

Unusually extreme cosmic ray events in July 2005

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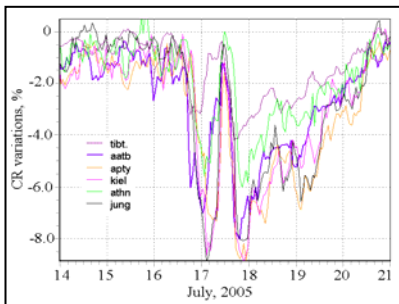
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Abstract

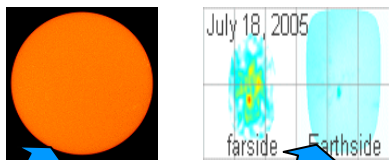
During the second half of July 2005, the Sun was rather active and a total of 24 C-class, 12 M-class and 1 X-class solar flares as well as 5 Halo Coronal Mass Ejections (CMEs) produced from a single active region (NOAA 786) within a week's time from 11th to 18th of July. A series of Forbush effects in cosmic rays occurred starting from 12th of July, as a result a rather intense Forbush decrease (FD) of cosmic rays (~8%) detected at neutron monitor stations all over the world on the 16th to 17th of July – as can be seen also from Athens Neutron Monitor Data Processing Center (ANMODAP). It started some hours before arrival of the weak shock associated with CME from 14th of July. Soon after the main phase, a sharp enhancement of cosmic ray intensity followed up, which was continued by a second large decrease in many NMs (within less than 24hours). It is rather peculiar event, as it is not a ground level enhancement of solar cosmic rays, and not a geomagnetic effect in cosmic rays. The event is characterized by unusually high anisotropy of cosmic rays (~7-8%), especially of equatorial component, with a direction to the western source of anisotropy.

Peculiar events during July 2005



The unusual CR variations as recorded by 6 NM stations (Aatb- Alma-Ata, Apty- Apatity, Athn- Athens, Jung- Jungfraujoeh, Kiel- Kiel, Tibt- Tibet)

Solar Activity in July 2005

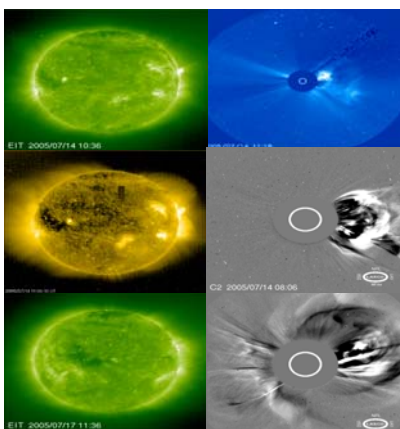


Spotless Sun at the 18th of July

Far side of the Sun at the same day

☐ Sunspot number decreased until a blank Sun revealed on the 17th of July.

☐ All major solar flares and halo CMEs produced by NOAA Region 786



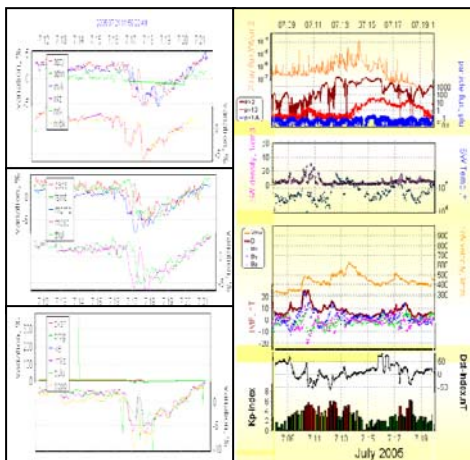
Solar flares and the associated CMEs on the 14th and 17th of July

☐ High activity recorded particularly on the 14th of July where two flares (M1.9 & X1.2) took place.

☐ A back-sided full halo CME observed by LASCO on the 17th of July on 11:30 UT which originated by region 786.

ANMODAP Center

The Athens Neutron Monitor on Data Processing (ANMODAP) Center of Athens University at the 17th of July recorded a Forbush decrease from 23 neutron monitors in real time around the globe which had a significant signature to almost all stations despite their geographical position

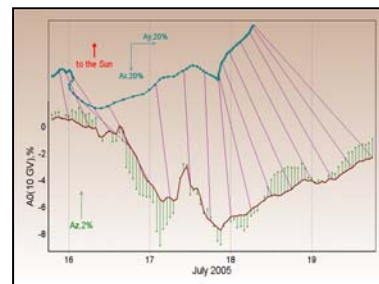


Data from ANMODAP Center (URL: <http://cosray.phys.uoa.gr>)

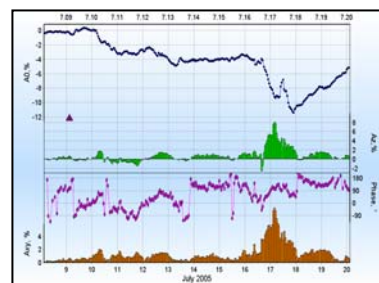
NM STATIONS	Event started at	Established alert signal	Maximum of the event
MOSCOW	9:52 UT	9:57 UT	10:48 UT
KIEL	10:13 UT	10:17 UT	10:48 UT
OULU	9:59 UT	10:03 UT	10:47 UT

☐ The outcome of the Onset process on 17th of July (Table 1) showed that it was nor a GLE or a geomagnetic disturbance

Cosmic Ray anisotropy



The behavior of CR density (A0, solid line) and anisotropy vectors



Characteristics of the 10 GV cosmic rays: A0 is CR density, Az-North-South and Axy-ecliptic components of CR anisotropy

Possible Explanations

➢ Solar activity of this period could provide the gigantic Forbush effect in the western part of the inner heliosphere as Earth crossed its periphery area on the beginning of 17th of July. In this day a “weak” shock was recorded at 1:32 UT, but Forbush decrease at Earth started before this shock arrive and at different time in different longitudes which is a consequence of the complicated conditions for CR propagation.

➢ Big equatorial component of CR anisotropy at this time is evidence of an intensive inflow of particle flux from the eastern direction that provided fast recovery of the FD.

➢ The cosmic ray enhancement within 17th to 18th of July can not be characterized as a GLE or a geomagnetic effect

Acknowledgements

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References

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