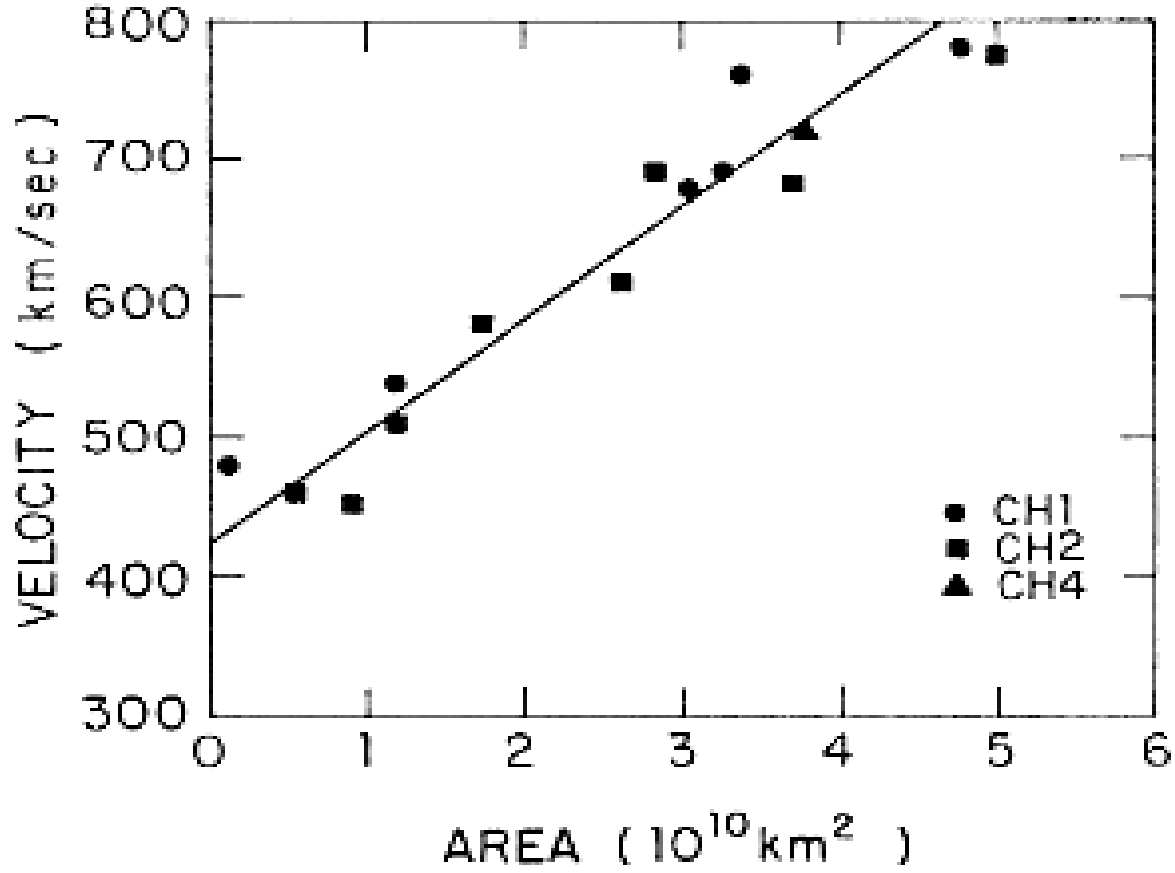
	Fast SW	Slow SW
Source	open field	above closed field/ open field
	Coronal hole	Coronal hole
V	steady	variable
N	steady	variable
Na/Np	high	low

