# *Popularizing description of the project results*

A Josephson junction is a kind of sandwich made of two superconducting electrodes separated by a very thin layer of isolator or normal metal. For example, in the case of the isolator layer the thickness is on the level of several Angstroms. Such a magnitude we would compare to the size obtained by placing four water molecules side by side.

This relatively simple device has found a variety of technical applications. Josephson junctions are used in the construction of SQUIDs (superconducting quantum interference devices) which are very sensitive magnetometers. For example, magnetic activity of tissues in animals is very small and corresponds to magnetic fields between $10^{-9}$ T and $10^{-6}$ T. On the other hand, SQUIDs are sensitive enough to measure magnetic fields of the order $10^{-18}$ T. This unusual sensitivity makes SQUIDs useful in medicine (magnetoencephalography, magnetogastrography, cardiology) in exploration of minerals, earthquake diagnostics and many different branches of industry and science.

The other electronic device that uses a Josephson junction is a single electron transistor (SET). This device can be seen as a switch which uses single electrons in order to change its state from “on” to “off”.

It seems that the Josephson Junction could find possible applications in construction of quantum computers. The basic element of the quantum computer is quantum bit called qubit. Nowadays several types of qubits are constructed (a few types of qubits are based on the operation of Josephson junctions).

The Josephson junction has also possible applications in digital electronics technology. RSFQ electronics (Rapid Single Flux Quantum) relies on quantum effects in Josephson junctions to process digital signals. The digital information in these devices is carried by magnetic flux quanta that are produced by Josephson junctions instead of transistors in semiconductor electronics. The magnetic flux quanta are carried by picosecond-duration voltage pulses that travel along superconducting transmission lines, instead of static voltage levels in semiconductor electronics. The pulses can be as narrow as 1 picosecond with an amplitude of about 2 mV. This property makes this technology really promising for computer applications. For example, if the computer produced in standard technology needs two hours in order to solve some numerical problem then a computer produced in RSFQ technology needs only one minute.

During realization of the project the influence of the curvature of the Josephson junction on fluxion movement was studied. The fluxion is a quasiparticle that caries unit magnetic flux quanta. At the first stage of the project the equation that describes the propagation and generation of electromagnetic waves in a one or quasi-one dimensional curved Josephson junction was obtained. This equation relates the shape of the junction with the evolution of the fluxion. Based on this equation several geometries were identified which can be used in RSFQ electronic elements. The first interesting shape is responsible for acceleration or deceleration of fluxions. This element can work in RSFQ circuits as a booster. The other geometry enables separation of fast from slow fluxions. This element can work as a discriminating element in RSFQ electronic devices. Finally, the last identified shape may be used in storing binary data in the form of fluxions. I am deeply convinced that all these elements in the near future will find a variety of applications in new generation RSFQ computer technology.