



Department of
PHYSICS

Low-cost Airglow Imager:
Integration of CEDAR Science Into the
Undergraduate Research and Course Curriculum

Stuart Johnson, Josh Childs, Jared Pugh, Brian Patchett, Kim Nielsen
Department of Physics
Utah Valley University



Motivation

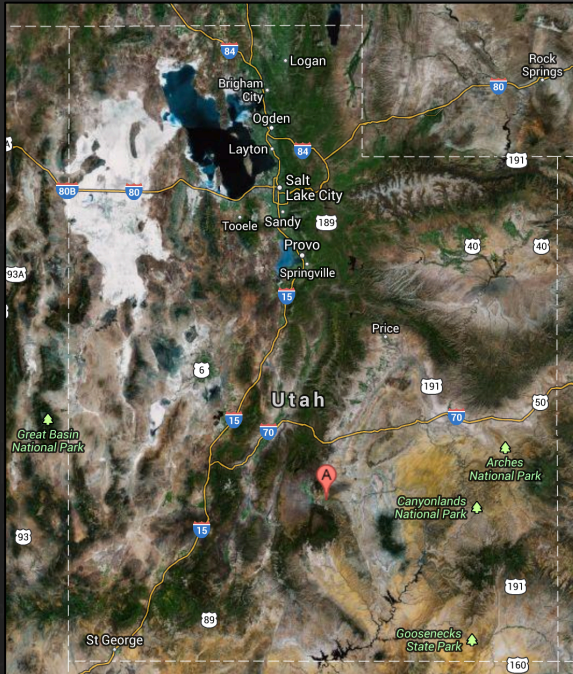
- ❁ Construct a low-cost experimental platform to introduce aeronomy and space physics into the undergraduate curriculum.
 - ❁ Hands-on experience
 - ❁ Apply physics learned in classroom to “real” science
 - ❁ Create opportunities for student research projects
- ❁ Supported by the UVU Scholarly Activities Committee



Observation Site

Capitol Reef Field Station

- ⊗ $38^{\circ}\text{N } 249^{\circ}\text{E}$, elevation ~ 2000 m.
- ⊗ One of the best dark skies on the northern American continent.
- ⊗ High-speed internet access
- ⊗ Solar powered with diesel generator back-up
- ⊗ Two dormitories that sleeps up to 24 people
- ⊗ Main building with lounge and dining room.
- ⊗ Professional kitchen
- ⊗ Currently pursuing funds to build new classroom building and permanent observatory

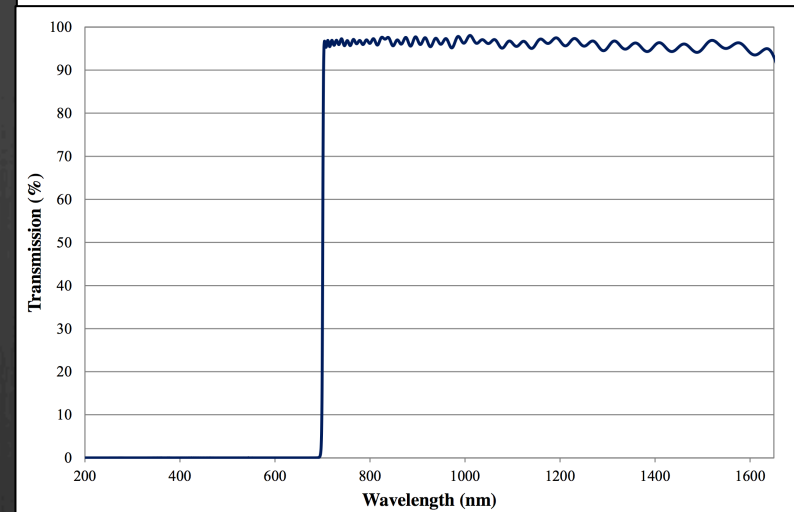
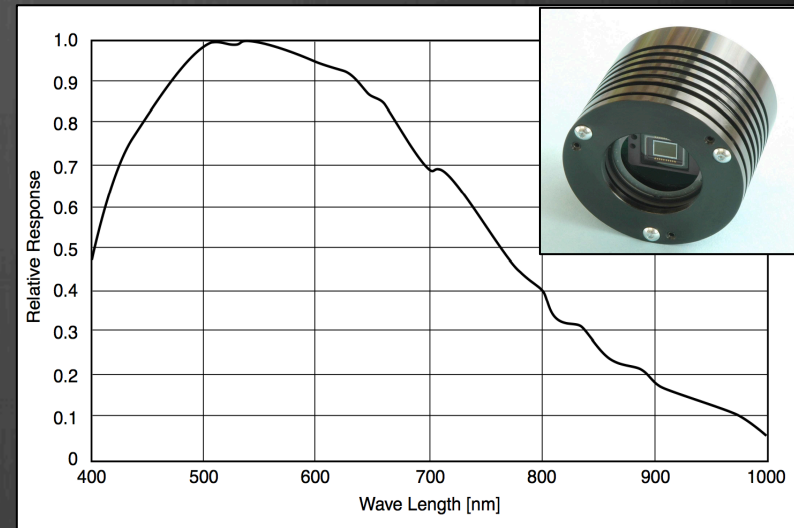






