

***INES (INtermediate Energy  
Spallation) code for Simulation  
of Intermediate Energy  
Spallation***

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# Introduction

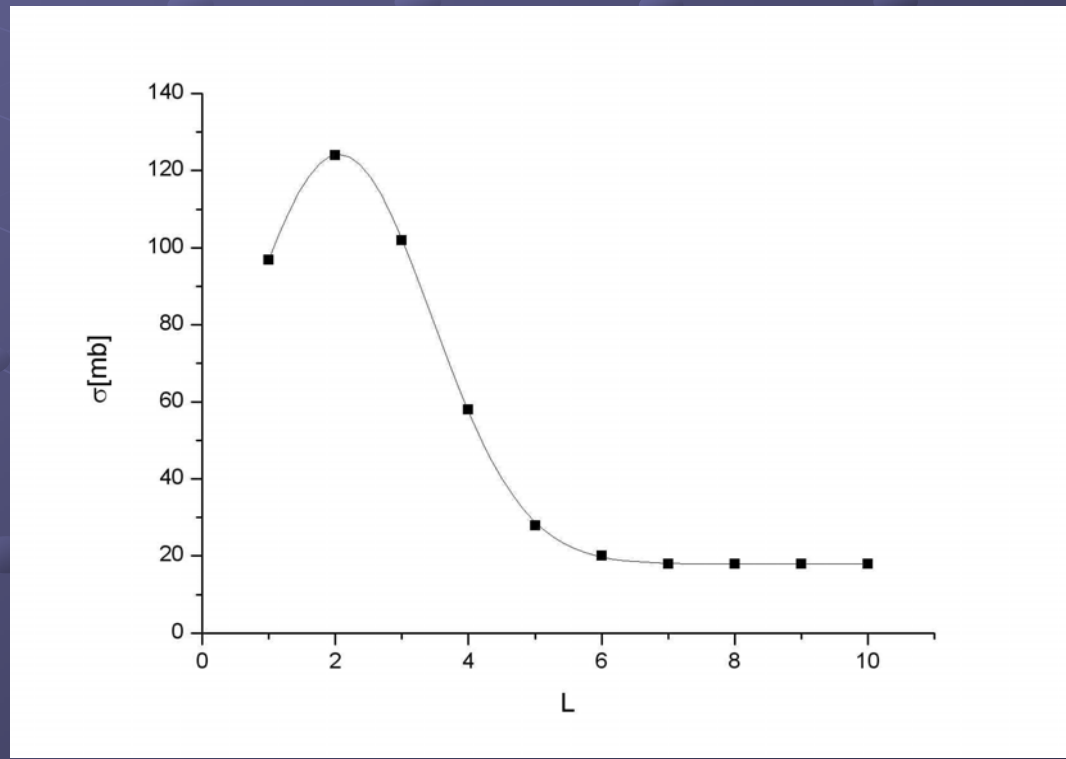
- Production of slow remnants of primary *TL* nuclei
- The reaction system  $^{20}\text{Ne}+^{27}\text{Al}$
- Bombarding energy 84 A MeV
- CR-39 nuclear track detectors
- Reaction mechanism is identified as interplay between *MFE* i *INC*
- *INES* code

