Nuclear temperature anomaly in ^{35}Cl+^{24}Mg reaction at $E_{c.m.}$=105 MeV

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Introduction and Aim

It was found earlier [1,2] from studies on A~100 mass region at (4-8) MeV/A bombarding energy that the temperatures obtained from the slopes of the spectra of the heavier evaporation fragments (such as α, Li, B, C etc.) were significantly higher than the expectations from statistical model calculations. We have now extended this investigation to lower mass region (A~60).

Data Analysis and Discussions

We have used the existing experimental data [3,4] on ^{35}Cl + ^{24}Mg system at $E_{c.m.}$=105.7 MeV. Evaporation fragment spectra studied were those of alpha, carbon and oxygen. The experimental spectra and the corresponding CASCADE code calculations were analyzed using Moretto's statistical formula [5] given by

$$P(x) \propto \exp\left(-\frac{x}{T}\right) erfc\left(\frac{p-2x}{2\sqrt{pT}}\right) \quad \ldots \quad (1)$$

where

$$x = E_{kin}(c.m.) - V_C.$$

Here $E_{kin}(c.m.)$, V_C, p, T, $P(x)$ are the exit channel center of mass kinetic energy, Coulomb barrier, amplification parameter, temperature of the ensemble of the residual nuclei and the corresponding probability of the emission of the particle, respectively. The results are displayed in Figures 1 and 2, respectively. Parameters obtained as a result of fitting with eq.(1) are shown in Table-1. We find that the temperatures obtained from the slopes of the experimental spectra of progressively heavier evaporation fragments remain about the same and significantly higher than the expected trend of progressively lower temperatures of the heavier

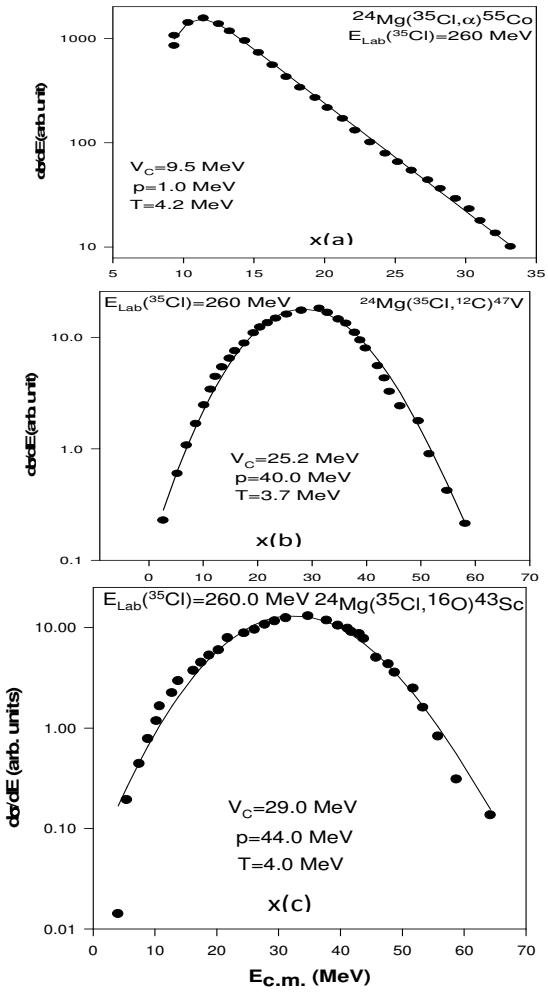

Fig.1: Experimental angle integrated α, carbon and oxygen spectrum from ^{35}Cl + ^{24}Mg reaction at $E_{c.m.}$(entrace channel)=105.7 MeV. The experimetal data are those extracted from Mahboub et al[3,4]. Corresponding fits (smooth lines) are due to formula (1).

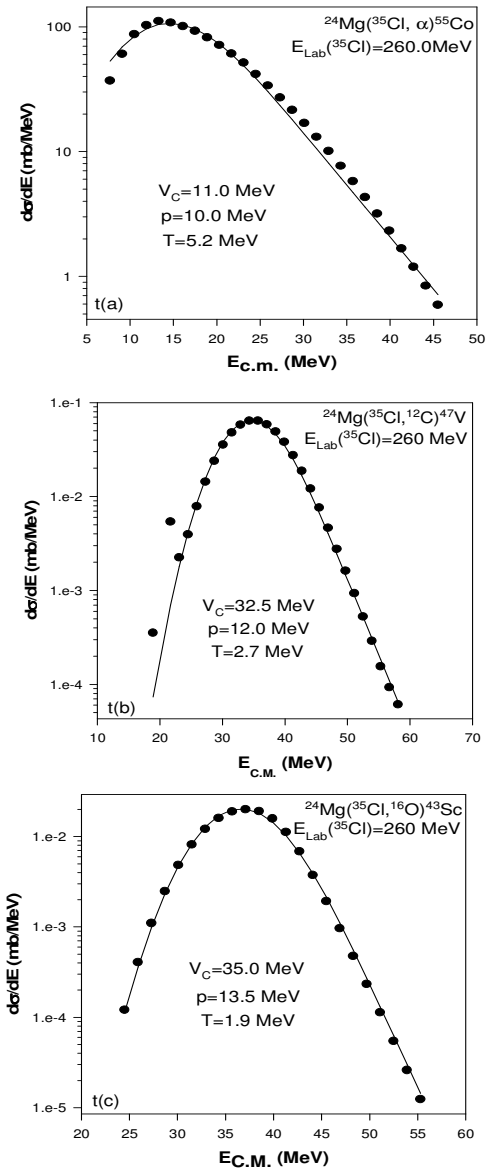

Fig. 2: Statistical model 'CASCADE' code calculations of α, carbon and oxygen spectra from ^{35}Cl + ^{24}Mg reaction at $E_{c.m.}$(entrace channel)=105.7 MeV. Corresponding fits (smooth lines) are due to formula (1).

fragments from the statistical CASCADE code calculations. Least square linear fits to the derived temperatures shown in Fig. 3 clearly show that the experimentally obtained temperatures remained about the same. The results support our earlier observations that the temperatures obtained from heavier evaporation fragments are significantly higher than the expectations from statistical model calculations.

Table-1
Comparison of experimental and statistical model results for ^{35}Cl + ^{24}Mg reaction at Ec.m.=105.7 MeV. [Parameters are in MeV]

Ejec-tile	Experiment			Stat. model cal.		
	V_c	P	T	V_c	P	T
α	9.5	1.0	4.2	11.0	10.0	4.2
^{12}C	25.	40.	3.7	32.5	12.0	2.7
^{16}O	29.	44.	4.0	35.0	13.5	1.9

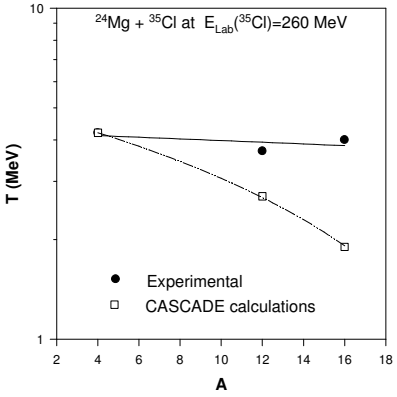

Fig. 3:. Temperatures derived by fitting different fragment spectra with eq. (1). A: mass no.

References

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