

## On the problem of chirality-induced spin selectivity (CISS)

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Chirality-induced spin selectivity (CISS) refers to an effect that was discovered as early as 1999 [1] and that still defies all current theoretical attempts at explanation [2]. Experiments suggest that an electron current traversing a molecule that has chiral symmetry (a property of most biomolecules) becomes spin polarized. This is surprising in view of the fact that none of the components of the problem is magnetic, and organic molecules typically have only a very small spin orbit coupling. We will start by giving a brief overview of the key experiments, list some of the theoretical attempts, and give some constraints that such theories should observe. In search for explanations of the CISS effect we will elaborate two simple model systems. Although they do not produce the wanted effect, they illustrate very clearly where the difficulties lie. Additional elements will need to be added into the model, and we will discuss which options could work.

[1] Ray, Ananthavel, Waldeck, and Naaman, *Science* 283 (1999) 814-816.

[2] Evers, Aharony, Bar-Gill, Entin-Wohlman, Hedegård, Hod, Jelinek, Kamieniarz, Lemeshko, Michaeli, Mujica, Naaman, Paltiel, Refaely-Abramson, Tal, Thijssen, Thoss, van Ruitenbeek, Venkataraman, Waldeck, Yan, and Kronik, *Adv. Mater.* (2022) 2106629.