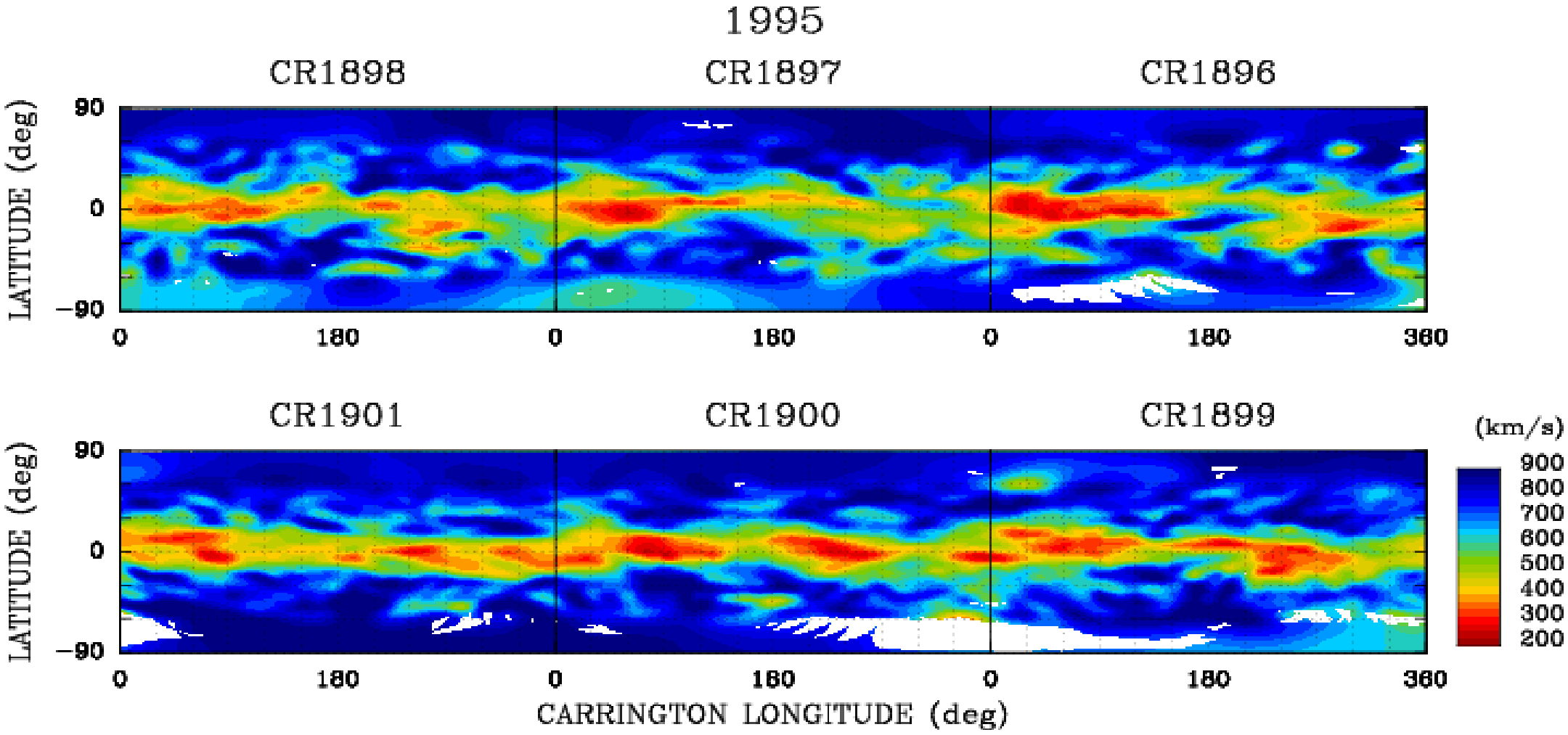
Relation between speed and coronal hole area

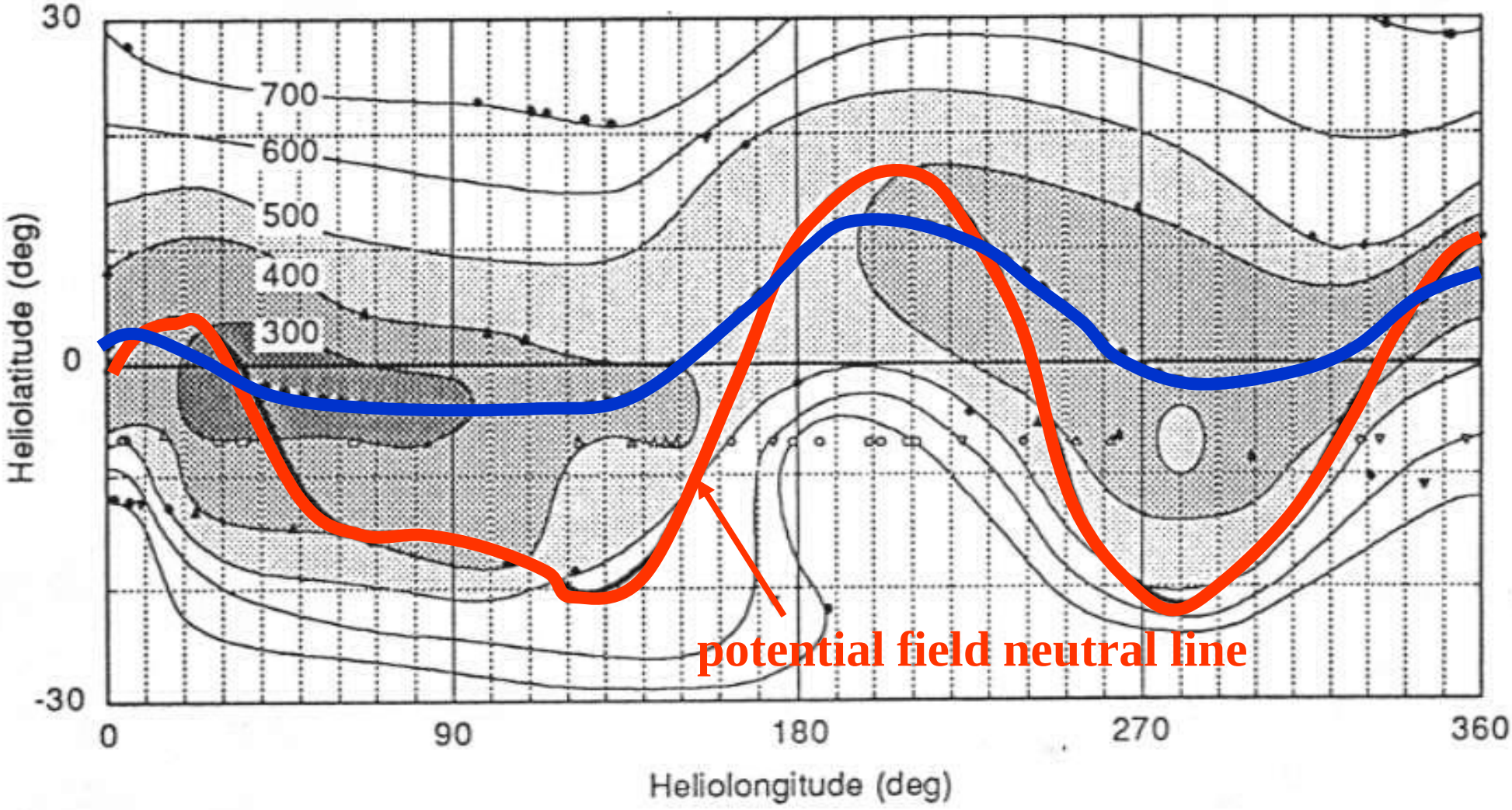
The speed of the solar wind scales with the coronal hole area.
[Nolte et al., 1976]



