Pairing in inhomogeneous and mesoscopic systems: cold atoms, metallic clusters, nuclei.

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Different aspects of pairing in finite size quantum systems will be presented.

i) Cold atoms in harmonic traps. Gap as a function of radius and temperature is discussed. It will be shown that the Local Density Approximation is not valid when approaching the critical temperature.

ii) Superconducting metallic grains show an increase of the gap with decreasing size before superconductivity breaks down due to the Anderson criterium.

iii) In the outer crust of neutron stars there are still isolated superfluid nuclei. Going deeper into the crust, it happens that the nuclei spill out neutrons which form a gas of superfluid itinerant neutrons. It will be shown that close to the spill out (overflow) point the gap becomes strongly quenched.