

# SPACELAB EXPERIMENT : ALAE

---

## ATMOSPHERIC LYMAN-ALPHA EMISSIONS

J.L. BERTAUX (PI,SA) ; FLORENCE GOUTAIL (CO-I,SA)  
G. KOCKARTS (CO-I,IASB)

### SCIENTIFIC OBJECTIVES

#### 1. DEUTERIUM (DAY SIDE)

- VERTICAL DISTRIBUTION
- EDDY DIFFUSION COEFF. K AT 100 KM
- TEMPERATURE (100 → 200 KM ?),

#### 2. PROTON PRECIPITATIONS

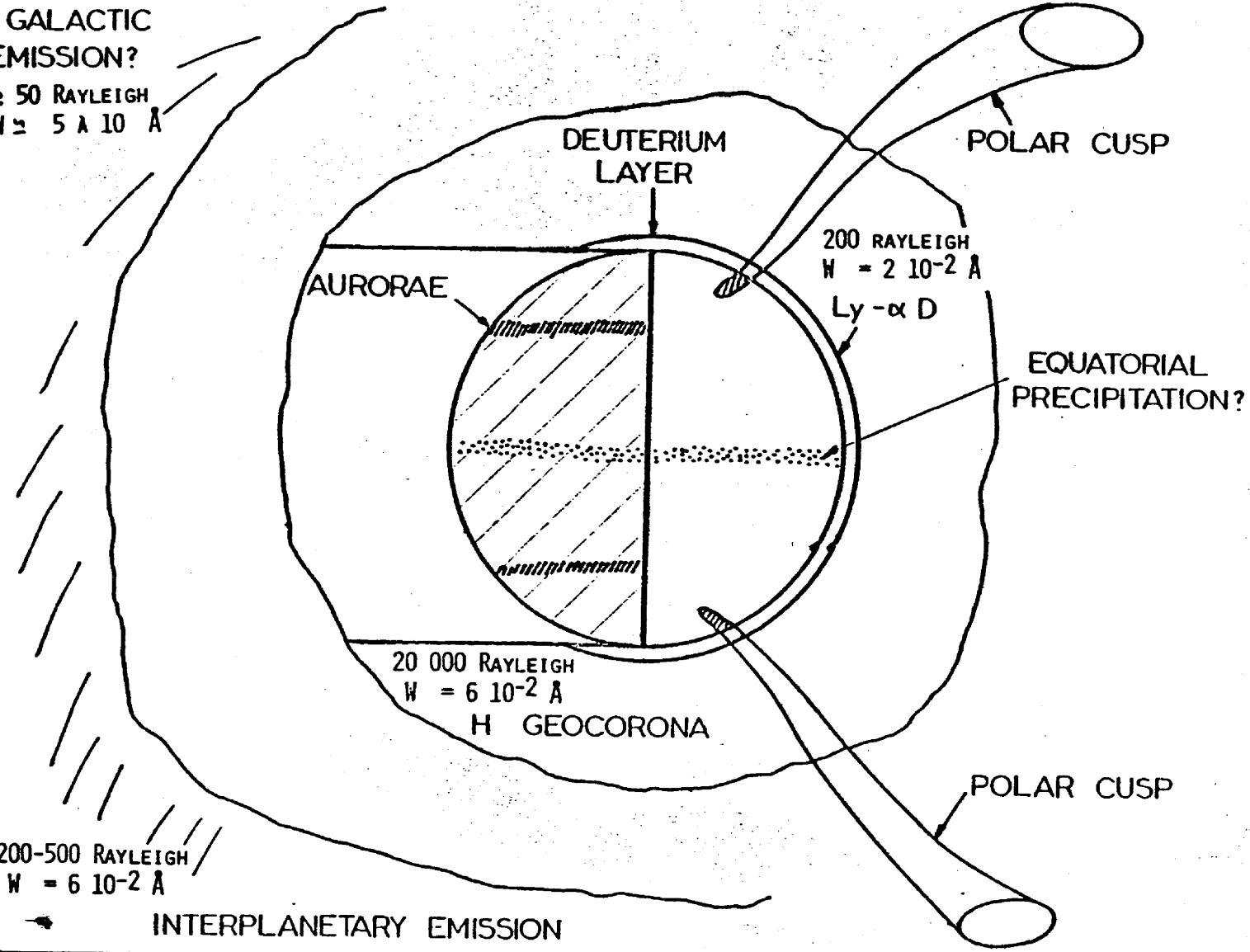
- AURORAL ZONES
- EQUATORIAL ZONES
- POLAR CUSP FOOT
- PROTON GUN OBSERVATIONS.

