Using the Tracer Method to Measure Solar Rotation: An Overview with an Example from the Solar Cycle 19

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Abstract

One of the fundamental properties of the Sun as a star is its rotation velocity. In the early seventeenth century it was discovered that sunspots at different solar latitudes rotate with different periods, and since then the solar differential rotation has been one of the extensive topics of solar research. The most widely used method for measuring solar rotation is the tracer method, which is based on following positions of discernible objects (tracers) in the solar atmosphere over a period of time. The important advantage of the tracer method is a broad selection of available tracers. Examples of suitable tracers are sunspots and sunspot groups, solar prominences (also called filaments when observed on the solar disk) and coronal bright points. The tracer method can be applied in three ways: as a daily shift method, as a passage method and as a period method. The analysis and reduction of the observational data includes the transformation of the synodic to the sidereal solar rotation velocity, height corrections for tracers located above the photosphere, and the application of filters to the measured velocities. The least-square method is then used to determine the solar differential rotation parameters.

In this seminar I will provide a brief overview of the tracer method and present our recent results of solar differential rotation for solar cycle No. 19 derived from tracing sunspot groups on the sunspot drawings of Kanzelhöhe Observatory for Solar and Environmental Research.

Keywords: Sun, differential rotation, tracer method, sunspots, photosphere