Intermediate and slow streams originated in smaller coronal holes at low latitudes and from open field regions just outside coronal hole boundaries.
[Neugebauer et al., 1998]

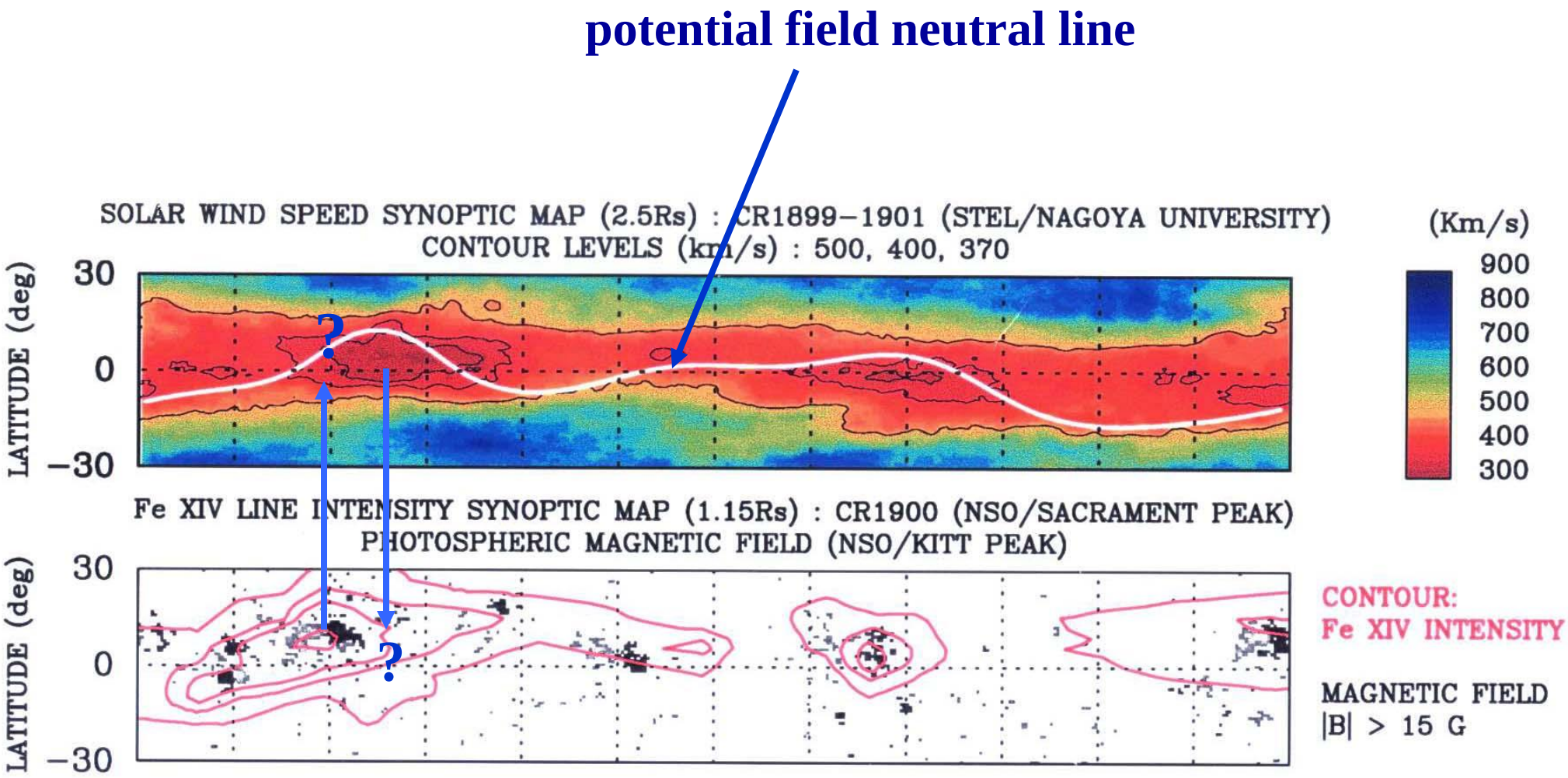
Solar Wind Structure at Solar Minimum





A neutral line does not traverse through the minimum speed locus.

