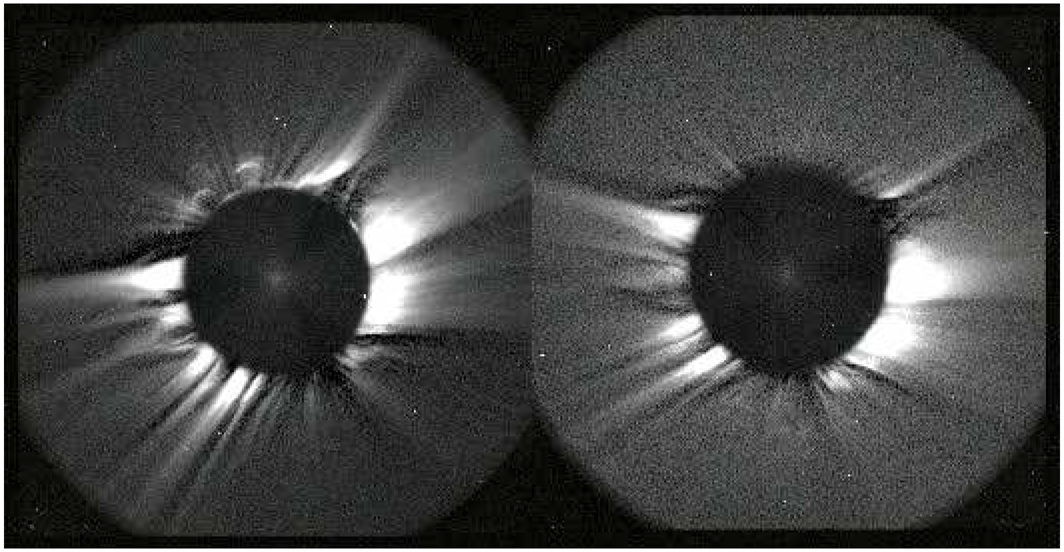
STEREO SECCHI COR1 Science



17-Feb-2007
"B" daily minimum pixel

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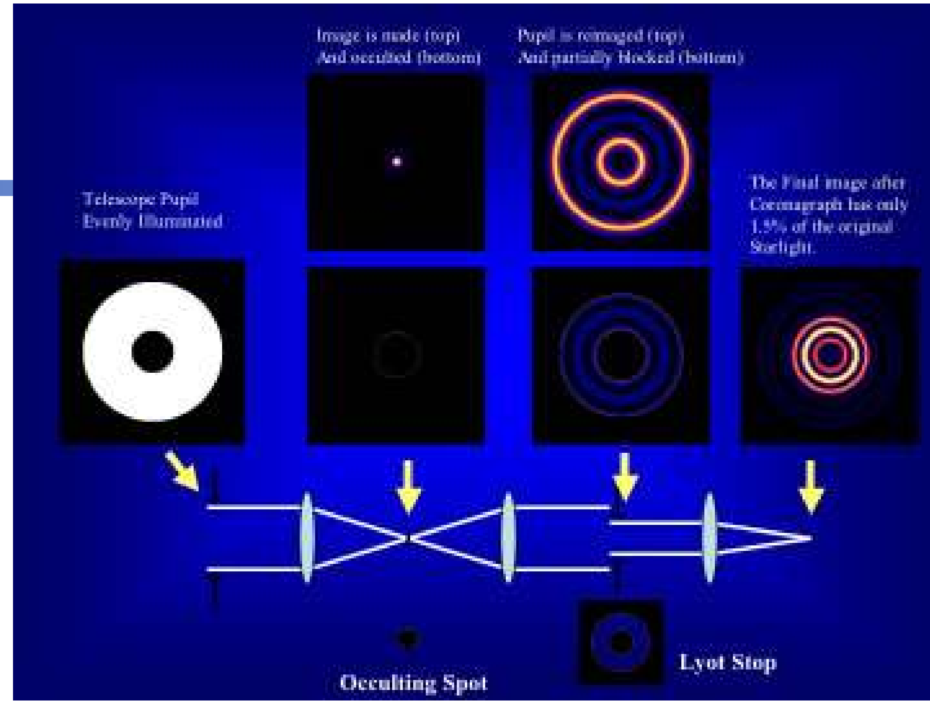
Outline

- Some historical notes about internally-occulted coronagraphs
- Science objectives for COR1
- A new use for synoptic maps?

Bernard Lyot

b. 1897 Paris

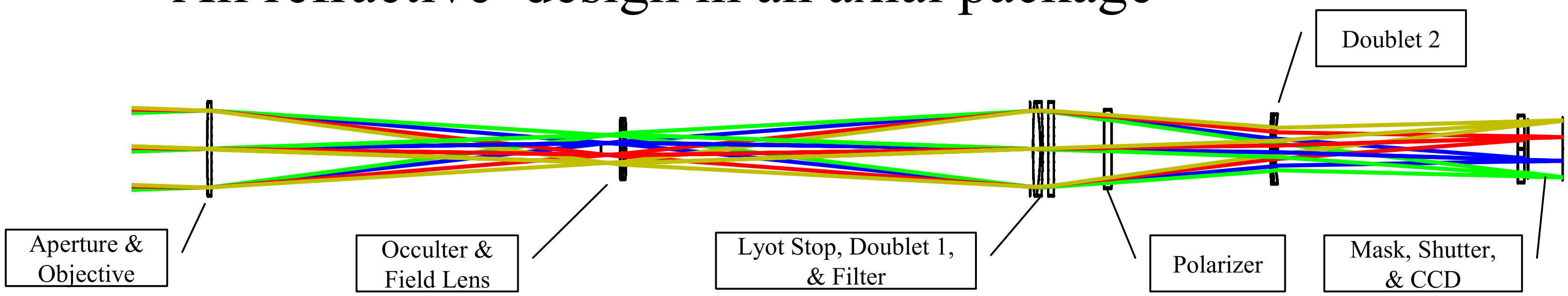
d. 1952 Cairo



- **Noted that serious attempts to reveal the corona outside eclipse began in 1878**
- **Showed that diffraction from the edge of the objective lens was the primary source of stray light (*Lyot stop*)**
- **Other stray light sources identified as scattering: bulk inhomogeneities; surface flaws; dust on surfaces; and surface reflections off objective front/rear (*Lyot spot*)**
- **Produced working coronagraph at Pic du Midi during the 1930's**

