Magnetoresistivity response of microwave excited 2D electron systems under different regimes.

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In the field of Condensed Matter Physics, very few problems have produced such an intense activity, experimental and theoretical, like Microwave Induced Resistivity Oscillations (MIRO) and Zero Resistance States (ZRS) in two dimensional electron systems (2DES). From the experimental standpoint, new and remarkable contributions are being published in a continuous basis. All these new experimental evidences establish new and real challenges for the theoretical models presented to date. Considering that all these models are not able to achieve consensus about the true origin of these striking phenomena, the new experimental results can be regarded as crucial tests for theories, for the existing ones, and for the new ones to come.

Among these new experimental results we can highlight three of them: the first one shows up when a 2DES is subjected to bichromatic MW radiation coming from two monochromatic sources with different frequencies. The unexpected result consists in a magnetoresistivity response which is clearly modulated in the oscillations amplitude[1]. In the second one, the authors[2] report on the observation of new MIRO's at the subharmonics of the cyclotron frequency and some distortion in the shape of the main oscillations. Finally the observation that MIRO and ZRS are notably immune to the polarization of MW radiation[3] is one of the most surprising results. In this experiment different MW polarizations were used, circular in both senses (left and right) and also linear in x (current direction) and y directions.

Here we provide an explanation to each of the three experimental evidences from above using a theoretical model developed by the authors as a common basis. In this model it was demonstrated that the origin of MIRO's and ZRS of a 2DES subjected to a perpendicular and low magnetic field and MW radiation, can be explained by the dynamics of the Larmor orbit centers which oscillate classically back and forth with the same frequency as the MW field. Good agreement between experiment and theory is achieved for the three cases. The first experimental result is explained in terms of superposition of both oscillations giving rise to a oscillatory movement in the orbits center whose amplitude is modulated in the way of pulses[5]. The second experiment is explained as a non-linear effect which shows up when the MW frequency reaches a small enough value. Because of this, large amplitudes are obtained for the Larmor orbit oscillations which become anharmonic[6]. Finally the polarization immunity can be explained through a damping mechanism: along with the Larmor orbit oscillations, interactions occur between electrons and lattice ions, yielding acoustic phonons and producing a damping effect in the electronic motion. The lattice damping is able to quench the influence of different MW polarizations equalizing their effects on the MIRO's[7].

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