Determination of Nuclear Level Densities and γ-Strength Functions of $^{205-208}$Pb Nuclei.

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The importance of finding nuclear level densities is of fundamental importance in nuclear structure and in nuclear reaction theory. The γ-strength function is another important parameter for understading the nuclear structure. So, emphasis of the present talk will be on the energy dependent nuclear level densities, ρ, and γ-strength functions of $^{205-208}$Pb nuclei below the nuclear binding energies.

The Oslo Cyclotron Group has developed an experimental method [1] that extracts nuclear level densities and radiative strength functions simultneously from primary γ-rays in light-ion reactions. The experimental primary γ-ray spectra per excitation energy bin, $P(E_i, E_\gamma)$, have been extracted for the (^{3}He, α) and (^{3}He, ^{3}He‘) reactions. The Axel-Brink hypothesis [2,3] has been employed to separate out level density and γ-strength function from the primary γ spectra by

$$P(E_i, E_\gamma) \propto \mathcal{T}(E_\gamma)\rho(E_i - E_\gamma),$$

where $\mathcal{T}$ is the γ-ray transmission coefficient.

The nuclear thermodynamical properties are extracted from the experimental nuclear level density within the microcanonical and canonical ensemble. The Boltzmann's postulate for *entropy* can be employed, stated under as

$$S(E, N) = k_B \ln \Omega(E, N),$$

where Ω is the number of microstates derived from experimentally found level densities, and k_B is the Boltzmann's constant. The radiative strength function (RSF) at low γ-ray energies will also be discussed with respect to temperature dependency.

[1] A. Shiller, Phys. Res. A**447**, 498 (2000).
[2] D.M. Brink, Ph.D. thesis, Oxford University, 1955.
[3] P. Axel, Phys. Rev. **126**, 671 (1962).