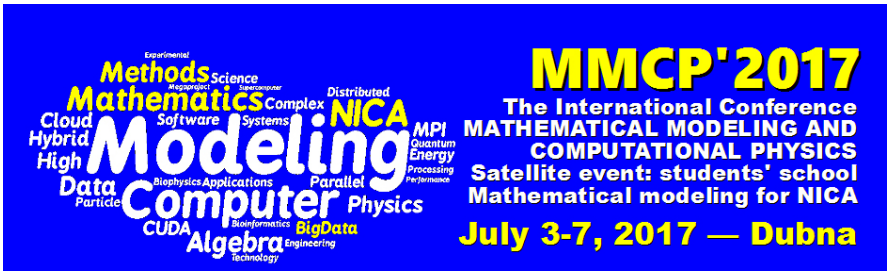


Contribution ID: **165** Type: **not specified**

# Modelling of the High Temperature Superconductors at Nonequilibrium Conditions

*Monday, 3 July 2017 17:00 (15 minutes)*

Nonequilibrium effects in layered superconducting materials that appears as a result of injection of a stationary current are actively studied in recent years [1,2,3]. An experimental proof of the existence of a nonequilibrium effect in intrinsic Josephson junctions was given in [4] and was explained by the charge imbalance in the superconducting layers, which arises as the result of injection of the quasiparticle current.

In our work, we provide a detailed numerical simulations of intrinsic Josephson junctions of high temperature superconductors under external electromagnetic radiation taking into account the charge imbalance effect [5]. We demonstrate that the charge imbalance is responsible for a slope of the Shapiro steps on the current-voltage characteristic. The value of slope increases with a nonequilibrium parameter. Coupling between junctions leads to a distribution of the slope's values along the stack. The nonperiodic boundary conditions shift the Shapiro step from the canonical position determined by a frequency of external radiation. This fact makes ambiguous the interpretation of the experimentally found Shapiro step shift by the charge imbalance effect [6].

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**Session Classification:** Physical processes modeling and related computational methods (I)