Invited lecture

RELATIONSHIP BETWEEN SOLAR MAGNETIC FIELDS OF DIFFERENT SPATIAL SCALES AND SOME CONTROVERSIAL PROBLEMS OF THE DYNAMO THEORY

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SOHO/MDI magnetograms obtained in the epoch of maximum of Cycle 23 are compared with 284 A solar images from the SOHO/EIT space telescope. The analysis has corroborated the existence of complexes of activity that involve active regions (AR) and equatorial coronal holes (CH). Both AR and CH are embedded in an extended magnetic region dominated by the magnetic field of one sign, but not strictly unipolar. Moreover, this magnetic region can only be isolated by smoothing over about 80 arc sec. It is suggested that the solar magnetic field consists of three components that are interrelated but are generated by different mechanisms. The main (or background) magnetic field has a strength of about 3 G, and it can be detected by reasonable smoothing and seems to provide the basis for the occurrence of coronal holes and open magnetic fields. The background field is superimposed by a small-scale magnetic field with the mean intensity of 18 G, which strongly fluctuates both in magnitude and in sign. The total flux of the fields lower than 100 Gs does not have cyclic variation. The occurrence of the latter requires an additional mechanism, which can be described as subsurface small-scale dynamo. And finally, there is a third mechanism, which enhances the field and controls the fields of active regions (i.e., the fields of sunspots and faculae). Although the fields here are much stronger (from 40 G up to 3000 G), their contribution to the total flux is not large 30-40%). These fields are extremely variable; they can change by 10-30% for one or two days. Since the flux from these fields is much smaller than that from the main field, the scenario of regeneration of the latter proposed by Babcock and Leighton seems doubtful.