

Sources of spin currents

A flow of electron charge is a charge current. The physics of the charge current has been studied for more than a century and is at the heart of modern electronics. However, because an electron also carries a spin, the existence of electron flow naturally implies the possibility of flowing spins and of spin currents. With the advent of novel nanofabrication techniques in the last decades, the interest in spin currents has grown, giving birth to many novel phenomena in modern Magnetism. In this lecture, we will introduce the concept of spin current and discuss the different sources that are available to generate it. From the theoretical point of view, the formulation is not simple and still challenging, but its concept is extremely useful and versatile. We will show that spin currents can be generated using ferromagnetic sources, Zeeman-split density of states, magnetization dynamics (spin-pumping) and relativistic effects involving spin-orbit coupling (spin Hall effect). We will also see that a spin current can be carried by a spin wave a collective excitation of magnetization in magnets, or driven by the topological band structure in certain types of solids.

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Bibliography

- [1] Igor Žutić, Jaroslav Fabian, and S. Das Sarma, Spintronics: Fundamentals and applications Rev. Mod. Phys. 76, 323 (2004).
- [2] Y. Tserkovnyak, A. Brataas, G. E. W. Bauer, and B. I. Halperin, Nonlocal magnetization dynamics in ferromagnetic heterostructures. Rev. Mod. Phys. 77, 1375 (2005).
- [3] Concepts in spin electronics, Oxford University Press, Ed. S. Maekawa (2006).
- [4] J. Sinova, S. O. Valenzuela, J. Wunderlich, C. Back. T. Jungwirth. Spin Hall effect, arXiv:1411.3249.