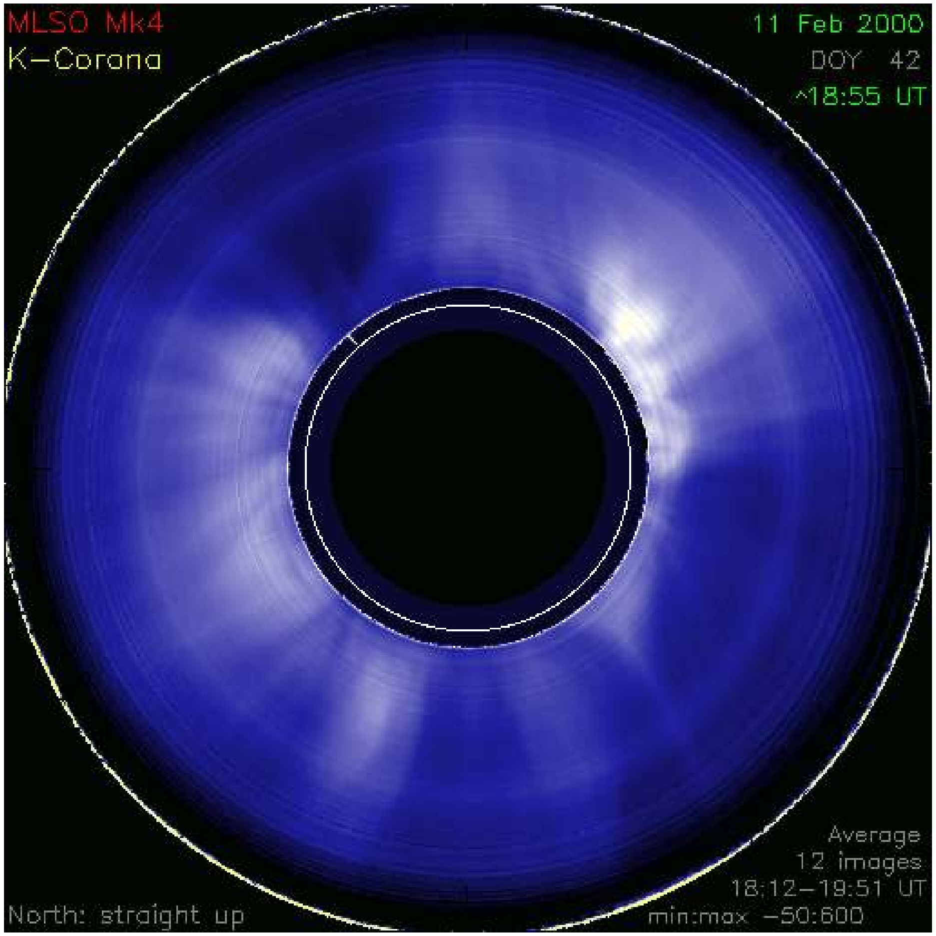
COR1 Optical System Overview

- All refractive design in an axial package

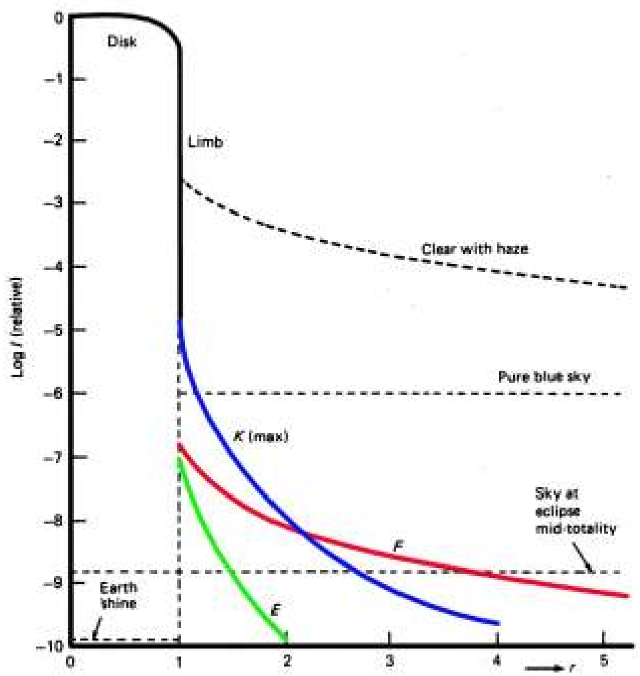


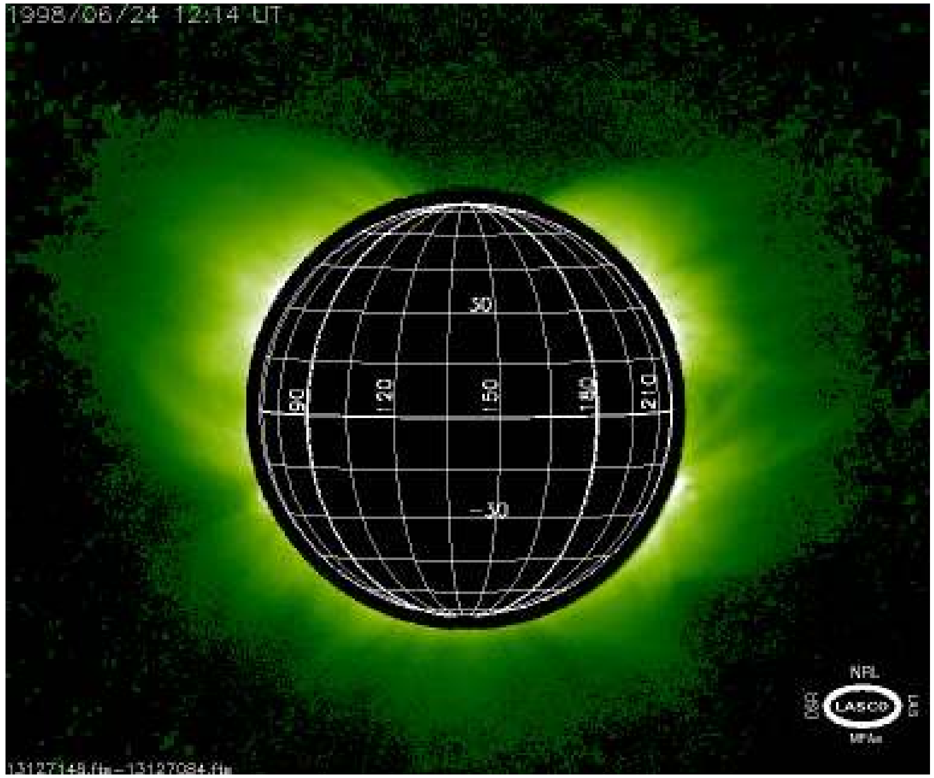
- Three cascaded imaging systems:
  - Objective lens forms a solar/coronal image at the occulter
  - Field lens images the front aperture onto the Lyot Stop
  - Pair of doublets relays the coronal image onto the CCD
- Seven spherical lenses, Rad Hard materials
  - (1 singlet, 3 cemented doublets)
- 1.2 meters long

MLSO Groundbased White-Light Coronagraph (Internally-occulted)



Green-Line (FeXIV) Coronagraph (Reflecting, Internally-occulted)





