Local Time variations of the hydrogen corona observed by SPICAV-UV/Venus Express

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LATMOS-IPSL/CNRS

International Venus Conference, Oxford, April 2016

SPICAV/Venus Express

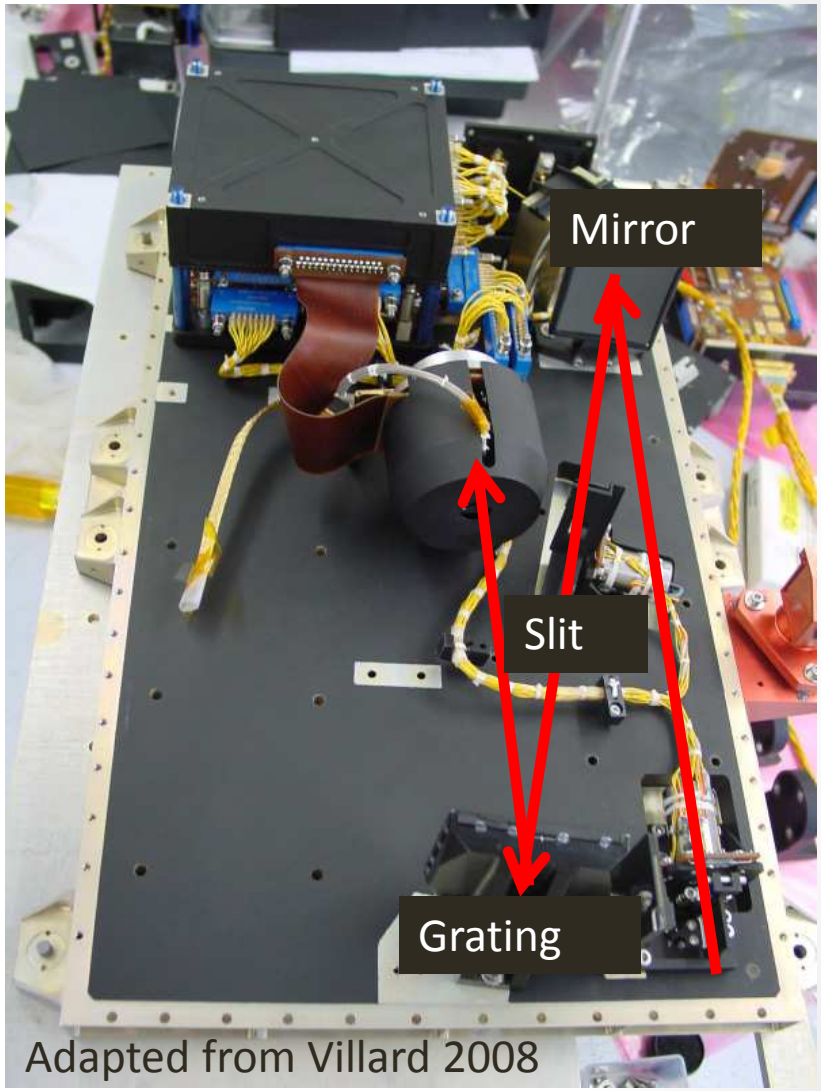
Spectral Range : 110 - 320 nm

Mechanical slit at the focal plane of off-axis mirror

Narrow Part : resolution 1.5 nm
Wide Part : resolution 6 nm

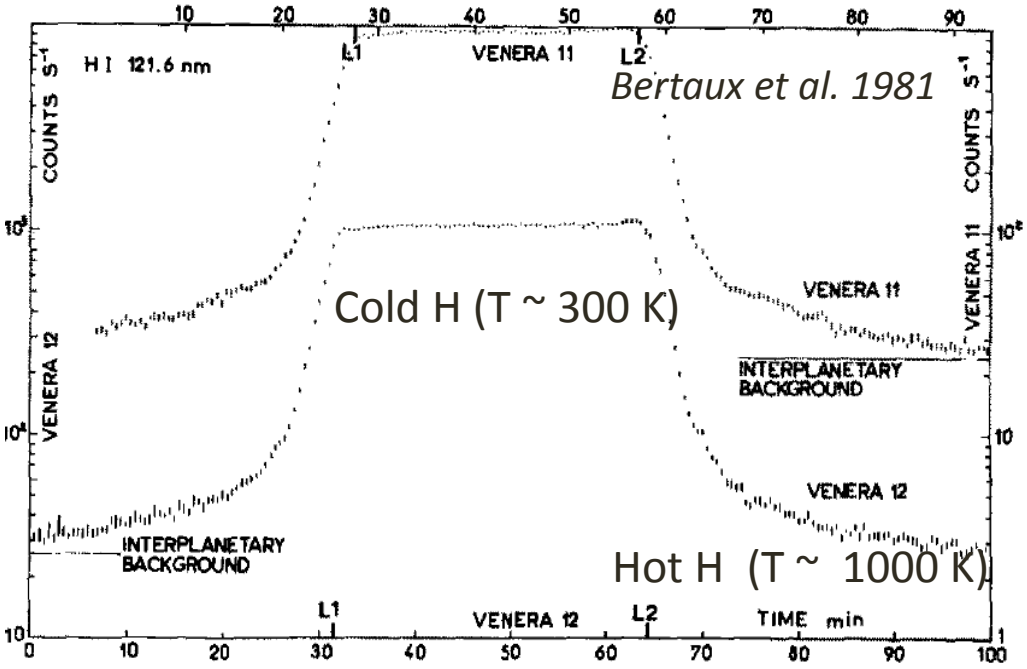
Intensified CCD with 384 (spectral) and 288 (spatial) pixels