# Mean field effects

- Cross section dependence on the incident angular momentum

$L_{cr}=67$

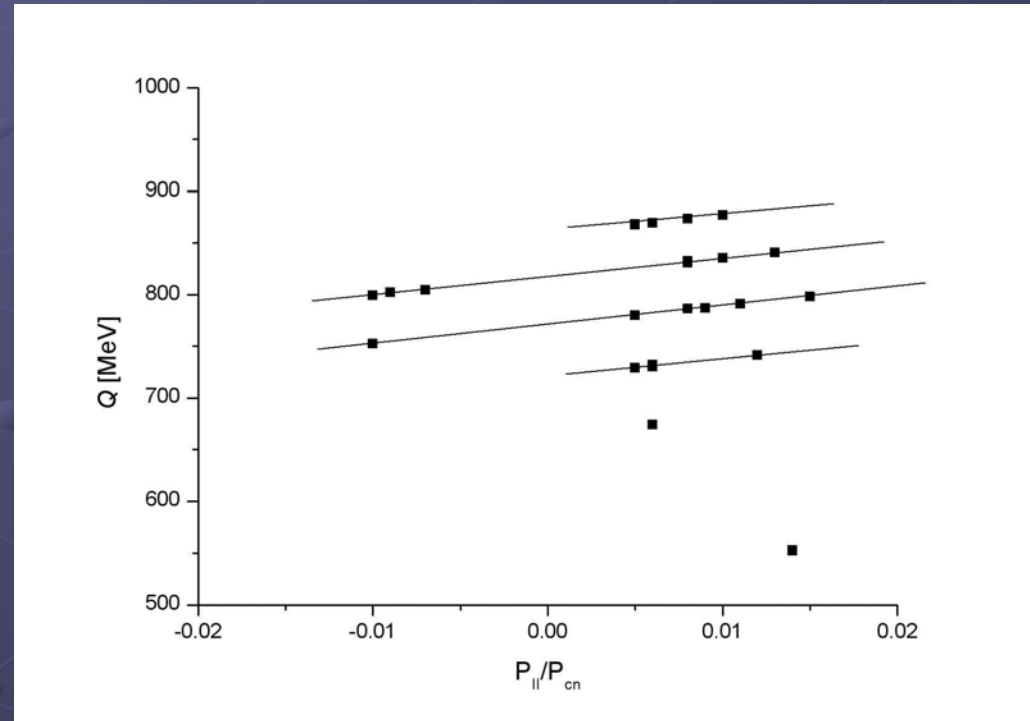
$$\frac{\hbar^2 \cdot L_{cr}^2}{2 \cdot \mu \cdot (R_t + R_p)^2} = 4\pi \cdot \gamma \cdot R_t \cdot R_p - \frac{1.44 \cdot Z_t \cdot Z_p}{(R_t + R_p)}$$



# Reaction kinematics

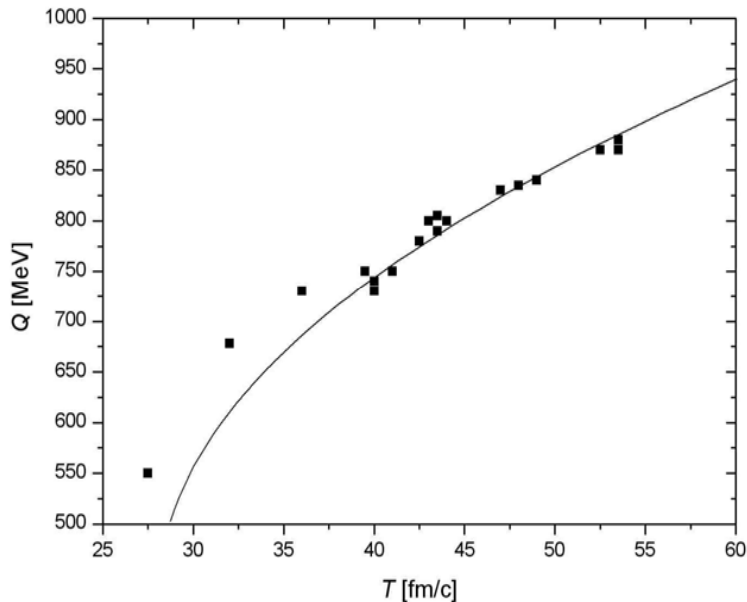
- The reaction Q value as a function of reduced longitudinal momentum

$$\frac{P_1}{P_{\text{cn}}} = k \cdot (Q - Q_0) \approx \frac{A_3}{A_4 (1 + \cos \theta_{\text{cm}})}$$



# Interplay of *MFE* and *INC* effects

- The direct correspondence between reaction  $Q$  value and the life-time of reaction transient system  $T_r$



