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Quenching of Meissner Diamagnetism in Superconducting Nanocrystals HELENA MOREIRA, IRENE RESA, BENOIT MAHLER, BENOIT DUBERTRET, HERVE AUBIN, CNRS — We developed a new chemical synthesis for the preparation of high quality monodisperse superconducting Lead (Pb) nanocrystals. They are obtained from the alcohol reduction of Lead carboxylates in a hot organic solution and lead to colloids stabilized and protected from oxidation by organic ligands. Large quantities of nanocrystals with tunable diameter (8 to 30 nm) can be obtained. This new material allows the study of the effects of quantum confinement on superfluid response with unprecedented size resolution. Magnetic susceptibility measurements show that the large critical field of the particles increases from 2 to 5 T as the diameter is reduced down to 16 nm. This critical field results from the competition between the kinetic energy for Cooper pairs and superfluid condensation energy. Below the diameter of 16 nm, no Meissner effect remains in the particles, but only the signature of residual superconducting fluctuations. Remarkably the size scale below which the superfluid response disappears (16 nm) is significantly larger than the value expected from Anderson criterion. This implies that, in the regime of quantum confinement, there are distinct size-scales for the formation of Cooper pairs and the establishment of the superfluid response.

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