#### 3. ATMOSPHERIC HYDROGEN

- NADIR : TOTAL H COLUMN
- ZENITH : EXOBASE TEMPERATURE.

GALACTIC  
EMISSION?

$\approx 50$  RAYLEIGH  
 $W \approx 5 \text{ \AA} \text{ } 10 \text{ \AA}$



DEUTERIUM  
LAYER

POLAR CUSP

AURORAE

200 RAYLEIGH  
 $W = 2 \cdot 10^{-2} \text{ \AA}$

Ly -  $\alpha$  D

EQUATORIAL  
PRECIPITATION?

SUN

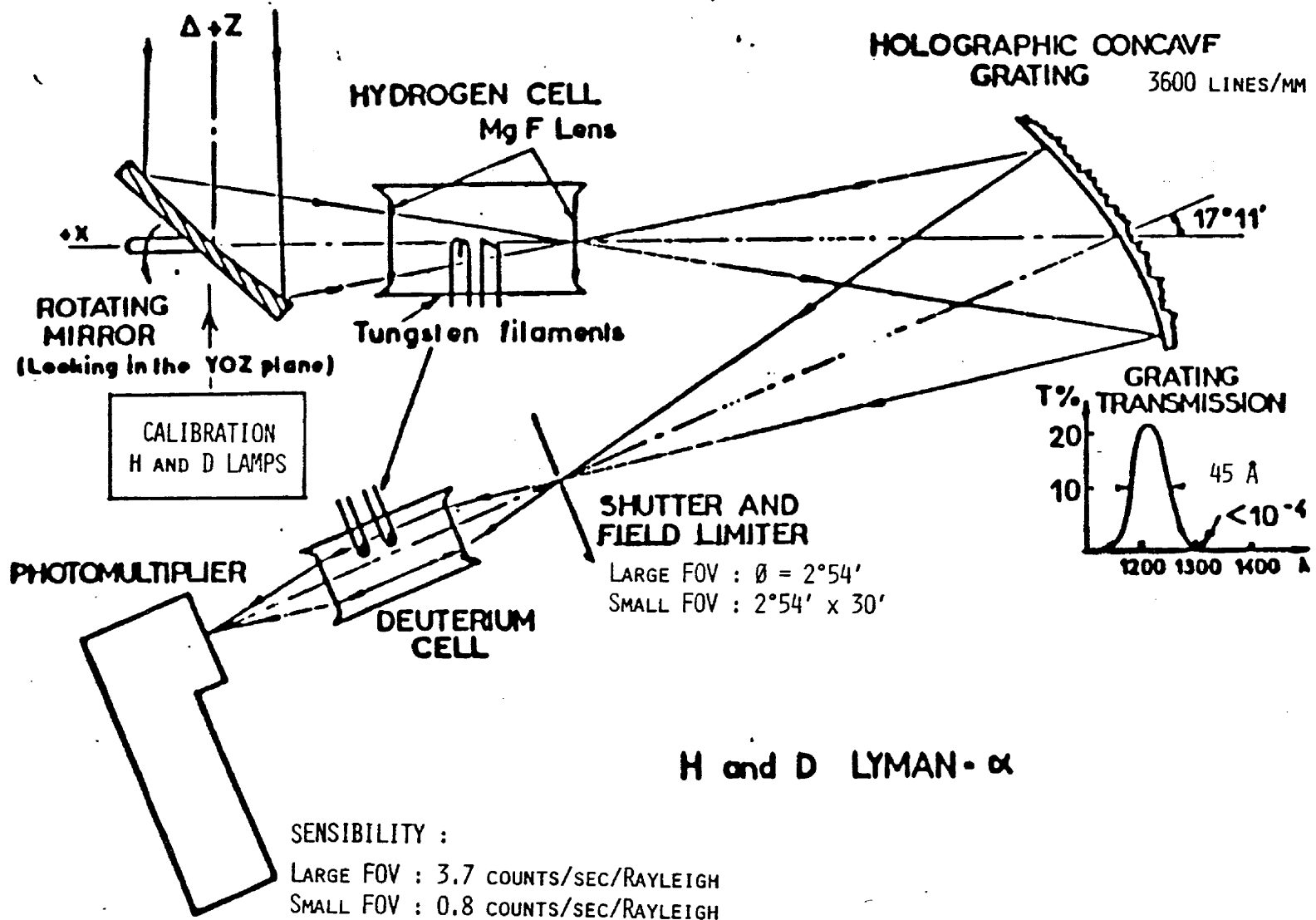
20 000 RAYLEIGH  
 $W = 6 \cdot 10^{-2} \text{ \AA}$

