The Ce-doped lithium lanthanide borates present a class of new scintillation materials for low-energy neutron detection. The primary investigation of the luminescent properties of LGO:Ce materials in form of fibers were presented in [1]. LYBO:Ce is more suitable for the thermal neutron detection because of the absence of (n,γ) neutron-capture reactions on 155Gd and 157Gd isotopes. As it is known the difference of kinetic decay after excitation with α-particles and γ-rays underlies of the separation of registered signals from neutron flux and accompanying γ-background.

LGO:Ce and LYBO:Ce fibers with 1% Ce concentration were produced using micro pulling down method at Université Lyon 1 (France) at argon atmosphere. X-ray luminescence spectra (LS) (2.5 – 5 eV), luminescence excitation spectra (LES) (45-250 eV) and luminescence kinetics at T=10 K and 300 K were measured on BW3 channel of DORIS synchrotron (HASYLAB, DESY, Hamburg). The luminescence was excited using Zeiss SX700 monochromator (average spectral resolution is 0.04 eV for energy range of 45-250 eV). The LES were corrected for the equal number of the exciting photons. LS at 2.5-5 eV was registered by means of 0.4 m vacuum Seya-Namioka monochromator coupled to MCP 1645 (Hamamatsu). Absolute light yield (ALY) after excitation with 239Pu (α-particles source) or 137Cs (γ-rays source) radionuclides was measured using standard method based on one-electron photomultiplier PMT-130, spectrometric amplifier and multichannel spectrometer.

After primary estimation of scintillation efficiency we concluded that absolute light yield of LYBO:Ce fibers after both α – and γ – excitation is higher than the ones of LGO:Ce fibers: ALYLYBO:Ce, α-excitation = 4.9 photon/keV, ALYLYBO:Ce, γ-excitation = 4.2 photon/keV, ALYLGO:Ce, α-excitation = 19.0 photon/keV ALYLGO:Ce, γ-excitation = 13.6 photon/keV.

In LES of both fibers we observed the manifestations of gadolinium. The typical structure at N-edge of absorption of gadolinium ions (energy range of 140-175 eV) is well-outlined in both spectra in Fig.1. This fact testifies that amount of gadolinium is enough to provide substitution of matrix yttrium atoms of LGO:Ce fibers by gadolinium ones. Simultaneously, the manifestations of Gd-luminescence one could see in LS of LGO:Ce in the region near 3.9 eV (Fig.3). In earlier work [1] we concluded that absence (or small intensity) of gadolinium emission can be related to optimal structure of fiber provided efficient energy transfer on Gd-Ce channel. The LES and LS confirm that in the case of LYBO:Ce investigated samples are not pure LYBO fibers, but L(Y, Gd)BO ones. The decay time of cerium emission for L(Y, Gd)BO is shorter in compare with LGBO samples that in the case of LYBO:Ce investigated samples are not pure LYBO fibers, but L(Y, Gd)BO ones.

Usually the excitation near the core levels of crystalline lattice elements leads to shortening of decay times due to increasing of excitation density and decreasing of fiber layer where interaction with ionizing radiation occurs. Moreover, the processes of energy transfer take place in surface layer with great defect’s concentrations. Usually, obtained decay kinetics demonstrates more short components in such situation. But, for L(Y, Gd)BO-fibers we observed the opposite dynamics of “decay time – excitation energy”: the decay kinetics increases under excitation near gadolinium and boron absorption edges (Fig.3), in contrary to typical picture in LGO fibers (Fig.4).
So, we can conclude that paths of energy transfer and the mutual allocation of the capture and emitting centres differ in researched fibers. Taking into account both the measured values of absolute light yield and profiles of kinetic decay it should be accepted that L(Y,Gd)BO fibers is really more suitable for scintillation technique.

Acknowledgements: This work was partially supported by NATO (grant CPB.EAP CLG 983489).

References