Remote Sensing

The past 20 years have seen a significant increase in the number of satellite based instruments making measurements of the earth's atmosphere. These remote sensing missions help to improve our understanding of the processes involved in climate change.

The same missions can often provide valuable data on the effects of solar activity on our atmosphere and the associated interference with communications and the power grid.

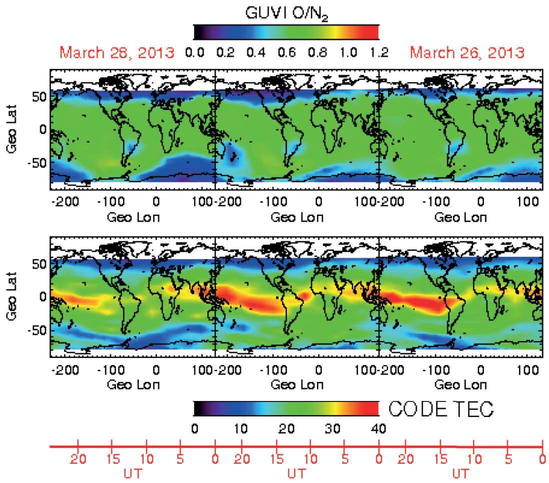
The Far Ultra-Violet (FUV) spectrum, covering the wavelengths from 121nm to 200nm, provides a unique window on processes involving N_2, O_2, O and H in the upper atmosphere. These wavelengths are completely absorbed by the ozone layer and cannot be measured by terrestrial observatories. However, from space, emission features from these chemical species can be detected by FUV instruments leading to a better understanding of their composition and changes in that composition due to atmospheric and solar dynamics.

Opposite is an image of the global O/N_2 ratio and the Total Electron Content (TEC) obtained with the Global Ultra-Violet Imager (GUVI) on NASA's Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) spacecraft.

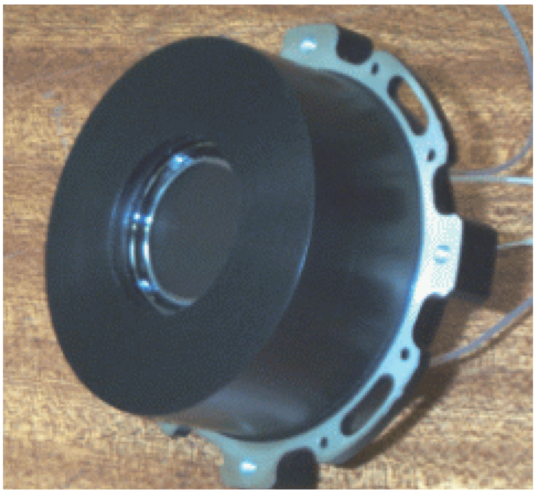
These data are calculated based on five of GUVI's selectable wavelength ranges: atomic Hydrogen (121.6 nm), atomic Oxygen (130.4 nm and 134.5 nm), and Nitrogen Lyman-Birge-Hopfield bands (140 nm – 150 nm and 165 nm – 180 nm).

Photek recommends

- **Contact PHOTEK for a Customised Solution**



Instrumentation



Above is an image of the ruggedized GUVI photon counting imager.

The GUVI instrument on TIMED is an imaging spectrograph that includes a custom Photek FUV photon counting tube. The optical system includes a scanning mirror that sweeps across the path of the satellite, covering a 108 km wide swath of the earth's atmosphere and extending roughly 70 degrees on either side of the spacecraft track. There are 14 pixels along this swath providing imaging pixels that cover roughly an 8 km square in the atmosphere. A spectrograph disperses the FUV emission from each pixel into 160 wavelength bins covering the 115 nm – 180 nm range. Typically, only the five key wavelength bands of interest are transmitted to researchers for scientific studies, helping to reduce the data volume requirements.

The photon detector, provided by Photek, is a custom FUV photon imager. The 25 mm active area vacuum tube has an MgF_2 input window to efficiently transmit the FUV photons. The top surface of the microchannel plates are coated with CsI, a photocathode material ideally suited to FUV wavelengths. The overall gain of the tube is 3 x 10^6. The amplified charge is collected on a wedge-and-strip anode providing precise location and arrival time of each photon detected. This anode can accommodate count rates of up to 10^6 photons per second. The wedge-and-strip anode is well suited to space applications since it requires only four readout channels to obtain high spatial resolution.

A particular challenge associated with space instrumentation is its requirement to withstand the rigors of both the rocket launch and the harsh environments encountered on orbit. Photek has successfully designed and built photon detectors for multiple space missions and has the expertise required to manufacturing rugged detectors for space. Design considerations include the ability to survive high levels of shock and vibration associated with both the launch and on-orbit deployment of mechanisms such as solar panels. These detectors must survive and operate over a wide range of temperatures and are subjected to both thermal and vacuum cycling. The use of low outgassing materials for encapsulation of the image tubes, which operate at high voltages, is critical both to the tubes operation and to prevent potential contamination of the sensitive FUV optics.