UV Spectropolarimetry for Coronal Magnetometry

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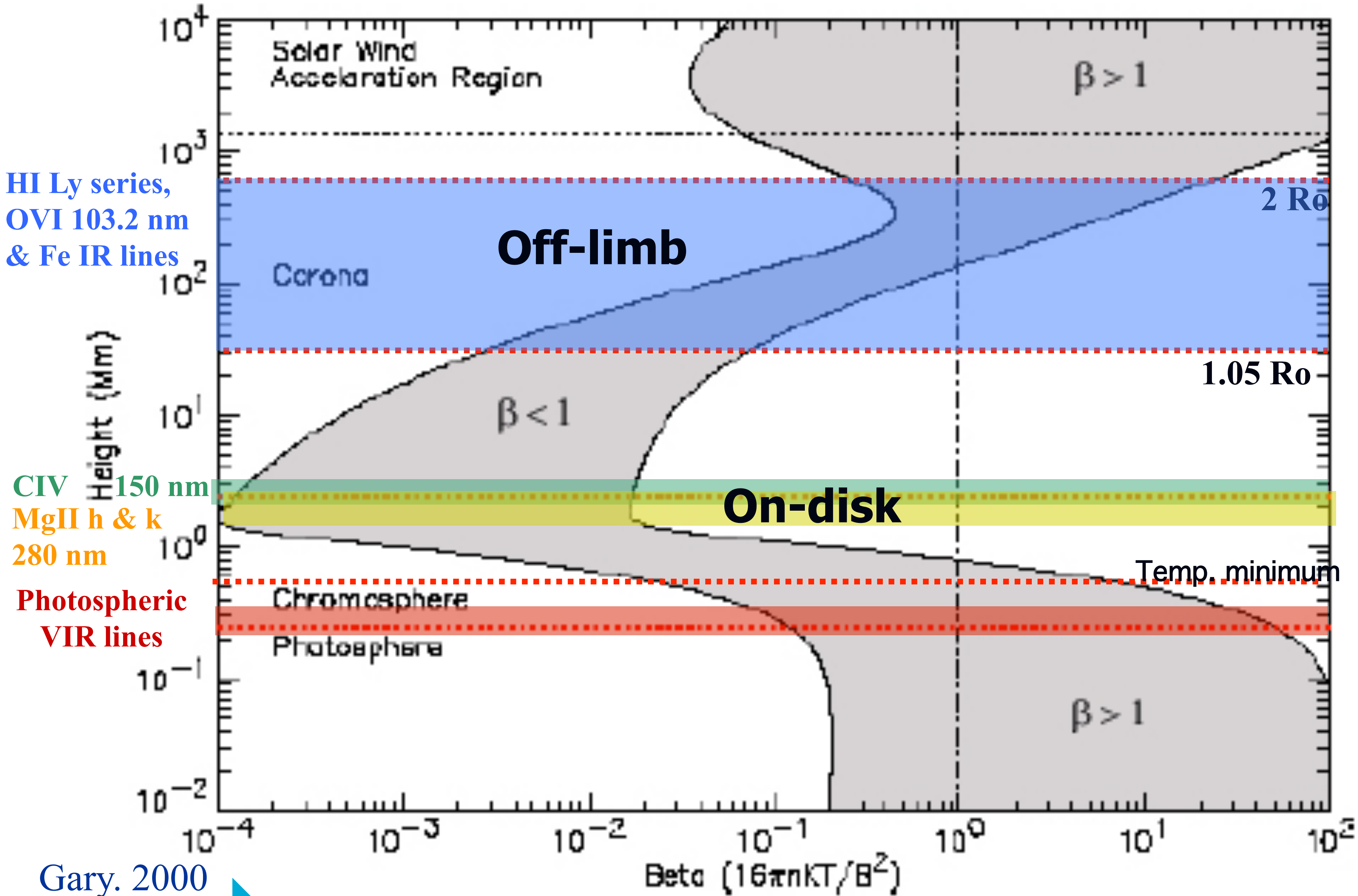


Ratio of gas pressure to magnetic pressure (β) as a function of height[1]. (photospheric field range: 100-2500 G)

