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CURVATURE EFFECTS IN 1-D AND 2-D JOSEPHSON JUNCTIONS

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Abstract. The gauge invariant phase difference between superconducting electrodes is a dominating dynamical degree of freedom in the Josephson junction. This rapport concerns the influence of the curvature of the junction on the dynamic of this field variable. The effects of curvature are discussed in the long and large area junctions. In particular the dynamics of the fluxion and the kink front are studied.

MSC: 53Z05, 35L70,53A04,53A05
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1. Introduction

The Josephson junction is a device that consists of two superconducting electrodes separated by a very thin layer of insulator or other material. For example, in the case of a dielectric barrier this thickness is in the range 10-20 Å. The leading effect that determines the operation of this device is tunnelling of Cooper pairs from one to the other electrode. The effect was first predicted by Josephson [17] and then observed experimentally by Anderson and Rowell [2]. As far as the dimension of the junction is considered we can classify the junctions in the following way

- Large area Josephson junction, which is two dimensional system.
- If one of the transverse dimensions is smaller than the Josephson length then there is no dynamics in this direction and we have one dimensional system.
- If both transverse dimensions are smaller than the Josephson penetration depth than we have zero dimensional system called point contact.

The analysis of this system can be performed on the background of the Maxwell equations with Landau-Ginzburg current of Cooper pairs. In case of superconducting electrodes we also use the Londons equation that relates the electric field with