Airglow System

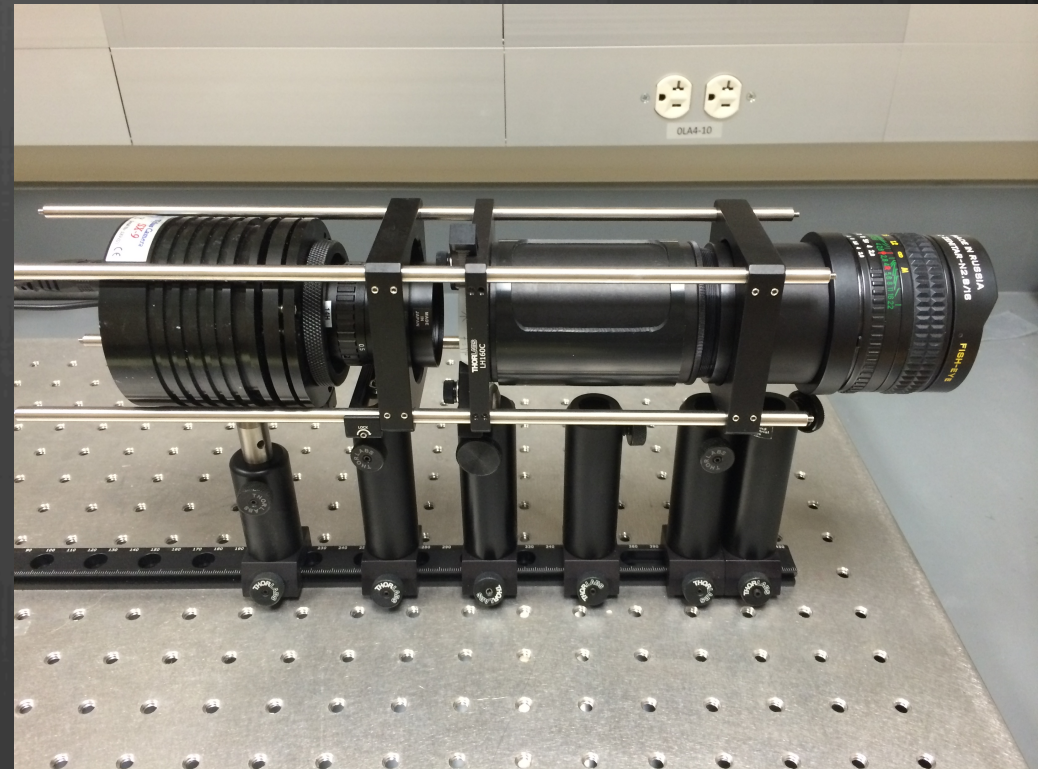
- Design provided by Jeffrey Bamgardner, Boston University
- Use a Starlight Xpress SXVR-H9 camera
 - Sony ICX285AL CCD (same as in Atik 314L+)
 - Peak QE of $\sim 65\%$ at 540 nm, sensitive out to ~ 1100 nm.
- Fitted with a 700 nm long-pass filter (OD > 4.0) with a transmission of $\sim 95\%$ to monitor the OH broadband airglow emission.