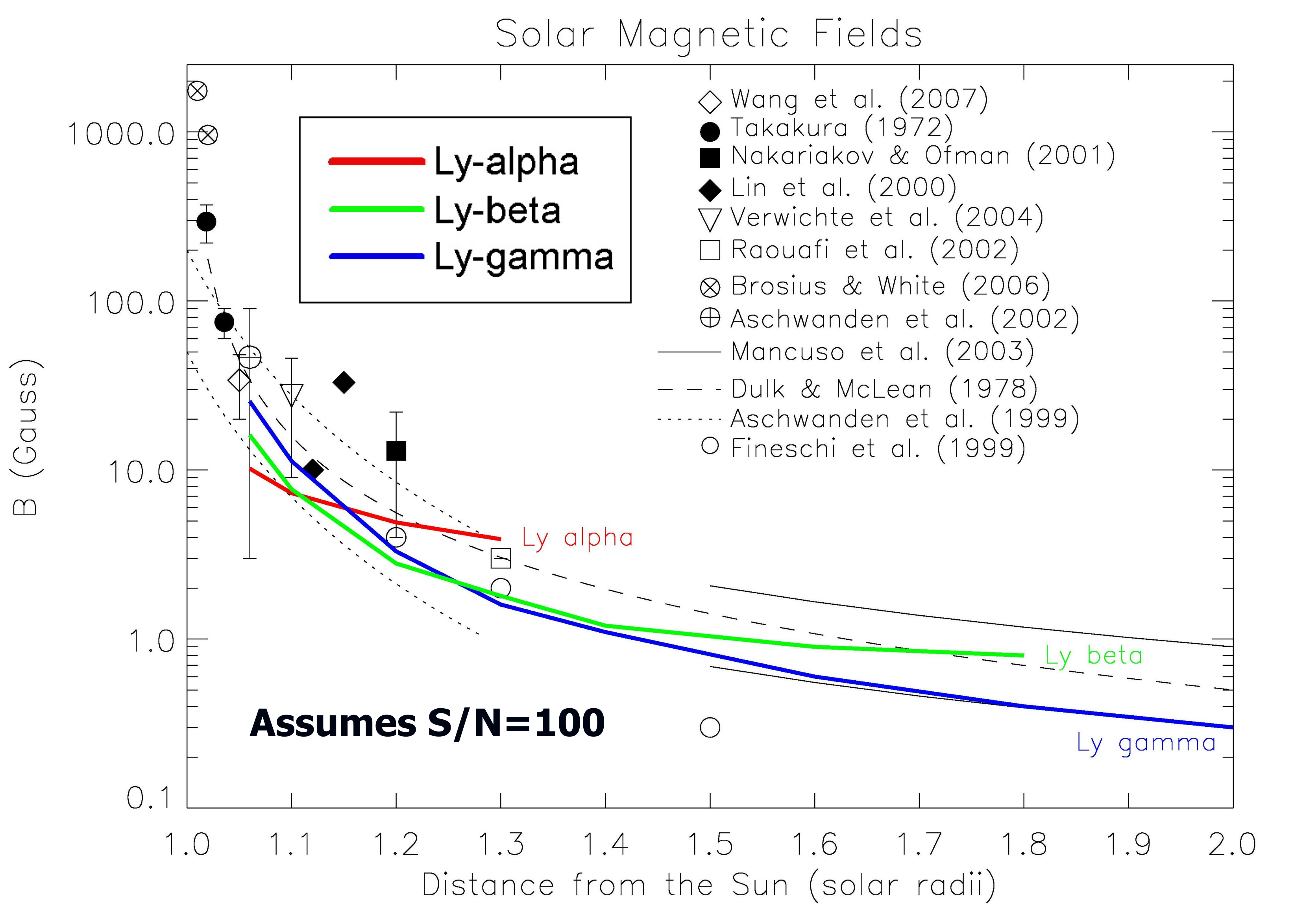
Hanle effect Sensitivity

Max sensitivity when
Line-transition's rate (A^{-1}) ≈ Larmor's frequency.

$$A\,[10^7\ s^{-1}] \sim 0.88 \cdot g_J \cdot B\,[G]$$

Spectral line	λ (Å)	A_{12} (10^7 Hz)	B_{Hanle} (gauss)
H I Ly-γ	972	6.82	1 – 7
H I Ly-β	1025	16.7	2 – 20
H I Ly-α	1216	62.7	10 – 70
O VI	1032	41.6	6 – 50

Hanle effect Minimum Detectable B Strength vs. Coronal Field Estimates above Active Regions



What is COMPASS?