H GEORONA

POLAR CUSP

200-500 RAYLEIGH  
 $W = 6 \cdot 10^{-2} \text{ \AA}$

INTERPLANETARY EMISSION



**H and D LYMAN- $\alpha$**

INVESTIGATION ON ATMOSPHERIC H AND D THROUGH THE  
MEASUREMENT OF THEIR LYMAN- $\alpha$  EMISSIONS  
(1ES017)

J. L. Bertaux  
Service d'Aéronomie du CNRS, France

The scientific objective of this experiment is to study various sources of Lyman- $\alpha$  emission in the atmosphere, in the interplanetary medium, and possibly in the galactic medium. The instrument is a spectrophotometer associated with two absorption cells, one filled with hydrogen, the other with deuterium (Fig. 1).

The main source of Lyman- $\alpha$  as seen from Spacelab is the result of resonance scattering of solar photons by atmospheric atomic hydrogen. This emission has been studied thoroughly with previous space experiments and is considered as "noise" in the present investigation; it is eliminated with the help of the hydrogen absorption cell run at a high absorption level. The other sources of Lyman- $\alpha$  are then studied (Fig. 2).

Lyman- $\alpha$  emission of atomic deuterium (D) is identified with the help of the deuterium absorption cell. Its intensity and line-width are measured, yielding the vertical distribution of D from 90 to approximately 250 kilometers and its temperature. From this vertical distribution, the eddy diffusion coefficient K around 100 kilometers is derived and mapped on the whole sunlit Earth.

Lyman- $\alpha$  emission resulting from charge exchange is possibly present at various places: auroral zones, equatorial zones, and possibly at the foot of the polar cusps, where the solar wind interacts directly with the neutral atmosphere. The foot of the polar cusps could be located precisely through observations of these regions with a scanning mirror.

Some emission is also expected from the plasma guns placed on board Spacelab.

Interplanetary hydrogen (which comes from the nearby interstellar medium) is a source of Lyman- $\alpha$ . It prevents astronomical observation of diffuse galactic Lyman- $\alpha$  emissions. With the help of the absorption cell, the level of diffuse galactic emission will be determined. The use of the absorption cell on Spacelab is also a test for determining if the presence of geocoronal and interplanetary emission will prevent future astronomical observations of Lyman- $\alpha$  emissions.

