Study of solar prominences evolution over last century can help predict solar cycles

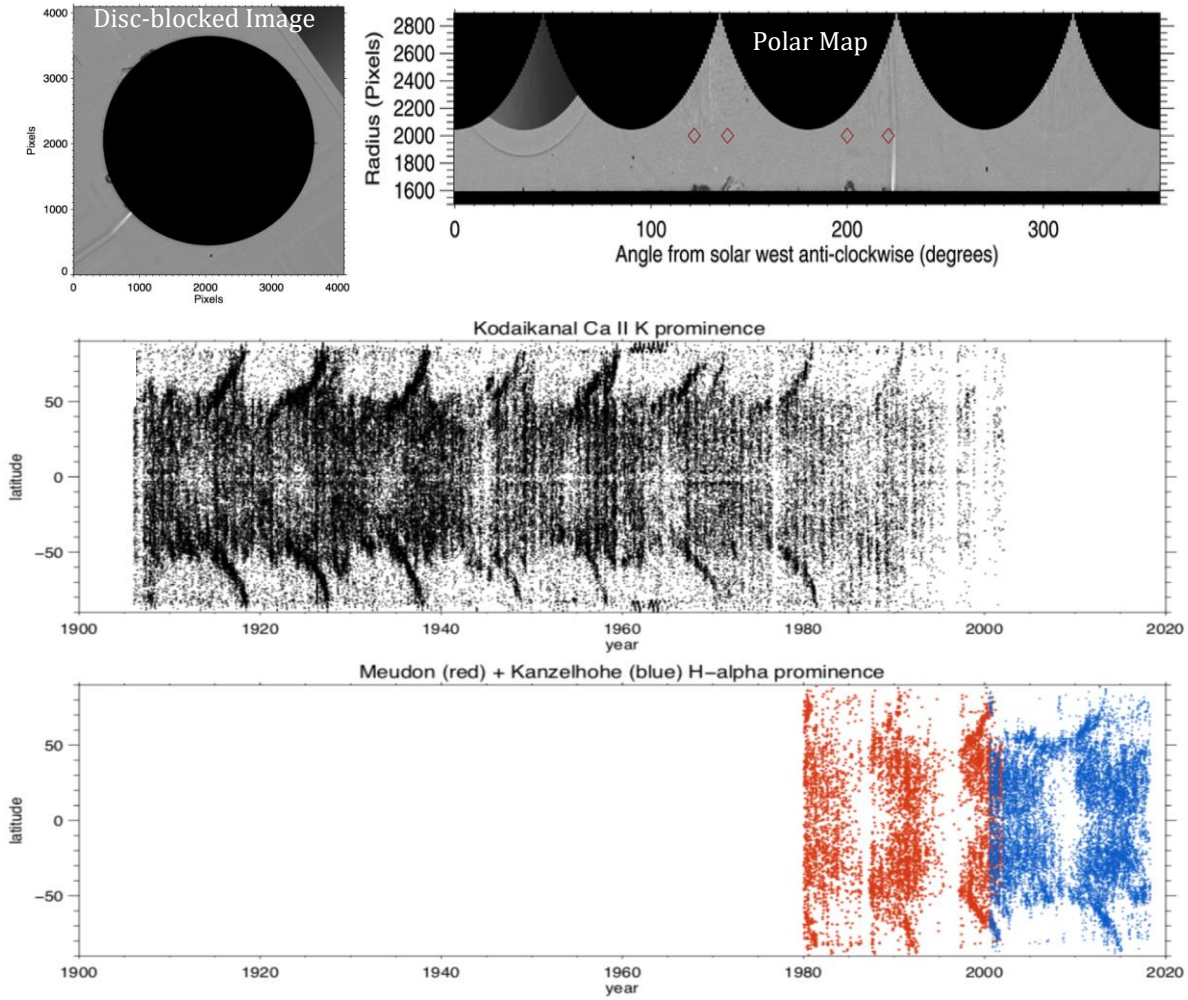
Scientists from Aryabhatta Research Institute of Observational Sciences (ARIES) and Indian Institute of Astrophysics (IIAP) autonomous institutes under the Department of Science & Technology (DST) have probed the evolution of Solar Prominences over the last century. Mapping Spatio-temporal pattern of solar prominence -- a large, bright, gaseous feature extending outward from the Sun's surface for the last 10 solar cycles, the scientists have found a clear trend of poleward migration.

Solar prominence is an index of solar magnetism, and its mapping can help predict solar cycles.

Dr. Subhamoy Chatterjee from IIA, led by Professor Dipankar Banerjee, Director, ARIES, used the digitized data archive from Kodaikanal Solar Observatory (KoSO) which is one of the oldest and richest across the globe that enabled the long-term study of the Sun using magnetic proxies like never before.

The team used KoSO digitized disc-blocked dataset, spanning over 1906-2002, to detect prominence locations through an automated image processing algorithm and found a clear trend of pole-ward migration. To make the detection recent, they supplemented KoSO data with those from Meudon and Kanzelhohe Observatories in Europe.

Solar prominence is a large, bright, gaseous feature extending outward from the Sun's surface, often in a loop shape. Prominences are anchored to the Sun's surface in the photosphere, and extend outwards into the Sun's hot outer atmosphere, called the corona. A prominence forms over timescales of about a day, and stable prominences may persist in the corona for several months, looping hundreds of thousands of miles into space. Scientists all across the globe are still researching how and why prominences are formed.



This study, for the first time, presents the spatio-temporal pattern of prominence for the last 10 solar cycles. They have also extracted the pole-ward migration rates of prominences for all the cycles having implication to polar magnetic flux build-up.

Current physical understanding of the self-sustained magnetic evolution of the Sun identifies polar flux at solar minima as the best precursor for predicting the following solar cycle. Also, long-term solar magnetic evolution is capable of modulating the Sun-Earth connection.

Unfortunately, no direct magnetic field measurements are available before 1967. However, historical observations reveal different features, known as magnetic proxies that map the complete picture of decadal-scale magnetic evolution. Prominence is one such vital proxy, which is aligned with the magnetic polarity inversion line and form all over the Sun depending on the phase of the solar cycle.

Such large statistics for prominence locations and inter-cycle variations will be an asset for the global heliophysics community to help in assessing magnetic evolution for decades to come.