Research interests:
Two-frequency magnetoresonance spectroscopy in the millimeter range:

- dynamic nuclear polarization mechanisms;
- spin dynamic in the substances with strong electron-nuclear interactions**.**

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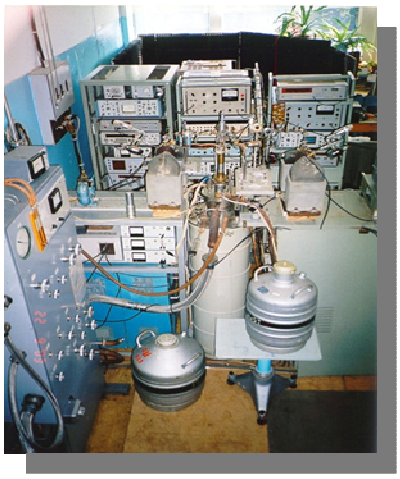
Experimental equipment:

Two-frequency spectrometer-relaxometer



Spectrometer-relaxometer

Magnetic field:	0 – 65 kE
SCS homogeneity:	10^{-4}
ESR frequency:	120 – 150 GHz
EHF source power:	1 W
ESR frequency stability:	$5 \cdot 10^{-6}$
Intermediate frequency:	500 MHz
Magnetic field modulation frequency:	1- 100 kHz
NMR frequency:	180-220 MHz
Temperature range:	1.7–300 K

Spectroscopic studies of different substances in a wide temperature range (4.2-300K) and magnetic fields (0 – 65kE) are carried out on a two-frequency spectrometer relaxometer by the ESR, NMR (f=180-220MHz) and DNP methods. The short-focus semisymmetrical open resonator with a set of special cuvettes for the samples under test is used as a resonance cell of the dual-frequency spectrometer-relaxometer. Here, the inductive coil of the NMR contour as a double diffraction lattice made of a silver wire is located directly in the dielectric cuvette.

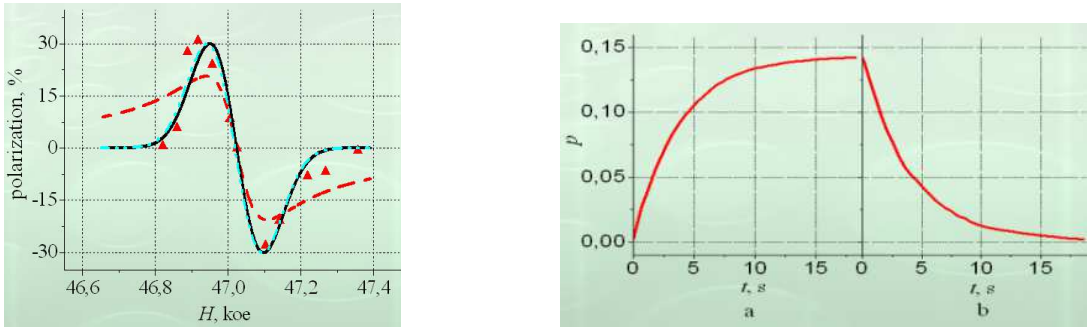
a b c

Electrodynamic module of the two-frequency spectrometer (a), the cuvette elements for the samples (b), elements of the resonance cell.

Research results

The performed spectroscopic studies of the complex solution *EHBACr*^{V} *i*n propanediol and deuterated propanediol under conditions of real working of the targets have made possible to establish the dominant mechanism of the DNP for this polarized nuclear target as the dynamic cooling with the "burnt hole", and to determine the optimum conditions to reach the maximum nuclear polarization. Furthermore, the parameters of the electron spin subsystem in terms of its

saturation has been determined at which a spin bistability appears resulting in a decrease of the maximum achievable nuclear polarization level.



a b

Nuclear polarization for the complex solution $EHBACr^{V}$ in the propandiol: points - the experiment, dotted line (red) - the dynamic cooling mechanism, solid line (black) - the dynamic cooling with the "burnt hole" mechanism (a) and the typical curves of transition processes at $T = 4.2K$: a - the nuclear polarization building; b - the free nuclear relaxation.

A detailed summary of the results is presented in publications:

1. I.V. Ivanchenko, S.Yu. Karelin, N.A. Popenko. Nonlinear spin subsystems interactions in the chromium (V) complexes under microwave pumping conditions. "*Telecommunication and Radio Engineering*", 1999, No.9-10, pp.69-78.
2. I.V. Ivanchenko, S.Yu. Karelin, N.A. Popenko. Dynamic processes into the substances of polarized nuclear targets. **"***Radiophysics and Electronics", Kharkov(Ukraine): Institute of Radiophysics and Electronics*, 2000, pp. 96-102.
3. A. Belyaev, N. Vorob'eva, A. Dzubak, I. Ivanchenko, S. Karelin, I. Karnauhov, A. Lukhanin, V. Orlov, N. Popenko. Magnetic resonance of Cr(V) complexes with 2-hydroxy – 2-ethyl-oil acid. "*J. of Applied Spectroscopy*", vol.68, No.4, pp.477-481, 2001.