

## Reentrant effect in a mesoscopic cylindrical structure of a superconductor coated with a normal metal layer

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The coherent phenomena in mesoscopic cylindrical normal metal (N)- superconductor(S) structures have been investigated theoretically. The magnetic moment (persistent current) of such a structure has been calculated numerically and (approximately) analytically. It is shown that the current in the N layer corresponding to the free-energy minimum is always diamagnetic. As the field increases, the magnetic moment (current) exhibits jumps at certain value of the trapped magnetic flux and the NS structure changes to a state with smaller absolute value of the diamagnetic moment. This occurs when the persistent current is unable to screen the external field. The magnetic moment increase stepwise and the system changes into a new stable state. The magnetic field penetrates into a larger volume of the N layer. The state has smaller absolute value of the diamagnetic moment <sup>1</sup>. Experimentally, this is interpreted as the presence of a paramagnetic addition in the system ( paramagnetic reentrant effect). The results obtained are in qualitative agreement with the experiments conducted by P.Visani,A.C.Mota and A.Pollini <sup>2</sup>

<sup>1</sup>G.A.Gogadze, et al., Phys. Rev. B. **80**, 054509 (2009).

<sup>2</sup>P.Visani, et al., Phys. Rev. Lett. **65**, 1514 (1990).