Particle evaporation as a probe for dynamical effects in heavy ion fusion reactions

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The compound nucleus $^{76}Kr^{*}$ was populated at the excitation energy of 75 MeV and angular momentum of 39 $\hbar$ in fusion reactions with two complementary, mass-symmetric ($^{31}P+^{45}Sc$) and mass asymmetric ($^{12}C+^{64}Zn$) entrance channels. The neutron and proton evaporation spectra were measured and compared with the predictions of the statistical model calculations using the transmission coefficients for the spherical nuclei in the inverse absorption channel, the rotating liquid drop model moment of inertia and the normal systematic value of A/8 for the small level density parameter **a**. The results for the mass-asymmetric reaction are found to be consistent with the predictions of the statistical model calculations. However, for the mass-symmetric reaction ($^{31}P+^{45}Sc$), the experimental spectra are found to be harder than the theoretical neutron spectra and the statistical model calculations require a lower value A/10 for the parameter **a** to reproduce the shape of the experimental spectra, indicating the neutron to be evaporated at higher temperature for the same excitation energy and angular momentum in symmetric system. While in case of proton spectra for symmetric system, the experimental spectra are found to be softer. The higher effective nuclear temperature of the compound system deduced from the neutron evaporation can be interpretted as manifestation of the dynamical effects leading to the temperature equilibrated intermediate dinuclear complex and the associated emission of the high energy neutrons during its large evolution time towards compound nucleus formation in the case of the symmetric entrance channel.