PREFORMATION PROBABILITY FOR COMPLETE BINARY FRAGMENTS OF ^{294}Og

L. Vasanthi

Research Scholar

Supervisor

Dr. N. S. Rajeswari

Department of Physics

Avinashilingam Institute for Home Science and

Higher Education for Women, Coimbatore- 641 043

Tamil Nadu, INDIA

OBJECTIVE

- ✓ To calculate preformation probability for the complete binary decay of ^{294}Og formed in heavy-ion fusion reaction using Cubic-plus-Yukawa-plus-exponential (YEM) potential with a third order polynomial potential for the overlapping region.

- ✓ *Temperature is incorporated through the surface energy constant of liquid drop model.*
- ✓ *Preformation probability is calculated for the use of both reduced and hydro dynamical mass within WKB framework.*

METHODOLOGY

- ✓ Cubic-plus-Yukawa-plus-exponential Model is used [1] & [2].
- ✓ The penetration probability corresponding to the over-lapping potential [3] is considered as the preformation probability of the alpha/cluster/heavy fragments.
- ✓ This idea is used to calculate the preformation probability of complete charge minimized binary fragments of ^{294}Og formed in heavy-ion fusion reaction $^{249}Cf+^{48}Ca$.

[1] G. Shanmugam and B. Kamalaharan, Phys. Rev. C 38, 1377 (1988)

[2] H. J. Krappe, J. R. Nix, and A. J. Sierk, Phys. Rev. Lett. 42,215 (1979);Phys. Rev. C 20, 992 (1979)

[3] D. N. Poenaru and W. Greiner, Phys. Scr. 44, 427 (1991).

$$V_{ov} = -E_V + [V_{nov} + E_V]\left[s_1\left[\frac{r - r_i}{r_t - r_i}\right]^2 - s_2\left[\frac{r - r_i}{r_t - r_i}\right]^3 \right] \quad (1)$$

$r_i < r < r_t$

$$V_{nov} = \frac{Z_1 Z_2 e^2}{r} + V_n \quad (2)$$

$r > r_t$

$$E_V = \frac{\pi\hbar}{2}\frac{(2Q/\mu)^{1/2}}{(C_1 + C_2)} \quad (3)$$

$$r_i = \frac{3}{4}\left[\frac{h_1^2}{R_0 + h_1} + \frac{h_2^2}{R_0 + h_2}\right] \quad (4)$$

$$V_n = -V_{red}(2 + s/a)\exp(-s/a) \quad (5)$$

$s = r - (R_1 + R_2)$

$$V_{red} = \frac{4a^3 g_1 g_2 [C_1 * C_2]^{1/2}}{r_0^2 r_t} * \left[4 + \frac{r}{a} - \frac{f_1}{g_1} - \frac{f_2}{g_2}\right]\left[2 + \frac{s}{a}\right]^{-1} \quad (6)$$

$$f_j = \left(\frac{R_j}{a}\right)^2 \sinh\left(\frac{R_j}{a}\right)$$

$$g_j = \left(\frac{R_j}{a}\right)\cosh\left(\frac{R_j}{a}\right) - \sinh\left(\frac{R_j}{a}\right)$$

$$C_S(j) = a_S\left(1 - K_S I_j^2\right)$$

$$I_j = \left(\frac{N_j - Z_j}{A_j}\right),$$

$$j = 1,2$$

- Preformation probability for the use of reduced mass by using WKB method is defined as,

$$P_{ov} = \exp\left[-\frac{2}{\hbar}\int_{r_a}^{r_t}\left[2\mu V_{ov}(r)\right]^{1/2} dr\right] \longrightarrow \quad (7)$$

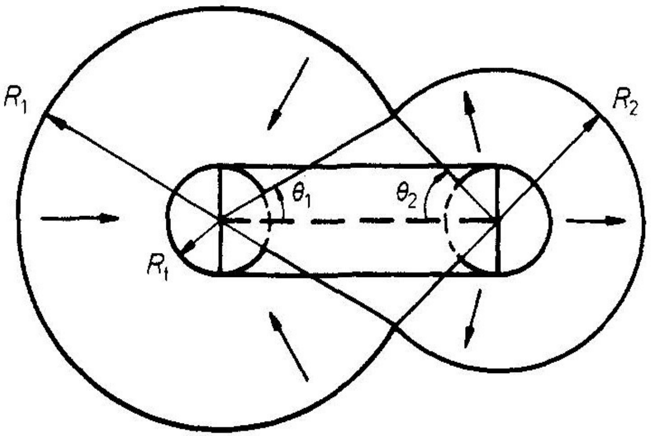
- Preformation probability for the use of hydro dynamical mass by using WKB method is defined as,

$$P_{ov} = \exp\left[-\frac{2}{\hbar}\int_{r_a}^{r_t}\left[2\mathrm{B}_\eta V_{ov}(r)\right]^{1/2} dr\right] \longrightarrow \quad (8)$$

