

HI Lyman- α imaging: intensities and spectral line-widths diagnostics

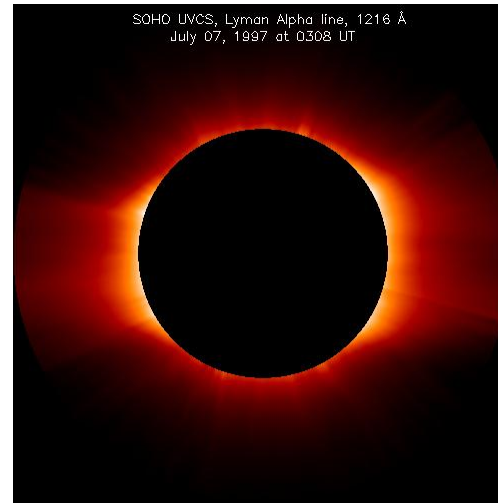
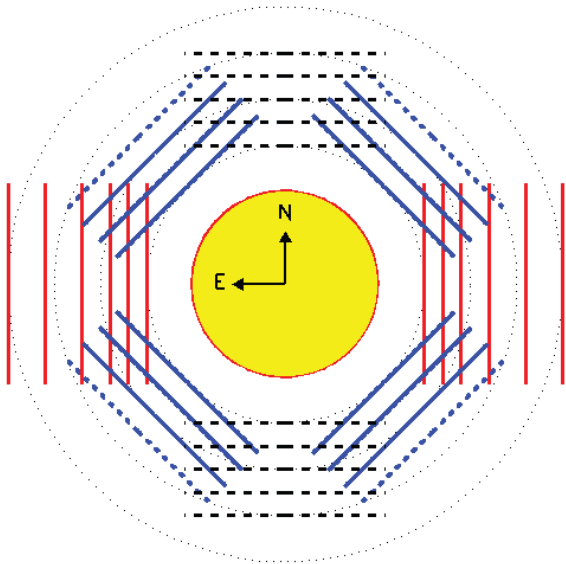
L. Abbo

INAF - Astrophysical Observatory of Turin

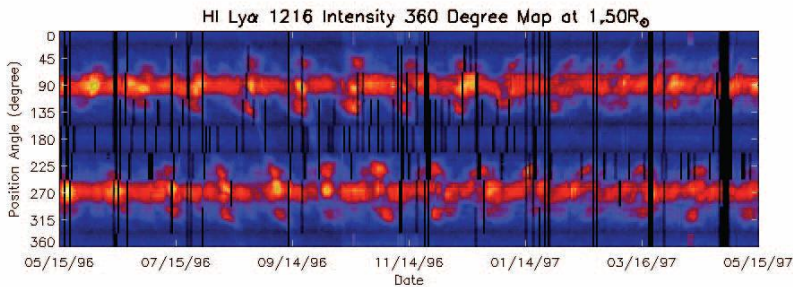
UVCS synoptic and mini-synoptic programs (1996-2005): in 12 hours/day, corona from 1.5 to 3.5 solar radii at eight different roll angles separated by an angular step of 45°

