Hinode-3: 3rd Hinode Science Meeting
Hitotsubashi Memorial Hall, Tokyo
1–4 December, 2009

On twist estimation in active regions

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Abstract. Dipole magnetic field are defined by

$$\begin{aligned} Bx &= B0 \cdot \frac{3xz}{r^5} \\ By &= B0 \cdot \frac{3yz}{r^5} \\ Bz &= -B0 \frac{(1 - 3 \cdot \frac{z^2}{r^2})}{r^3} \end{aligned}$$

where $r = \sqrt{x^2 + y^2 + z^2}$ and $B0$ scales the strength of the magnetic field.
We extrapolated the coronal magnetic field in 3D, using an IDL code (J.K. Lee, 2002), for three active regions where flares occured and compared with coronal images, especially with XRT/Hinode images.
We analysed these active regions for two different days and compute the 3D magnetic field for moments before, during and after important flares (CMEs).

Observational estimates of the alpha parameter associated to the force-free field equation are considered to be measure of the twist associated with active regions flux system. We computed the alpha parameter by $\alpha = \frac{1}{Bz} \cdot (\frac{\partial By}{\partial x} - \frac{\partial Bx}{\partial y})$, with the components of magnetic field defined above and using MDI magnetograms. Our investigation intend to estimate the values of α as measure of twist of the magnetic field lines and to understand its behaviour in time and during explosive events.

Reference
Lee, J. K., Coronal Loop Identification, Master Thesis, University of Alabama in Huntsville, 2002.