NUCLEON PREEQUILIBRIUM EMISSION IN LIGHT AND HEAVY ION INDUCED REACTIONS

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In light and heavy ion induced reactions, inclusive spectra of nucleons emitted with high energies have been described quite successfully with semiclassical models. These models more or less have a few basic concepts in common[1], namely the equilibration through a sequence of intranuclear nucleon-nucleon collisions, the classification of transient configurations by the number of single particle degrees of freedom (excitons), and application of Ericson-Williams-type exciton distribution functions $\rho_{EW}(E^*,n_o)$. Whenever these underlying assumptions oversimplify the description of the thermalization process - e.g. by neglecting residual interactions or by putting constraints on the injection of the projectile into the target nucleus - discrepancies may occur. In this contribution we discuss two of them.

(i) Deviations from the equidistant spacing of single particle states occuring near the double shell closure N=126, Z=82 generate structures in the partial densities of $(1p)(1n)^{-1}$

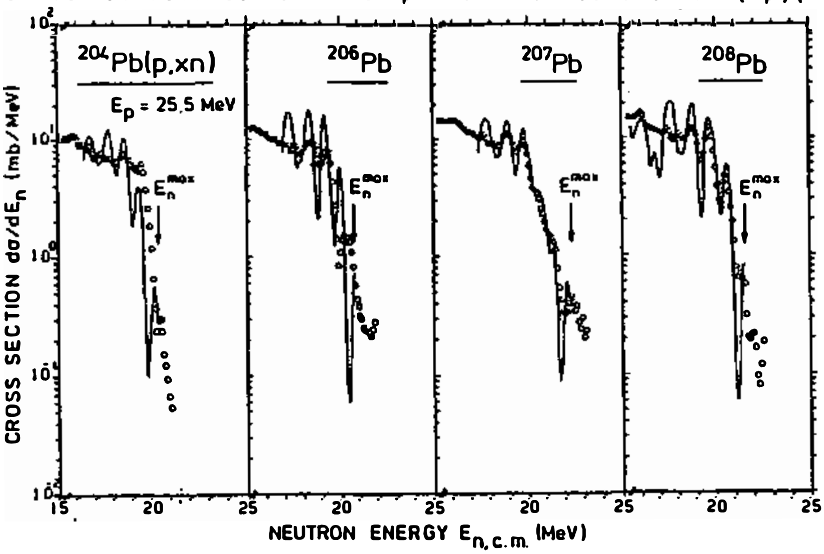

Fig. 1. High energy part of the Pb(p,xn) spectra in the forward cone $\theta_{lab} \leq 60°$. The solid line is a microscopically calculated $1p1n^{-1}$ state density[2].

states populated by proton induced neutron emission[2] from the initial n_o=3 exciton configuration (Fig. 1). In addition, the average preequilibrium yield for residual excitations U≤15 MeV is substantially enhanced.

(ii) Nucleon energy spectra of reactions induced with E_R = 10-30 MeV/nucleon projectiles (^{12}C, ^{20}Ne, ^{32}S) have been analyzed with the exciton as well as with the Boltzmann master equation model[3,4]. It has been found that the initial exciton number n_o is in the order of the nucleon mass number A_p, but seems to increase with E_p. In order to study the significance of the values n_o introduced by use of $\rho_{EW}(E^*,n_o)$ for the injection term[5], we replaced it by an expression that is derived from pure phase space considerations for two interpenetrating Fermi spheres[6]; it is inspired by the Fermi jet idea and allows to include noncentral collisions. For a given n_o, both approaches lead to different, but similar injection spectra (Fig. 2).

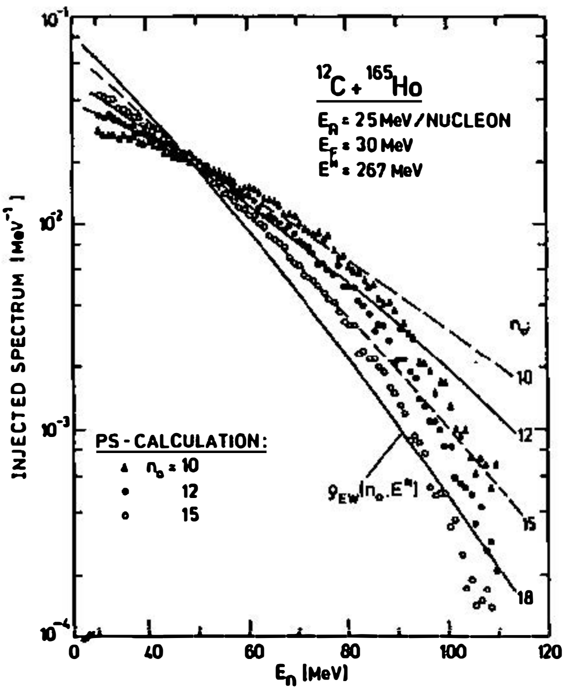

Fig. 2. Comparison of different injection spectra,[6].

1. J. Bisplinghoff, Phys. Rev. C33 (1986) 1569
2. K. Harder et al., submitted to Phys. Rev. C (1987)
3. E. Holub et al., Phys. Rev. C33 (1986) 143
4. R. Čaplar et al., Verhandlg. DPG(VI) 22 (1987)
5. M. Blann, Phys. Rev. C31 (1985) 1245
6. W. Scobel and M. Blann, to be published