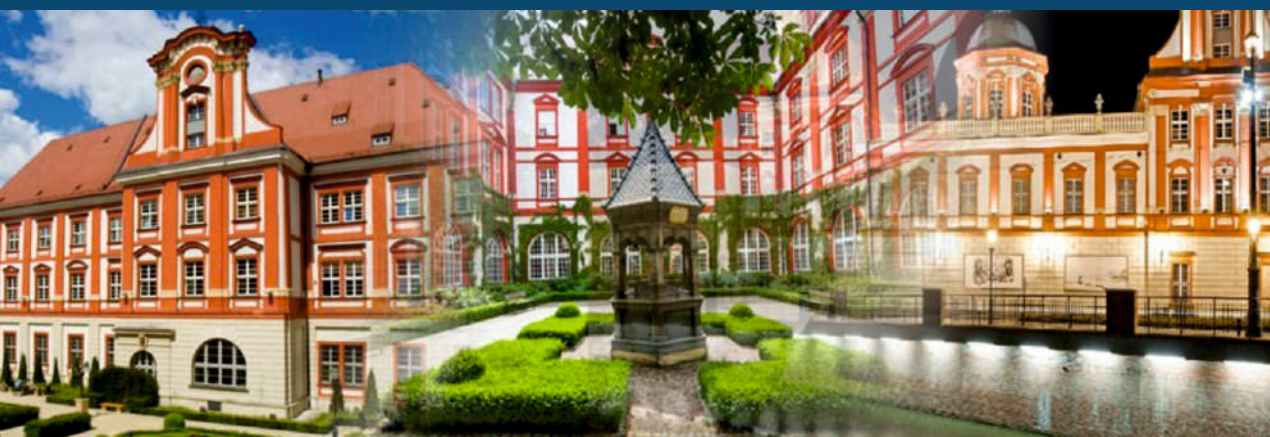




8th International Symposium
on Optical Materials
June 9-14, 2019

Book of Abstracts



Ossoliński National Institute,
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Conference Venue

Ossoliński National Institute in Wrocław (Poland)

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High-resolution spectroscopy of LiYF₄-Ho in magnetic fields

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Lithium-yttrium double fluorites doped with rare-earth (RE) ions are multifunctional optical materials widely used in different branches of photonics. It should be mentioned that LiYF₄:RE³⁺ crystals, for reasons not fully understood, demonstrate the narrowest inhomogeneously broadened lines. That is why they are also excellent model systems for studying various interactions and very fine effects. In particular, manifestations of the electron-nuclear hyperfine interactions and of the isotopic disorder in the lithium sublattice due to the presence of ⁷Li and ⁶Li isotopes (their natural abundances are 93% and 7%, respectively) were studied by high-resolution spectroscopy of LiYF₄:Ho³⁺ singlecrystals.

In the present study, we have investigated broad-band high-resolution low-temperature optical spectra of LiYF₄:Ho³⁺ in magnetic fields [1,2]. Absorption spectra in an external field 0.5 – 0.9 T parallel to the tetragonal crystallographic axis reveal strong mixing of wave functions of neighboring crystal-field levels, mediated by Zeeman and hyperfine terms in the Hamiltonian of a Ho³⁺ ion[1].

An effect of the hyperfine levels' anticrossing was observed in magnetic fields 20 – 180 mT. As far as we know, it was the first direct observation of the hyperfine level anticrossings in optical spectra. Analysis of the spectral envelopes corresponding to transitions between the electron-nuclear sublevels of crystal-field non-Kramers doublets and singlets of the Ho³⁺ ions, based on the microscopic model of the electronic 4f¹⁰ configuration, allowed us to retrieve information on the hyperfine structure of electronic singlets, nuclear quadrupole interactions, and random lattice strains[2].

Recently, we have observed the hyperfine structure and the hyperfine level anticrossings in the luminescence spectra of LiYF₄:Ho³⁺. This finding opens the way for studying the hyperfine effects in the transitions between the excited crystal-field levels.

K.N.B. and M.N.P. acknowledge a support by the Presidium of RAS under the Program No 5 "Photonic technologies in probing inhomogeneous media and biological objects".

References:

- [1] Popova, M. N.; Boldyrev, K. N., High-resolution spectra of LiYF₄:Ho³⁺ in a magnetic field, *Optical Materials* 63, **2017**,101-104.
- [2] Boldyrev, K. N.; Popova, M. N.; Malkin, B. Z.; Abishev, N. M., Direct Observation of Hyperfine Level Anticrossings in Optical Spectra of a ⁷LiYF₄:Ho³⁺ Single Crystal, *Phys. Rev. B* 99, **2019**,041105(R).