PICO (Pic Du Midi Coronagraph)

SOHO LASCO C1

MICA (MIrror Coronagraph for Argentina)

Outline

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THE ASTROPHYSICAL JOURNAL, 246:1004–1009, 1981 June 15
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CORONAL ACTIVITY BELOW 2 $R_\odot$: 1980 FEBRUARY 16

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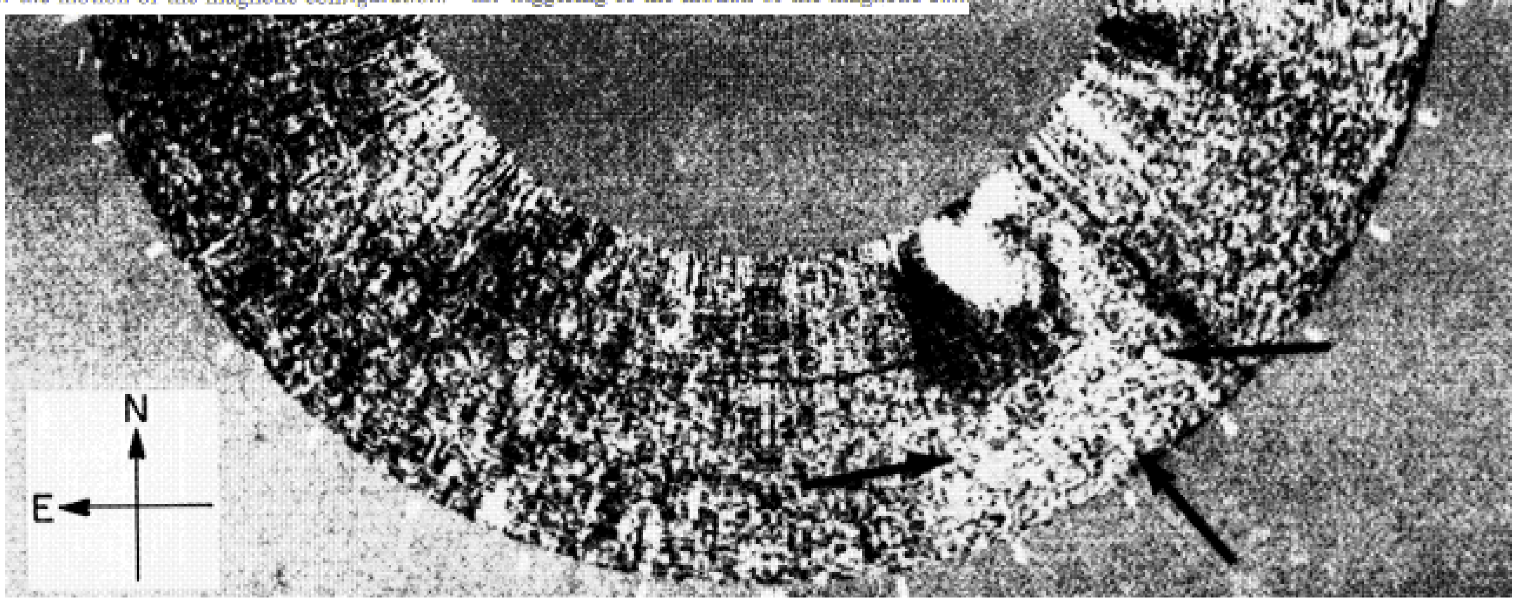
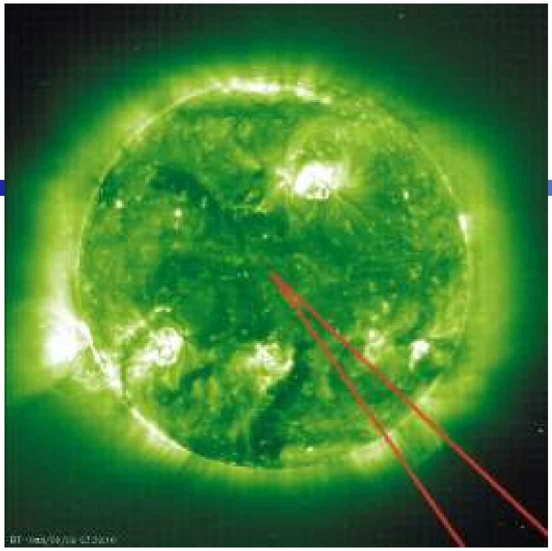
High Altitude Observatory, National Center for Atmospheric Research,[2] Boulder, Colorado
Received 1980 October 17; accepted 1980 December 29;