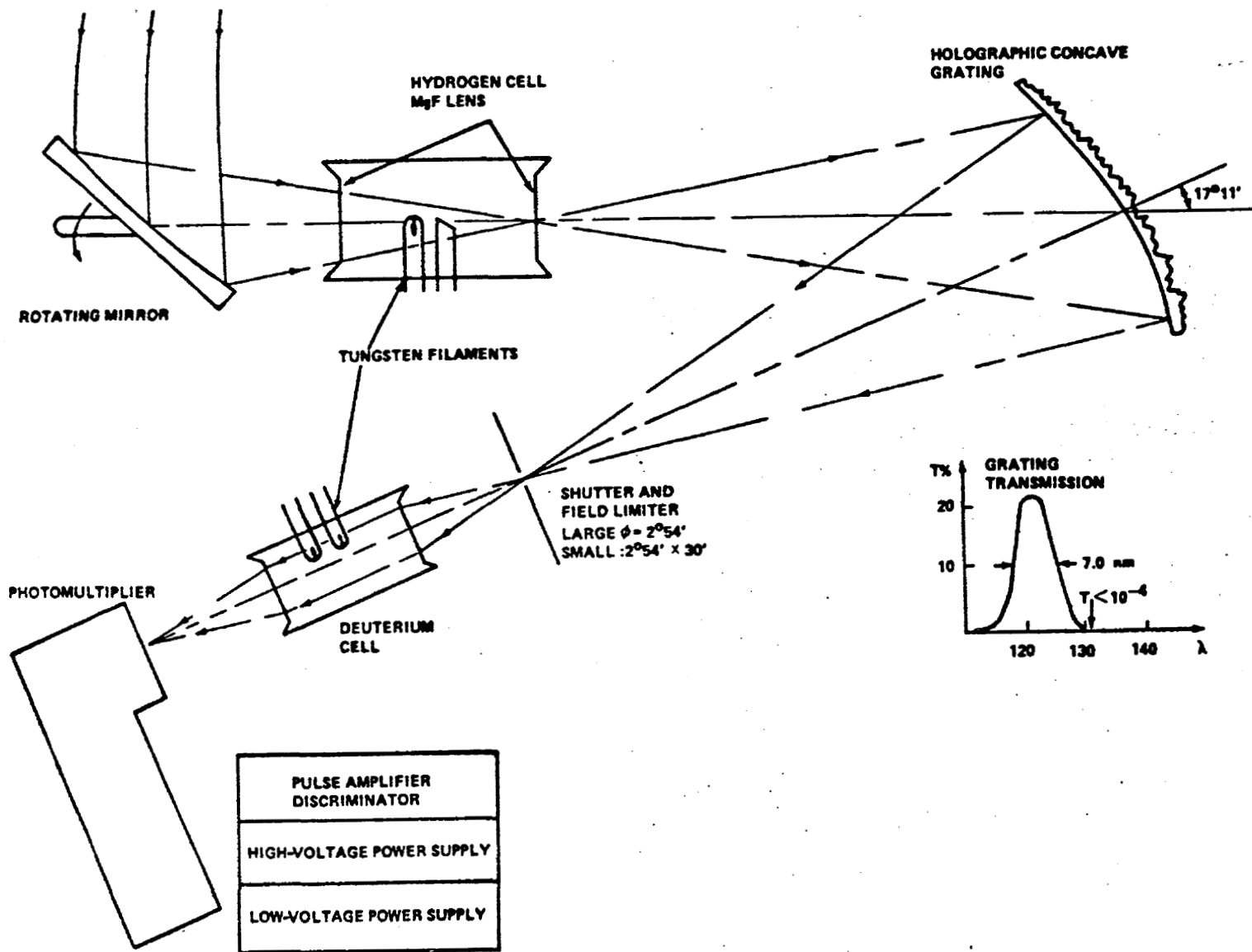


Figure 1. Schematic of instrument for measurement of hydrogen and deuterium Lyman- $\alpha$  emission.