CLASSICAL HYDRODYNAMICAL MASS*

- Classical hydrodynamical mass is the transfer mass.
- The transfer mass given by Kroger *et al*, is based on radial flow between the spherical surfaces with radius R_1 and R_2 given by the express

$$\boldsymbol{B_\eta = \frac{B_{\eta\eta}}{R^2} = \frac{M}{4}\frac{M}{4}\left(\frac{V(1+\beta)}{V_c(1+\gamma)^2} - 1\right)}$$



$$\beta = \frac{R_c}{2R}\left[\frac{1}{1+cos\theta_1}\left(1-\frac{R_c}{R_1}\right) + \frac{1}{1+cos\theta_2}\left(1-\frac{R_c}{R_2}\right)\right]$$

$$\gamma = \frac{1}{2R}[(1-cos\theta_1)(R_1 - R_c) + (1-cos\theta_2)(R_2 - R_c)]$$

*H. Kroger, and W. Scheid, JPG 6 (1980) L85.

$$V_c = \pi R_c^2 R$$

- Here, α_0 is varied between 0.4 to 1.0 in steps of 0.2
- The geometry of the model is also shown.

- Temperature is incorporated through the surface energy constant of liquid drop model.

$$C_S(j) = a_S\left(1 - K_S I_j^2\right)$$

$a_s(T)$ is defined as,

$$a_s(T) = a_s(0)\left(1 - x_s T^2\right) \longrightarrow (9)$$

x_s = 0.00553 MeV^{-2}

- The nuclear temperature correlated to the excitation energy is calculated using this expression,