Absolute calibration at H I Lyman alpha estimated from SPICAV-VEX/SWAN-SOHO cross calibration



Adapted from Villard 2008

Observations of the dayside hydrogen corona

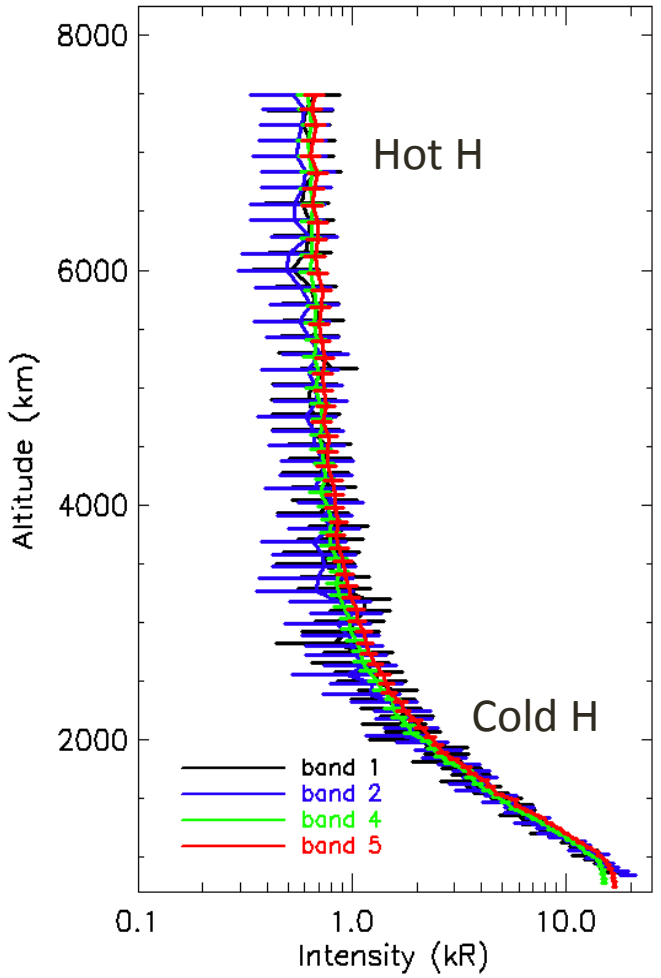


Bertaux et al. 1981

Cold H (T ~ 300 K)

Hot H (T ~ 1000 K)

