Cross-correlations in spin-dependent transport through a quantum dot Cooper pair splitter

P. Trocha[1], K. Wrześniewski[1], and I. Weymann[1]

[1]*Faculty of Physics, Adam Mickiewicz University, ul. Umultowska 85, 61-614 Poznań, Poland*

We investigate Andreev transport through a quantum dot attached to two external ferromagnetic leads and one superconducting electrode [1]. The transport properties of the system are studied by means of the real-time diagrammatic technique in the sequential tunneling regime. In the considered system, two main tunneling processes play role: direct Andreev reflection (DAR) and crossed Andreev reflection (CAR). The former one consists of superpositions of processes: an electron, of energy smaller than superconducting gap, tunnels from the normal metal lead through discrete dots level and it pick up another electron with opposite energy and opposite spin to create a Cooper pair which is able to propagate into the superconductor. During this process, a hole with opposite energy and spin opposite to that of the incident electron is reflected back into the normal metal lead. The latter one consists of such processes where the hole is reflected into the second, spatially separated electrode.

Generally, both DAR and CAR processes contribute to the Andreev current. However, under certain conditions, by properly changing device parameters, one can tune the contributions due to CAR and DAR processes or even suppress one of them. Thus, there is sought a tool which allows to distinguish both contributions. A perfect one seems to be given by current cross-correlations, i.e., correlations calculated between currents flowing through two junctions with normal leads. Thus, we show dependence of current cross-correlations on various parameters of the considered model, both in linear and nonlinear transport regimes. The processes and mechanisms leading to enhancement or suppression of current cross-correlations are examined and discussed.

[1] I. Weymann and P. Trocha, *Phys. Rev B* **89**, 115305 (2014).