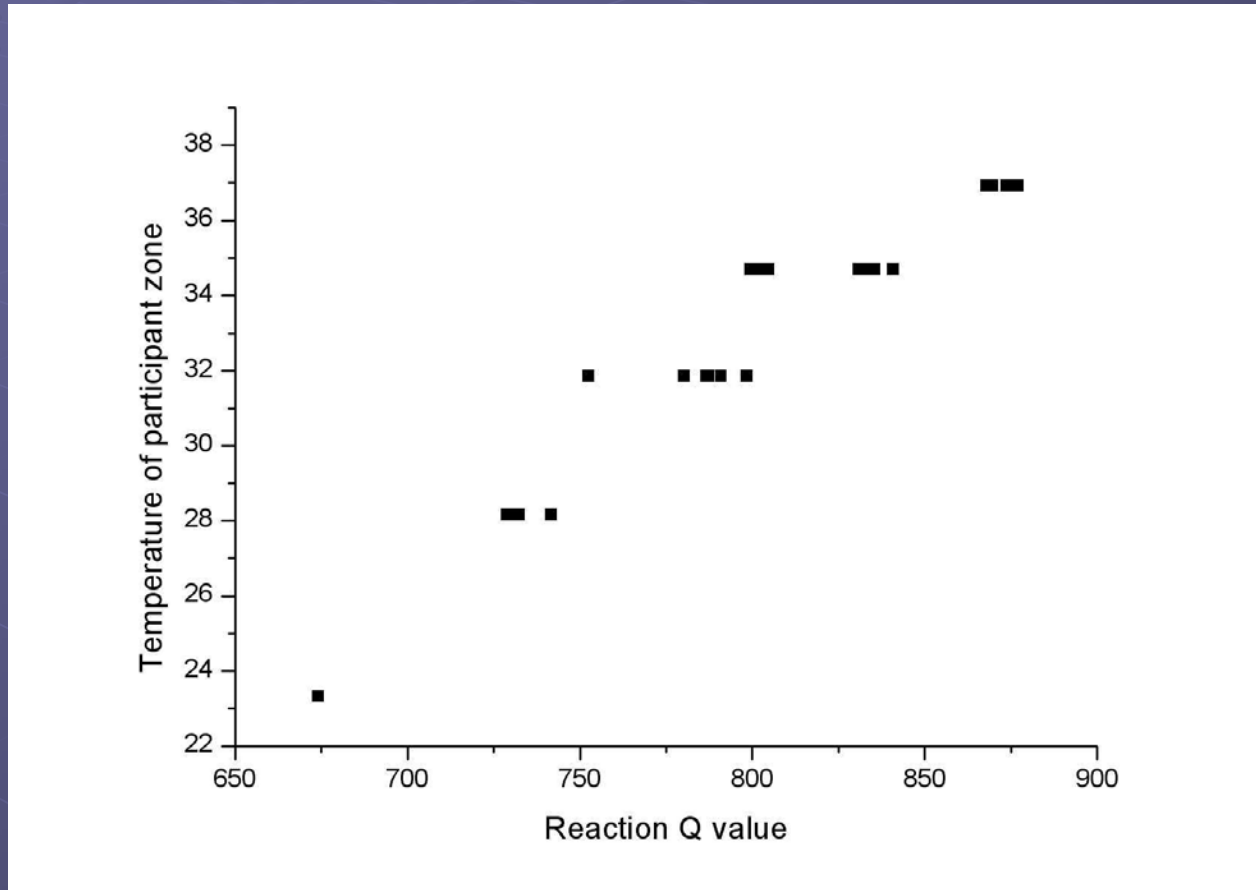
- Shows systematic behavior confirming the assumption of the interplay of *INC* and *MFE*
- *MFE* models were used to define working volume at equilibrium  $T$  (as that of *CN*)
- *INC* model, in our case Participant Spectator one: participant zone
- At consistent timing aforementioned models may serve as useful framework for systematizing and interpreting the effects of the interplay of the *MFE* and *INC* in the near central collisions leading to spallation events in the light reaction systems at intermediate energies