Chaufray et al. 2012

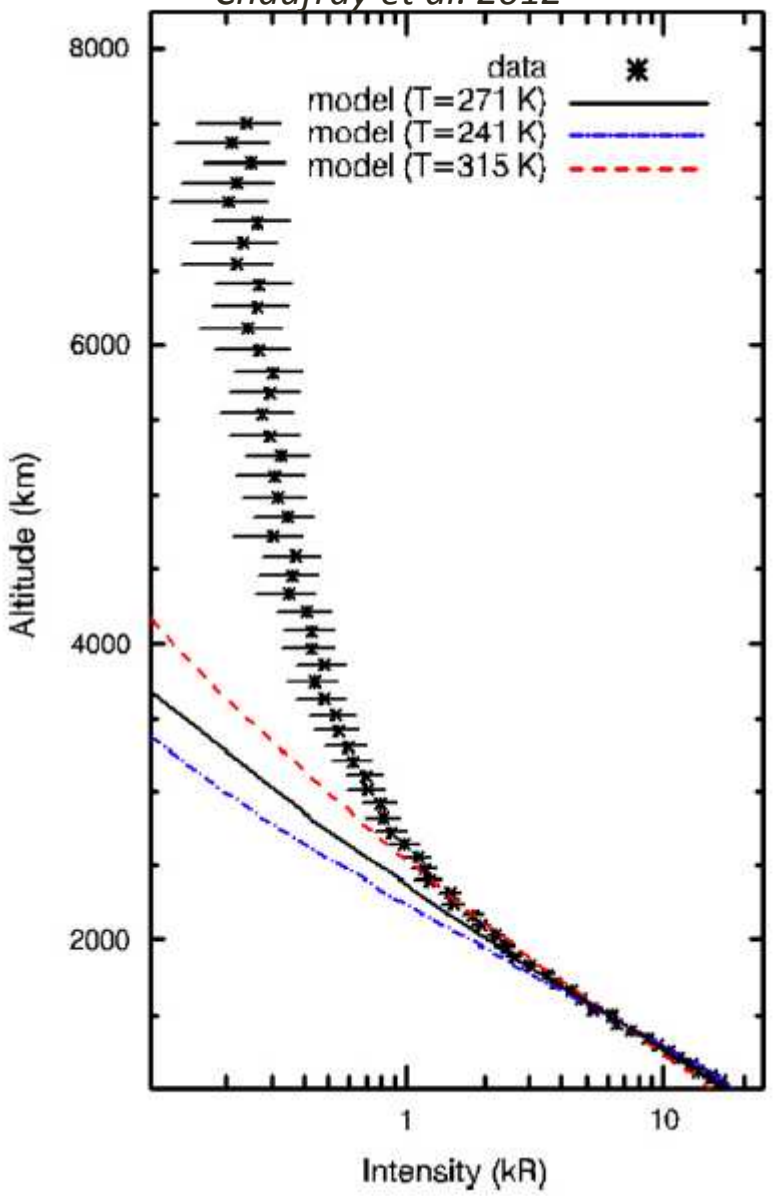


Hot H produced by H^+ (O^+) and H collisions (momentum transfer) *(Hodges 1999)*

Limb observations

Observations of the dayside hydrogen corona

Chaufray et al. 2012



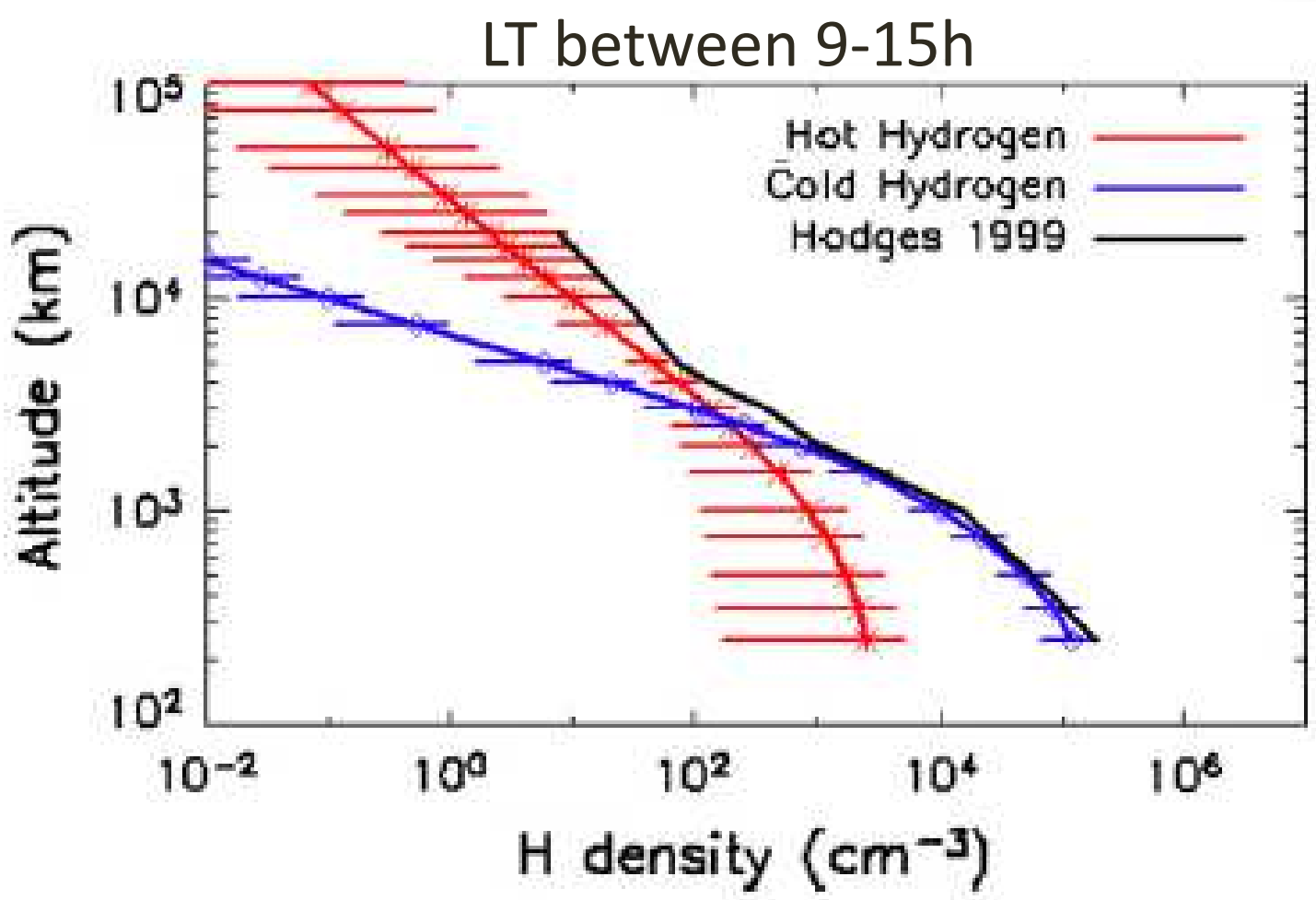
Derivation of the hydrogen and exospheric temperature : Method

- Spherically symmetric model of hydrogen density parametrized by n_{exo} and T_{exo} **(250 km)**
- Radiative transfer model (multiple scattering) without hot hydrogen
- Brightness computation using the geometry of the observations
- Comparison between models of hydrogen density and observations by χ^2 minimization

- From Nov 2006 to July 2007
- Between LT = 10 – 16 hours

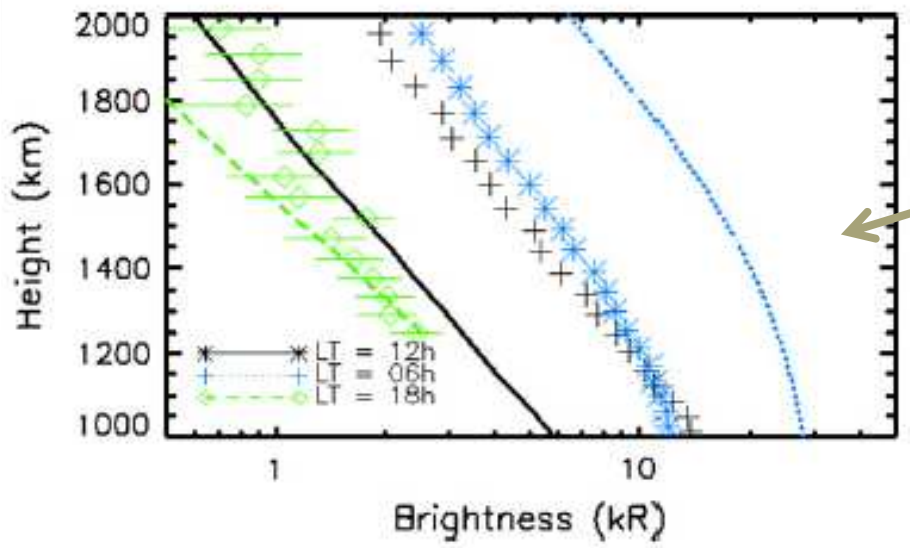
T_{exo}= 270±15 K
n_{exo}=1.2±0.4 x 10^5 cm^{-3}

