1) The amplitudes of signal extrema exhibit a strong temperature dependence in both ReM_2 and ImM_2 and ImM_2 with maximum at $T \approx T_N$ (critical enhancement) and with signal shape being unchangable.
2) The positions of signal extrema in static field H and ratio of ReM_2/ImM_2 in extrema are independent on temperature near T_N.

The signals were well reproducel in all the experiments.

In crystals with $T_{ps} \geq T_N$ the oxygen-poor regions ($x \approx 0.01$) are respondible for the critical NLR since only this phase exhibits magnetic ordering. As it was shown in [4,5] the NLR of this crystals can be due to formation of the 3D domains, which possess a weak ferromagnetism, at the PS. It means an appearence of new magnetic properties in the course of PS. A typical domain is assumed to be a 3D stoichiometric fragment of La_2CuO_{4+x} in which rare inclusions of O-rich planar regions are alternated along out-of-plane direction. The simplest model of such a fragmentation is system of the periodically arranged elementary domains containing N "pure" CuO_2-planes and one O-rich plane. Due to the inequivalence of the O-rich and "pure" planes, the sum (L) of antiferromagnetism vectors of the planes that belongs to the elementary domain becomes a critical quantity. The Dzyaloshinskii-Moriya interaction connects the in-plane fluctuations of L and the out-of-plane ones of a magnetization M that leads to a nonlinear, critical, anisotropic dependence of M on H and to critical anisotropic NLR.

The estimation of domain sizes was obtained: about 4.5×10^3 A in CuO_2-plane and *not* less than 260 A in orthogonal direction.

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MEAN-SQUARE DISPLACEMENTS AND CHARACTERISTIC FREQUENCIES OF THE THERMAL VIBRATIONS OF RARE-EARTH IONS IN THE HEXABORIDES REB_6(RE=La→Sm)

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The rare-earth (RE) hexaborides exhibit a large variety of unusual physical properties. Depending on the rare-earth element, these borides can be described as Kondo systems (CeB_6), exhibit valence fluctuations (SmB_6), or can be metallic (PrB_6, NdB_6), or superconductors (LaB_6).

