Scattering in ICOOL

R.C. Fernow
BNL

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Scattering models

- Bethe version of Moliere theory has been standard model
- known problems
  - atomic screening of nucleus for low-Z elements
  - scattering from atomic electrons
- models by Fano and Tollestrup address these issues
- compare ICOOL implementation with MuScat data

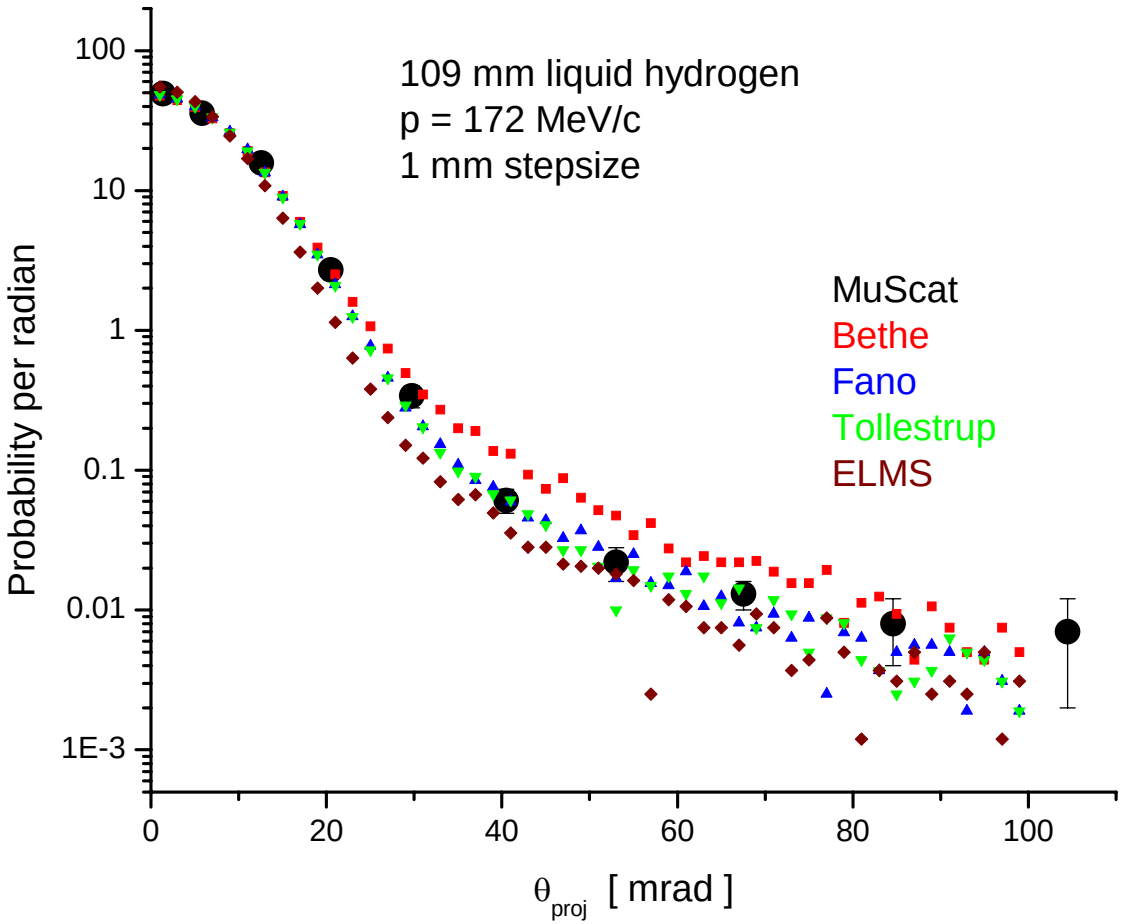
Method

- Fano model
  - uses Z^2 to calculate characteristic angle χ_C^2
  - computes integral of inelastic form factor for low-Z
  - modifies Moliere *b* parameter (related to number of scatters)

