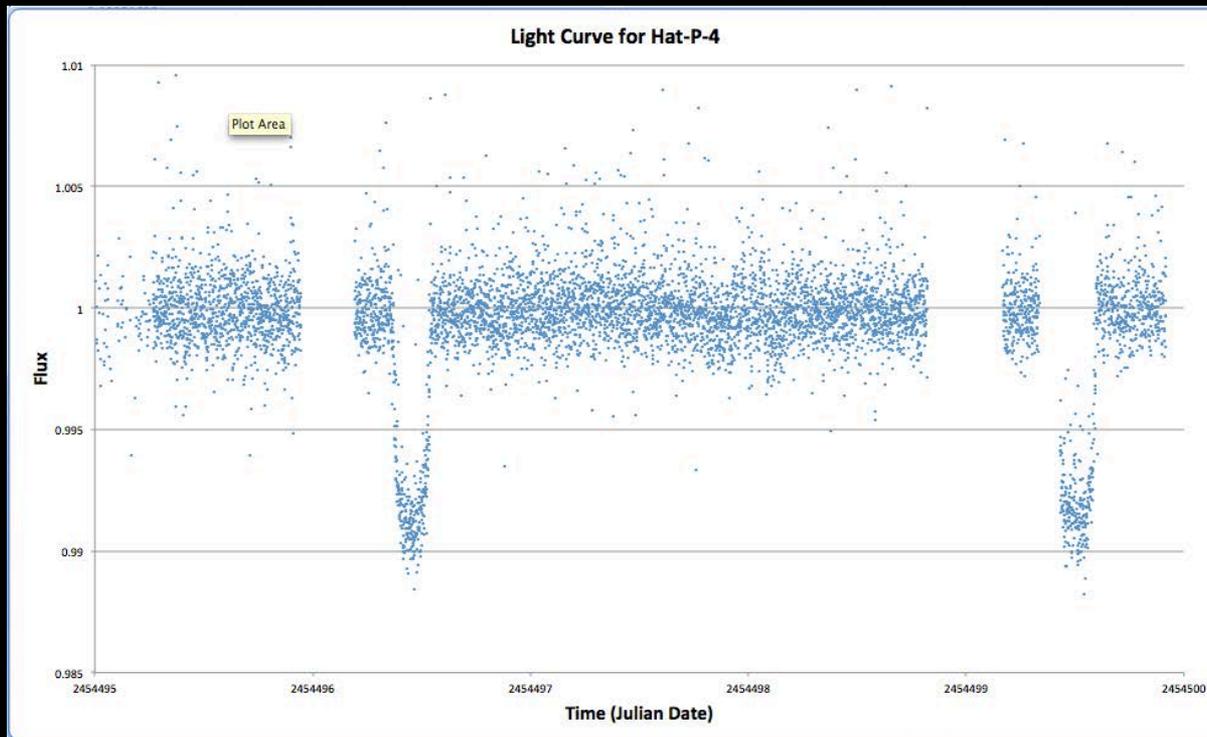
- Light curves are very useful in terms of characterizing the orbits and atmospheres of exoplanets.
- High Student Interest

Bad:

- Light curves are hard to make!!!!

# Image Analysis

- Solution: Use previously composed light curves that are available via the Deep Impact Science Team.



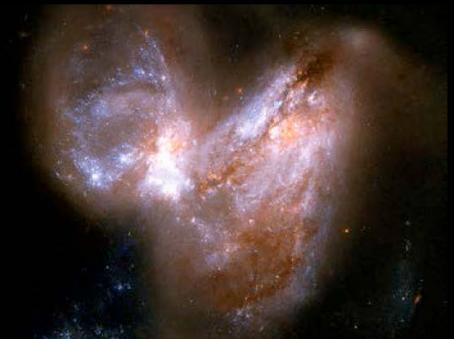
- With the data that is archived by the DI Science Team I was able to make 3 activities that relate light curves to Kepler's 3<sup>rd</sup> Law.

# General Guideline for Phase 3

- “Eye Candy 2” modeling the guidelines for student observations
- Two objects NGC 3690 and M82 will be observed on 8/22

Things to consider when creating a science campaign

- Scientific purpose of observation
- Objects available based on spacecraft's location
- Angular size of object and amount of pixels covered on CCD
- Memory necessary for capturing images
- Time for downlink to Earth



# Conclusion

- Phases 1 and 2 could be implemented without any major work.
- Educators have two options in terms of using the data provided by the DI Flight and Science Teams.
- This program is recommended for the time that teachers have after state testing is finished.
- Phase 3 is challenging yet highly rewarding for a high school student

# Future Work

- Setting up a website that allows students and educators to work collaboratively with scientists.
- Phase 3 is very demanding and would take a lot of work on the part of educators if this is going to succeed.
- Creating more structure for the activity since it is time consuming in an educational world governed by standardized tests.
- Processing “Eye Candy 2” images

# References

- J. L. Christiansen et al., "STUDYING THE ATMOSPHERE OF THE EXOPLANET HAT-P-7b VIA SECONDARY ECLIPSE MEASUREMENTS WITH EPOXI, SPITZER, AND KEPLER." *Astrophysical Journal*. 710. (2010): 97–104. Print.
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