Final Optical System

- ❁ Off the shelf components
- ❁ Main obstacles
 - ❁ No optical support components initially → increased cost of project.
 - ❁ Lack of adequate tool/mechanical shop

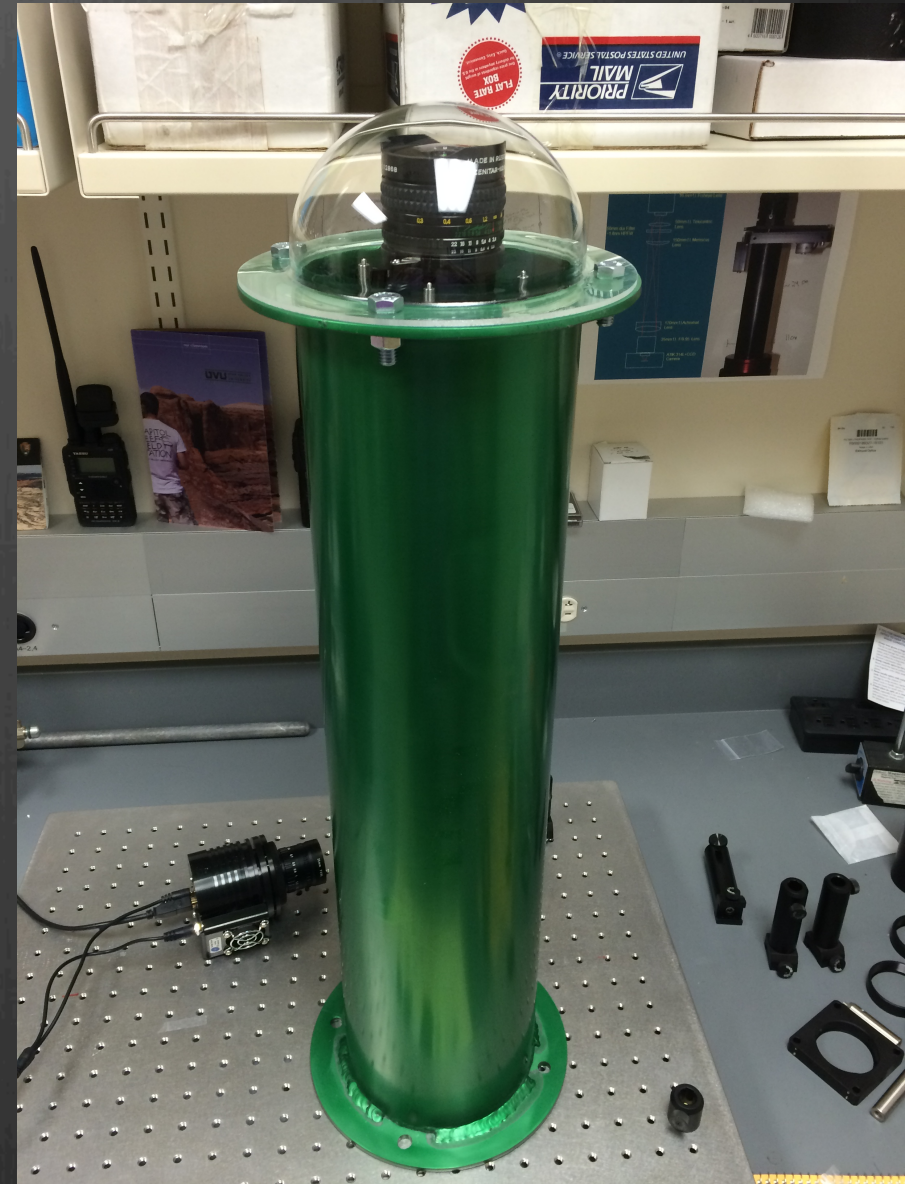






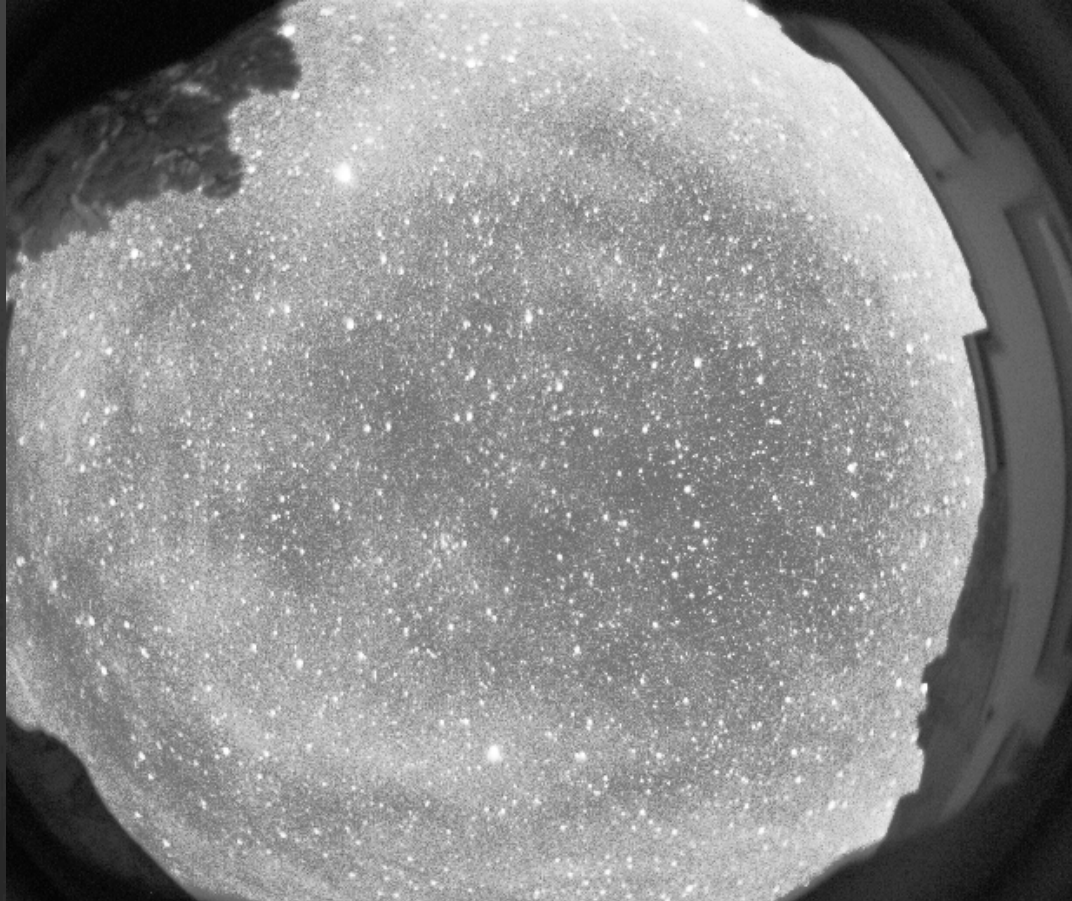
The Final Product

- ❁ Aluminum tube (2 ft, Ø6")
- ❁ Constructed and anodized in-house (Josh Childs)
- ❁ Insulated with Spaceloft
- ❁ Contains heating/cooling system (aluminum-housed power resistors and circulation/cooling fan) controlled by Arduino
- ❁ Data acquisition computer (Raspberry Pi)





First Light



60-second integration and binned 2x2 on-chip



Summary

- ⊗ We have constructed a low-cost airglow imaging based on schematics provided by Jeffrey Baumgardner, Boston University.
- ⊗ The camera system is fully housed in a 2 ft x Ø6” weatherproof aluminum tube and can be remotely controlled.
- ⊗ Several student projects utilizing this instrument have already been internally funded and will begin Fall 2015, and will be an integral component of the fluid dynamics and basic space plasma courses at UVU
- ⊗ Internal funds to construct two more cameras have been awarded
 - ⊗ One system equipped with a 630 nm filter to be donated to Tribhuvan University, Nepal and supervised by Prof. Narayan Chapagain.
 - ⊗ One system to monitor light pollution in collaboration with the National Park system.