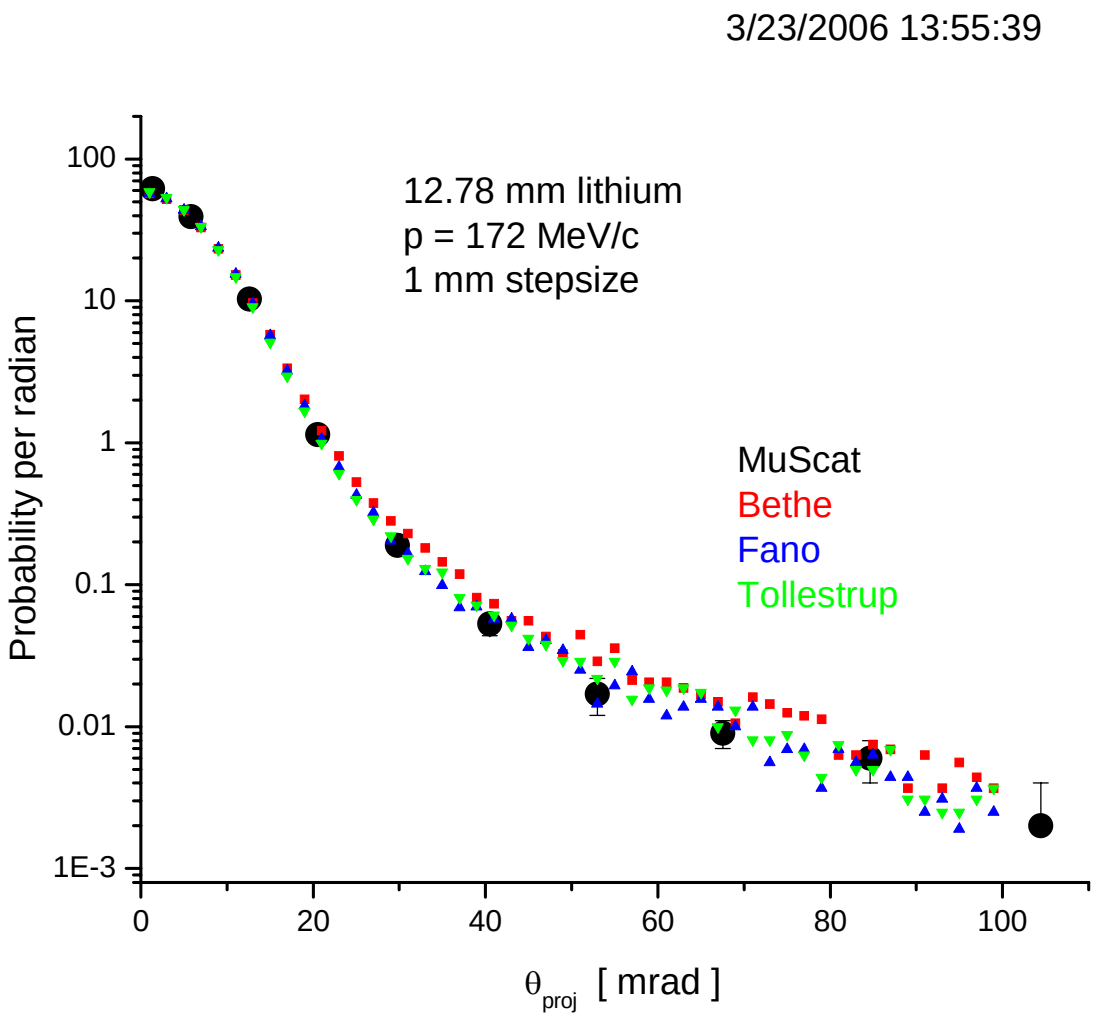
- Tollestrup model
  - makes explicit use of $\theta_0 = 4.8$ mrad
  - uses $Z(Z+1)$ up to θ_0 , then Z^2 to calculate χ_C^2
  - computes integrals of elastic and inelastic form factors for low-Z
  - modifies Moliere *b* parameter

