LAMPS Laboratory in LNF

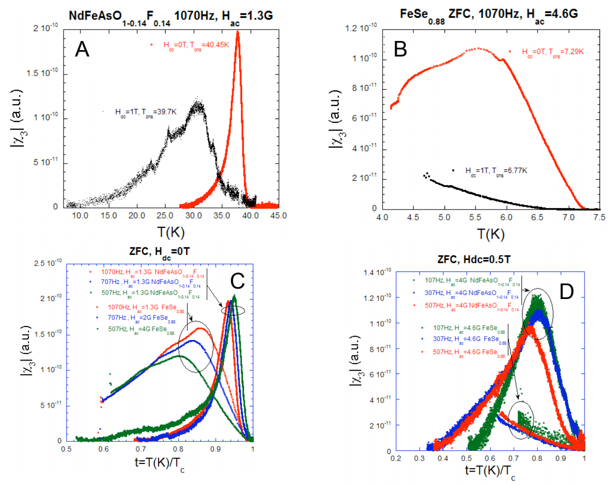
It is start up and operative the new ***LA**boratory **M**agnetic high **P**ressure and **S**pettroscopy* (**LAMPS**) of the Research Division of LNF. The laboratory is located inside the LNF in the Building 'LEGNARO', whose responsible is Dr. Daniele Di Gioacchino.
This laboratory hosts the PRESS-MAG-O 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

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 T_c superconductors with the comparison between $NdFeAsO_{1-0.14}F_{0.14}$ (T_c=49K) and $FeSe_{0.88}$ superconductors (T_c=7K), they have similar structures but only $NdFeAsO_{1-0.14}F_{0.14}$ 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 $NdFeAsO_{1-0.14}F_{0.14}$ 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 $NdFeAsO_{1-0.14}F_{0.14}$ 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 (μ~3.6 μ_B) are present, strongly contributes to the pinning mechanism in addition to doping in $NdFeAsO_{1-0.14}F_{0.14}$ sample.



Magnetic susceptibility third harmonic $|\chi_3|$ modulus of the $NdFeAsO_{1-0.14}F_{0.14}$ and $FeSe_{0.88}$ samples respect to DC magnetic field (A,B) and frequencies (C,D)

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

2. D. Di Gioacchino, A. Marcelli, M. Cestelli Guidi, M. Piccinini, A. Puri, P. Postorino, E. Pace, A. De Sio, L. Gambicorti, *Status of PRESS-MAG-O: the experimental apparatus to probe material and phenomena under extreme conditions*, Journal of Physics and Chemistry of Solids 71 (2010) 1042–1045

3. W. Xu, A. Marcelli, B. Joseph, A. Iadecola, D. Di Gioacchino, A. Bianconi, N.L. Saini, *Oxygen disorder and its effects on the local structure of REOFeAsO Experiments and multiple scattering calculations*, J. Phys.: Condens. Matter 22 (2010) 125701

4. W. Xu, B. Joseph, A. Iadecola, A. Marcelli, W. S. Chu, D. Di Gioacchino, A. Bianconi, Z. Y. Wu and N. L. Saini," *Arsenic K-edge XANES study of REFeAsO oxypnictides*" EPL, 90 (2010) 57001

5. D. Di Gioacchino, A. Marcelli, M. Cestelli Guidi, A. Puri, P. Postorino, E. Pace, A. De Sio and L. Gambicorti, PRESS-MAG-O: a unique instrument to probe materials and phenomena under extreme conditions at Frascati, High Pressure Research **31** (2011) 91–97

6. D. Di Gioacchino A. Marcelli, A. Puri, A. Iadecola, N.L. Saini, A. Bianconi "Influence of the extra layer on the transport properties of $NdFeAsO_{1-0.14}F_{0.14}$ and $FeSe_{0.88}$ superconductors from magneto dynamic analysis" J. Supercond. Nov. Magn. (2011) in press

7. A. Puri,, A. Marcelli, M. Cestelli Guidi, P. Postorino, E. Pace, A. De Sio, L. Gambicorti D. Di Gioacchino "PRESS-MAG-O: new advances in the instrument commissioning" Internal note LNF- 11/ 19 (NT) (2011)

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