$$E^*_{CN} = \frac{1}{a} A T^2 - T (MeV) \longrightarrow (10)$$

RESULTS AND DISCUSSION

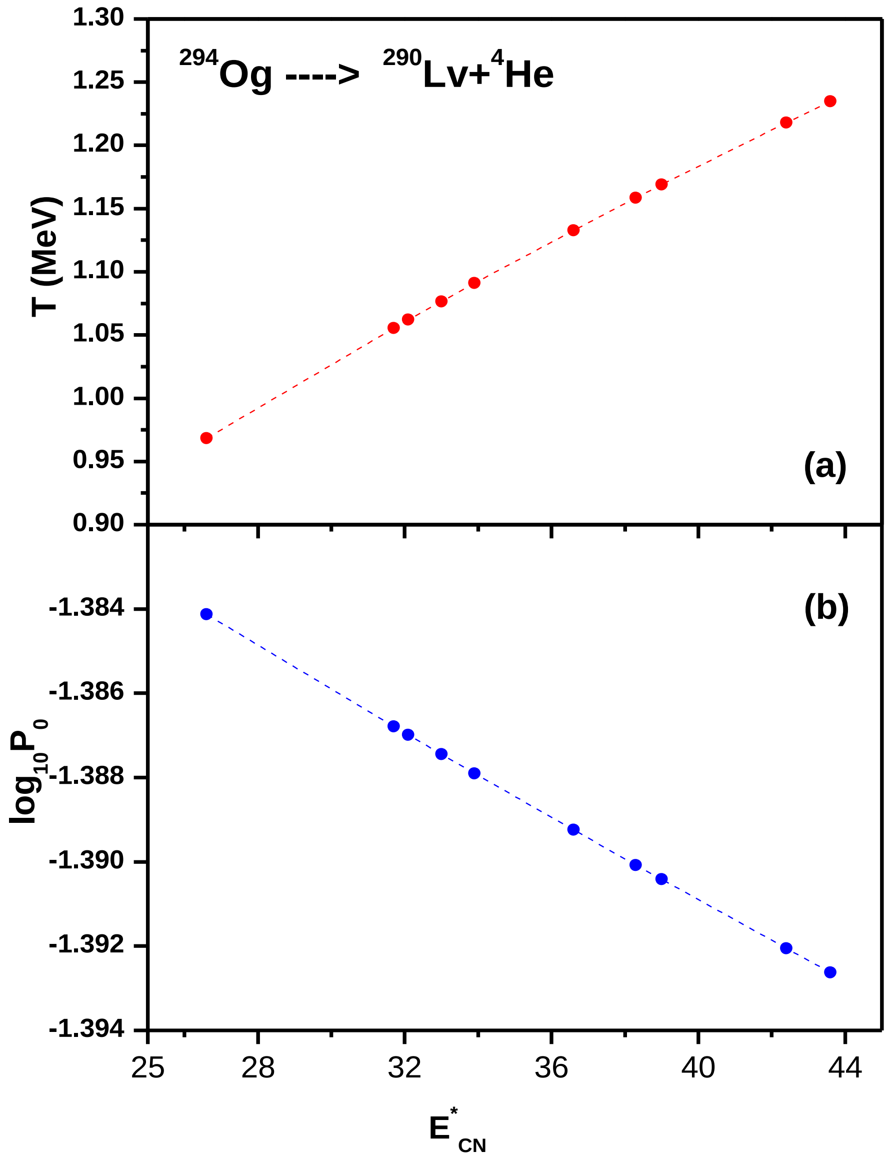


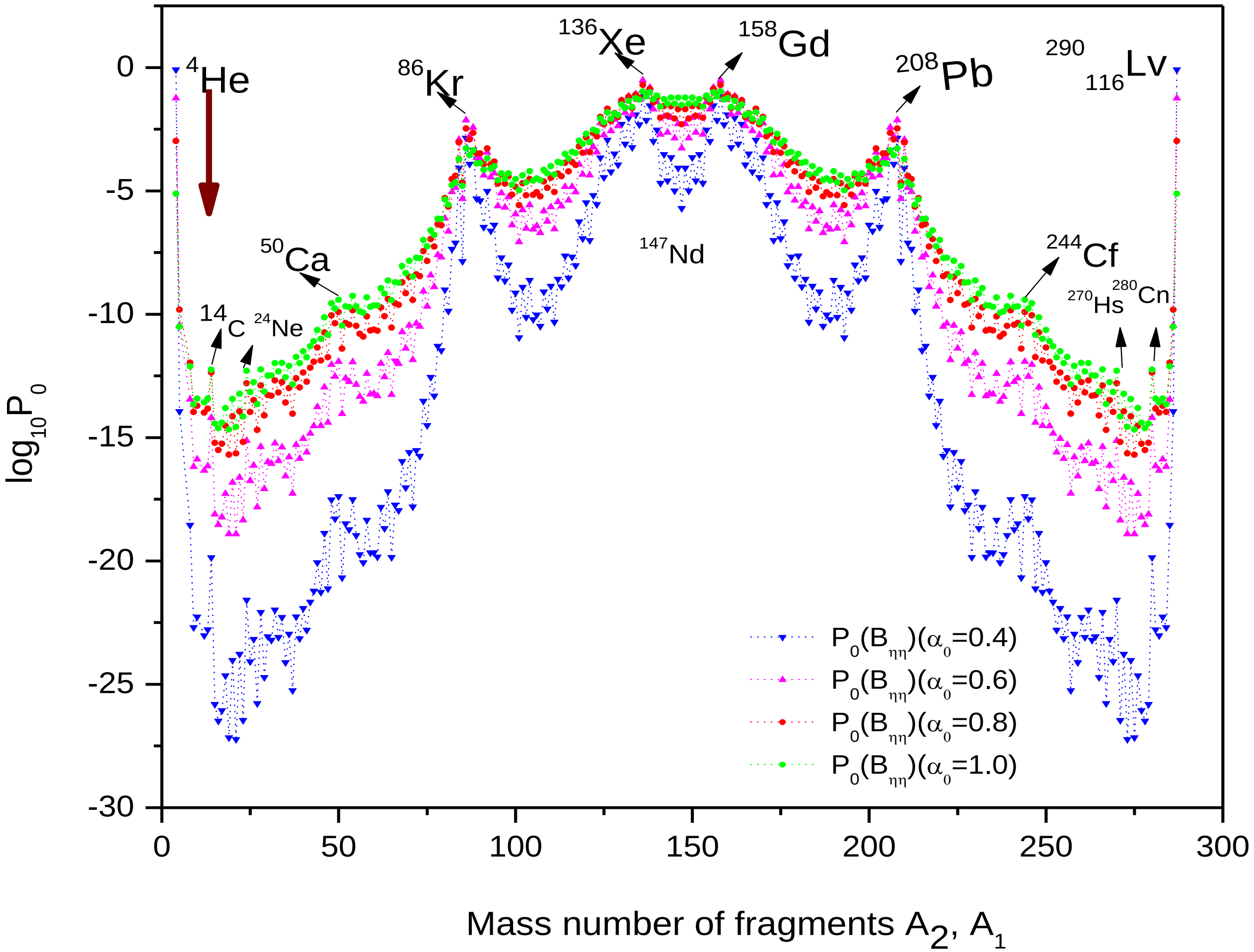
Figure 1

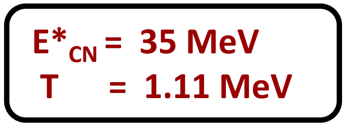
Panel (a) **:** Variation of temperature with respect to the excitation energy is presented.

Panel (b) **:** Logarithmic preformation probability values for different values of excitation energy is presented , for the use of reduced mass in the expression for preformation probability.

- The excitation energy of compound nucleus increases, temperature are also increases.
- logarithmic preformation probability decreases. But the variation is not significant

Figure. 2: Preformation probability values of complete binary decay of ^{294}Og for the use of hydrodynamical mass.





SUMMARY AND CONCLUSIONS

- ✓ The preformation probability of complete binary decay modes of compound nucleus ^{294}Og formed in 3n-evaporation heavy-ion fusion reaction $^{249}Cf+^{48}Ca$ are analysed within the frame work of Cubic-plus-Yukawa-plus exponential potential with third order polynomial potential for the overlapping region, by incorporating temperature of the compound nucleus formed, through the surface energy constant of liquid drop model .
- ✓ When excitation energy increases, the temperature of the compound nucleus increases and found to vary between 0.968 to 1.235 MeV and the area under the potential curve is found to increase and preformation value is found to decreased.
- ✓ For the use of hydro dynamical mass as the value of parameter α_o is increased from 0.4 to 1.0, near symmetric fragments are preferred than alpha particle.


THANK
YOU