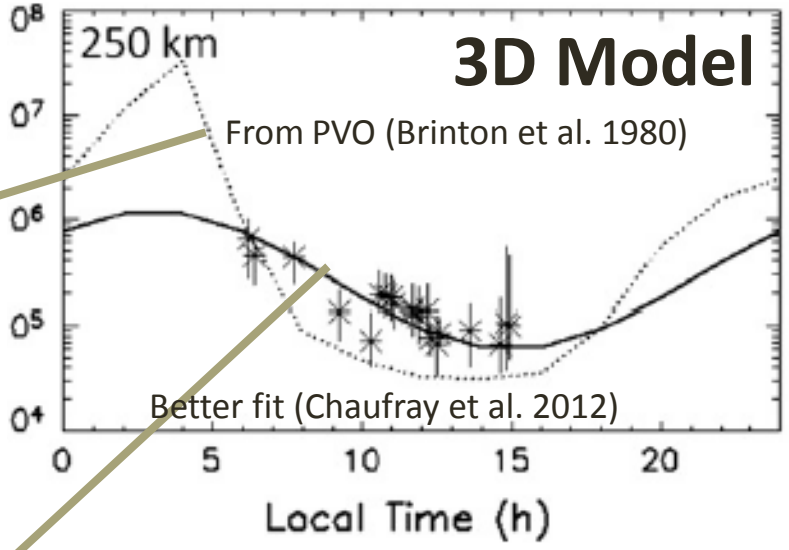
Observations of the dayside hydrogen corona

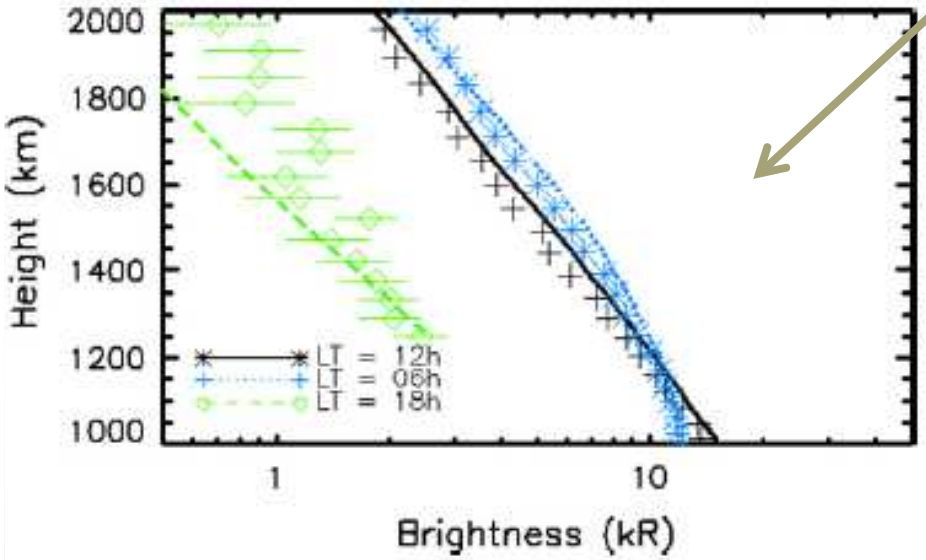


- The hydrogen density profile simulated by Hodges (1999) is in good agreement with SPICAV observations.
- The hot hydrogen density profile is consistent with a source from proton-neutral momentum transfert collision.

