Josephson effect in p-wave nanostructures

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We have studied quantum transport in nanostructures of p-wave (spin-triplet) superconductors such as Josephson junctions and mesoscopic rings. Electric Josephson currents in SNS junctions are very sensitive to pairing symmetry of superconductors, where N denote diffusive normal metals. This is because midgap Andreev resonant states (MARS) governs electron transport in such structures[1]. We discuss relations between pairing symmetries of superconductors and anomalous Josephson effect. In a p-wave symmetry MARS penetrates into normal metals in the presence of the proximity effect and amplitudes of Josephson current becomes much larger than those in conventional s-wave junctions in low temperatures[1].

We also discuss spin current in p-wave nanostructures such as Josephson junctions and rings. In Josephson junctions, it is known that spatial gradient of macroscopic phase drives electric supercurrents. Spin supercurrents flows in the presence of spatial gradient in d-vector. Such spin current has been studied in helium III since 1980's. We discuss interesting features of spin current in curved structures of p-wave superconductors[2].

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[2] Y. Asano, Phys Rev. B **72**, 092508 (2005).