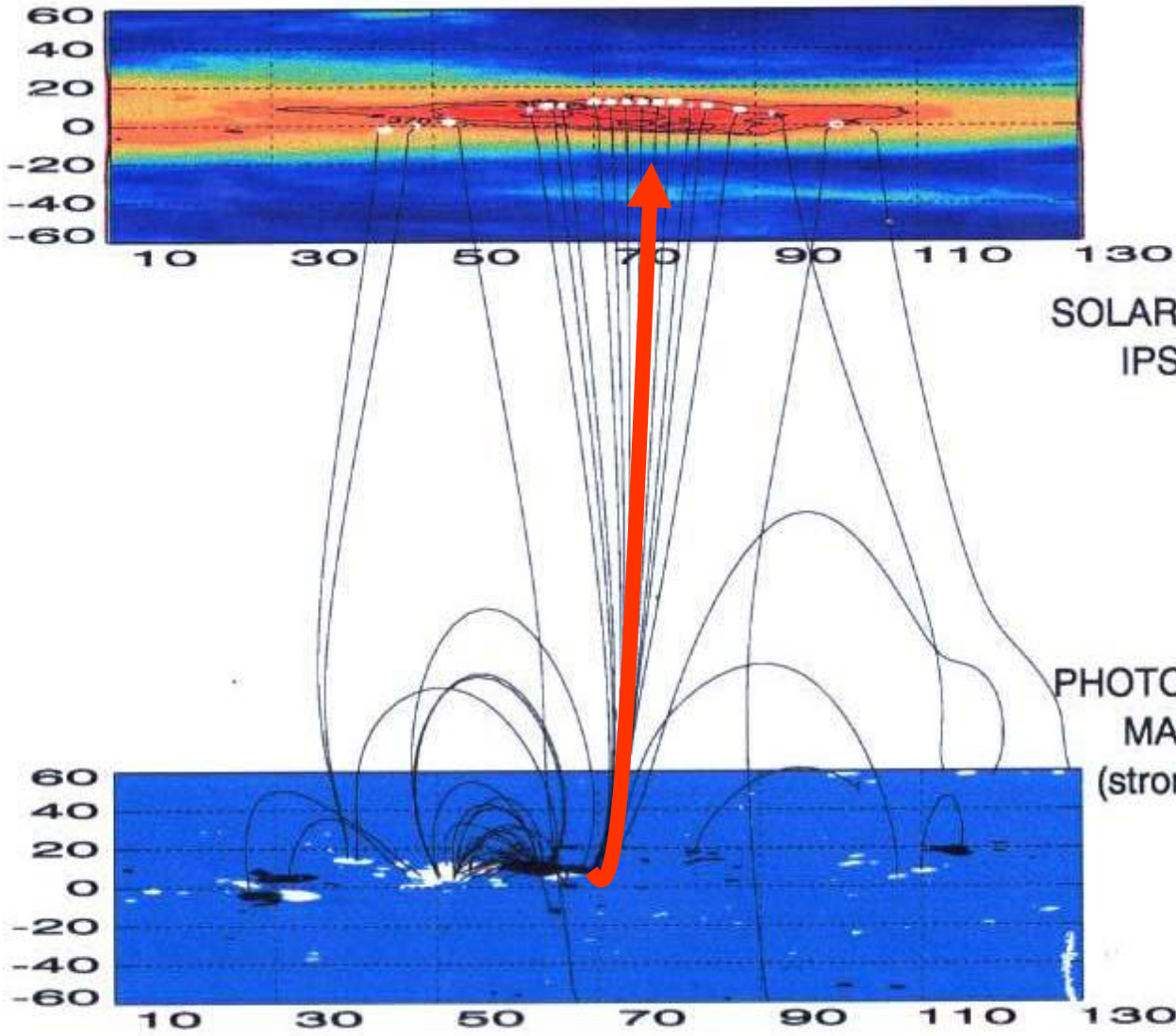
after Crooker et al., 1997



after Kojima et al., 1999

CARRINGTON ROTATION NUMBER : 1900