COronal Magnetism, Plasma and Activity Studies from Space (COMPASS)

- **understanding the origin and evolution of the Sun's magnetic field and its interaction with the heliospheric plasma**
- **COMPASS observables: polarization in UV spectral lines (+IR + vis.)**

Who is COMPASS?

COMPASS Consortium:

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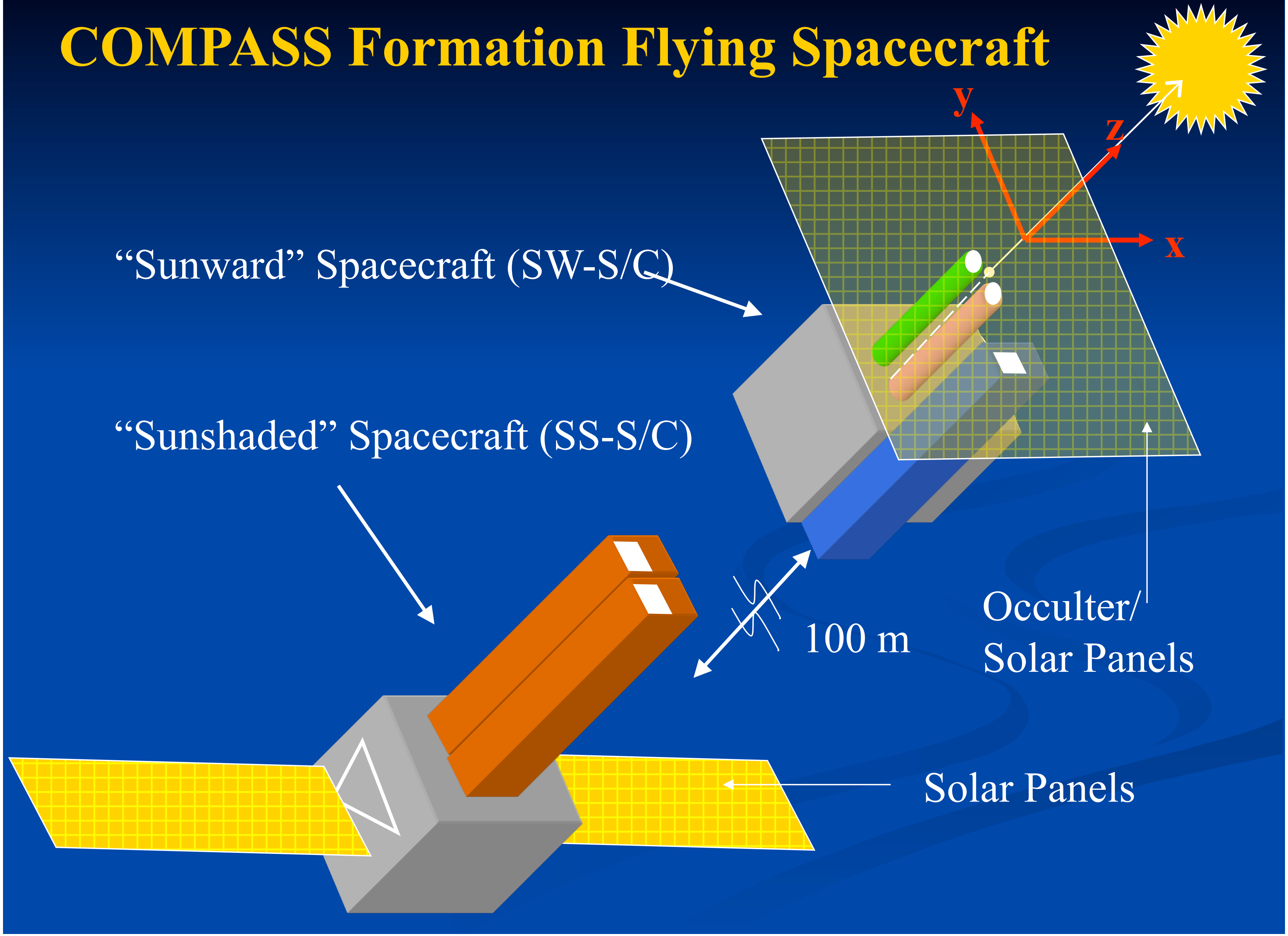
mission proposed to ESA in response to the call for ideas for the Cosmic vision program 2015-2025