1997

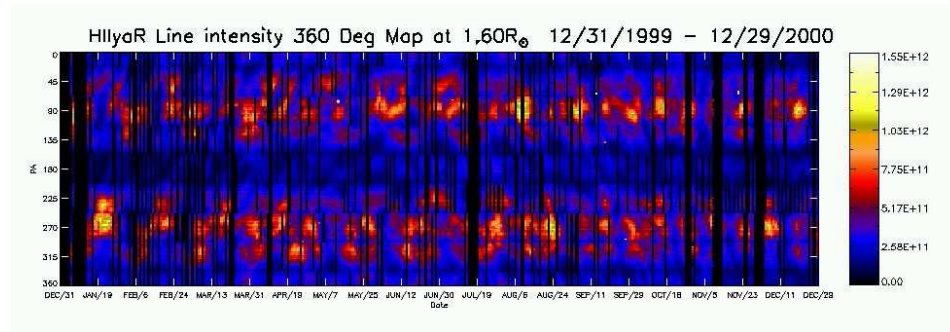
2000



courtesy Y.-K. Ko



solar min (1996-97), 1.5 R



solar max (2000), 1.6 R

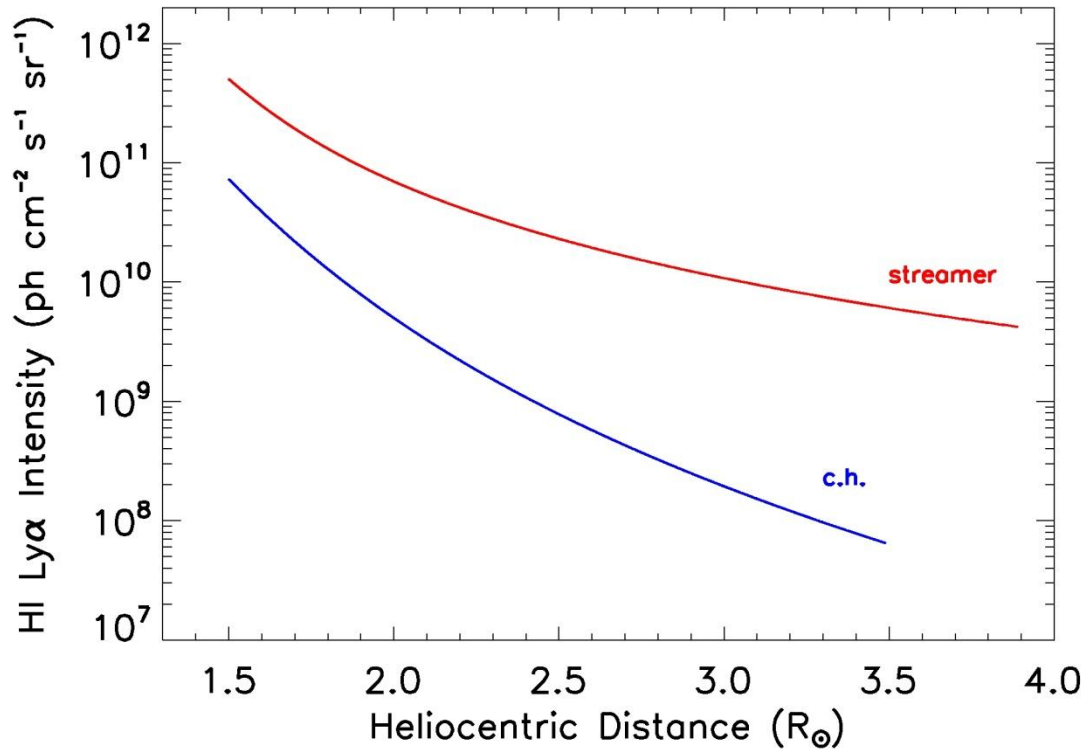
Giordano & Mancuso, 2008

UVCS special observing programs 'Global Sun' in 12 days

HI Ly α intensity @ solar minimum

(1996-1997, UVCS data, METIS-OACT-TNO-004_Coronal Radiances and Modelling-Issue 01.pdf)

@ Solar Minimum



Streamer:

11 April 1996 (PA = 270°)

4 June 1996 (PA = 90°)

31 August 1996 (PA = 255°)

5 May 1997 (PA = 72°)

Coronal Hole:

6 April 1996 (PA = 360°)

16 May 1996 (PA = 360°)

21 May 1996 (PA = 360°)

29 August 1996 (PA = 195°)

3 May 1997 (PA = 360°)

9 May 1997 (PA = 180°)

20 December 1997 (PA = 180°)

streamer

$$I = c * \left[a_1 * \left(\frac{r}{R_s} \right)^{b_1} + a_2 * \left(\frac{r}{R_s} \right)^{b_2} + a_3 * \left(\frac{r}{R_s} \right)^{b_3} \right]$$

