



Contribution ID: 425

Type: **Poster contribution**

Five-year correlation of the Sun shadow in cosmic rays observed by ARGO-YBJ with the Interplanetary Magnetic Field variability

Thursday 30 July 2015 15:30 (1 hour)

The shadow that the Sun casts on high energy cosmic rays is affected by the interplanetary and solar magnetic fields and has been shown to vary according to the solar rotation and activity cycle. Using the data of the ARGO-YBJ experiment, a large-area air shower detector located at high mountain altitude (4300 m a.s.l., in Tibet, China), the deficit of ~ 5 TeV cosmic rays due to the Sun shadowing effect has been monitored on a three-month basis from 2007 November to 2013 February, a time interval that includes a period of very low solar activity, followed by an activity increase towards the sunspot maximum. We found that the Sun shadow deficit started to decrease significantly in early 2010, about one year before the sunspot number had a fast increase, in early 2011. We observed indeed a significant anti-correlation between the Sun shadow deficit and the Interplanetary Magnetic Field (IMF) variability. This variability became more evident from early 2010, when the IMF showed frequent fluctuations and reversals, that could account for the observed decreased deficit of the shadow.

Registration number following "ICRC2015-I"

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