Measurement of fusion excitation functions
using a novel superconducting solenoid

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SOLITAIRE

SOLenoid for In-beam Transport And Identification of Recoiling Evaporation residues

Main features:

- 6.5 T superconducting solenoid
- Gas filled solenoid
- Separation of ERs from elastics (due to different q)
- Angular acceptance: 0.5° to 9.5° (dΩ=86 msr) (1 shot measurement of angular distribution)
- Excellent transmission for ERs: 80 – 90%
The focal point for particles depends on the momentum, average charge state of the particles, and the magnetic field applied.
Identification of ERs

**Evaporation Residues**

- $^{58}\text{Ni}^{+}$ to $^{60}\text{Ni}$
- $E_{\text{CM}} \sim 96$ MeV
- 4 MeV below $V_b$

(\sim3200$ events detected in 21 min)

**Beam particles**

**Evaporation Residues**

- $E_{\text{CM}} \sim 126$ MeV
- 26 MeV above $V_b$

(\sim96000$ events detected in 23 min)
Fusion excitation function for $^{58}\text{Ni} + ^{60}\text{Ni}$

Relative fusion cross section measured for $^{58}\text{Ni} + ^{60}\text{Ni}$

- Present Work
Barrier distribution for $^{58}\text{Ni}+^{60}\text{Ni}$

(Connecting line is just as a guide to the eye)
Barrier distribution for $^{58}\text{Ni}+^{60}\text{Ni}$

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Present Work

$\frac{d^2(E\sigma)/dE^2}{\text{MeV}}$

$E_{cm}$ [MeV]

(Connecting line is just as a guide to the eye)
Barrier distribution for $^{58}\text{Ni} + ^{60}\text{Ni}$
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Barrier distribution for $^{58}\text{Ni} + ^{60}\text{Ni}$

![Graph showing barrier distribution](image)

- Present Work
- 3 ph on each nucleus (CCFULL calculation)

Axes:
- $d^2(E\sigma)/dE^2$ on the y-axis
- $E_{cm}$ [MeV] on the x-axis

Energy range:
- 90 to 115 MeV

Labelled energies:
- $^{58}\text{Ni}$
- $^{60}\text{Ni}$
Summary and Conclusions

- Precise fusion excitation function measurements were performed successfully with SOLITAIRE.

- The previously measured features of the barrier distribution are confirmed by our data.

- The better defined barrier distribution for $^{58}\text{Ni} + ^{60}\text{Ni}$ appears to need more than 2 phonon couplings in each nucleus.