# *INES* code

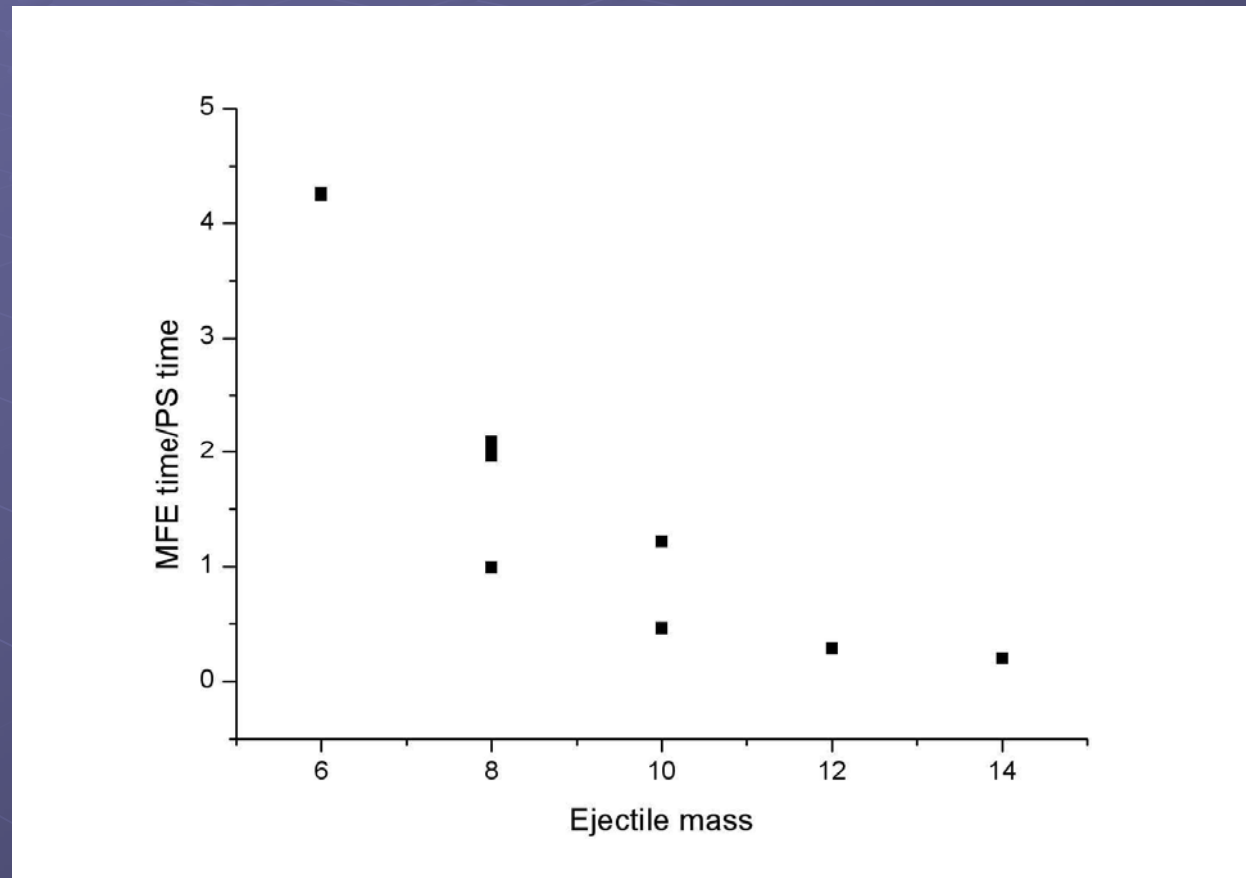
We developed the *INES* code that was applied to determine:

