Researchers highlight acousto-optic tunable filter technology for balloon-borne platforms

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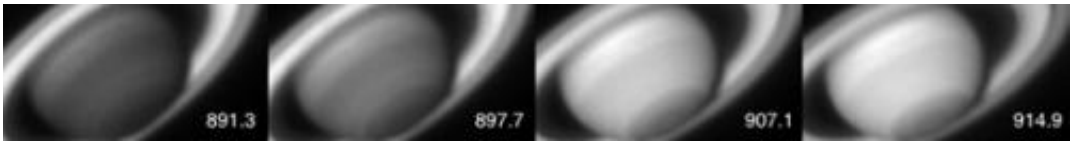

These are example images of Saturn taken with an AOTF imager mounted on the 3.67-m advanced electro-optical system (AEOS) telescope at the Maui Space Surveillance Complex (MSSC). The data were acquired on UT 8 February 2002. Images were acquired in nearly 160 wavelengths between 500-950 nm, which enabled a detailed study of the cloud structure and aerosol properties of Saturn's equatorial region. Credit: *Journal of Astronomical Instrumentation*

Narrowband or hyperspectral imaging is a valuable technique used in planetary science for characterizing surfaces and surrounding environments. For example, it can be used to spatially map molecular species of interest on the surface of a solid or icy body, or to sound to different depths in a giant planet atmosphere. However, conducting narrowband or hyperspectral imaging of solar system targets from a balloon-borne platform presents several technical challenges, including mechanical failures and power requirements. These risks can be mitigated with the use of an electronically tunable filter such as an acousto-optic tunable filter (AOTF).

This paper describes the operating principles behind AOTFs, which are solid state devices that act as narrow optical filters when a traveling

acoustic wave interacts with incident radiation in the crystal. Tunable cameras utilizing AOTFs provide great flexibility, since they are very compact, electronically programmable, and have low power requirements. They have extensive heritage in ground-based instruments with planetary science applications and they are radiation tolerant, hence they are well-suited to balloon-borne platforms.

While there is a myriad of potential applications of hyperspectral imaging to solar system targets, this paper discusses several example use cases for a balloon-borne AOTF imaging system: synoptic studies of clouds on the giant planets and Venus, the mapping of hydrocarbon ices on the surfaces of icy bodies, studies of cometary comae, and polarimetry. The paper describes a notional AOTF imager design that includes both visible and near-infrared channels, in order to take full advantage of the spectral coverage of an AOTF.

The AOTF technology would greatly benefit from flight demonstration on a high-altitude balloon. Balloons have long served as a proving ground for testing instrument prototypes for high-energy and particle astrophysics, solar physics, and Earth science, some of which eventually flew on satellites. AOTF technology would benefit similarly, with the ultimate goal of developing an AOTF-based instrument for planetary flight projects.

More information: *Journal of Astronomical Instrumentation* (*JAI*), www.worldscientific.com/doi/ab … 42/S2251171714400054

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