necessary to have $\Delta E_f \approx \Delta E_a \geq kT$, i.e., it is necessary to increase the quantum energy and to choose materials with small effective mass. In CdS ($m \approx 0.2m_0$), when working with an argon laser ($\hbar\omega = 2.4$ eV) we have $\Delta E_a \approx 3.5 \times 10^{-4}$ eV. In GaAs ($m = 0.065m_0$), when working with a laser of the same material ($\hbar\omega \approx 1.4$ eV) we have $\Delta E_a \approx 4 \times 10^{-4}$ eV. As to the forbidden bands, $\Delta E_f > kT$ already when $\Delta n_0/n_0 \approx 10$. Thus, this effect can be registered at liquid-helium temperature.

In conclusion, the author thanks S. M. Ryvkin for interest in the work and N. I. Kramer and I. M. Fishman for useful discussions.

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VIOLATION OF P-PARITY IN INELASTIC SCATTERING REACTIONS WITH PHOTON EMISSION

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The existence of a weak interaction between nucleon causes the nuclear states to be no longer characterized by a definite parity. This results in a number of experimentally-observed effects such as the angular asymmetry of the photons emitted by polarized excited nuclei [1] and circular polarization of the photons emitted by unpolarized nuclei [2]. The weak interaction between nucleons is of the order of $G\mu^2 \approx 3 \times 10^{-7}$ ($G = 10^{-5}/m^2$ is the weak interaction constant, and μ and m are the pion and nucleon masses) relative to the strong interaction. As a result of a number of phenomena [3], the effects of weak nucleon interaction can be appreciably enhanced and reach a value on the order of 10^{-4}. One of the enhancement effects is dynamic enhancement, wherein [3] the amplitude a_{0n} of the admixture of the state n, with a parity opposite to that of the "principal" state 0 with a given spin and parity, can be greatly increased as a result of the proximity of these states, since $a_{0n} \sim (E_0 - E_n)^{-1}$. This effect may turn out to be significant at high excitation energies, where the level density is large and levels with the same spin values but with different parities may turn out to be very close to each other.

We consider in this paper circular polarization of photons from excited nuclei produced by inelastic particle scatterg.

Appreciable enhancement effects can be expected when the P-parity violation is connected with resonant scattering accompanied by formation of states of mixed parity. The enhancement effects may cause the weak nucleon interaction to reach a value on the order of 10^{-4}.

Let us spin of the incoming particle be j_1, the spin of the nucleus in the initial state j_2, the spin of the excited state j_3, the angular momentum of the emitted photon j_γ, and the spin of the nucleus produced after photon emission j_4. We expand the scattering amplitude in partial waves with definite total spin j, total orbital angular momentum L, and total angular momentum J:

$$< n' m_1' m_3 | S | n, m_1, m_2 > = \Sigma C^{jm}_{j_1 m_1; j_2 m_2} \; C^{JM}_{L\mu; jm} \times$$

$$\times C^{j'm'}_{j_1m'_1;\, j_3m_3}\; C^{JM}_{L'\mu';\, j'm'}\; Y^{*}_{L\mu}(\mathbf{n})\; Y_{L'\mu'}(\mathbf{n}') < L'j' \| S^{J} \| Lj >, \tag{1}$$

where $\vec{n}$ and $\vec{n}'$ are unit vectors in the directions of the incident and scattered particle momenta. The density matrix $\rho_{m_3m'_3}$ constructed with the aid of the amplitudes (1) determines the polarization momenta of the nucleus with spin j_3:

$$\mathcal{P}_{L_1\mu_1} = i^{L_1}\{(2L_1+1)(2j_3+1)\}^{1/2} \sum_{m_3m'_3} (-1)^{j_3-m'_3} \begin{pmatrix} j_3 L_1 j_3 \\ -m'_3\, \mu_1 m_3 \end{pmatrix} \rho_{m_3m'_3}. \tag{2}$$

Let us examine resonant scattering with P-parity violation. In this case the partial amplitude $<L'j' \| S^J \| Lj>$ has a pole corresponding to the angular momentum J of the resonant state, and only the term corresponding to this momentum value will be significant in the expansion (1). The unitarity condition together with the T-invariance requirement leads to the following expression for the partial scattering amplitudes:

$$< L'j' \| S^{J} \| Lj > = (2ik_a)^{-1}(\exp 2i\delta_{\bar{a}} - 1)\,\delta_{\bar{a}\bar{b}} - \\ - (2\sqrt{k_a k_b})^{-1} \exp i(\delta_{\bar{a}} + \delta_{\bar{b}})(\Gamma_{\bar{a}}\Gamma_{\bar{b}})^{1/2}\left(E - E_0 + \frac{i\Gamma}{2}\right)^{-1}, \tag{3}$$

where $\bar{a} = \{aLj\}$, $\bar{b} = \{bL'j'\}$, a and b are the indices of the reaction channels, $\Gamma = \sum_a \Gamma_a = \sum_{aLj} \Gamma_{aLj}$ is the total width of production of the resonance with angular momentum J, and $\delta_a = \delta_{aLj}$ is the phase of the elastic scattering in channel a with orbital angular momentum L and total spin j. The quantities Γ_b and δ_b are similarly defined.