$a_1=518.56; a_2=32.17; a_3=1.29; b_1=-11.07; b_2=-5.10; b_3=-2.32; c=4.85e10$

Coronal hole

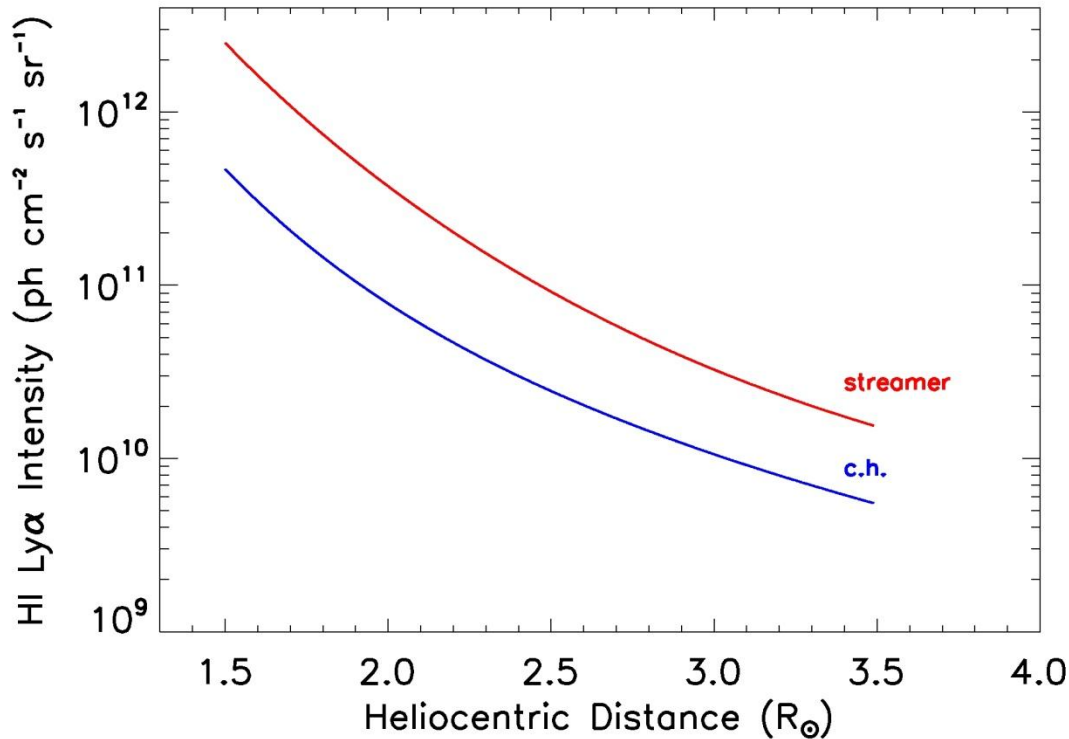
$$I = c * \left[a_1 * \left(\frac{r}{R_s} \right)^{b_1} + a_2 * \left(\frac{r}{R_s} \right)^{b_2} \right]$$

$a_1=2155.27; a_2=128.98; b_1=-10.77; b_2=-6.73; c=2.04e9$

HI Ly α intensity @ solar maximum

(2000, UVCS data, METIS-OACT-TNO-004_Coronal Radiances and Modelling-Issue 01.pdf)

@ Solar Maximum



Equatorial observation:

8 August 2000 (PA = 90°)

21 January 2000 (PA = 270°)

1 October 2000 (PA = 90°)

20 December 2000 (PA = 90°)

24 August 2000 (PA=270°)

6 December 2000 (PA=270°)

Polar observation:

19 March 2000 (PA = 360°)

22 November 2000 (PA = 180°)

Streamer and Coronal hole

$$I = c * \left[a_1 * \left(\frac{r}{R_s} \right)^{b_1} + a_2 * \left(\frac{r}{R_s} \right)^{b_2} \right]$$