Observations of the dayside hydrogen corona



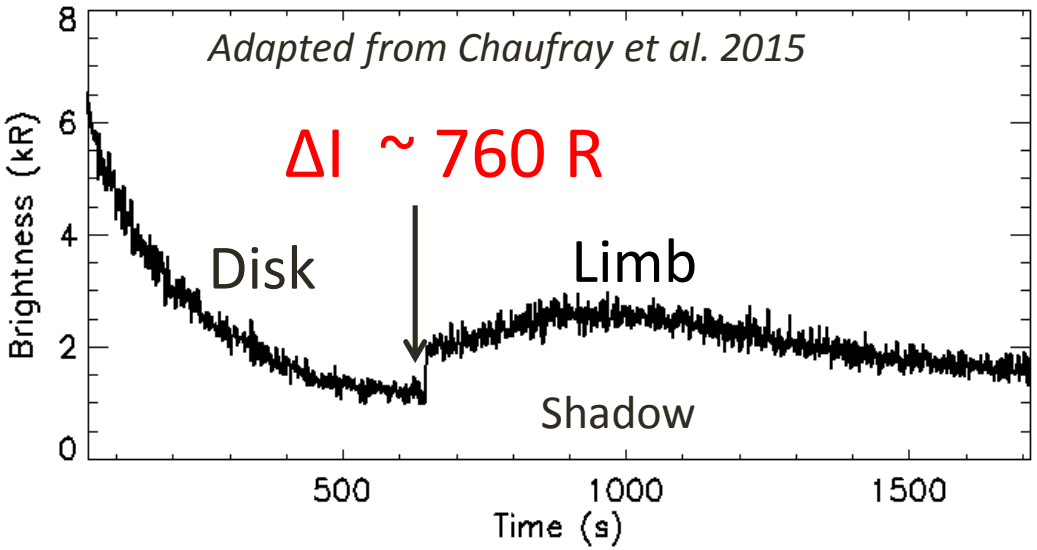


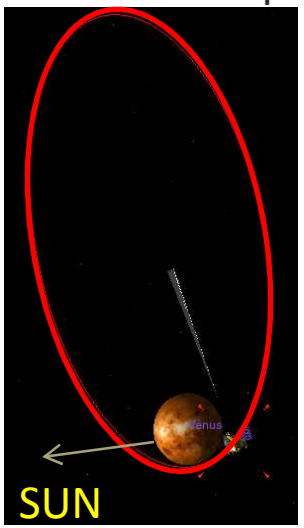


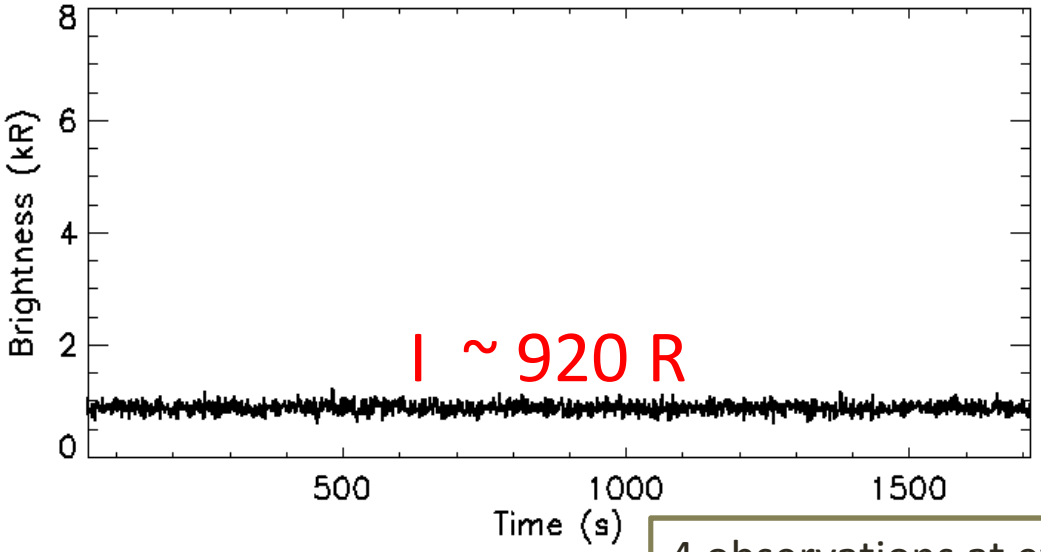
- Asymmetry Morning/Evening observable from the brightness profile
- The local variations derived by PVO lead to overestimate the brightness at 6h

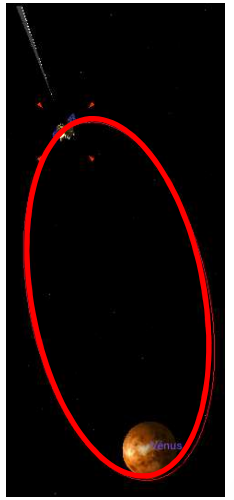
Observations of the nightside hydrogen corona

