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Collective ESR in strongly correlated heavy fermion metal CeB_6

S.V. Demishev[a], A.V. Semeno[a], A.V. Bogach[a] H. Ohta[b], S. Okubo[b], Yu.B. Paderno[c], N.Yu. Shitsevalova[c], T.V. Ishchenko[a], N.A.Samarin[a] and N.E. Sluchanko[a]

[a]*Low Temperatures and Cryogenic Engineering Department, A.M.Prokhorov General Physics Institute of Russian Academy of Sciences, Vavilov street, 38, 119991 Moscow, Russia*

[b]*Molecular Photoscience Research Center, Kobe University, 1-1 Rokkodai, Nada, Kobe 657-8501, Japan*

[c]*Department of Refractory Materials, Institute for Problems of Materials Science of Ukranian National Academy of Sciences, Krzhyzhanovsky street, 3, 03680 Kiev, Ukraine*

We report observation and detail study of a new magnetic resonance specific to the so-called antiferro-quadrupole (AFQ) phase of strongly correlated heavy fermion metal CeB_6. The current theoretical understanding of this low temperature magnetic phase implies orbital ordering effects. However, in contrast to manganites, where orbital ordering leads to simultaneous lattice distortion and change of magnetic structure and thus modify the magnetic resonance modes [1], it is supposed that for CeB_6 (i) the low temperature orbital ordering occur without change of the lattice constant and no magnetic order develops at the boundary between paramagnetic and orbitally ordered phases; and (ii) orbital ordering precedes formation of an antiferromagnetic phase at low temperatures (see [2,3] and references cited therein). It is found that in AFQ phase stable for $T < T_Q$ a new mode of the magnetic resonance, which is missing in paramagnetic phase at $T > T_Q$, develops. Cavity measurements in the frequency range $\omega/2\pi$=40-100 GHz and quantitative analysis of the line shape together with the static magnetization data allowed concluding that the observed mode is (i) EPR-like, (ii) has a collective nature and (iii) caused by a special contribution to magnetization appearing in the orbitally ordered phase at $T < T_Q$. The quasi-optical reflection measurements for the range $\omega/2\pi$=100-360 GHz shows that the g-factor for this resonance increases with frequency from $g(\omega/2\pi = 44GHz) \sim 1.55$ to $g(\omega/2\pi > 250GHz) \sim 1.7$. In addition to the orbital ordering resonance for the frequencies exceeding 200 GHz a new magnetic resonance with the g-factor 1.2-1.3 is detected. We have also carried out anisotropy measurements of the g-factor. The obtained data are discussed using two models. The first one assumes the appearance at AFQ phase boundary of a free dipole magnetic moments with magnitude $\sim 0.8\mu_B$, which are missing in the paramagnetic phase [4]. The second model is based on the idea of ordering of complex orbitals, for which ground state is described by magnetic octupole [5]. Support from the programme of RAS

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