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The solar energetic particle propagation of solar flare events on the 24th solar cycle

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Now the Sun is in the 24th solar cycle. The peak of solar cycle corresponding to the number of the Sun activities, which one of them is solar flare. The solar flare is the violent explosion on the surface of the Sun and releases the high energy ion from the Sun to the interplanetary medium. Solar energetic particles or solar cosmic ray have important effect on the Earth, such as disrupt radio communication. We analyze the particle transport of the solar flare events on August 9, 2011, January 27, 2012, and November 3, 2013 in 24th solar cycle. The particle data for each solar flare was obtained from SIS instrument on ACE spacecraft. We simulate the particle transport with the equation of Ruffolo 1995, 1998. We solve the transport equation with the numerical technique of finite different. We find the injection duration from the Sun to the Earth by the compared fitting method of piecewise linear function between the simulation results and particle data from spacecraft. The position of these solar flare events are on the west side of the Sun, which are N18W68, N33W85, and S12W16. The results show the mean free path was increased as well as the injection time was decreased while the energy level was increased. The resultant variation of the highest energy and lowest energy was small because the effect of space environments and the number of data was small. The high mean free path of the high energy particles showed the transport capability of particles along to the variable magnetic field line. The violent explosion of these solar flares didn't affect on the Earth magnetic field with Kp-index less than 5.

Primary author: Ms PALUK, Papitchaya (Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand)

Co-authors: Ms KHUMLUMBERT, Thiranee (Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand); Ms KANLAYAPRASIT, Nattida (Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand); Ms AIEMSA-AD, Nalinee (Faculty of Science and Technology, Rajabhat Rajanagarindra University, Chachoengsao, 24000, Thailand)

Presenter: Ms PALUK, Papitchaya (Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand)

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