ABSTRACT

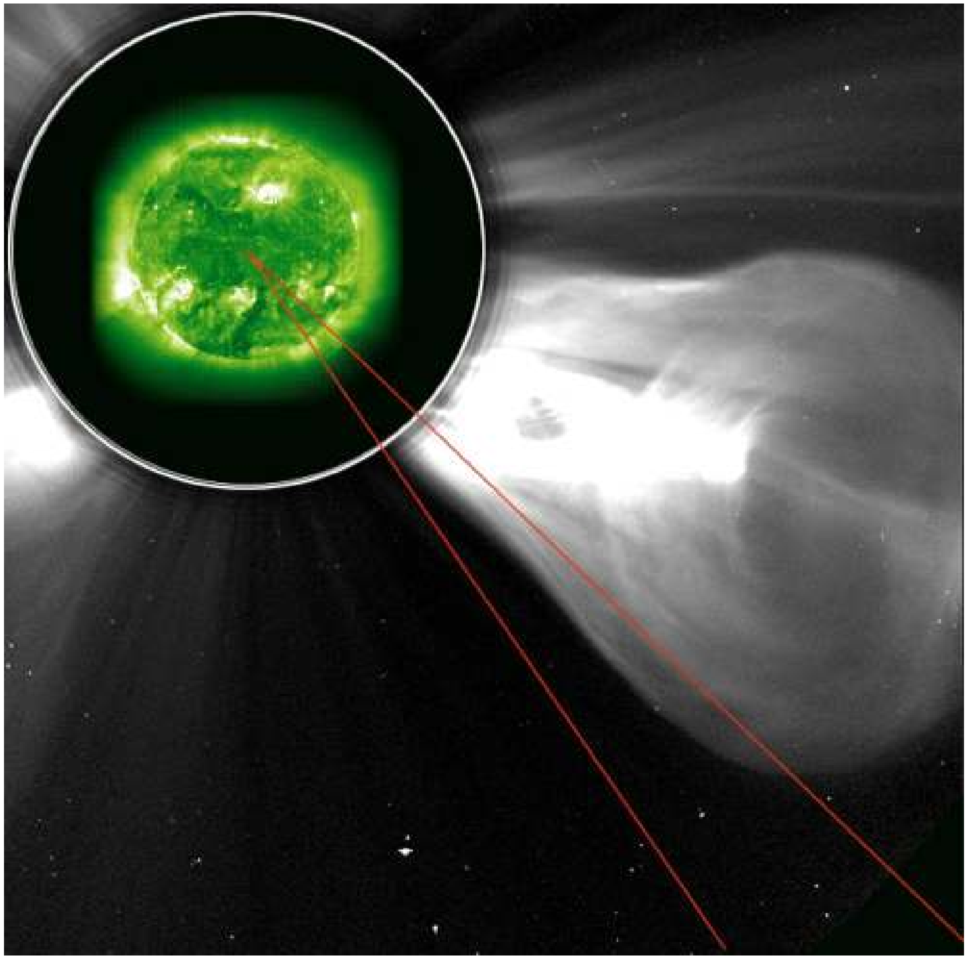
In this paper we present the first observations of an eruptive prominence and coronal transient observed below 2 $R_\odot$ and discuss the morphological changes observed throughout the period of the 1980 February 16 total solar eclipse. A dark loop (a volume of depleted electron density) was observed in association with a prominence rising below 1.4 $R_\odot$. A bright loop formed ... After approximately 2 hr, ... in the central part ... This same material was observed later in Hα. ... K-coronameter ... of electron scattering ... The speed of the material through the ... was 100 km ... was 2×10^{15} g (equivalent to the prominence mass). These values are ... lower than those observed for other transients ... which may explain the formation of the dark loop and the triggering of the motion of the magnetic configuration.





COR1 Primary Science Goal:

Understanding the Origin of CMEs



There are four parameters that are critical to understanding the origins of CMEs and the forces acting on them. But these are difficult to measure above 2 R_S (depicted by white circle).

- initial acceleration
- non-radial motions
- transverse (latitudinal) expansion
- initial radial expansion

1998-06-02 SOHO EIT (195A) and LASCO C2 (Plunkett et al, 2000)

15-Jan to 18-Feb-2007

	COR1-A	COR1-B
Observing [Days]	31	35
Data Gaps [Days]	4	0
Average [Images/Day]	67	62
Cadence [min]	21.5	23.2
CMEs Detected	27	24
Questionable CMEs	6	9
Stars Detected	1	7
Debris Sightings	1	2