COMPASS Formation Flying Spacecraft



COMPASS - Lite

- If we do without formation-flying:

Telescope – occulter distance: 100 m ⇒ 1.5 m

That is, with a "small" coronagraph on one S/C (COMPASS Lite):

- Occulter to tel. mirror distance ~ 1.5 m
- Telescope mirror's width ~ 15 cm
- What can still be measured?

Which lines are useful?

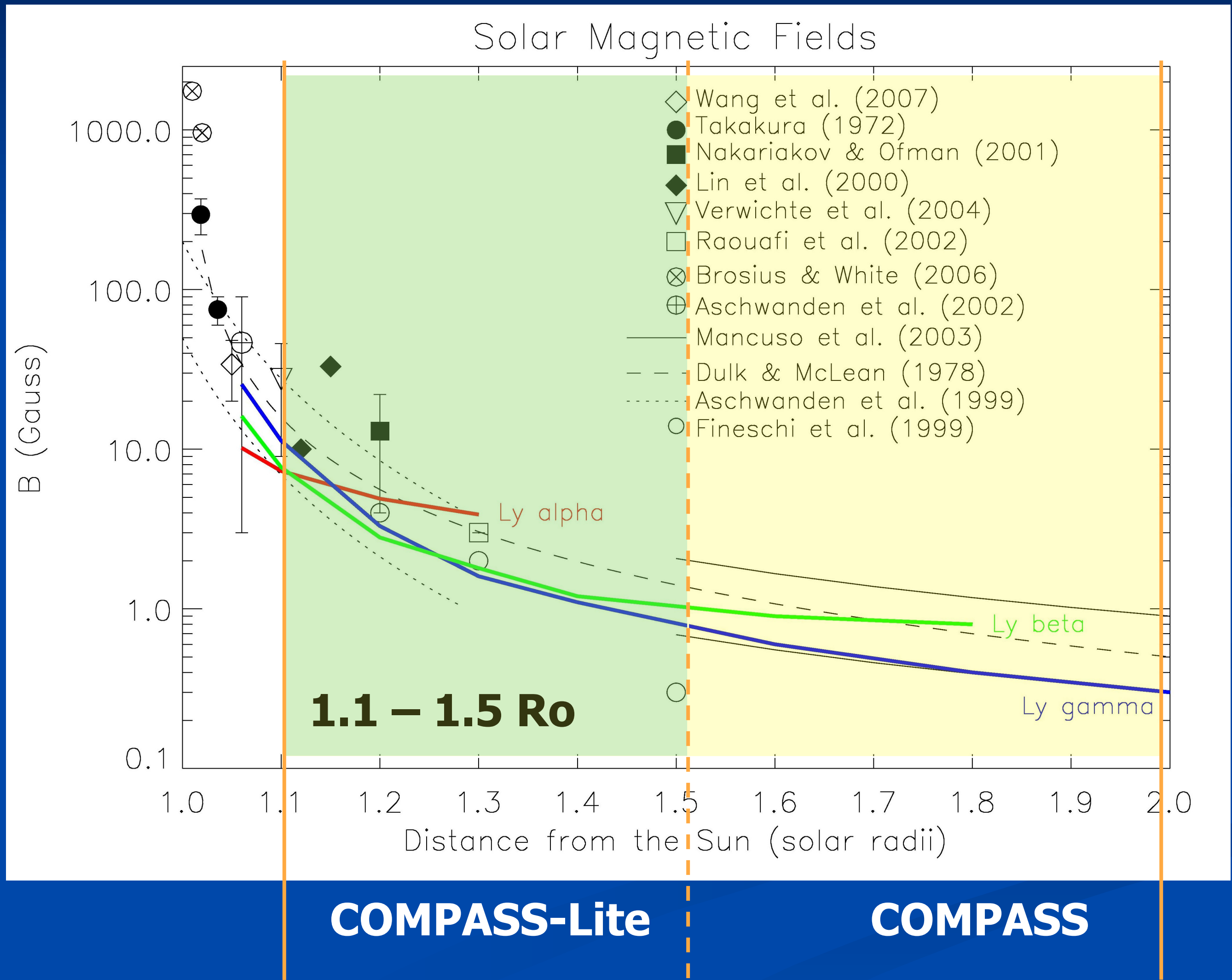
- Occulter to tel. mirror distance ~ 1.5 m
- Telescope mirror's width ~ 15 cm

