Muon track induced current measurements in semi-insulating GaAs

D.G. Eshchenko [1,2], V.G. Storchak [3] and S.P Cottrell [4]

[1]*Physik-Institut der Universität Zürich, CH-8057 Zürich, Switzerland*
[2]*Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, CH-5232, Villigen, Switzerland*
[3]*Russian Research Centre "Kurchatov Institute", Kurchatov Sq. 1, Moscow 123182, Russia*
[4]*ISIS Facility, Rutherford Appleton Laboratory, Oxfordshire OX11 OQX, UK*

RF μSR experiments in electric fields have revealed a metastable behavior of commercial semi–insulating GaAs samples. After the treatment of the sample with strong ($|E| > 10$ kV/cm) electric field at $T = 70$ K for at least one hour, the diamagnetic RF amplitude at $T \sim 100 - 140$ K becomes two times bigger than in the "virgin" sample. Sample can be returned to the original state by raising the temperature to 250 K. Big diamagnetic fraction can be explained by two machamisms: Mu_T captures an excess electron and forms Mu^-, or Mu_T captures an excess hole and forms Mu^+. To make a conclusion on the nature (electrons vs holes) of the non-equilibrium charges transport in the metastable GaAs we have performed muon track induced current measurements in the asymmetric geometry: electron–hole pairs were generated close to the incoming electrode. In

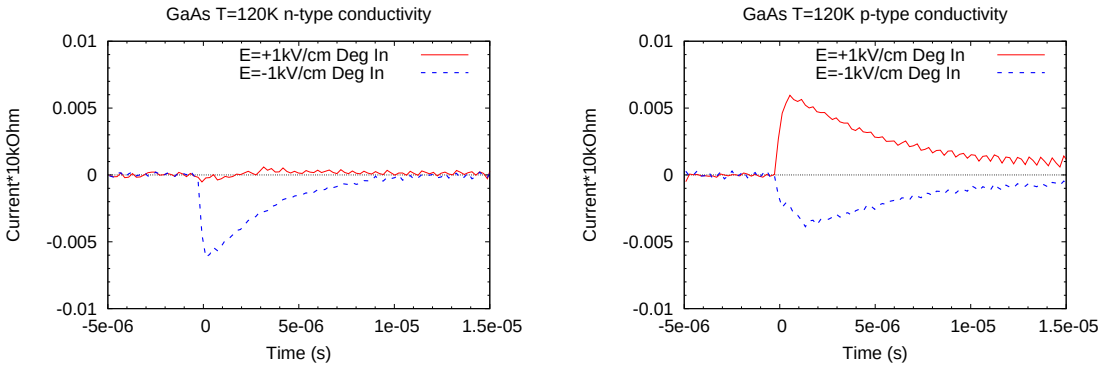

Fig. 1: Muon beam induced current in the virgin (left) and the metastable (right) states of GaAs. In the metastable state, conductivity is switched from n to p-type.

this case the path for electrons and holes to the appropriate electrode is different and, by choosing the polarity of applied electric field, one can distinguish between electrons and holes currents. From Fig. 1 it is clear that in the metastable state the conductivity is switched from n to p-type or the holes are responsible for the enhanced diamagnetic asymmetry.