Outline

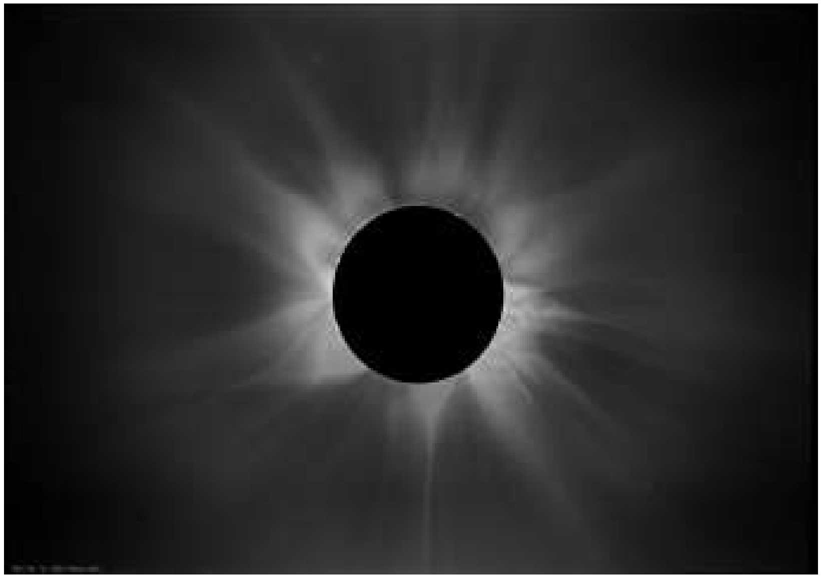
- Some historical notes about internally-occulted coronagraphs
- Science objectives for COR1
- **A new use for synoptic maps?**

Solar Cycle 24 Predictions

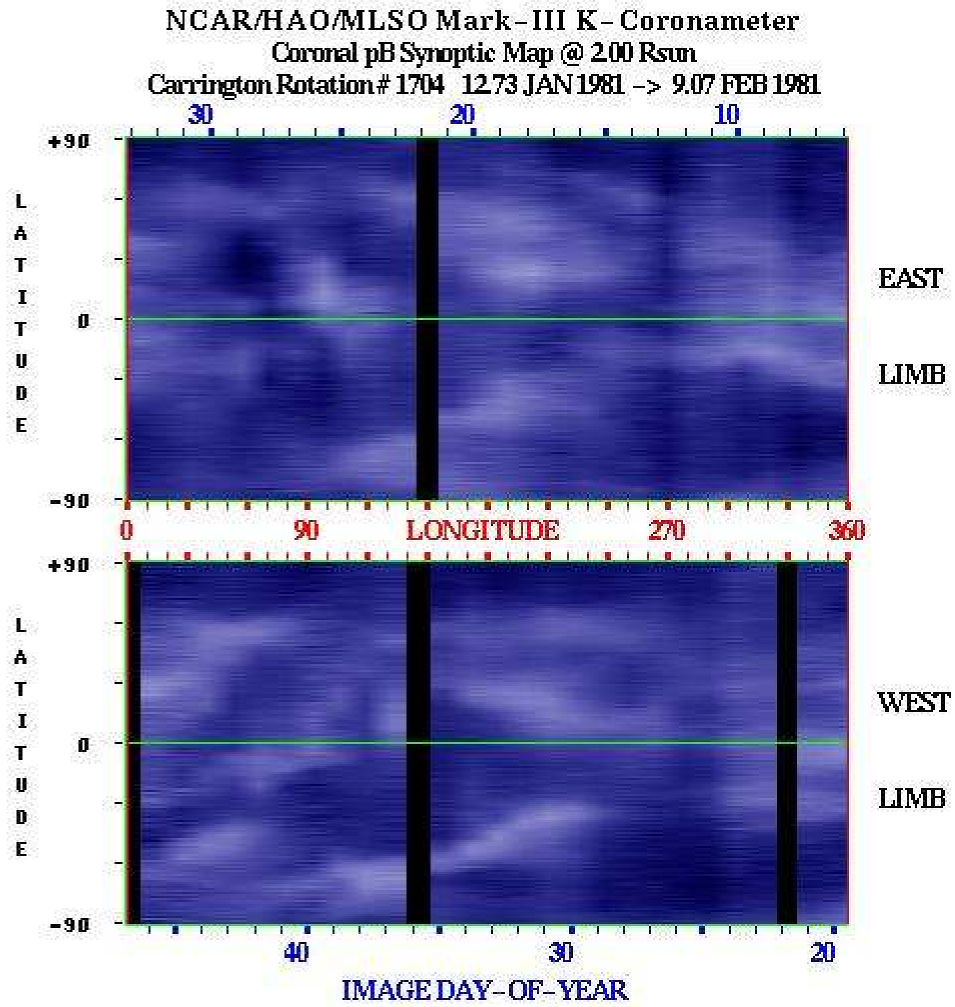
Table 2: Predictions of the Magnitude and Timing of Solar Cycle 24