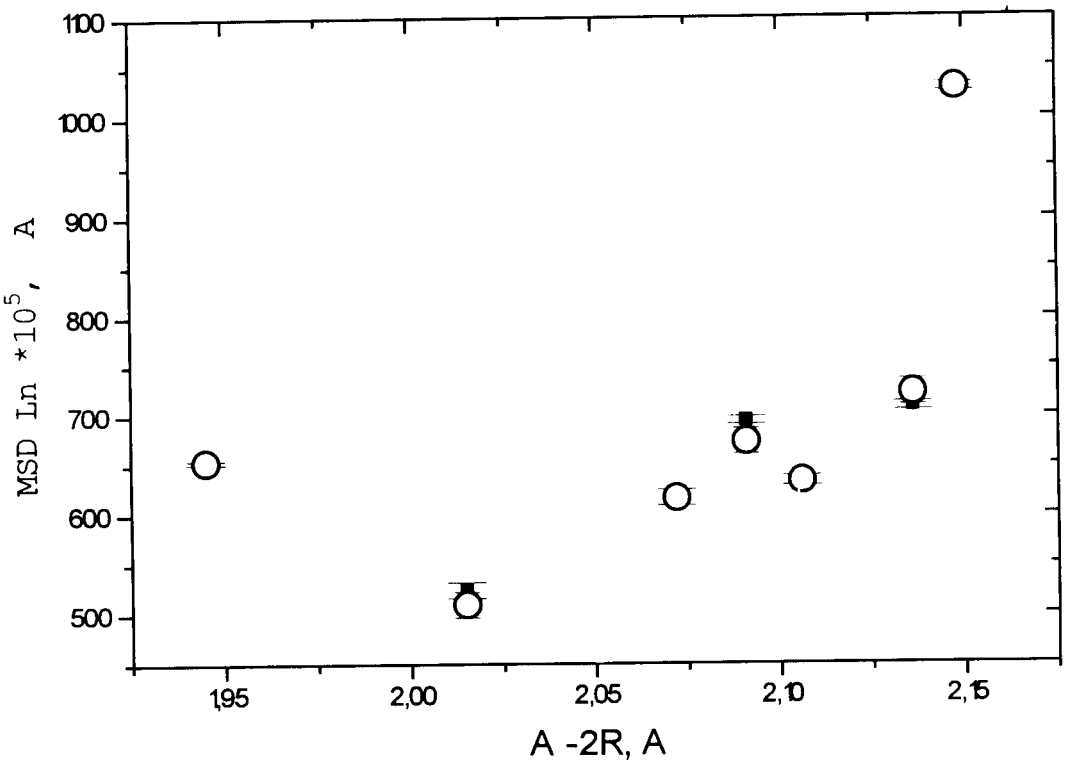

Fig. Mean-square displacement of rare-earth metal atoms as a function of the difference between lattice constant and sum of ion radii ($\Delta = A - 2r^{3+}_{\mathrm{REM}}$)

This variety of properties in isostructural borides makes them attractive subjects for detailed structural studies especially with respect to dynamical parameters of atomic thermal vibration.

In present work the results that have been published (LaB_6 and CeB_6 – [9,10], SmB_6 – [8]), and new results of X-ray single crystal (PrB_6 and NdB_6) and neutron powder (NdB_6) diffraction studies are used.

Neutron diffraction measurements were performed on the high-resolution powder diffractometer "MINI-SFINKS" using the reverse Fourier time-of-flight method.

An interesting tendency of the REM mean-square displacements to increase with decreasing lattice constants was found previously in the hexaborides of La, Ce, Sm [3]. Our results confirm this tendency for the whole series La, Ce, Pr, Nd, Sm. It is interesting to note that this dependence correlates with the increase of the difference between lattice constant and ion radii sum ($\Delta = A - 2r^{3+}_{\mathrm{REM}}$) in this series and the MSD of rare-earth ions increases linearly with Δ (Fig.). Thus there is an enlargement of vibrational amplitude of metal atoms with decreasing lattice constant but with increasing "interionic" distance Δ.

The characteristic Einstein frequency of thermal vibrations has been calculated using atomic MSD. These data strongly suggest the general character of the obseved softening and show close agreement with the data from inelastic neutron scattering [4–5].

The above results seem to be quite promising in that they demonstrate that powder diffraction data can be used to study dynamical properties of hexaborides. Based on the data

obtained, the occurrence of flat accoustic modes with decreasing frequency in the phonon spectra of CeB_6, PrB_6 and NdB_6 and a decrease of the metal-boron force constant can be predicted. As a main reason for this weakening of metal-boron interactions the low compressibility of the boron framework with decreasing RE ionic size in the 3^+ valence series is proposed. Additive softening of the Einstein frequence was found for SmB_6. More sophisticated theoretical models should be elaborated to account for the observed general trend.

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SPREADING OF SDTD TO CASE OF LOW-DISLOCATION CRYSTALS

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In the last years the main direction in development of the theory of X-ray diffraction is connected to a fundamental problem of the description of diffraction processes in single crystals in the most general case, when the crystal structure of a single crystals not given beforehand, and can be considered in all real variety with every possible deviations from an ideal structure. First of all the successes of the theory are connected with creation of the bases of the statistical dynamical theory of a diffraction (SDTD). The present work is one of the first teleological experimental work in a given direction. In addition to recent gamma-ray [1] and X-ray diffractometry [2] experimental tests of SDTD results on high-perfect single crystal silicon by measurement of period of dynamical oscillations of intensity and values of integrated intensity as functions of thickness of a crystal or function of wavelength of incident radiation, that can be used in case of enough perfect crystals only, we have carried out experiments on a diffraction of high-monochromatic short-wavelength gamma-radiation ($E = 412$ keV, $\lambda = 0.03$ Å, $\leq \Delta\lambda/\lambda 10^{-6}$), on quartz single crystals with dislocation density ≤ 300 cm^{-2} in experimental conditions of complex, from the standpoint of results interpretation, intermediate case, when the dislocations because of their small concentration