Geophysical Research Abstracts
Vol. 16, EGU2014-14426, 2014
EGU General Assembly 2014


# Photometric Observations of Interstellar Hydrogen by HDAC: In-flight Calibration

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HDAC is part of the ultraviolet imaging spectrometer (UVIS) onboard the Cassini spacecraft. The instrument scans the Lyman-$\alpha$ emission lines of hydrogen and deuterium atoms. In the photometer mode only the CEM detector is used to register the signals within a 3 degree field of view (FOV). HDAC has been switched on in photometer mode most of the time producing a unique continuous data set for more than a decade. An analysis of the Lyman-$\alpha$ background data serves two purposes: determination of the parameters of the interstellar/interplanetary hydrogen and determination of the properties of the solar wind. The exhaustive pre-flight laboratory calibrations included evaluation of the absolute sensitivity of the instrument; evaluation of the instrument spectral sensitivity; evaluation of the off-axis response. During the mission these characteristics may change over time due to continuous time degradation of electronics and/or abrupt events.

We have systematically analyzed photometric observations of the star SPICA in order to perform in-flight calibrations. All three aspects listed above were explored. We find that the instrument is still in good condition. The current sensitivity of 12 count/s/Rayleigh is sufficient to provide good signal to noise data. Off-axis responsivity is non-uniform and visibly differs from pre-flight determinations. At the same time the shape of the spatial sensitivity response is constant and can be used for all observations.

Because of the rather wide FOV and spectral sensitivity of HDAC stellar contributions are always in the data. This leads to considerable disturbances in the measured signal during observations. In order to clean the data, we use the TD1 Catalog of Stellar Ultraviolet Fluxes.
That allows us to estimate flux values around 120 nm for many bright UV stars. The developed software detects secondary local peaks and cleans the measurements visibly.

HDAC is part of the Cassini UVIS instrument and is operated independently but often in parallel. The far ultraviolet spectrometer (FUV) also covers Lyman alpha but generally with more noise because its slit is much narrower than the HDAC FOV. Data of the hydrogen background taken by both instruments are compared and used for cross calibration over the duration of the Cassini mission.

The calibrated data can be compared with sophisticated theoretical models describing the spatial distribution of interstellar/interplanetary hydrogen streaming through the solar system. First results will be reported.