Author		Predicted maximum R_z	Date		Based on
Horstman	2005	185	2010-2011	C	A projection of a single 11-year cycle based upon the last 5 historic cycles (Johnson SFC)
Tsirulnik, *et al.*	1997	180	2014	S	Modified global minimum analysis
Dikpati, *et al.*	2006	155–180	—	B	Modified flux-transport dynamo model calibrated with historical run of sunspot area
Podladchikova, *et al.*	2006	152–197	—	P	Integral of sunspot number used as precursor
Hathaway & Wilson	2006	160 ± 25	—	P	Analysis of aa index
Pesnell	2006	160 ± 54	2010.6	C	Cycle $n+1 =$ Cycle $n-1$
Maris and Oncica	1006	145	12/2009	N	Neural network forecast
Hathaway, *et al.*	2004	145	2010	B	Assumes that a fast meridional circulation speed during cycle 22 would lead to a strong solar cycle 24
Gholipour, *et al.*	2005	145	2011-2012	S	Spectral analysis and neurofuzzy modeling.
Kennewell & Patterson	2006	134 ± 50	2011.7	C	Based on the average of the last 8 solar cycles (Cycles 15 to 23, verified)
Kim, *et al.*	2004	122 ± 6	11/2010	C	Statistical analysis of cycle parameters
Pesnell	2006	120 ± 45	2010.0	C	Cycle $n+1 =$ Cycle n
Pesnell	2006	115 ± 40	2011.3	C	Cycle $n+1 = \bar{n}$
Prochasta	2006	114 ± 43	—	C	Climatology of sunspot number (appears to be the mean of cycles 1–23.)
Tlatov	2006	114 ± 7	—	P	Weighted average of 4 predictions
Sello	2003	115 ± 21	2011	S	Nonlinear prediction method
Euler and Smith	2006	110^{196}_{49}	2/2011	C	Modified McNish-Lincoln model (MSAFE)
Lantos	2006	108 ± 38	2001	C	Skewness of previous cycles separated into even/odd cycles
Kane	1999	105 ± 9	2010-2011	S	Extrapolation of dominant spectral components found by MEM
Wang, *et al.*	2002	$83.2 - 119.4$	3/2012	C	Statistical characteristics of solar cycles.
Sello	2003	96 ± 25	4/2011	P	Precursor method
Roth	2006	91.9 ± 27.9	1/2011	S	Auotregressive-moving average process (appears to be a linear prediction method)
Duhau	2003	87.5 ± 23.5	—	S	Non-linear coupling function between sunspot maxima and aa minima modulations found in a wavelet analysis.
Baranovski	2006	80 ± 21	2012	S	Mathematical theory of nonlinear dynamics. Predicts a long cycle lasting 12 years.
Schatten	2005	80 ± 30	2012	P	Sun's polar field serves as a predictor of solar activity on the basis of dynamo physics.
Svalgaard, *et al.*	2005	75 ± 8	—	P	Polar magnetic field strength at solar minima
Kontor	2006	70 ± 17.5	12/2012	S	Statistical gaussian-based extrapolation
Badalyan, *et al.*	2001	< 50	2010–2011	C	Statistics of the λ5303 Å coronal line
Mariş, *et al.*	2004	low	—	C	Observations of flare energy release during the descending phase of cycle 23 (empirical)
Clilverd, *et al.*	2004	weak cycle	—	C	Variation of the atmospheric cosmogenic radiocarbon.

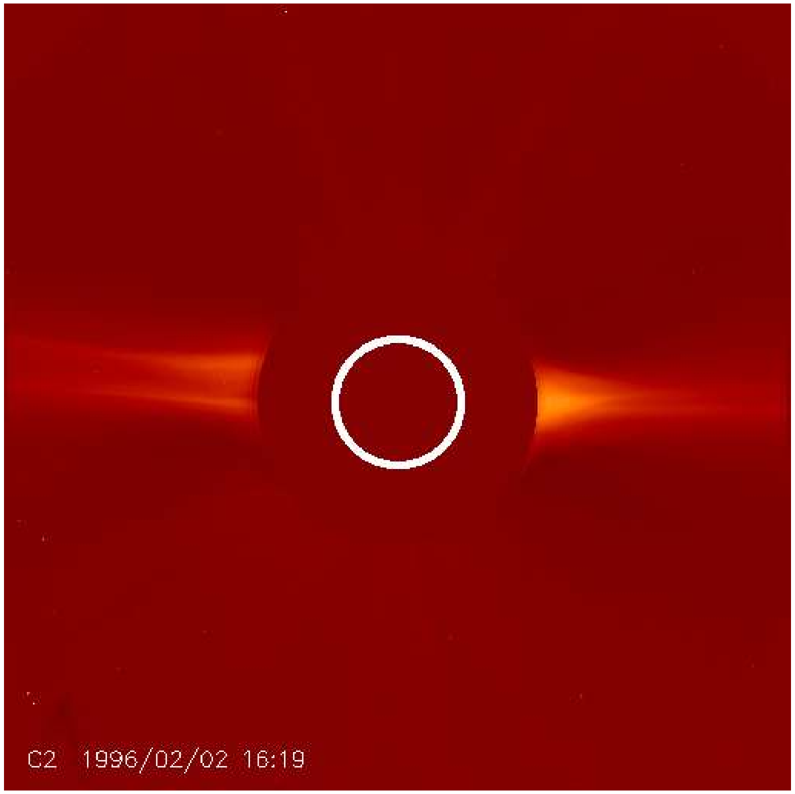
Solar Maximum



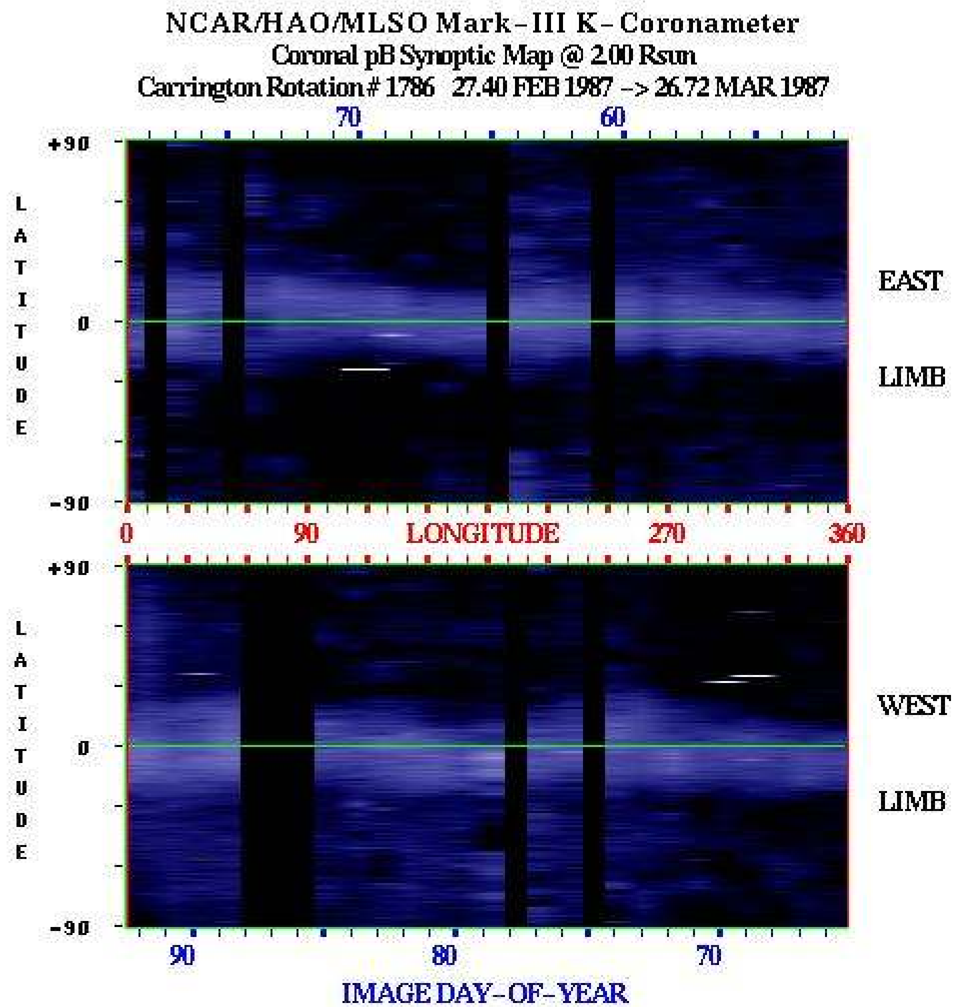
Total Eclipse of 16 February 1980
Palem, India



