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Interplay between impurities and correlations in small metallic and superconducting rings

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The properties of nanoscopic rings with electronic correlations and impurities are analyzed numerically by means of two methods. First, we carry out exact diagonalization of one-dimensional rings, that consist of up to several lattice sites. Then, we perform the Bogoliubov–de Gennes–equations studies of finite-width rings consisting of a few hundred sites. Results obtained from both the approaches are shown to be consistent. We demonstrate how the properties of the systems are affected by various configurations of impurities for both repulsive and attractive electron–electron interactions. In the case of attractive interaction we show that the nanoscopic properties are mainly determined by the competition between tendencies toward pairing and formation of the density waves. Since the impurities act as pinning centers for the density waves, their configuration determines the result of this competition.

Keywords : nano, persistent current, superconductivity