Perpendicular to eclipitc plane



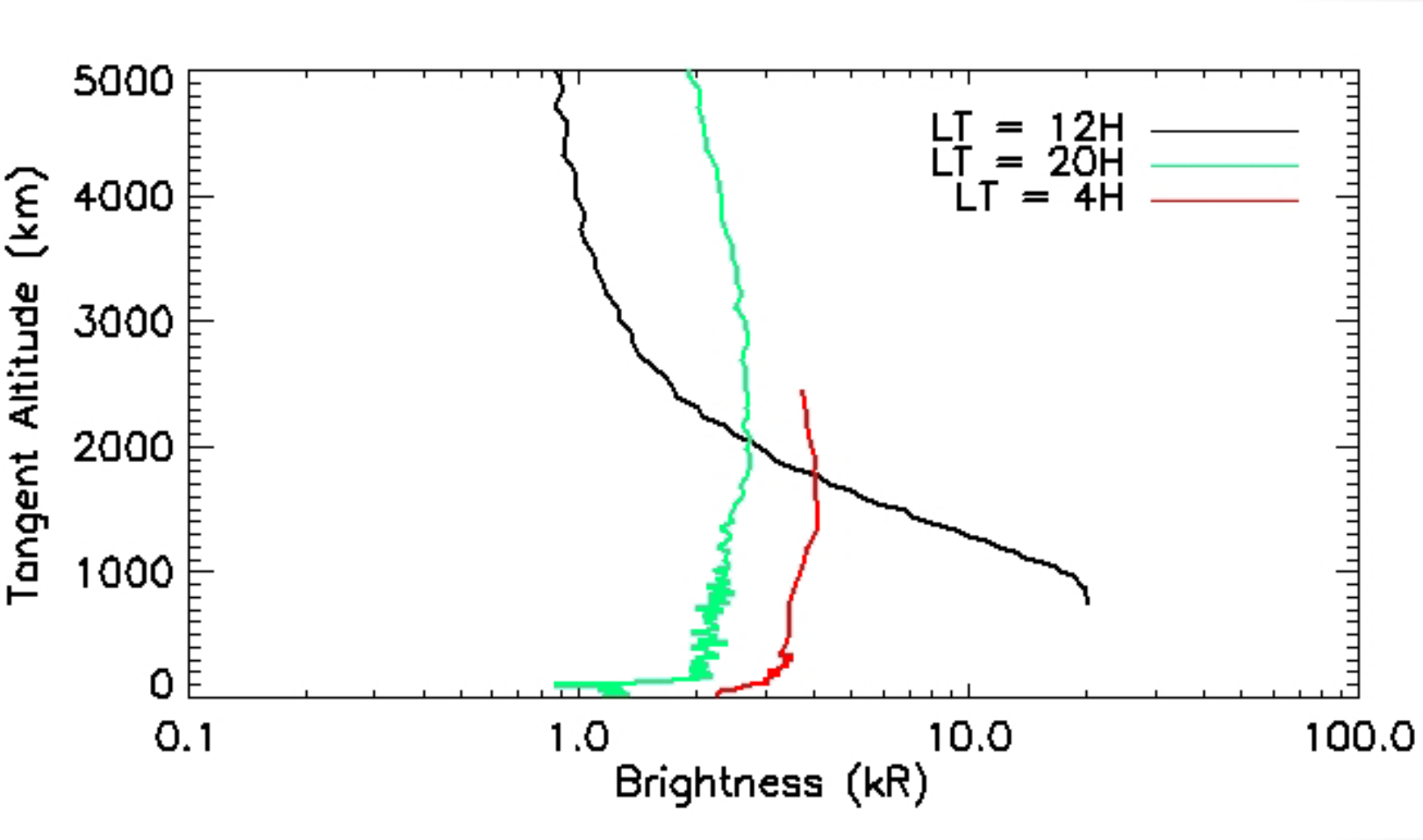






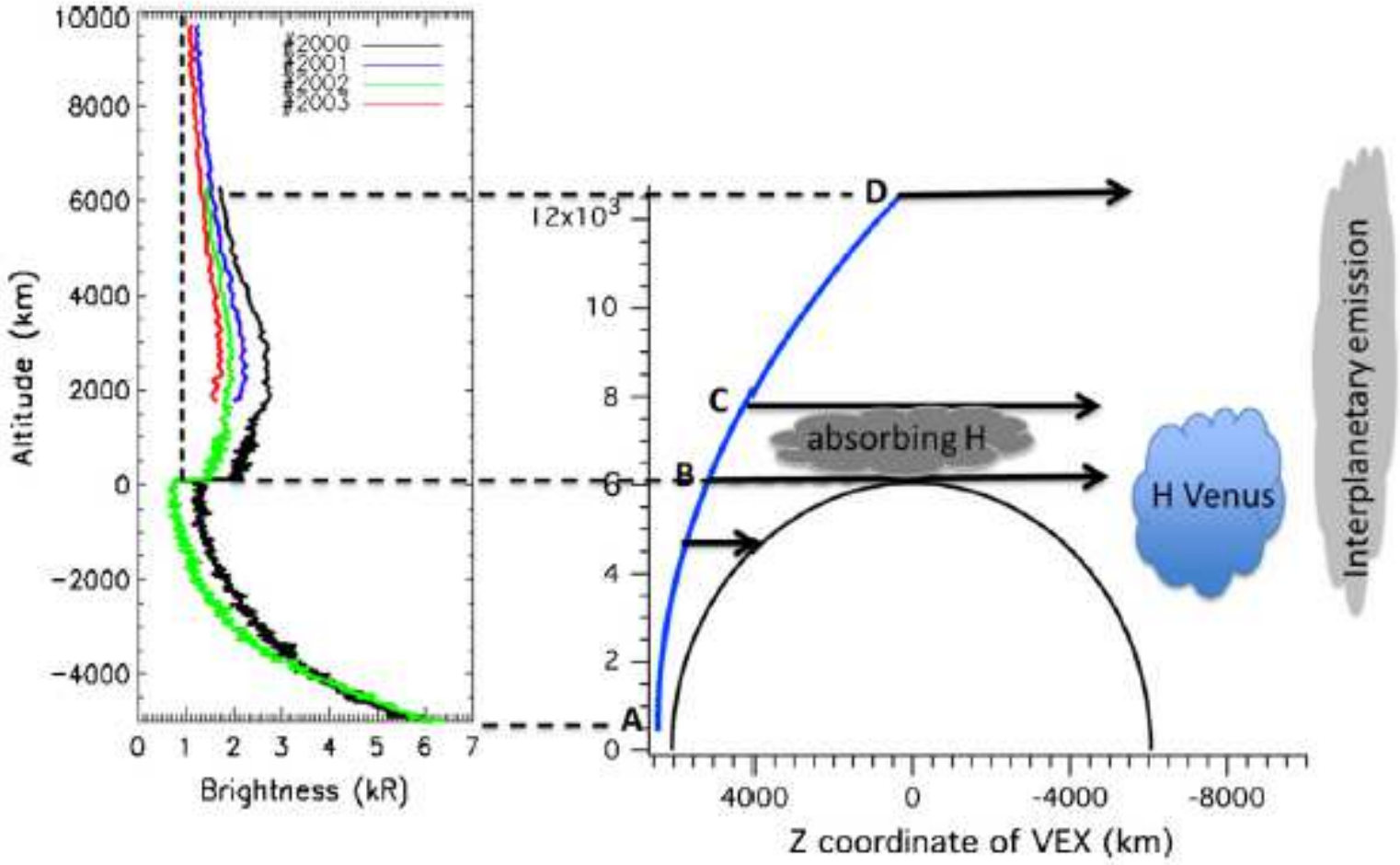
4 observations at evening (LT=20h) Oct 2011
2 observations at morning (LT = 4h) Fev 2014