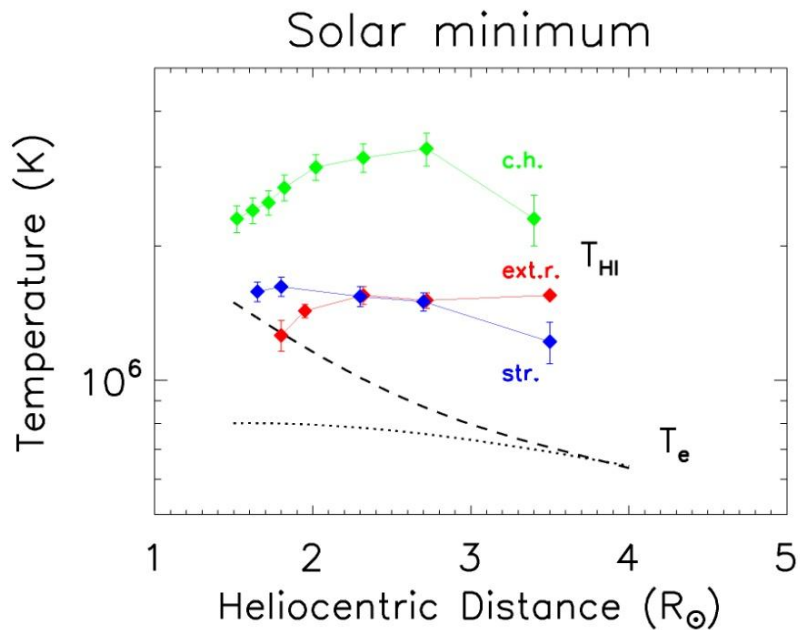
streamer

$a_1=2258.13$; $a_2=6.9$; $b_1=-6.81$; $b_2=-2.20$; $c=1.72e10$

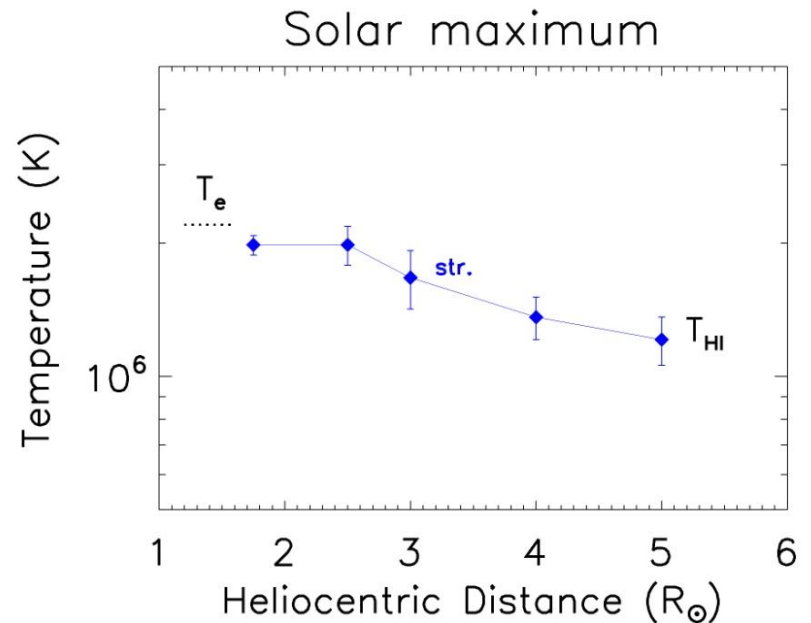
c.h.

