

Block 1

Step 1 - The experimental puzzle

The CISS effect in transport measurements is observed as an asymmetric charge current response when the magnetization of a ferromagnetic contact is switched. Experimentally, this magneto-current is nearly constant over a range of several volts around equilibrium, and maintains the same sign for both positive and negative voltage polarities. As far as I gather, these two facts are well documented across many experimental groups.

But there is a problem! For Onsager reciprocity to hold, time-reversal symmetry must be intact in equilibrium. So, if the magneto-current is semi-voltage-independent and persists even near zero bias (equilibrium) then it looks as if CISS violates Onsager reciprocity. This apparent contradiction is the **CENTRAL PUZZLE**.

The way this is resolved is if the central molecule acquires a stable spin configuration when coupled to the reservoir one that breaks time-reversal symmetry spontaneously.