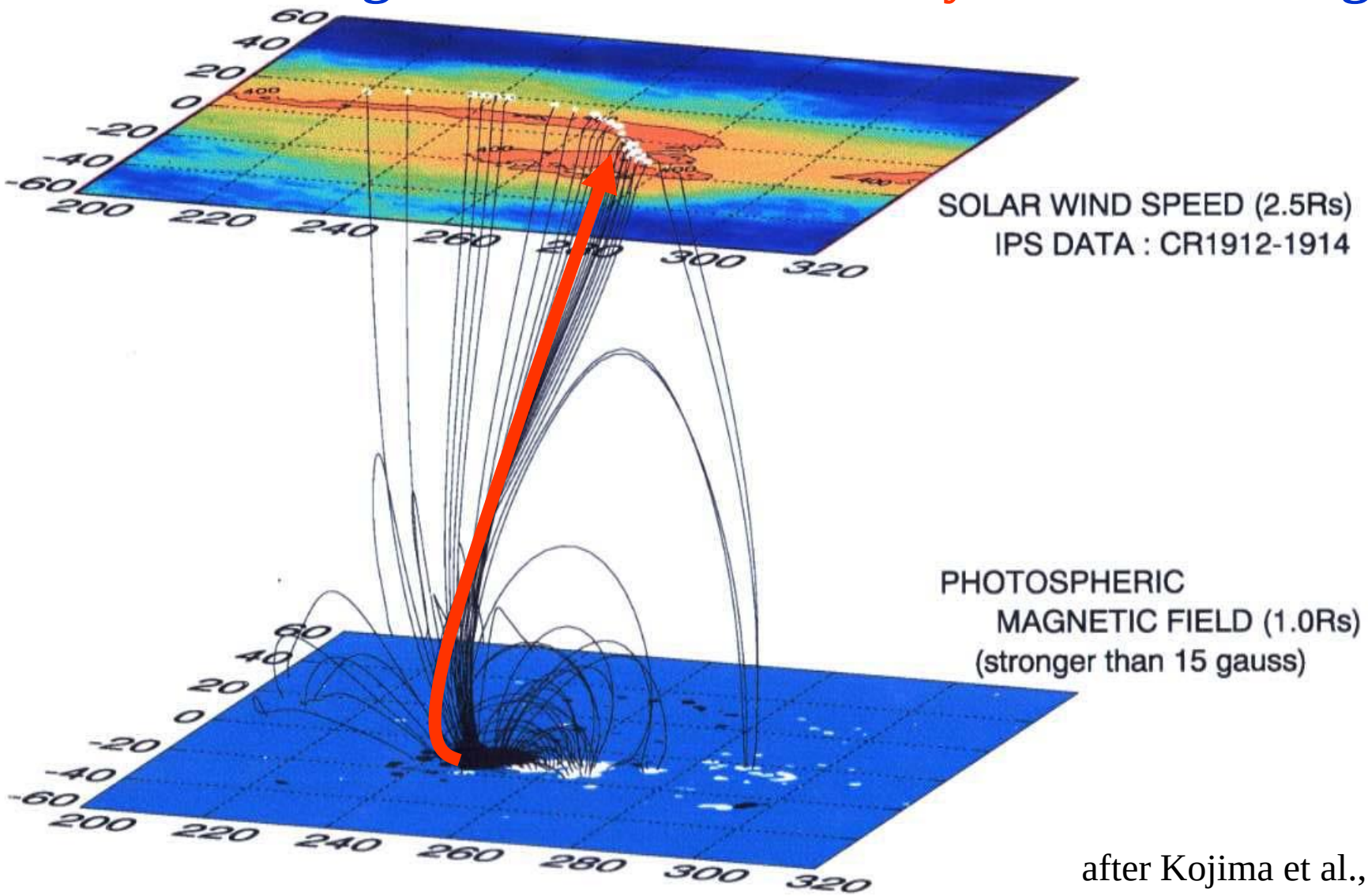
The slowest wind originates from the vicinity of an active region.