$a_1=3194.05$; $a_2=262.17$; $b_1=-8.00$; $b_2=-3.92$; $c=2.63e9$

HI Ly α kinetic temperature and T_e



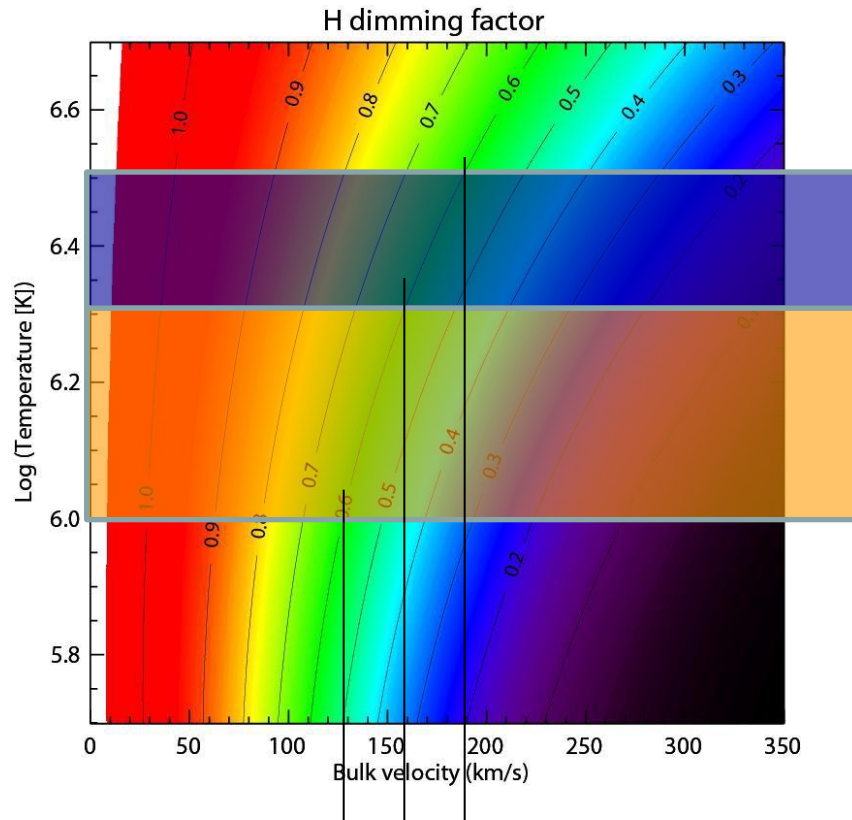
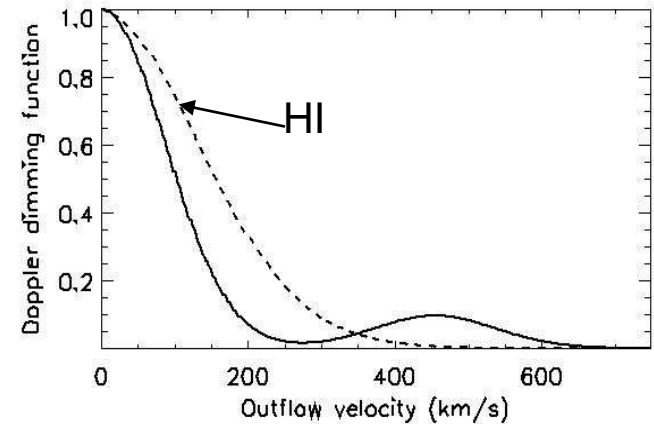
T_{HI} : Antonucci, Abbo & Doderò 2005
 T_e : Gibson et al 1999, David et al. 1998,
Guathakurtha et al. 1999



T_{HI} : Uzzo et al. 2007
 T_e : Foley et al. 2002

HI Doppler dimming factor

$$\Phi(\delta\lambda) = \int_0^{+\infty} \Psi(\lambda - \lambda_0) I_{ex}(\lambda - \delta\lambda, n') d\lambda$$



