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QUANTUM CRYSTALLOGRAPHIC APPROACH TO QUASICRYSTALS : COMPTON SCATTERING STUDIES

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Quasicrystals are a new form of solids that differs from crystalline and amorphous materials since they possess quasi-periodicity and non-crystallographic rotational orders. The presence of the pseudo-gap across the Fermi level is conceivably responsible for the stability of the unconventional structures. Two mechanisms have been proposed for the gap opening; one is due to the p-d hybridization and the other is the Fermi surface (FS) - quasi Brillouin zone (qBZ) interaction, both of which are accessible to Compton scattering spectroscopy. Here, we report recent experiments on Cd- and Al-based quasicrystals at BL08W, SPring-8. Analyses of experimental Compton profiles of CdYb and CdCa quasicrystals reveal the presence of Yb5d(Ca3d) - Cd5p bonding states induced by the p-d hybridization effect. They also show a good agreement in size between the FS and qBZ's. These results conclude that both the d-p hybridization and the FS-qBZ interaction contribute to the pseudogap opening in the Cd-based quasicrystals. From the Compton profiles of AlCuCo, AlCuRu, AlCuFe, AlPdMn, AlLiCu, and AlNiCo quasicrystals, the valence values of the 3d-transition elements are experimentally obtained. The results are much greater than the Raynor's values that are commonly employed for examining the FS - qBZ matching. This suggests the necessity to revise the FS - qBZ interaction scenario in Al-based quasicrystals.

Keywords: QUASICRYSTALS, COMPTON SCATTERING, HYBRIDIZATION

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SELF-INTERFERENCE EFFECT OF NUCLEAR FORWARD SCATTERING IN AN ANTIFERROMAGNET $^{57}FeBO_3$ SINGLE CRYSTAL WHICH IS EXCITED WITH MAGNETO ELASTIC VIBRATION OF 27.56 nHz

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The influence of magneto elastic vibration on coherent collective nuclear decay was investigated by measuring time spectra of nuclear forward scattering (NFS) from an antiferromagnet $^{57}FeBO_3$ single crystal which is excited with magneto-elastic vibration of 27.56 nHz. The acoustic wave was excited by an external rf magnetic field, which was synchronized with synchrotron radiation (SR) X-ray pulse exactly. In this case, the resonant atoms in the crystal were oscillated in comparable frequency of nuclear Larmor precession. As the result of self-interference effect of an X-ray photon, the measured time spectra of NFS revealed that Zeeman and dynamical beets were disappeared completely. In contradistinction, periodical magneto-elastic nuclear exciton echo signals appeared clearly, and its frequency was correlated closely with the coherent vibration of resonant atoms in the crystal. In this presentation, we report on the experimental set-up and obtained results.

Keywords: **MAGNETO ELASTIC WAVE SYNCHROTORON RADIATION NUCLEAR RESONANT SCATTERING**

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HIGH-RESOLUTION MONOCHROMATOR FOR NUCLEAR RESONANT SCATTERING BY ^{151}Eu AND ^{149}Sm

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The three bounce type high-resolution monochromator for the study of nuclear resonant scattering by ^{151}Eu and ^{149}Sm has been developed. Its resonant energies are 21.53 keV and 22.51 keV respectively. The (+, +, -) setting of asymmetric Si 440 reflection, asymmetric Si 12 12 8 reflection and asymmetric Ge 422 reflection was adopted for ^{151}Eu. And that of asymmetric Si440 reflection, asymmetric Si 8 8 16 reflection and asymmetric Ge 422 reflection was adopted for ^{149}Sm. Although the second reflection is different between in case of ^{151}Eu and in case of ^{149}Sm, the same Si crystal with (111) surface is used. So all the crystals and instrumentations are common in both settings. Its performance was measured at BL09, SPring-8. The X-rays through the Si 111 double crystal from the undulator source were incident on the high-resolution monochromator. The energy resolutions were measured by the nuclear forward scattering from $^{151}Eu_2O_3$ and $^{149}Sm_2O_3$. The measured energy resolution (FWHM) and flux were 1.8 meV and $1.7x10^9$ /sec for ^{151}Eu, and 1.5 meV and $1.4x10^9$/sec for ^{149}Sm. This newly developed monochromator will be used for the Mossbauer study and the nuclear inelastic scattering study at SR.

Keywords: **MONOCHROMATOR, NUCLEAR RESONANT SCATTERING, INELASTIC SCATTERING**

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X-RAY RESONANT MAGNETIC SCATTERING AT Fe 2p AND Ce 3d CORE LEVEL IN Ce(α)/Fe AND Ce(γ)H_2/Fe

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The X-ray resonant magnetic scattering is a technique corresponding to the XMCD in scattering condition. The element and shell selectivities allow us to probe the weak induced magnetism in spacer layers. Moreover, the q-dependence of XRMS allows the determination of the magnetic distribution throughout the layers. We applied that technique to investigate the magnetic properties of alpha-like and gamma-like Ce thin layers in multilayered systems. In [Ce/Fe] and [LaCeLa/Fe] multilayers, Ce is found α-like and the 5d magnetic profile is found oscillating with amplitude decreasing from the Fe interfaces. In [CeH_2/Fe], where hydrogen leads to a strain relaxation and to a 4f states relocalisation (γ-like), XRMS indicates a non-oscillating decreasing profile. The induced magnetism, which is mainly related to the 5d-3d hybridisation at the interface, is also depending on the role played by the 4f sates. Therefore, the 4f magnetism has been directly probed by soft X-ray resonant magnetic reflectivity at the Ce M4,5 edges. The information is recovered from the analysis of the energy dependent scattering, a magn-DANES like experiment, measured on top of several Bragg peaks for two opposite directions of an applied magnetic field.

Keywords: **XRMS MULTILAYERS**