after Kojima et al., 1999

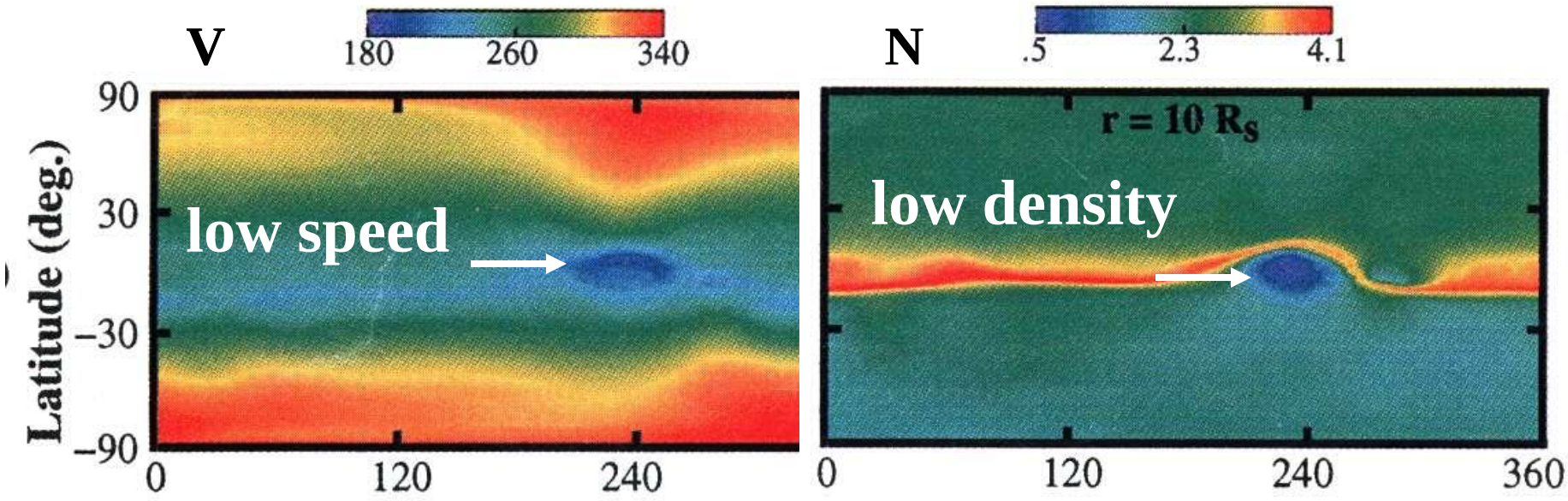
CARRINGTON ROTATION NUMBER : 1913

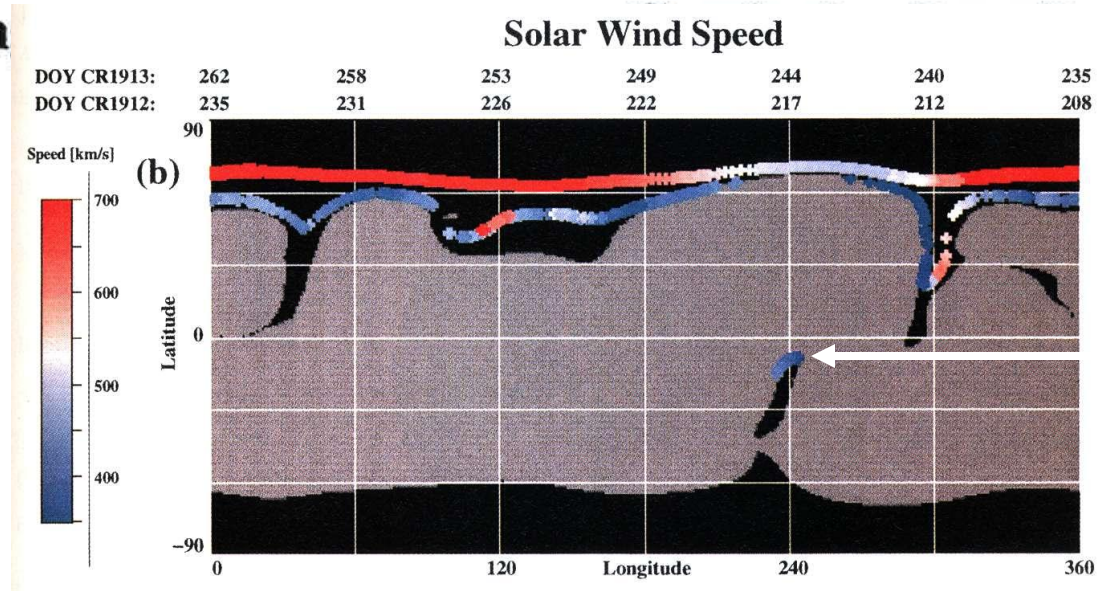
The slowest wind originates from the vicinity of an active region.