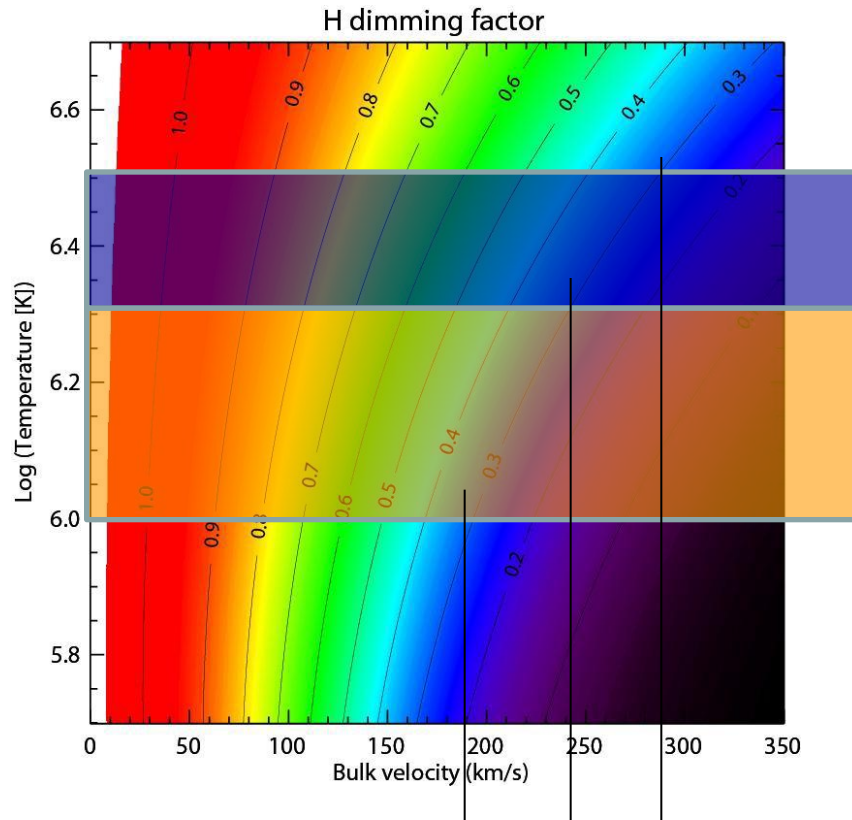
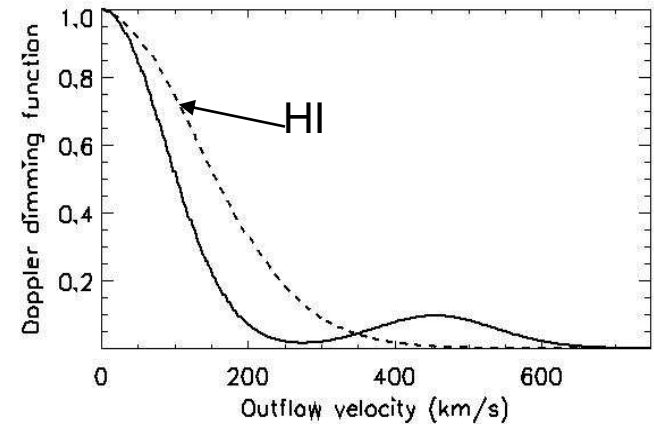
c.h.

streamer

0.6 dimming factor

HI Doppler dimming factor

$$\Phi(\delta\lambda) = \int_0^{+\infty} \Psi(\lambda - \lambda_0) I_{ex}(\lambda - \delta\lambda, n') d\lambda$$



c.h.

streamer

0.3 dimming factor

METIS HI COUNT RATES at solar min (detected-photon/s/pixel)

IO 2,75 mm

Solar minimum with perihelion at 0.28 AU

Streamer

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 1,58 | 1,80E+00 |
| 1,80 | 1,89 | 2,66E+00 |
| 2,10 | 2,21 | 2,25E+00 |
| 2,40 | 2,52 | 1,71E+00 |
| 2,70 | 2,84 | 1,27E+00 |
| 3,00 | 3,16 | 7,91E-01 |

Coronal Hole

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 1,58 | 1,97E-01 |
| 1,80 | 1,89 | 1,88E-01 |
| 2,10 | 2,21 | 1,28E-01 |
| 2,40 | 2,52 | 8,25E-02 |
| 2,70 | 2,84 | 4,90E-02 |
| 3,00 | 3,16 | 2,55E-02 |

Solar minimum with perihelion at 0.5 AU

Streamer

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 2,82 | 7,11E-02 |
| 1,80 | 3,38 | 1,14E-01 |
| 2,10 | 3,94 | 9,39E-02 |
| 2,40 | 4,51 | 6,65E-02 |
| 2,70 | 5,07 | 4,68E-02 |
| 3,00 | 5,64 | 2,69E-02 |

Coronal Hole

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 2,82 | 2,78E-03 |
| 1,80 | 3,38 | 3,28E-03 |
| 2,10 | 3,94 | 1,54E-03 |
| 2,40 | 4,51 | 4,39E-04 |
| 2,70 | 5,07 | 9,83E-05 |
| 3,00 | 5,64 | 1,72E-05 |

pixel=15um

METIS HI COUNT RATES at solar max (detected-photon/s/pixel)