Observations of the nightside hydrogen corona



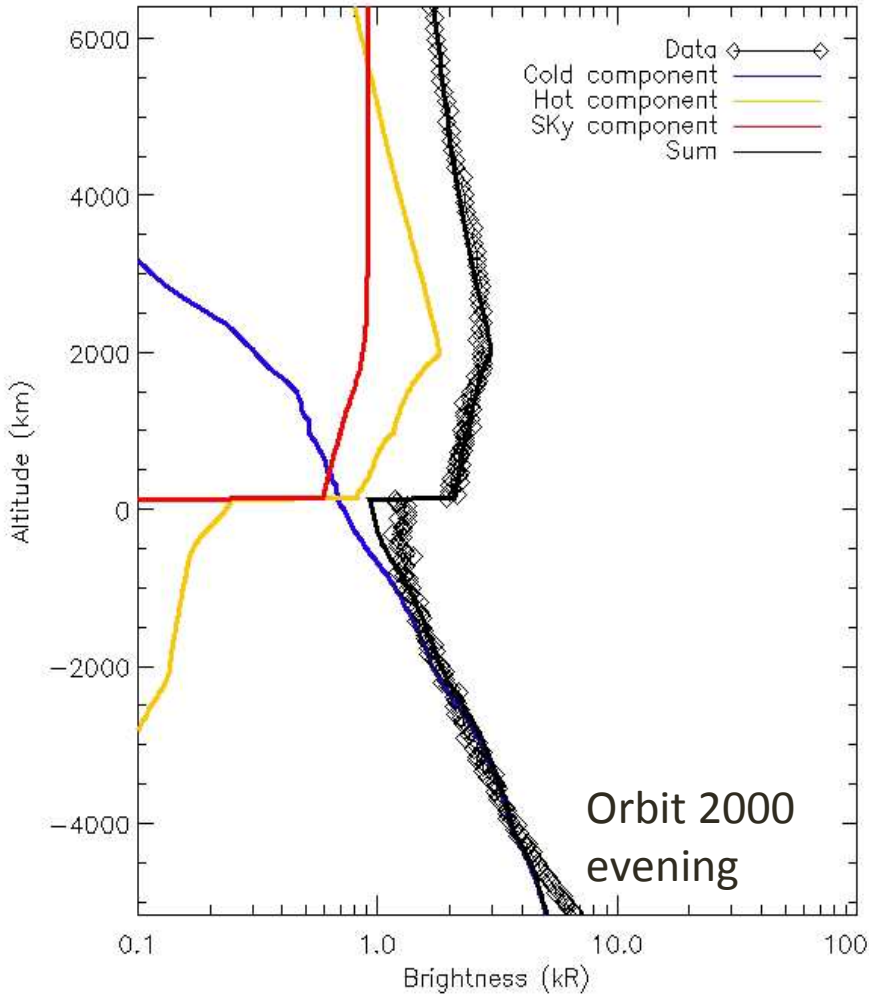
Nightside brightness profiles very different from dayside brightness profiles

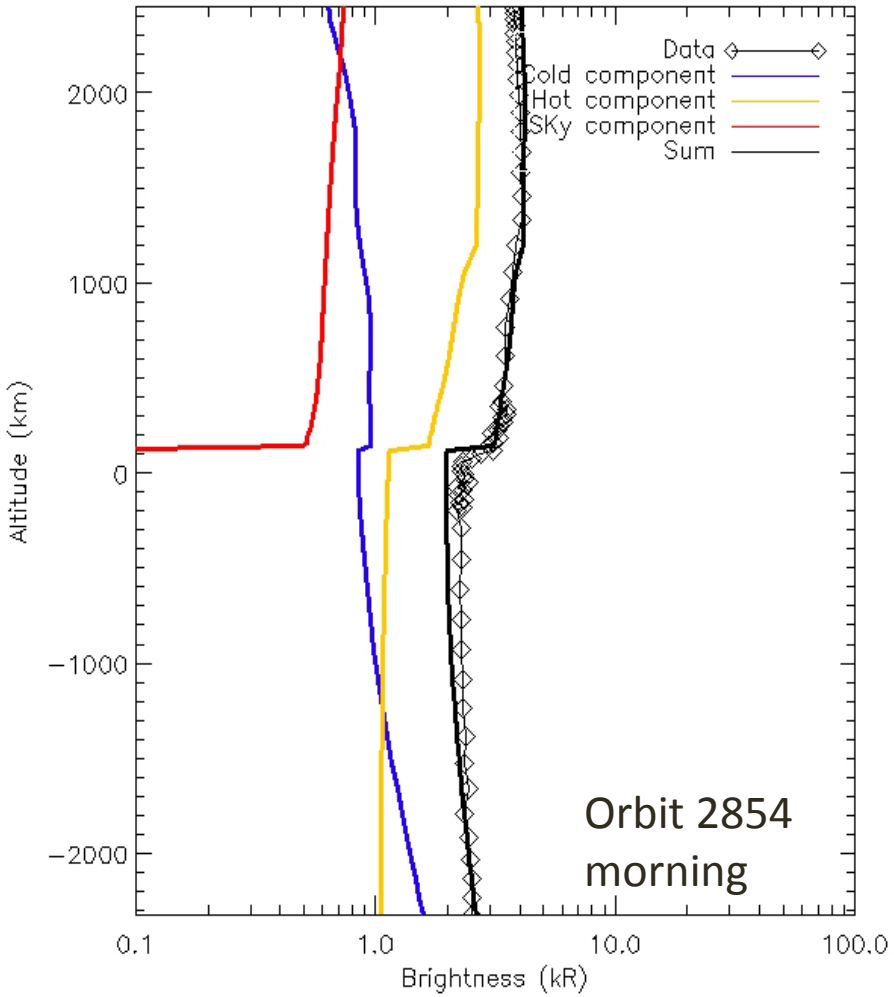
Observations of the nightside hydrogen corona