after Kojima et al., 1999

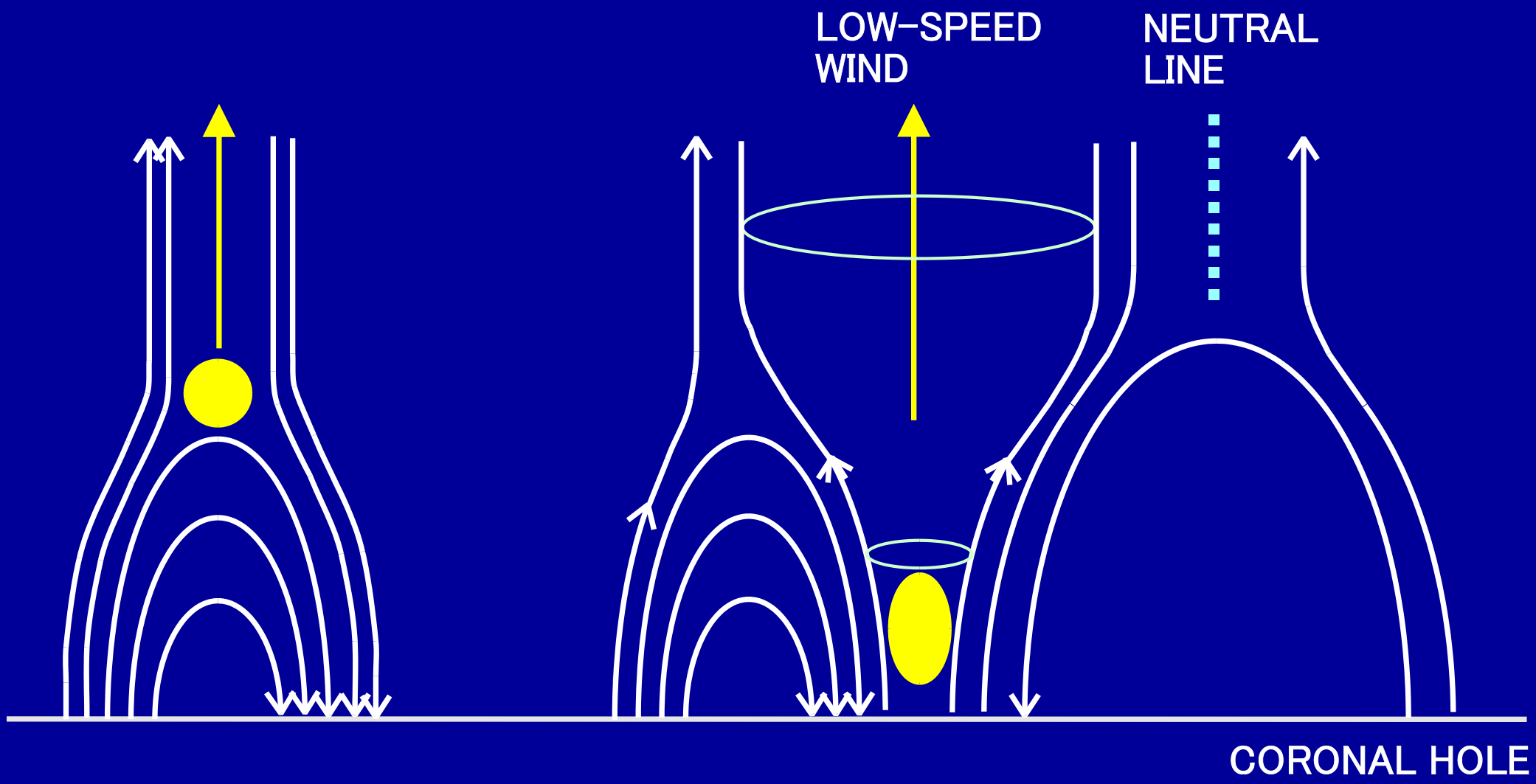
MHD simulation by Linker & Mikic '99





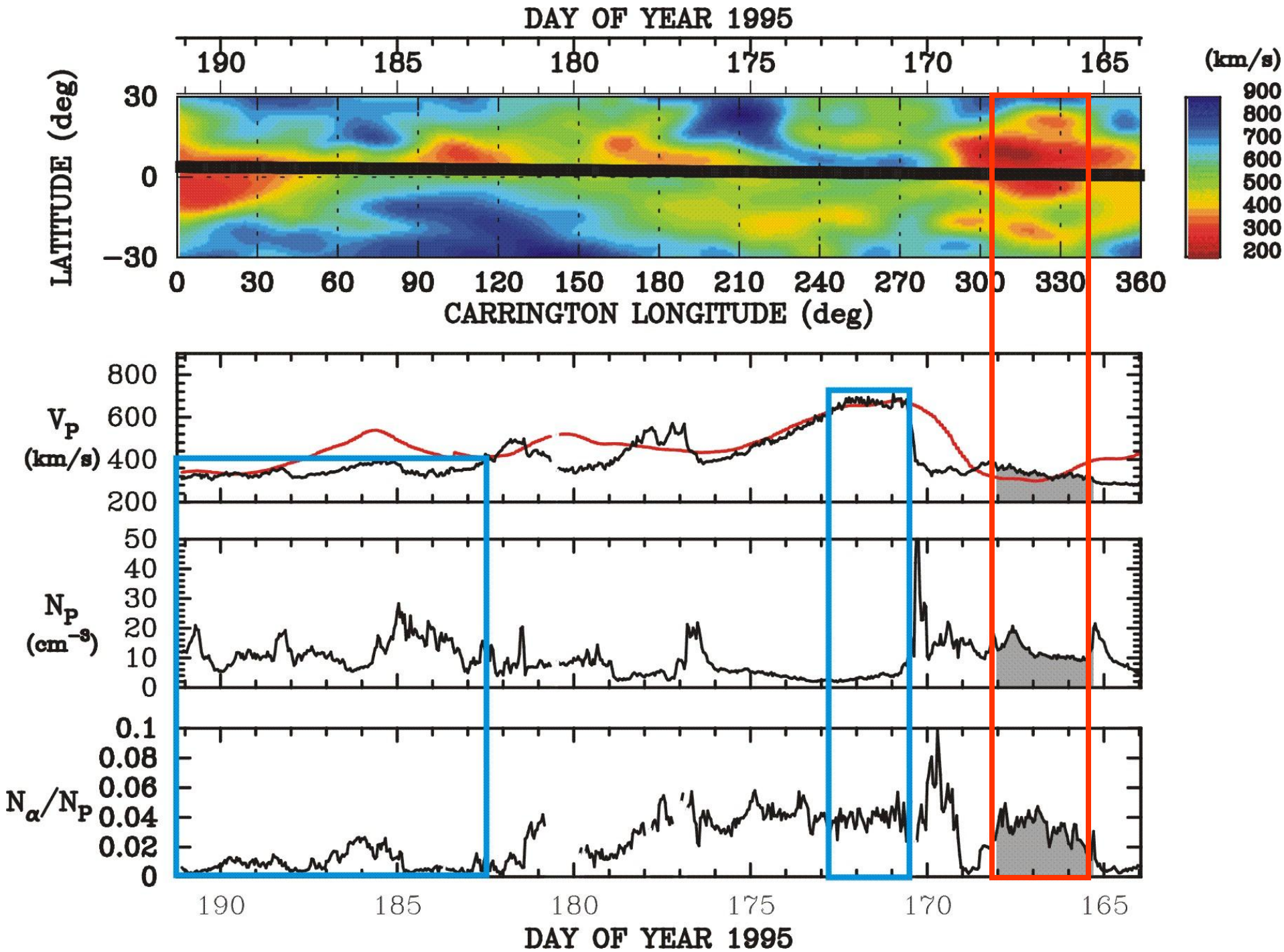
from coronal hole

after Kojima et al., 1999



Helmet streamer model

Coronal hole model


DAY OF YEAR 1995
190
185
180
175
170
165
(km/s)
900
800
700
600
500
400
300
200
LATITUDE (deg)
30
0
−30
0
30
60
90
120
150
180
210
240
270
300
330
360
CARRINGTON LONGITUDE (deg)
V_P (km/s)
800
600
400
200
N_P (cm^{-3})
50
40
30
20
10
0
N_α/N_P
0.1
0.08
0.06
0.04
0.02
0
190
185
180
175
170
165
DAY OF YEAR 1995

Solar Wind in CR 1897 (June 12 – July 10, 1995)

Parameter	Slow (HPS)	Slow (seCH)	Fast (leCH)
V_P [km/s]	343±22	**323±9**	665±13
N_P [cm^{-3}]	11.8±3.9	**10.2±0.7**	3.8±0.6
T_P [10^5 K]	0.39±0.21	**0.55±0.11**	2.39±0.34
T_O [10^6 K]	1.92±0.30	**1.99±0.19**	1.38±0.07
N_α / N_P	0.013±0.013	**0.031±0.008**	0.040±0.004

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	Fast SW	Slow SW
Source	open field	open field
