

# Zero-resistance states induced by electromagnetic-wave excitation in GaAs/AlGaAs heterostructures

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## Abstract

We report the experimental detection of novel zero-resistance states [1], which are induced by electromagnetic wave excitation in ultra high mobility GaAs/AlGaAs heterostructure devices including a two-dimensional electron system. Radiation-induced vanishing-resistance states, which do not exhibit concomitant Hall resistance quantization, are demonstrated in the large filling factor, low magnetic field limit, at liquid helium temperatures. It is shown that the observed resistance minima follow the series  $B = [4/(4j+1)] B_f$  with  $j=1,2,\dots$ , where  $B_f = 2\pi f m^* / e$ ,  $m^*$  is the electron mass,  $e$  is electron charge, and  $f$  is the radiation frequency. These resistance-minima exhibit an activated resistance as a function of the temperature that leads into zero-resistance states, around  $B = 4/5 B_f$  and  $B = 4/9 B_f$ , at the lowest temperatures. The dependence of the effect is reported as a function of experimental parameters such as the electromagnetic wave frequency, incident power, temperature, and the current.

[1] R. G. Mani, J. H. Smet, K. von Klitzing, V. Narayanamurti, W. B. Johnson, and V. Umansky, Nature 420, 646 (2002).