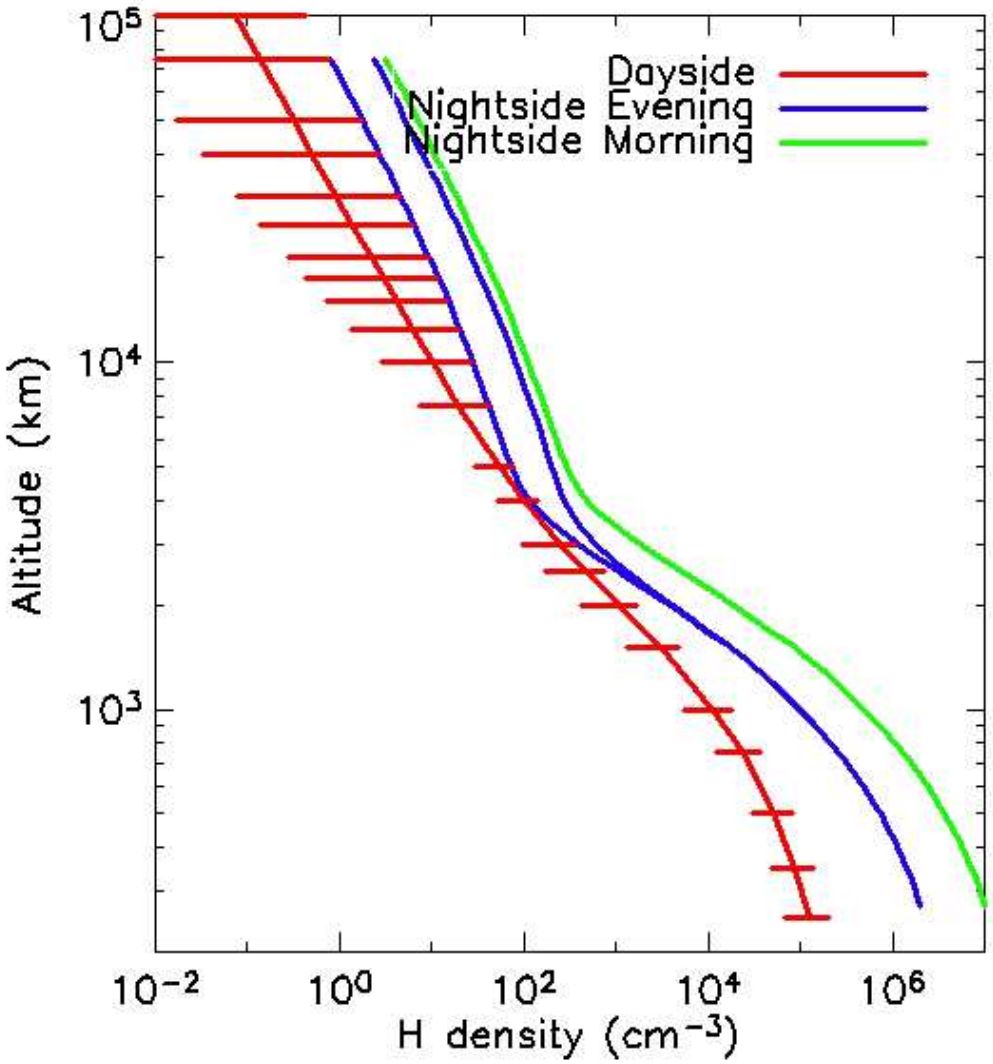
Chaufray et al. 2015

Observations of the nightside hydrogen corona





Observations of the nightside hydrogen corona



- More cold hydrogen at LT = 20 H than dayside
- More hot hydrogen at LT = 20 than dayside with large variability
- Consistent with a source of hot hydrogen at the nightside (bulge of H^+ at nighside morning).

Summary & Future work

Summary

- First detailed study of the local time variations of the hydrogen corona from UV
- Large night/day – morning/evening variations of the cold hydrogen population consistent with hydrogen distribution driven by thermospheric winds
- Large night/day – morning/evening variations of the hot hydrogen population consistent with a production from H+ and H momentum transfer but differences with the Hodges predictions (less spherically symmetric ?)
- Possible short temporal variations of the hot hydrogen population driven by the ionopause altitude variations ?

Future Work

- Extension of the set of studied observations, other local times, temporal variations of the dayside corona ?
- Better estimate of the hot hydrogen population (dayside) using a better estimate of the interplanetary emission
- Derivation of an empirical 2D (or 3D) hydrogen corona fitting the full set of observations
- Development of a physical hot hydrogen model to estimate neutral H escape.