Magnetic nanoparticles: from fundamental physics to biomedical applications

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In the last decades magnetic nanoparticles (MNP) had a large impact in several fields, the interest of which extending from fundamental physics to technological applications, among which biomedecine is one of the most relevant.

In this widespread scenario we started a project aimed to design new biocompatible materials based on MNP combining the antitumoral therapeutic effect of magnetic fluid hyperthermia for the treatment of widespread diseases with enhanced relaxometric properties, in order to simultaneously track the path and the deposition of the carriers inside human body and tumor cells by magnetic resonance imaging (MRI). In this contribution we present the synthesis, the investigation of the static and dynamic magnetic properties and the hyperthermic and relaxometric efficacy of highly monodisperse ferrite particles with average size of few nanometers embedded in different chemical environments and coated by properly designed grafting molecules.

On the other hand we will present through a magnetic study on very small iron oxide MNPs grown in the cavity of the Dps proteins (DNA-binding protein from starved cells) from the bacterium *Listeria innocua*, experimental evidence for the existence of small size effects, like the quantum effects that are typical of molecular nanomagnets, MNM. These results help to develop a common approach for the two classes of systems as well as can provide important information on the role the ferroxidase centres in the iron uptake and storage mechanism.