LAMPS Laboratory in LNF

It is start up and operative the new LABoratory Magnetic high Pressure and Spectroscopy (LAMPS) of the Research Division of LNF. The laboratory is located inside the LNF in the Building ‘LEGNARO’, whose responsible is Dr. Daniele Di Gioacchino. This laboratory hosts the PRESS-MAG-O apparatus. Moreover now are active other cryostats: 1) one with a temperature control using a manual dip in liquid He bath of the resistive measurement insert, 2) second with a control of the temperature via a cold flux from liquid helium bath by means of a needle valve, in this second system are effective the electric transport insert and the ac magnetic multi-harmonic susceptibility insert, in this cryostat is present also a superconducting magnets up to 8 T. In figure are shown pictures of the LAMPS laboratory

Experimental activity

In addition to the commissioning of the PRESS-MAG-O instruments, in LAMPS laboratory are operative researches on LTc and HTc superconducting, magnetic materials and resistive devices. As example of various researches at the present (2011-2012) are under analysis the flux dynamic behavior of the new iron based high Tc superconductors with the comparison between NdFeAsO$_1$-0.14F$_{0.14}$ (T$_c$=49K) and FeSe$_{0.88}$ superconductors (T$_c$=7K), they have similar structures but only NdFeAsO$_1$-0.14F$_{0.14}$ has included a stack of layers along the c-axis direction, this system is composed by alternating FeAs and NdO layers which act like spacers, while the FeSe$_{0.88}$ is composed by only FeSe layers. We characterized the flux dynamics of these materials by performing ac multi-harmonic magnetic susceptibility measurements and show that the $|\chi_3|$ third harmonic component modulus of the magnetic susceptibility is larger for the NdFeAsO$_1$-0.14F$_{0.14}$ sample with respect to the FeSe$_{0.88}$. Moreover the FeSe$_{0.88}$ measurements show that this harmonic component is much more dependent by amplitude and frequency of the applied H$_{ac}$ field than in the NdFeAsO$_1$-0.14F$_{0.14}$ sample and in the FeSe$_{0.88}$ this component of the magnetic susceptibility is strongly reduced with the application of a H$_{dc}$ field. These analysis are shown in figure, it is evident that, the
NdFeAsO$_{1-0.14}$F$_{0.14}$ system could be characterized by a strong pinning strength even with a larger thermal fluctuations. Usually the pinning processes in the case of NdFeAsO$_{1-0.14}$F$_{0.14}$ are due to F doping and a similar pinning contributions in the FeSe$_{0.88}$ is correlated to Se vacancies. To explain the observation of the strong pinning in the NdFeAsO$_{1-0.14}$F$_{0.14}$ respect to FeSe$_{0.88}$ we hypothesize that in the REO plane a stack of layer along the c-axis direction, where are Nd magnetic moment ($\mu$~3.6 $\mu_B$) are present, strongly contributes to the pinning mechanism in addition to doping in NdFeAsO$_{1-0.14}$F$_{0.14}$ sample.

Moreover are active Research Doctorate and research thesis for undergraduate students.

**References (2010-2011)**

1. D. Di Gioacchino, A. Marcelli, P. Puri, A. Bianconi, "the a.c. susceptibility third harmonic component of NdO$_{1-0.14}$F$_{0.14}$FeAs" Journal of Physics and Chemistry of Solids 71 (2010) 1046–1052


8. Dr. Alessandro Puri PhD Materials Science Universita’ Sapienza Rome, ‘Experiments on strongly correlated materials under extreme conditions’, 2011/12