Differences Between a Polar Coronal Hole and Its Equatorial Extension

Introduction

-Coronal hole – definition, Importance, properties

- Data
 -SOHO/CDS observations
- Results
- Conclusions

Introduction

-Coronal holes - low density, low temp, unipolar, magnetically open field regions of the solar corona

-Importance: source regions of the fast solar wind that may cause intense geomagnetic storms (Krieger et al. 1973)

-Acceleration of the fast solar wind has not been understood well and it remains as a fundamental problem.

-temperature of the coronal hole is less than a million K cannot provide the additional momentum required by the fast solar wind –velocity of the fast solar wind is 800 km/s and temperatures of 3–4 MK are required near the base of the corona, according to the Parker model - MHD waves? solar cycle dependence:

-Large polar coronal holes dominate the polar regions of the Sun during solar minimum and through much of the solar cycle.

-Near solar minimum, polar holes develop equatorward extensions - trans-equatorial coronal holes best known example is CH1, the boot-shaped coronal hole observed by Skylab during 1973-1974 - nearly rigid rotation and had a long life time of about eight solar rotations

-Another boot-shaped hole appeared in August 1996 and lasted for three solar rotations - Elephant's Trunk Like CH1, this also showed near-rigid rotation.

-During the years before solar maximum, the polar holes shrink and then disappear, smaller coronal holes develop at lower latitudes















-present work: to study the intensity distribution of coronal Holes and quiet Sun – in polar and equatorial regions

-SOHO data – advantage – simultaneous spectroscopic observations at different levels of solar atmosphere

Data

- project: to study coronal hole evolution throughout the solar cycle
- Barbara Bromage Centre for Astrophysics, Univ. of Central Lancashire, UK
- SOHO CDS(Coronal Diagnostic Spectrometer) Observations
 present study uses data Aug-Sept 1996 24 data sets
- Observed spatial window 240"x60" part of coronal hole, boundary & quiet Sun
- low intensity of emission lines in coronal holes both spatial & temporal averaging – spatial resolution 20"

No.	Ion	λ	Т
		[Å]	[MK]
1	HeII(2)	607.56	0.083
2	OIII	599.59	0.11
3	OIV	608.40	0.19
4	NeIV	542.89	0.19
5	OV	629.73	0.25
6	NeVI	562.80	0.43
7	NeVII	561.73	0.52
8	CaX	557.76	0.66
9	MgVII	367.7	0.66
10	SiVIII	316.22	0.81
11	MgVIII	315.01	0.81
12	MgIX	368.06	0.95
13	SiIX	349.9	1.07
14	MgX	624.94	1.10

Results

-identification of coronal hole & quiet Sun region – intensity contours of Mg X 625 A line

-observed window in different emission lines – contour levels represent coronal hole, boundary, quiet Sun – FIG

-network structure prominent in lower TR lines; slowly disappears

-intensity histograms of Polar Coronal Hole (PCH), Polar Quiet Sun (PQS), Equatorial Coronal Hole (ECH), Equatorial Quiet Sun (EQS) – FIG

- -Intensity histograms of the quiet Sun and the hole are more similar for lower transition region (TR) lines, while they are increasingly different for upper TR lines and the corona.
- -The He line and the Ca line behave as if their line formation temperatures are shifted towards higher temperatures.

-histograms of polar hole for the lower TR lines OIII, OIV, NeIV, OV and NeVI are shifted towards the bright side. At the NeVII level, histograms of both regions nearly coincide. From Ca X level onwards, the trend is reversed, i.e., histograms of polar regions show a shift towards the darker side.





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-The flux transport in the solar surface is carried out by supergranulation, meridional circulation, &differential rotation. Supergranular diffusion is expected to be isotropic; differential rotation moves the flux in longitude, while the meridional circulation carries the flux at the surface poleward. As the meridional circulation drives more flux towards the poles, the field in the boundary becomes compressed, which may lead to magnetic reconnection events taking place between the open and closed magnetic field. In this way, the boundary region becomes hotter and brighter as a result of the meridional flow which is moving perpendicular to the boundary.

Conclusions

-The intensity distributions of 14 strong EUV emission lines with a temperature of line formation in the range 0.083 MK to 1.10MKin a PCH, ECH and the adjacent quiet Sun region

-coronal holes affect line intensities at most of the atmospheric heights through the TR to the corona. It has been found that emission lines are affected quite differently in the PCH and the ECH.

-PCH appears to be brighter than the ECH for lines forming below T = 0.52 MK, while the PCH increasingly appears to be darker than the ECH above this temperature. The polar hole is brighter by about 30% compared to its equatorial extension in the lower TR, while it is weaker by about 30% in the lower corona.

Possible reasons for the polar-equatorial differences in coronal holes
are explained on the basis of flux transport & different orientation of the boundaries of the two holes, and magnetic reconnection