Solar Minimum



SOHO LASCO C2
02-Feb-1996



MLSO MK3 pB West Limb Synoptic Maps (1980-1999)

N90°

Equator

S90°

R=1.25 R_{Sun}

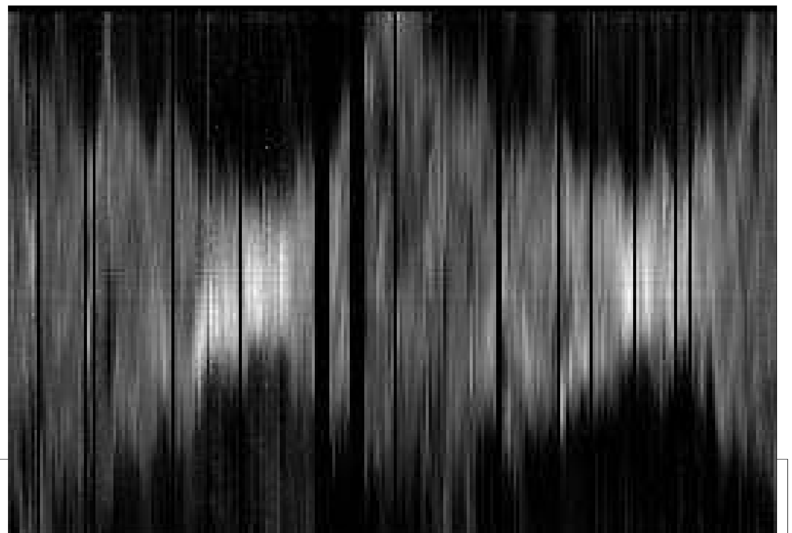
N90°

Equator

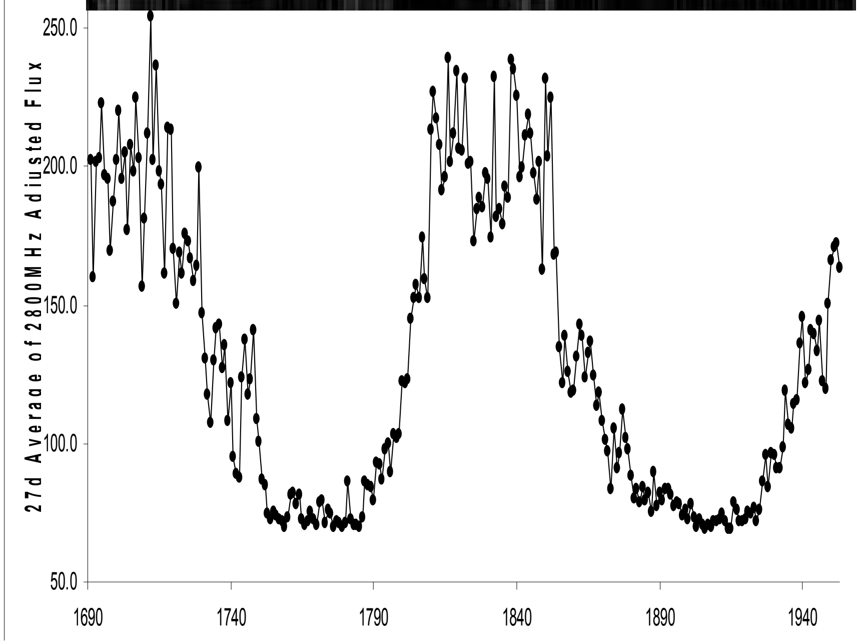
S90°

R=1.75 R_{Sun}

MLSO MK3 pB West Limb Synoptic Maps (1980-1999)

