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Screening effects in bipolaron theory and high temperature superconductivity

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The subject of the present thesis is a study on bipolaron formation in heavily doped and polar materials. The study is applied to the physics of superconducting compounds with high transition temperature. In particular this thesis addresses the problem of the formation and superconducting properties of real space electron (hole) pairs in these systems and their dependence on the carrier density. The pairing mechanism results from the dynamical cooperation of photonic and electronic degrees of freedom which characterize the heavily doped polar material. We call these pairs biplasmapolarons (BBP) because they can be thought as quasi-particles composed by two electrons (holes) and their cloud of virtual photons and plasmons. In the present work we extend the theory to the calculation of both BPP binding energy and effective mass and we discuss the features of the effective electron-electron interaction.

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