

## Knots, links and braids in magnetic fields

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Solar magnetic loops, courtesy of the NASA SDO team

The relation between knot theory and magnetic fields can be traced back to Gauss' linking integral, which is used to calculate the linking number between two closed curves (knots) in 3-space. The linking integral can be generalised to measure the asymptotic Hopf invariant, the average linking number of pairs of field lines in a magnetic field (V.I. Arnold 1974). This integral, called magnetic helicity, plays an important role in technical and astrophysical plasmas.

We shall explain the properties of magnetic helicity and give an overview of the attempts to generalise further notions of knot theory to magnetic fields. In particular we shall present integrals for higher order linking numbers in three and four dimensions and discuss their relevance for magnetic fields in plasmas.

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