- Reaction timing,
- Friction and potential well at nucleon abrasion,
- Diffusion coefficients and nucleon drift velocities, for nucleon's diffusion
- T and T field distribution in participant zone

# The dependence of T of participant zone on reaction Q-value

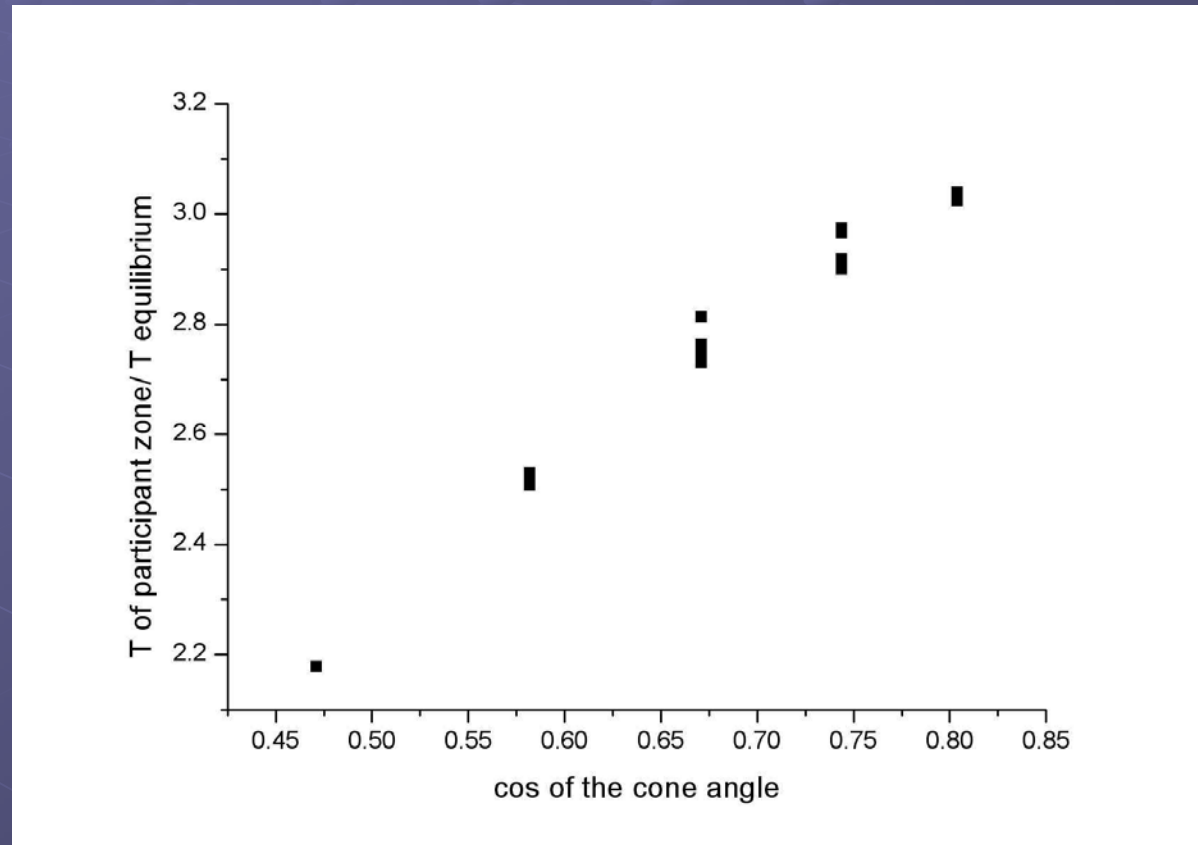


The ratio of life-time of the reaction transient system versus time of passage of projectile over target as a function of ejectile mass number





The dependence of the ratio of  $T$  of participant zone versus  $T$  of nuclear matter in equilibrium on the angle of the cone of the nucleon's abrasion



The obtained results are in excellent agreement with spallation scenario which at intermediate energy regime develops through the interplay of *MFE* and *INC* effects.