Wisconsin Hα Mapper Fabry-Perot Aeronomy Program

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Winter solstice, low galactic emission region
WHαM thermospheric+exospheric Hα column emission intensities

Winter solstice thermospheric+exospheric Hα column emission intensities from solar cycles 22 and 23
Scientific Results from the WHαM Aeronomy Program

• Statistically significant solar cycle variation in the thermospheric + exospheric Hα column emission over the rise of solar cycle 23.

• The higher signal-to-noise WHαM observations corroborate suggestions of a solar cycle trend seen in Hα column emission observations from Pine Bluff, WI over solar cycle 22.

• Agreement between mid latitude observations taken from the Kitt Peak, AZ and Pine Bluff, WI during the same month.

• There was ~20% rms scatter in the Hα column emission intensities for mid range shadow altitudes (2000-3000 km) during the 1997 extensive WHαM survey observations.

• Possible statistically significant variation in the Hα column emission intensity between the solar maximum periods of cycles 23 and 22.
Science Questions for the WHαM Aeronomy Program

• What are the signatures of the solar cycle in the thermospheric + exospheric Hα column emission observations?

• Does the hydrogen column abundance vary over the solar cycle and/or between solar cycles?

• Can forward modeling analysis of our observations with the TIMESGCM and global radiative transport code of Bishop provide information about fluxes of middle atmospheric hydrogenous species into the upper atmosphere?

• How do upper atmospheric hydrogen emission observations from Kitt Peak, AZ and Pine Bluff, WI compare with those taken at Arecibo, PR and elsewhere?

• Are there any signatures of long term climatic trends in the thermospheric + exospheric Hα column emission observations?

• How do any variations in upper atmospheric hydrogen compare with observations of middle and lower atmospheric hydrogenous species?
Suggested priorities for new upgrades, instruments, & observations:

• Continued Hα observations by WHαM and/or a similar instrument
• High resolution solar Lyman line observations
• Development of an updated tropospheric scattering correction code
• Hα observations at multiple sites using similar instruments and observing strategies.

• Observations of emission and/or absorption lines from other middle and upper atmospheric hydrogenous species such as H₂O, OH, H₂, CH₂O, CH₄, and H⁺.
Requirements for Long Term Optical Observations

• Well understood, cross-calibrated, stable instrumentation
• Stable calibration source
• Reproducible observing conditions
• Accounting for small scale influences on the observations
• Consistent data analysis techniques
Wisconsin Hα Mapper Fabry-Perot

• Double-etalon Fabry-Perot coupled to a CCD camera
• Located at the Kitt Peak Observatory near Tucson, AZ, and remotely operable from Wisconsin
• Primary scientific purpose to make an all-sky map of galactic Hα emissions, but astronomical spectra also contain the terrestrial line.
• Approximately 38,000 Hα spectra over more than 100 nights spanning 1997-2001.
• Resolution ~25,000.
• Similarities in design to the Fabry-Perots at Pine Bluff, WI