IO 2,75 mm

Solar maximum with perihelion at 0.28 AU

Streamer

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 1,58 | 1,60E+01 |
| 1,80 | 1,89 | 2,15E+01 |
| 2,10 | 2,21 | 1,55E+01 |
| 2,40 | 2,52 | 1,03E+01 |
| 2,70 | 2,84 | 7,36E+00 |
| 3,00 | 3,16 | 4,78E+00 |

Coronal Hole

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 1,58 | 3,00E+00 |
| 1,80 | 1,89 | 4,33E+00 |
| 2,10 | 2,21 | 3,59E+00 |
| 2,40 | 2,52 | 2,79E+00 |
| 2,70 | 2,84 | 2,26E+00 |
| 3,00 | 3,16 | 1,62E+00 |

Solar maximum with perihelion at 0.5 AU

Streamer

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 2,82 | 4,10E-01 |
| 1,80 | 3,38 | 7,22E-01 |
| 2,10 | 3,94 | 6,73E-01 |
| 2,40 | 4,51 | 4,91E-01 |
| 2,70 | 5,07 | 3,33E-01 |
| 3,00 | 5,64 | 1,82E-01 |

Coronal Hole

| Angular | Rsun | 121.6 nm |
|---------|------|----------|
| 1,50 | 2,82 | 1,26E-01 |
| 1,80 | 3,38 | 2,54E-01 |
| 2,10 | 3,94 | 2,50E-01 |
| 2,40 | 4,51 | 1,92E-01 |
| 2,70 | 5,07 | 1,38E-01 |
| 3,00 | 5,64 | 7,96E-02 |

pixel=15um

METIS HI Exposure time (s), S/N=10 (IO=2,75 mm)

Perihelion at 0.28 AU

| Coronal hole | | | |
|--------------|------|----------|----------|
| Angular | Rsun | min | max |
| 1,50 | 1,58 | 5,08E+02 | 3,33E+01 |
| 1,80 | 1,89 | 5,31E+02 | 2,31E+01 |
| 2,10 | 2,21 | 7,84E+02 | 2,78E+01 |
| 2,40 | 2,52 | 1,21E+03 | 3,59E+01 |
| 2,70 | 2,84 | 2,04E+03 | 4,43E+01 |
| 3,00 | 3,16 | 3,92E+03 | 6,18E+01 |
| Streamer | | | |
| Angular | Rsun | min | max |
| 1,50 | 1,58 | 5,56E+01 | 6,24E+00 |
| 1,80 | 1,89 | 3,76E+01 | 4,65E+00 |
| 2,10 | 2,21 | 4,44E+01 | 6,45E+00 |
| 2,40 | 2,52 | 5,86E+01 | 9,69E+00 |
| 2,70 | 2,84 | 7,88E+01 | 1,36E+01 |
| 3,00 | 3,16 | 1,26E+02 | 2,09E+01 |

Perihelion at 0.5 AU

| Coronal hole | | |
|--------------|----------|----------|
| Rsun | min | max |
| 2,82 | 3,60E+04 | 7,97E+02 |
| 3,38 | 3,05E+04 | 3,94E+02 |
| 3,94 | 6,49E+04 | 3,99E+02 |
| 4,51 | 2,28E+05 | 5,20E+02 |
| 5,07 | 1,02E+06 | 7,26E+02 |
| 5,64 | 5,80E+06 | 1,26E+03 |
| Streamer | | |
| Rsun | min | max |
| 2,82 | 1,41E+03 | 2,44E+02 |
| 3,38 | 8,81E+02 | 1,38E+02 |
| 3,94 | 1,06E+03 | 1,49E+02 |
| 4,51 | 1,50E+03 | 2,04E+02 |
| 5,07 | 2,14E+03 | 3,01E+02 |
| 5,64 | 3,72E+03 | 5,49E+02 |

| | |
|------------------------|----------|
| | 121.6 nm |
| Filters transmission | 0,2 |
| | |
| Mirror reflectivity M1 | 0,7 |
| Mirror reflectivity M2 | 0,7 |
| Grating diffr. | |
| Polarimeter | |
| Detector QE (KBr) | 0,119 |