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Magnetic Properties of Quantum Corrals

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One of the iconal experiments in nanotechnology has been the fabrication of a circular arrangement of 48 Fe atoms on a Cu(111) surface and the direct observation, by Scanning Tunneling Microscopy, of charge oscillations within the circle. Now, the remarkable developments in spin-polarized STM make the observing of spatial variations in the magnetic density a distinct possibility and therefore an attractive new area of research. We present 'first principles' calculations for electronic and magnetic properties of surface states confined by a circular quantum corral built of magnetic adatoms (Fe) on a Cu(111) surface. The calculations are performed fully relativistically using the embedding technique within the Korringa-Kohn-Rostoker method. We show the 'Friedel like' oscillations of charge and magnetization densities and the possibility of the appearance of spin-polarized states. In order to classify the peaks in the calculated density of states with orbital quantum numbers the problem is analyzed in terms of a simple quantum mechanical circular well model. This model is also used to an estimate the behavior of the magnetization and energy with respect to the radius of the circular corral.