Time to accumulate 10^4 counts (SNR = 100)

- H I Ly-α, λλ 1216, in 1 sec.
- O VI, λλ 1032, in 1 min.
- H I Ly-β, λλ 1025, in 10 min.
- H I Ly-γ, λλ 972, in 2 hr.

Sensitivity to Coronal fields' strength: **5-50 G**

COMPASS-Lite FOV



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VUS: A VUV SPECTROMETER FOR SOLAR-C

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Max Planck Institut für Sonnensystemforschung

Max-Planck-Institut für Sonnensystemforschung

Why look in the VUV?

•It contains lines and continuum emission formed at temperatures from 0.01 to 1 MK.

•As such, it allows the sampling of the solar atmosphere from the chromosphere up to the 1 MK corona.

•The good coverage of the chromosphere and Transition Region (TR) is particularly suited for combined studies with instruments providing the photospheric and chromospheric magnetic vector.

•Working at relatively long wavelengths allows motions of less than 1 km/s to be measured with a relatively compact instrument.

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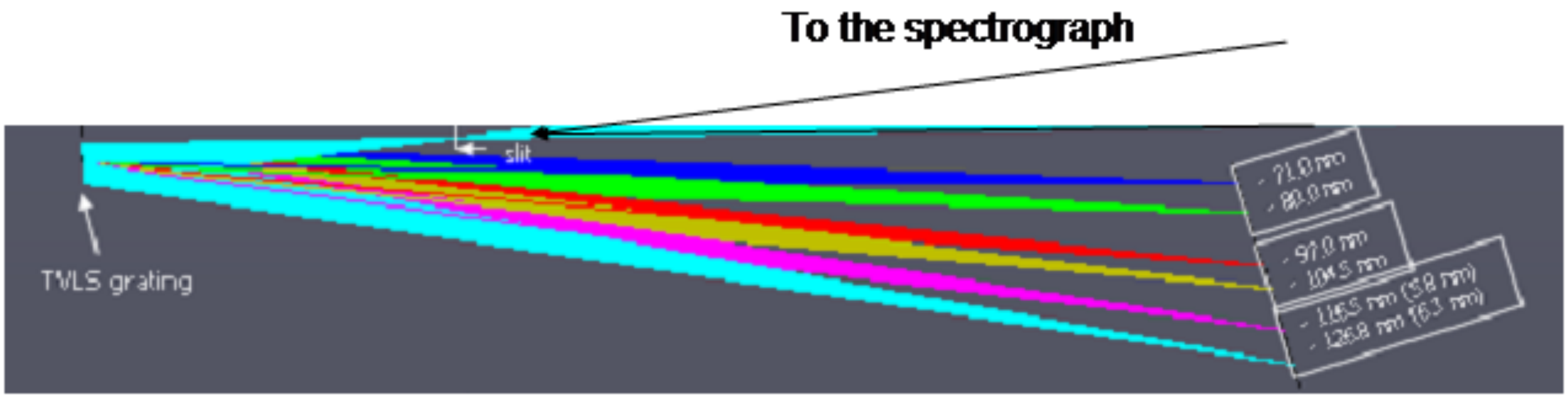
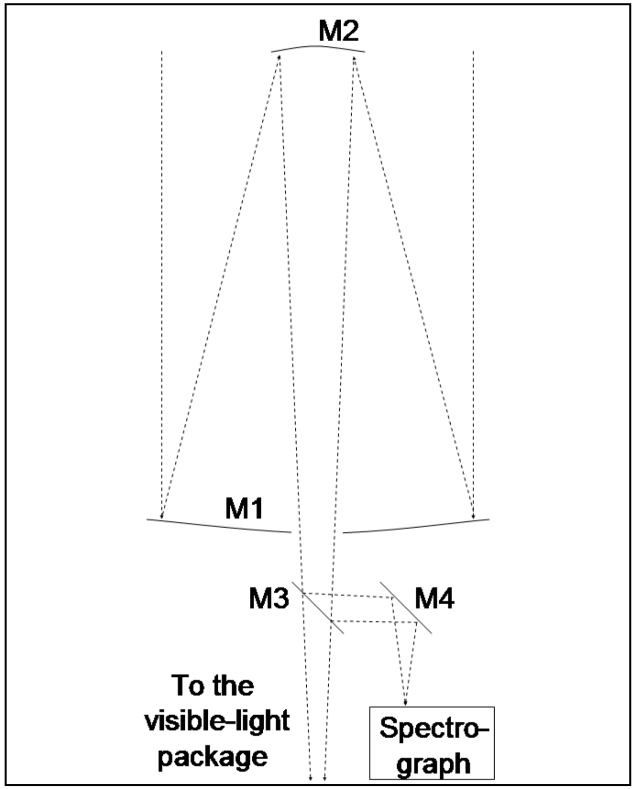
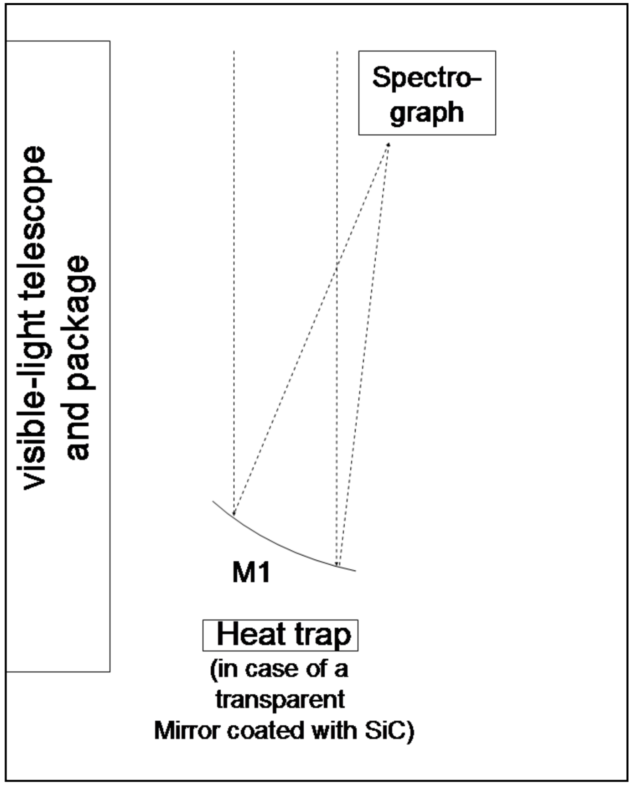
The spectrograph assembly