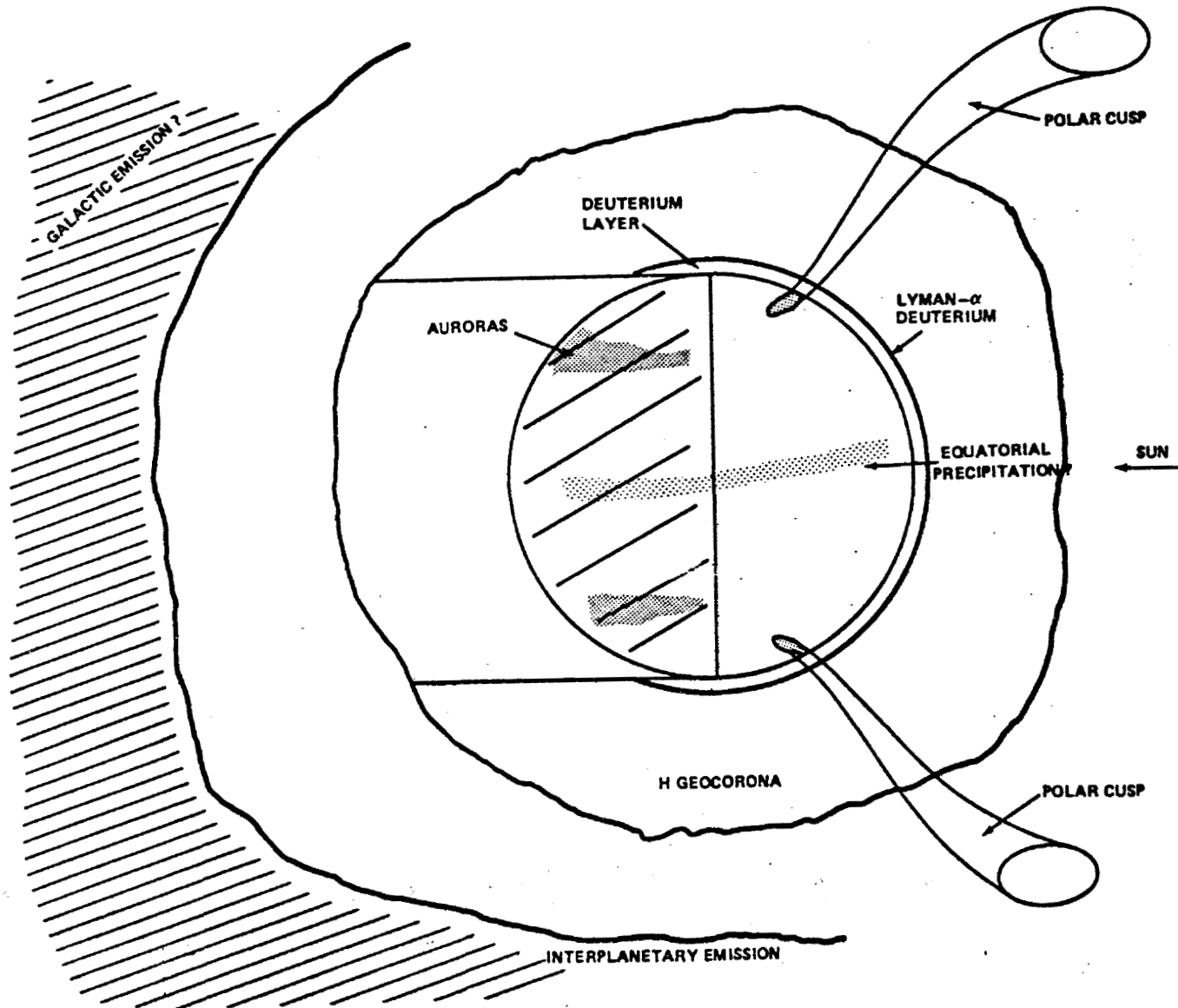


Figure 2. Sources of Lyman- $\alpha$  emissions.

SECTION II. ATMOSPHERIC EMISSION PHOTOMETRIC  
IMAGING (AEPI)