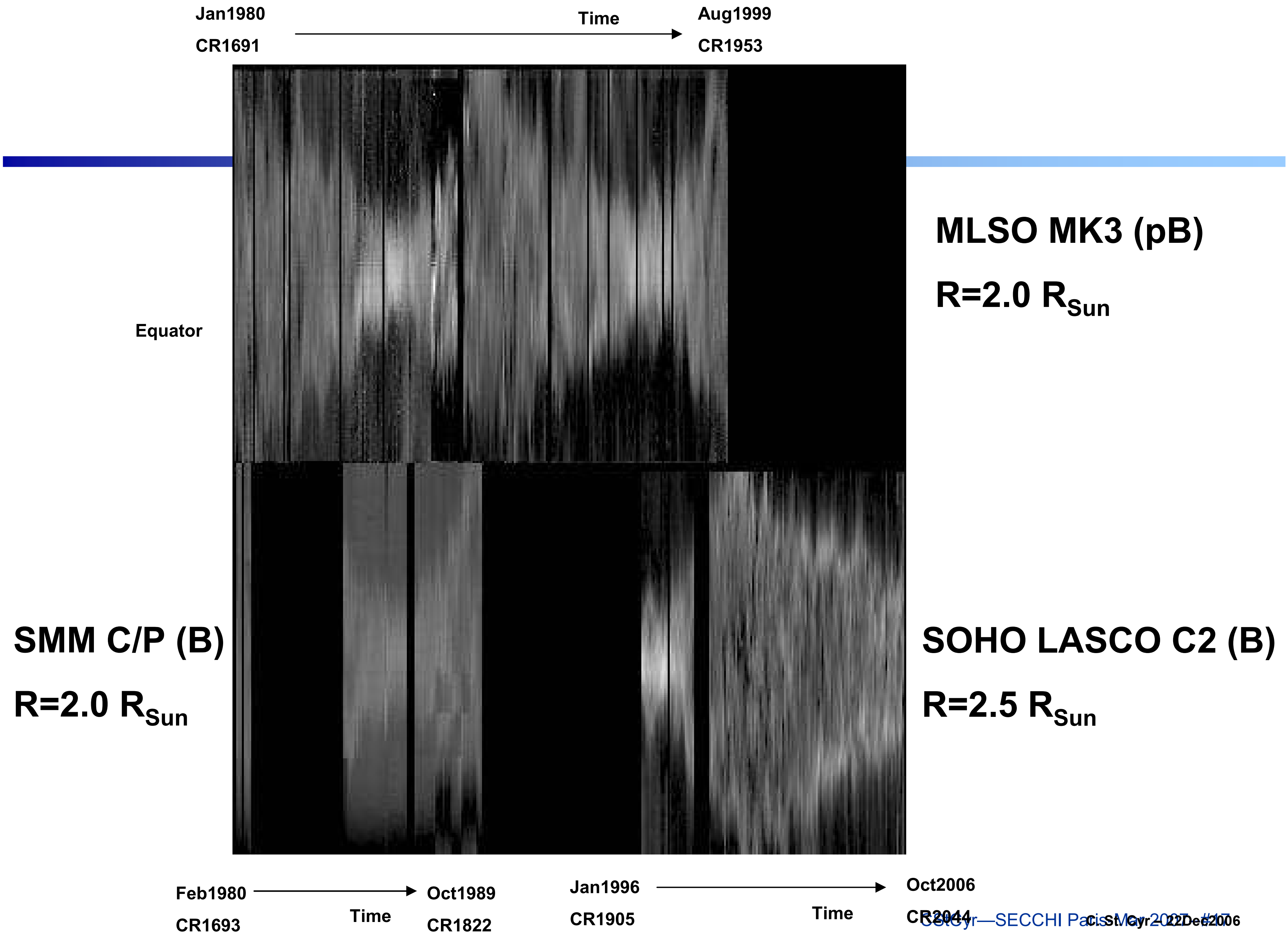


R=1.75 R_{Sun}



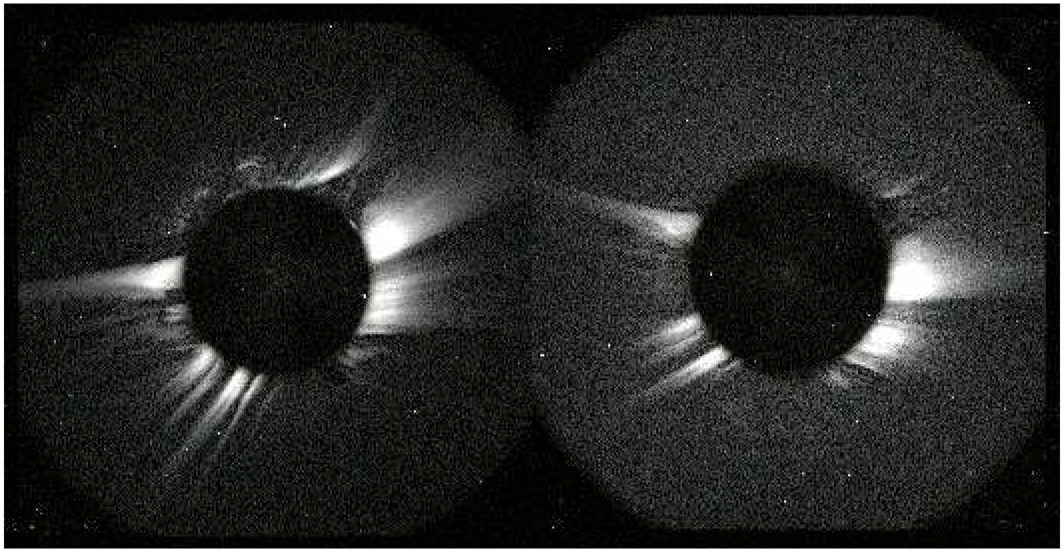
27-day Average

2800 MHz Adjusted Flux



Jan1980
CR1691
Time
Aug1999
CR1953
Equator
MLSO MK3 (pB)
R=2.0 R$_{Sun}$
SMM C/P (B)
R=2.0 R$_{Sun}$
SOHO LASCO C2 (B)
R=2.5 R$_{Sun}$
Feb1980
CR1693
Time
Oct1989
CR1822
Jan1996
CR1905
Time
Oct2006
CR2044
C. St. Cyr – 22Dec2006

Conclusions



17-Feb-2007
“pB” daily minimum pixel

- New data sources with constantly-changing vantage points!
- More than 25 CMEs already detected by both COR1-A and -B

BACK-UP