Heavy ion fusion cross section of strongly bound ^{32}S on ^{64}Ni using nuclear proximity potential

M.G.V.Sankaracharyulu[1,2],* K. P. Santhosh[2], K. M. Nissamudeen[2]
[1]Department of Physics, Mahatma Gandhi Govt Arts College, Chalakkara, New Mahe, U T of Puducherry, - 673311, INDIA
[2]School of Pure and Applied Physics, Kannur University, Swami Anandatheertha Campus, Payyanur, Kerala - 670327, INDIA

· * email: smgvenkata@gmail.com

Introduction

The study of Heavy Ion induced Nuclear Fusion Reactions is of immense interest and fascinating for the past few decades. In the interaction of two Heavy Ions a number of channels open up. It has been observed that for the projectile energies above the coulomb barrier, both CF and ICF may be considered as dominant mechanism. A part of the projectile/ejectile fuses with the target and the remaining part moves forward with the same velocity and angular momentum leading to ICF. The first experimental evidence of ICF reactions were given by Britt and Quitton [Harold C.Britt and Arthur R,Quinton;1961] who observed the break up of incident particles like ^{12}C and γ,^{16}O. Inamura[2] and Udagawa [3]et al. observed incompletely fused α particles peaked at forward angles in their particle and γ coincidence measurement. In the present work an attempt has been made to address some important issues and aspects of CF and ICF dynamics for the system $^{32}S+^{64}Ni$ in the lab energy of projectile 80-120 MeV range.. The excitation functions were calculated theoretically and reproduced the experimental data.

The model

The interacting Potential Barrier for a parent nucleus decaying in to different channels consists of Coulomb Potential and Nuclear proximity potential, Vp (Blocki.J et al;1977)[4,5]and centrifugal potential given by

$$V = \frac{Z_1 Z_2 e^2}{r} + V_P(z) + \frac{\hbar^2 \ell(\ell+1)}{2\mu r^2}$$

$$V_P(z) = 4\pi\gamma b\left[\frac{C_i C_j}{(C_i + C_j)}\right]\Phi\left(\frac{z}{b}\right)$$

Here z is the distance between the near surfaces of the projectile and target, μ is the reduced mass.φ is the universal proximity potential and z is the distance between the near surfaces of the fragments. The Süssmann central radii C_i of the fragments related to sharp radii and the total fusion cross section (Wong C Y;1973) is given by

$$C_i = R_i - \left(\frac{b^2}{R_i}\right)$$

$$\sigma_{fusion} = \frac{\pi}{k^2}\sum_{l=0}^{\infty}(2l+1)T(E,l)P_{CN}(E,l)$$

Where P_{CN} denotes probability of compound nucleus formation and *T* (*E*, *l*) denotes the total fusion probability with energy *E* and angular momentum *l*. In the present work, l=0.

	Bass Potential	Proximity Potential	Dasgupa M	Stefanini
Barrrier height(MeV)	59.01	59.00	59.0	58.8
Barrier position(Fm)	10.2	10.157	10.4	9.3

TABLE 1.

Results and discussion

The Total Fusion Cross Section was calculated using Bass potential and Nuclear Proximity Potential and the results are compared with the experimental values of M.Dasgupta and Stefanini. The results are in agreement and shown in fig.1 (below).

The Angular Momentum at different projectile energies are calculated theoretically and compared with experimental values.They are in agreement and shown in fig. 2 (below).

Further Studies are in progress to separate complete and Incomplete fusion excitation functions.

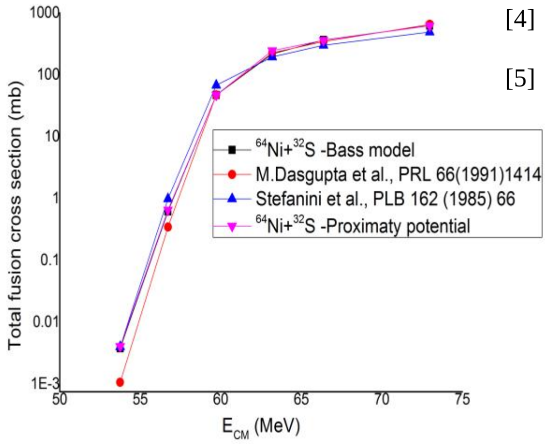

Fig. 1 Excitation function of total fusion of ^{32}S on ^{64}Ni

.

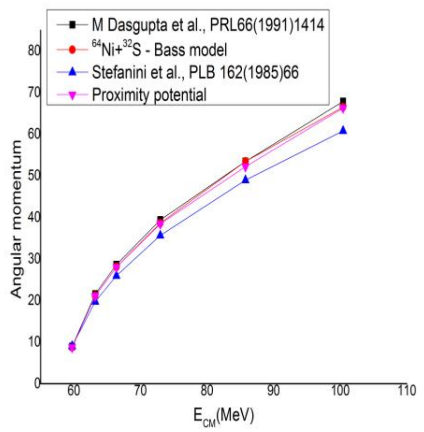

Fig. 2 Angular momentum of fusion of ^{32}S on ^{64}Ni

References

[1] H.C.Britt and A.R.Quinton, Phys. Rev.124,877(1961)
[2] T.Inamura etal.,Phys. Lett B 68,51(1977)
[3] T.Udagawa and T.Tamura, Phys. Rev. Lett. 45,1311 (1980)
[4] J.Blocki etal, Ann. Phys.(N.Y)105, 427(1977)
[5] C.Y.Wong, Phys. Rev. Lett. 31, 766(1973) .