•High-efficiency, one-optical element design.
•Entrance slit assembly: 0.2″, 0.3″, 0.6″, 0.9″, 3″ wide slits
•Toroidal variable line space (TVLS) grating.
•Three 2k×2k detectors with 0.2″ pixels matching the narrower slit. APS sensors mated with opportunely coated MCP-intensifiers.
•Spectral element of 3.3 pm at 155 nm.

The telescope: two possible solutions





Solution 1: Uses the 50 cm optical telescope (M1, M2 and M4 Al/MgF_2). M3 is of quartz coated with 10 nm SiC. M4 is used for scanning.

Solution 2: Independent 30 cm quartz mirror coated with 10 nm SiC (or B_4C). Due to the lower number of optical surfaces, it yields similar count-rates as Solution 1.

The telescope: two possible solutions

Solution 1:

Pro:

- Minimal mass and volume.
- Strictly simultaneous and cospatial VUV and visible observations.

Contra:

- The impact of M3 on spectropolarimetric measurements needs to be evaluated.
- Large FUV fluxes on M2, M3 and M4 require stricter cleanliness to minimise degradation.
- Only lines above 120 nm are accessible. Hottest bright line is N V 123.88 nm (0.15 MK).

Solution 2:

Pro:

- Spectral range from 55 nm (45 nm with B_4C), including upper TR and coronal lines (e.g., He I, O IV-V, Ne VII-VIII, Mg IX-X, Si XII).
- No interference with polarisation measurements.
- Simpler overall design.

Contra:

- Extra mass and volume of the independent VUV telescope.

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Temperature coverage