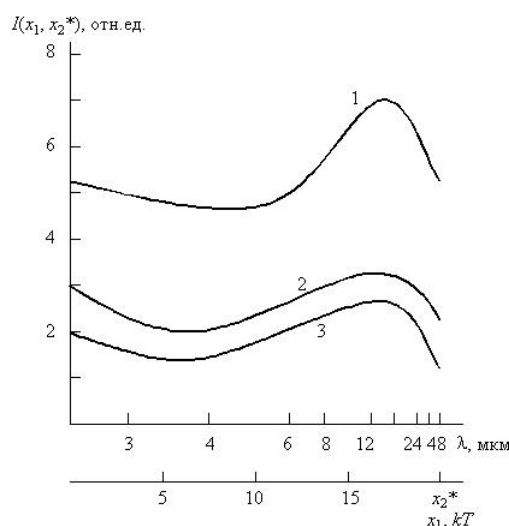


Laser Photo-Ionization (Dissociation) of Molecules in the Isotopes Separation and Relativistic Calculating the Hyperfine Structure Parameters in Heavy-Element Chemistry and Spectroscopy

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Relativistic calculation of spectra and hyperfine structure (hfs) parameters for heavy elements (^{133}Cs , ^{201}Hg , ^{223}Ra , ^{252}Cf) is carried out. Calculation scheme is based on the relativistic perturbation theory [1]. The contribution due to inter electron correlations to hfs constants is about 120-1200 MHz for different states, contribution due to the finite size of a nucleus and radiative contribution is till 2 dozens MHz. Obtained data for hfs parameters are used in further in laser photo-ionization (dissociation) detecting the isotopes. We propose the new optimal schemes of laser photo-ionization method in the isotopes and nuclear reactions products detecting. As example, it's studied the reaction of spontaneous ^{252}Cf isotope fission on non-symmetric fragments, one of that is Cs. Resonant excitation of Cs is realized by the dye laser pulse, the spectrum of which includes the wavelengths of two transitions $6^2\text{S}_{1/2}-7^2\text{P}_{3/2}$ (4555Å) and $6^2\text{S}_{1/2}-7^2\text{P}_{1/2}$ (4593Å). The corresponding optimal parameters of laser and electric fields, quantum transitions etc are given. We present a new multi-level optimized model for definition of the optimal real form of laser pulse to reach maximal effectiveness of laser action in process of laser ionization (dissociation) of molecules too. Model is based on differential equation of the Focker-Plank type for density of molecules with the vibration energy x on some vibration level and operators, describing RT relaxation and laser filed [2]. The conditions and parameters for optimal excitation for molecules of HCl (PH_3 , CF_3Br , SiH_4) are given. In fig. we give a dependence (of number of particles) of functional: $I(u) = \text{Int} f(x_1, t_1; x_2, t_2) h(x) dx$ in the interval $x_1 \sim \{15, 21\}$ on x_1 and laser wavelength, corresponding to rotational transition x_1-x_2 ($T = 300 \text{ K}$). Here $h(x)$ is the function, corresponding to required form of the final distribution $f(x, t, u)$, i.e. density of molecules with vibration energy x at moment $t \sim [0, R]$.



- [1] A.Glushkov, O.Khetselius et al., Nucl. Ph. A 734 (2004) 21-28; J. Phys. CS 35 (2006) 425-430.
 [2] O. Khetselius, Photoelectronics 15 (2006) 101-108; Mol. Phys., Europ. Phys. J. (2008).