Using formulas (1) - (3) we obtain, after summing the Clebsch-Gordan coefficients, the following expression for the degree of circular polarization of the photons emitted by excited nuclei with spin j_3:

$$\mathcal{P} = (W_+ - W_-)(W_+ + W_-)^{-1} = \beta(-1)^{j_1+2j_3+j_4}(2j_\gamma+1)(2j_3+1) \times \\ \times (4\pi)^{-1/2} \sum (-1)^{j+j'+\bar{j}'} (2J+1)^2 [(2L+1)(2\bar{L}+1)(2j'+1)(2\bar{j}'+1)(2\ell+1)]^{1/2} \times \\ \times \begin{Bmatrix} J\ell J \\ \bar{L} j L \end{Bmatrix} \begin{Bmatrix} j_3\ell j_3 \\ \bar{j}' j_1 j' \end{Bmatrix} \begin{Bmatrix} J\ell J \\ j' L' \bar{j}' \end{Bmatrix} \begin{Bmatrix} \bar{j}_3 \ell j_3 \\ j_\gamma j_4 j_\gamma \end{Bmatrix} \begin{pmatrix} j_\gamma j_\gamma \ell \\ 1\, -1\, 0 \end{pmatrix} \begin{pmatrix} \bar{L} L \ell \\ 0\,0\,0 \end{pmatrix} \times \\ \times (\Gamma_{aLj}\Gamma_{bL'j'}\Gamma_{a\bar{L}j}\Gamma_{bL'\bar{j}'})^{1/2} \left\{ \sum_{Lj,\, L'j'} \Gamma_{aLj}\Gamma_{bL'j'} \right\}^{-1} \cos(\delta_{aLj} + \\ + \delta_{bL'j'} - \delta_{a\bar{L}j} - \delta_{b\bar{L}'\bar{j}'})\, P_\ell(\cos\theta)$$

where W_+ and W_- are the probabilities of emission of right- and left-circularly polarized photons, θ is the angle between the momenta of the photon and the incident particle, β is the amplitude of the impurity state with parity opposite that of the intermediate state with given angular momentum J and parity. All the barred quantities in (4) correspond to interference in the square of the matrix-element modulus. The summation in (4) is over the j, j', $\bar{j}'$, L, and $\bar{L}$ and over the odd values of $\ell \leq \min\{2j_\gamma, 2j_3\}$.

In the derivation of (4) it was assumed that the contribution of a single resonance is of importance in the scattering. If several resonant states take part in the reaction, then β in (4) must be replaced by $\bar{\beta}$, the mean value of the amplitude of the impurity states with opposite parity over a certain energy interval.

By way of an example let us consider several particular cases of formula (4). If $j_2 = j_4 = 3/2^+$, $j_3 = 5/2^+$, $\ell = L = L' = j = j_\gamma = 1$, $\bar{L} = 0$, $j' = \bar{j}' = 2$, and $J = 1^- + \beta 1^+$, then the degree of the circular polarization of the photons is given by

$$\mathcal{P} = -\frac{21\sqrt{2}}{40\sqrt{\pi}} \frac{\sqrt{\Gamma_{11}\Gamma_{01}}}{\Gamma_{11}+\Gamma_{01}} \cos(\delta_{11}-\delta_{01})\cos\theta .$$

In the case when $j_2 = j_4 = 1/2^+$, $j_3 = 3/2^+$, $\ell = L = j = j_\gamma = 1$, $L' = 0$, $j' = \bar{j}' = L = 2$, and $j = 2^- + \beta 2^+$, the degree of circular polarization is

$$\mathcal{P} = -\frac{3}{2}\sqrt{\frac{15}{\pi}} \frac{\sqrt{\Gamma_{21}\Gamma_{11}}}{\Gamma_{21}+\Gamma_{11}} \cos(\delta_{11}-\delta_{21})\cos\theta .$$

We note that a formula similar in many respects to formula (4) holds also in the case of non-resonant scattering of particles by nuclei.

To obtain a large effect of dynamic enhancement in experiment, it is convenient to use nuclei and reactions in which the level density of the excited nucleus is small, so that levels with a given spin but with different parity strongly overlap.

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E R R A T A

In the article by V. A. Karmanov and G. A. Lobov, Vol. 10, No. 7, p. 214, the first formula (line 11) should read

$$\mathcal{P} = -\frac{21\sqrt{7}}{40\sqrt{\pi}} - \beta\frac{\sqrt{\Gamma_{11}\Gamma_{01}}}{\Gamma_{11}+\Gamma_{01}}\cos(\delta_{11}-\delta_{01})\cos\theta$$

The second formula (line 14) should read

$$\mathcal{P} = -\frac{3}{2}\sqrt{\frac{15}{\pi}}\,\beta\frac{\sqrt{\Gamma_{21}\Gamma_{11}}}{\Gamma_{21}+\Gamma_{11}}\cos(\delta_{11}-\delta_{21})\cos\theta$$

In line 18, read:"... the level density of the excited nucleus is large," and not ",,, is small,".