	Coronal hole	Coronal hole
V	steady	steady
N	steady	steady
Na/Np	high	high

Magnetic Field in the Coronal Holes

- **Polar CH**
  : <12 G> at the poles
  : < 3 G> at the equatorward boundary
  [Svalgaard *et al.*, 1978]
- **Low latitude CH**
  : up to 15 G [Harvey and Sheeley, 1979]
  : 9 (2~18) G [Burlaga *et al.*, 1978]
- **Polar CH (just before disappear)**
  : <10 G>
- **Small equatorial CH**
  : <18 G> [Ohmi *et al.*, 2002]

Origin of slow SW(seCH)

Unipolar, steady flow, large Na/Np ⇒ Coronal hole origin

T(in seCH) as high as slow wind ⇒ heating

T(@1AU) as low as slow wind ⇒ Adiabatic cooling

B (in seCH) as strong as active region

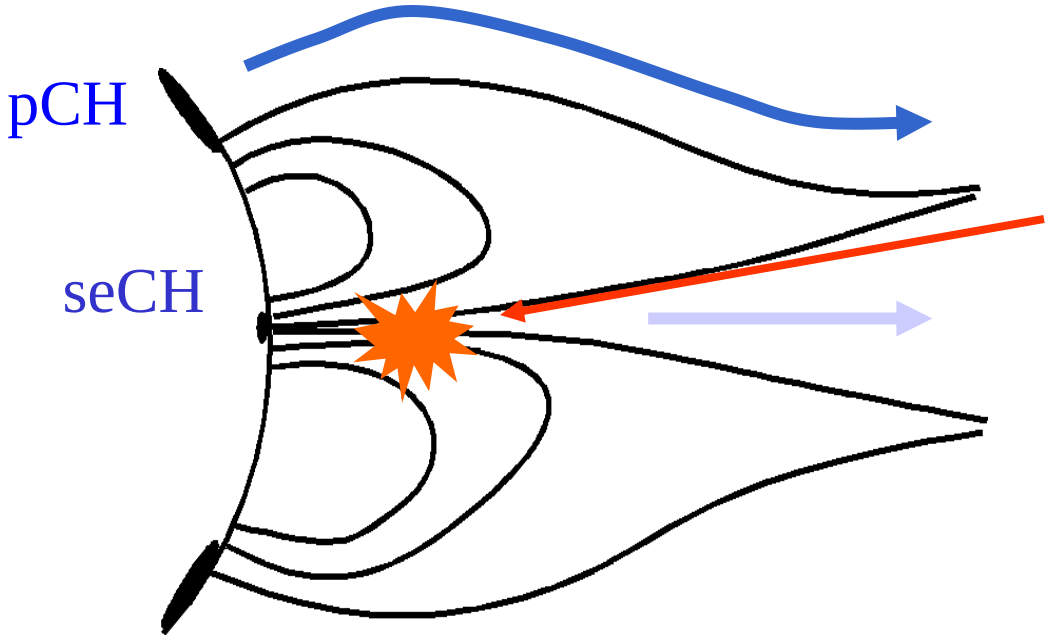
Origin of slow SW(seCH)

Coronal hole origin

Large NV

⇒ extra momentum source in lower corona

High T(in seCH)



Enhanced Heating in lower corona

Strong B (in seCH)

Origin of variability in (90%) slow SW

Axford:

changing foot points of field line as result of reconection.