The High-Throughput Multislit Imaging Spectrograph

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HiT&MIS

HiT&MIS is a High-Throughput Multislit Imaging Spectrograph for extended sources designed for spectral imaging with a high resolution.

- The Earth's magnetosphere interacts with ionized particles emitted from the sun which can be seen by the Aurora Borealis and Aurora Australis.
- HiT&MIS is able to image the aurora, allowing us to know it's composition and physical Properties.

What HiT&MIS Does

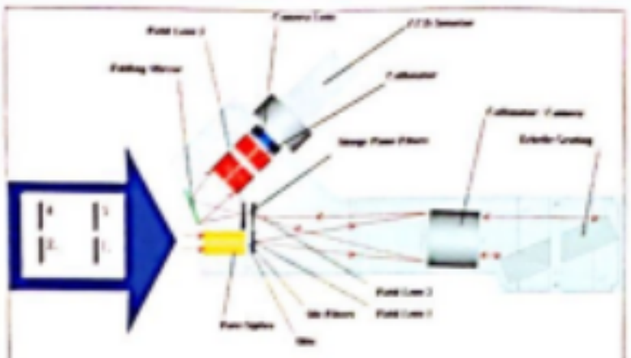
HIT&MIS uses an echelle grating at high dispersion order to observe atmospheric airglow at a high resolution.

- Using an echelle grating, light from the atmosphere can be filtered in such a way as to allow for spectral lines in the aurora to be distinguishable from one another.
- HiT&MIS allows for individual spectral lines to be image simultaneously.
- Characteristics of the aurora can then be investigated based on data acquired from these spectral lines.

The Need for Auroral Physics

The interaction between the Sun and the Earth's magnetosphere is one of great importance. A severe solar storm could result in Trillions of dollars in damage, as a result of satellites lost and electronic failure.

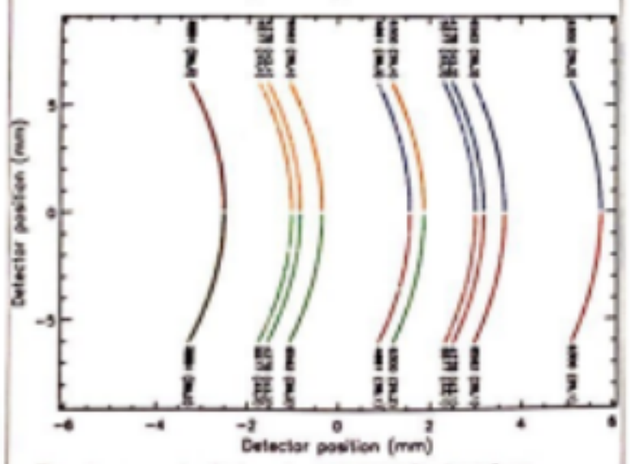
- This experiments focus is to learn more about the interaction between the Earth's magnetosphere and the Sun by studying the aurora. The more information available, the more prepared we can be for future solar storms.
- All users of electronics will greatly appreciate the efforts made to further our understanding of auroral physics



Incoming light is imaged by a set of optics onto the slits of the instrument, where a group of filters block certain wavelengths of light from passing though.

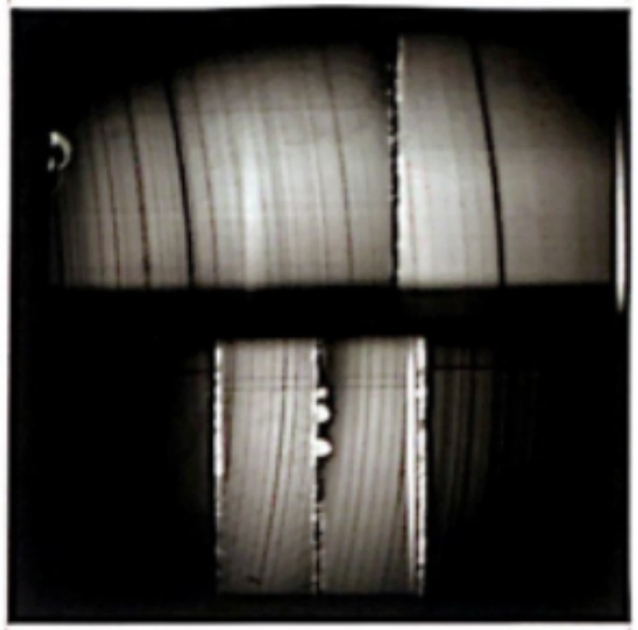
The echelle grating diffracts this incoming light at a high-dispersion order, so that incoming light can then be separated by the grating. This is possible because the dispersion is proportional to the wavelength (or color) of the light.

A mosaic of filters then further separates the various wavelengths of light, imaging each of the spectral lines on each respective filter. The result is 6 images of the sky, each representing a different wavelength of light.



Ray trace calculation for HiT&MIS showing prominent airglow features and the effects of slit curvature on the photon positions in the image plane. Wavelengths of the features are shown from the four slits. The numbers inside the parenthesis indicate the diffraction order and the slit number, respectively. Without filters the spectra from different orders overlap and are quite confusing as seen in the two leftmost features: the 486.1-nm line in the 34th order and the 777.4-nm line in the 24th order essentially overlap one another.

Initial Data



Above is an image of the sky above Lowell taken by HiT&MIS

After aiming HiT&MIS at the sky, the above image was taken. The 6 images are identical in that they represent the exact same picture. The fore-optics at the front of the instrument imaged the sky in four identical pieces. What is shown then, is the same part of the sky as seen through various filters.

The black lines are absorption lines. These are lines of light that are either not produced by the Sun (Fraunhofer Lines) or absorbed by the atmosphere before they can reach the instrument. The two dominant absorption lines in the upper panels represent H-alpha and H-Beta lines.

The next step is to create a second instrument, identical to the first. This would allow us to triangulate the position of the aurora and get it's height above sea level. Thus, the position of the aurora as a function of time can be obtained, allowing the dynamics of this system to be measured.

HiT&MIS is planned to deploy sometime in the next year to take continuous data of the Aurora

- So far the first instrument is fully operational.
- The second instrument is currently being built and tested. Some minute differences exist between the two that need to be corrected.

References

Chakrabarti, Supriya, Olli-Pekka Jokiaho, Jeffrey Baumgardner, Timothy Cook, Jason Martel, and Marina Galand. "High-throughput and Multislit Imaging Spectrograph for Extended Sources." *SPIE*. N.p., n.d. Web. 17 Apr. 2014.

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