Discussions and Conclusion:

The amplitudes of northern and southern hemispheres shows decreaseses magnetic solar activity during cycles 22-24. The two hemispheres are asymmetrical between the years 1989 to 1991, 1999 to 2002, and 2011 to 2014 with a high diffusivity forced (magnetic field) present in that year. Solar cycle 23 shows pronounced double peaks in case of absolute asymmetry of sunspot area is connected with solar activity maximum on the photosphere. Our Absolute Asymmetry (A) techniques revealed that the presence of phase shift between magnetic activities in the hemispheres on solar surface of the Sun. The differential rotation and meridional circulation in each hemisphere are related to the solar magnetic activity (Chowdhury et al., 2013). It means the change of dominant activity of northern maximum to southern maximum is connected with each other.

In this study, we examined the highest time lag between GCRs (Moscow NM station) and sunspot area during the descending phase of solar cycles 23 with 12 months and maximum cross-correlation ~ 0.68. This indicates that the recovery rate of the GCRs' during the descending phase of solar cycles 22 and 24 is much faster than the solar cycles 23. But during cycles 22 and 24 are similar time lag ~4 months with cross-correlation of ~0.65. Our investigation exhibits a negative time lag between galactic cosmic rays (GCRs) and sunspot area (SSA) during the descending phase of cycles 22-24, which is consistent with the earlier results (Usoskin et al. 2001, Chowdhury et al. 2013, Chowdhury and Kudela, 2018). Some previous studies indicated that the time lag between GCRs and SSA is relatively small in even-numbered cycles in comparison with the odd-numbered cycles (Chowdhury and Kudela, 2018 and references therein).

The significant periodicity of absolute asymmetry of sunspot area for the quasi-biennial (QBO) period varies 1.16 - 3.89 years. The period ~0.97 years (~350 days) of absolute asymmetry of sunspot area is prominent during the study period. Our result shows a period of absolute asymmetry of sunspot area is the rotational rate at the base of the solar convection zone is ~1.38 years during combined solar cycles 22-24, whereas Chowdhury et al. (2013) observed ~1.40 years based on daily based data (normalized asymmetry value) during solar cycle 23. The quasi-biennial (QBO) period shows the change in phase and behavior of solar activity from one hemisphere to the other. QBO periods are evidence of a strong asymmetry in both sides of the solar equator with period 1.94 years. It is the highest power that appears around the period 2011.