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Peak magnetic field in sunspots: a comparison between the CrAO and SDO/HMI data

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An archive of maximum sunspot magnetic fields has been compiled at the Crimean Astrophysical Observatory since 1956. To have a possibility of applying the compiled data, we need to compare magnetic field values obtained at CrAO and the magnetic fields derived with modern solar instruments.







We perform digitization of maximum magnetic field measurements in sunspots. The original data were acquired as drawings at the Crimean Astrophysical Observatory of the Russian Academy of Sciences (CrAO RAS). All sunspots observed in 2014 were analyzed. The data was compared to the corresponding measurements from the SDO/HMI instrument. For the same sunspot, the maximum modulus of the magnetic field derived at CrAO was compared to the corresponding value from HMI (the line-of-sight magnetic field Bz(HMI) and the modulus of the magnetic field vector B(HMI)).

² Methods

To compare data from CrAO RAS and SDO/HMI we did several steps:

- 1. To open a drawing from BST-2 (https://sun.crao.ru/observations/sunspots-magnetic-field)
- 2. To download corresponding files from the Joint Science Operations Center (JSOC) website (http://jsoc.stanford.edu/HMI/HARPS.html)
- 3. For each sunspot recorded at CrAO the maximum strength of the longitudinal magnetic field and the modulus of the full magnetic field vector was detected from the HMI map
- 4. The information about the date and time of observation, NOAA number of active region and magnetic field data in Gauss was imported into the txt-file



³ Results

These diagrams represent the relation between the magnetic field mesures at CrAO and the full magnetic field vector (1 and 2 figure), the line-ofsight component (3 and 4 picture) measured with SDO/HMI.

In both cases the correlation coefficient is of about 0.7, that implies a rather solid statistical relationship between the Crimean data and HMI data. The slope of the linear regression fit is of about 1.1 for full magnetic field and 0.89 for line-of-sight component. In both cases the offset is zero.



The magnetic field measured by the CrAO versus the modulus of the full magnetic field vector measured by SDO/HMI. The sign is counted in the left figure. The absolute field magnitude is plotted in the right figure

The magnetic field measured by the CrAO versus the longitudinal component of the magnetic field measured by SDO/HMI. The sign is counted in the left figure. The absolute field magnitude is plotted in the right figure

4 Conclusion

- By definition, the Crimean BST-2 telescope measures the full magnetic field vector.
- We have shown a direct proportion between the Crimean data and space-based data of both types (B and BLOS).
- The full magnetic field vector from HMI is by 10% larger than the BST-2 data, and the BST-2 data is by 11% larger than the HMI line-of-sight data.
- The CrAO data exhibit a good agreement with values acquired with such a present-day spacecraft as SDO/HMI, so the data from magnetic field measurements at CrAO may be applied for scientific purposes.