



# PEDAGOGICAL SCIENCES AND TEACHING METHODS INTERNATIONAL CONFERENCE

**2021**  
**JUNE 13**

ISBN978-955-3605-86-4

**PEDAGOGICAL SCIENCES AND TEACHING METHODS**: a collection scientific works of the International scientific conference (12-13 June, 2021) - Copenhagen: "Science Edition", 2021. Part 1 - 215 p.

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The compilation consists of scientific researches of scientists, post-graduate students and students who participated International Scientific Conference "PEDAGOGICAL SCIENCES AND TEACHING METHODS". Which took place in COPENHAGEN on 12-13 June, 2021.

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# PEDAGOGICAL SCIENCES AND TEACHING METHODS

ISSUE1 (1) Part 1  
June 2021

Collection of Scientific Works

Copenhagen "Science Edition" 12-13 June 2021



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### SECTION MEDICAL SCIENCE

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## NODIR YER GRANATLARINING MAGNIT XOSSALARI.

Terbiy nodir yer ionli ortaluminatning magnit xossalarini 420 – 750nm to'liqin uzunliklari intervalida, 90 - 300K temperatura oralig'ida harorat va spektral bog'liqliklari batafsil tadqiqot qilingan.  $TbAlO_3$  kristallning [110] o'qi bo'ylab o'lchangan Verde doimiysining haroratga proporsionalligi, tajribaning berilgan geometriyasida Faradey aylanishida (tashqi H maydonda)  $Tb^{3+}$  - NY-ion elektron holatlarining Van-flek "qo'shilishlari" mexanizmining hissasi o'rganilgan.

**Kalit so'zlar:** Zeeman effekti, kristall maydon, Shtark effekti, kramers singletlari, granat struktura, ortoalyuminat, kvazidublet, kvaziizing.

Nodir yer (NE) granatlari-gallatlari va alyuminatlarining magnit xossalarini asosiy holatidagi Rassel-Saunders bog'lanishiga bo'ysinadigan NE-ionlarning tugallanmagan  $4f$  -qobig'i belgilaydi. Shu bilan birga  $4f$  - elektronlarning to'liqin funkstiyalari yaxshi lokallashtirilgan, ya'ni  $4f$  - qobiqlarning radiuslarini panjara doimiysiga nisbatan ancha kichik deb hisoblash mumkin, bu esa kristallardagi NE-ionlarni magnit ma'nosida erkin va o'zaro bir-biri bilan ta'sirlashmaydigan deb hisoblashga imkon beradi ( $R^{3+} - R^{3+}$  magnitodipol o'zaro ta'surot faqatgina  $T \sim 1K$  temperaturada ahamiyatga ega bo'ladi). Shuning uchun, NE-granatlar – gallatlar va alyuminatlar temperaturaning keng sohalari parametrik hisoblanadi va faqat  $\sim 2K$  dan past temperaturalarda antiferromagnit holatda bo'ladi. Lekin oxirgi vaqtlarda NE-birikmalar (granatlar ortoalyuminatlar va boshqalar) magnetizmida quyidagi asosiy faktdan aktiv foydalaniladilar. NE-grnatlarning magnit qabul qiluvchanligi  $\chi$  (asosan T ning past sohalari) ning temperaturaga bog'liqligini (o'zini tutishini) aniq ifodalash uchun  $D_2$  simmetriyaga ega bo'lgan past (kam) simmetrik kristall maydonning NE-ionlar energetik spektriga ta'sirini hisobga olish zarur. Bu holat past temperaturalarda hisobga olinsa past simmetriyali ( $D_2, C_s$  va h.k.z. simmetriyani) o'zini notrevial tutadi. Birinchidan, NE-granat magnit qabul qiluvchanligi anizotropiyasiga, ikkinchidan, NE-ionlar ( $Dy^{3+}, Er^{3+}$

) qatori asosiy dubletining  $g$  - faktori kuchli darajada anizotrop bo'lib – uning yagona  $g$  -parallel komponentasi noldan farqli bo'ladi va ion faqat bir yo'nalishda magnitlanadi.

Past simmetriyasi KM effekti va ancha katta bo'lgan kristallografik anizotrop magnit energiyasi – kristall panjara bilan magnit momentining o'zaro ta'sir energiyasi  $R^{3+}$  NE-ion magnit momentlarini «izing» magnetikka aylantirib, granat kristalida aniq bir yo'nalish bo'yicha joylashtiradi. Kramers NE-ionlari holida, atrof simmetriyasi va KM ning aniq parametrlari, NE-ion o'zini «izing» magnitdek tutishda katta rol o'ynaydi. Kramers dubletining aniq to'liq funkstiyalaridagina  $g$  - tenzor anizotrop bo'ladi.

Bundan tashqari KM NE-ioni qabul qiluvchanligining ancha katta anizotropiyasiga olib keladi va buning natijasida tajriba ma'lumotlari mos keladi. Turli kristallografik yo'nalishlar bo'yicha  $\chi(T)$  temperatura bog'lanishining sifat jihatdan farqli xarakterini aniqlaydi. Ishga asosan  $H_{kr} = \alpha_2 B_2^0 O_2^0$  ko'rinishdagi sodda gamiltonian bilan bir o'qli KM da kramers NE-ionining NE-ionining asosiy dublet holatini qarab chiqish mumkin. Ancha yuqori T da qabul qiluvchanlik izotrop bo'lishini ko'rsatish mumkin:

$$\chi_{//}^0 = \chi_{zz}^0 = \frac{2g_{j_0}^2 \cdot \mu_B^2 \cdot N}{3kT} \quad (1.2)$$

Bunda  $g_{j_0}$  - NE-ion asosiy multiplati Lande faktori. Shu vaqtning o'zida, temperatura pasayishi bilan  $z$  o'qi bo'yicha qabul qiluvchanlik  $\frac{1}{T}$  ko'rinishda o'sib boradi va  $kT \gg \Delta_1$  ( $\Delta_1$  -kramers ioni asosiy va birinchi qo'zg'olgan holatlari orasidagi masofa) shart bajarilganda ikki sathli sistemaning  $\chi$  qabul qiluvchanligi ga mos keladi:

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