Hydrogen

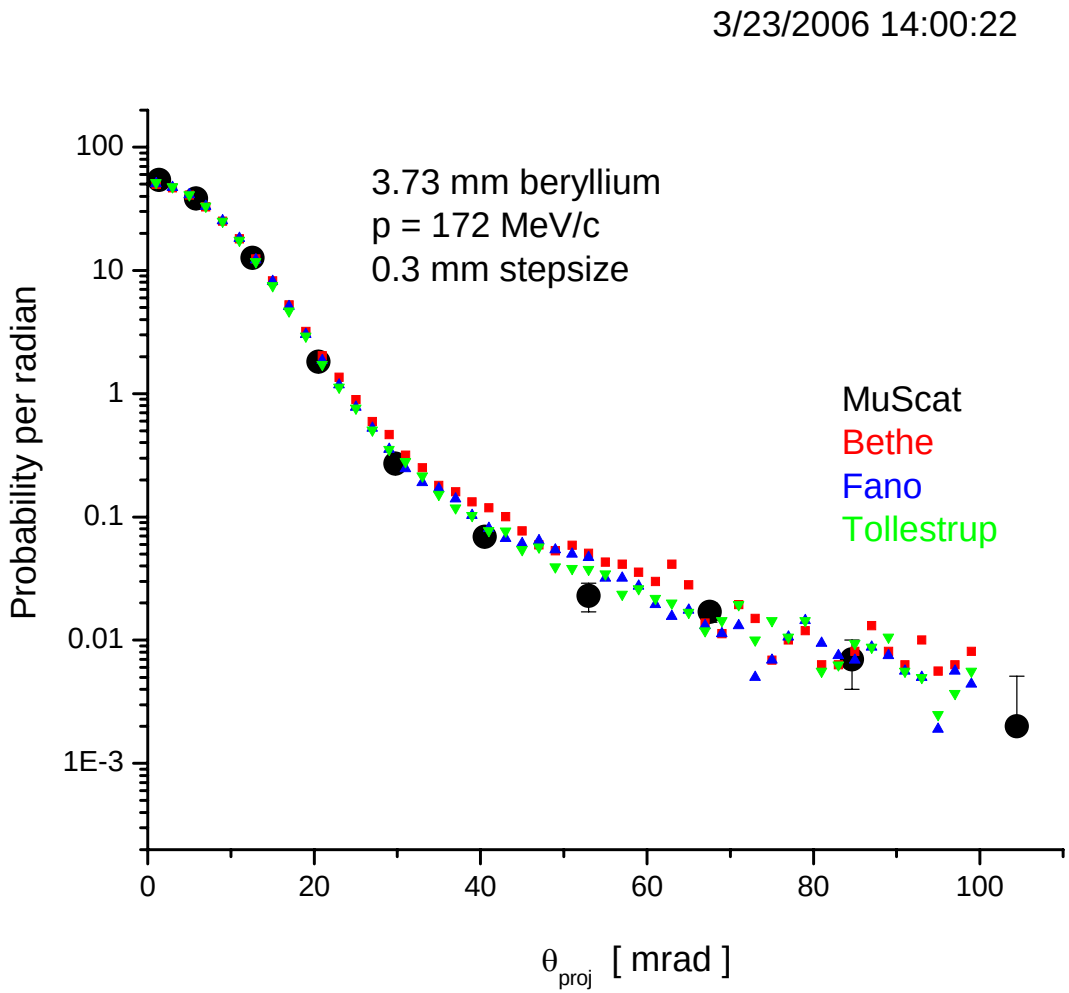
3/23/2006 13:48:38



Lithium

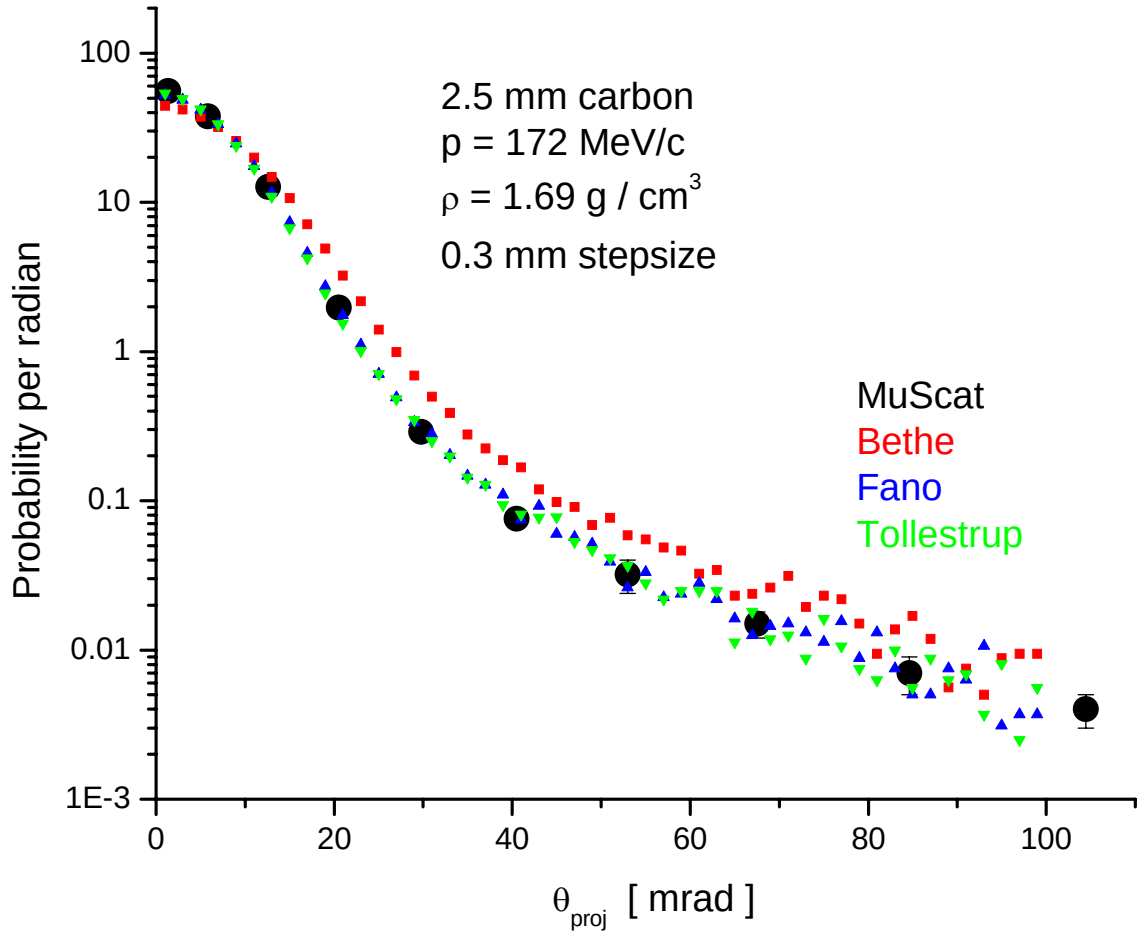

3/23/2006 13:55:39
12.78 mm lithium
p = 172 MeV/c
1 mm stepsize
MuScat
Bethe
Fano
Tollestrup
Probability per radian
100
10
1
0.1
0.01
1E-3
0
20
40
60
80
100
θproj [mrad]

Beryllium

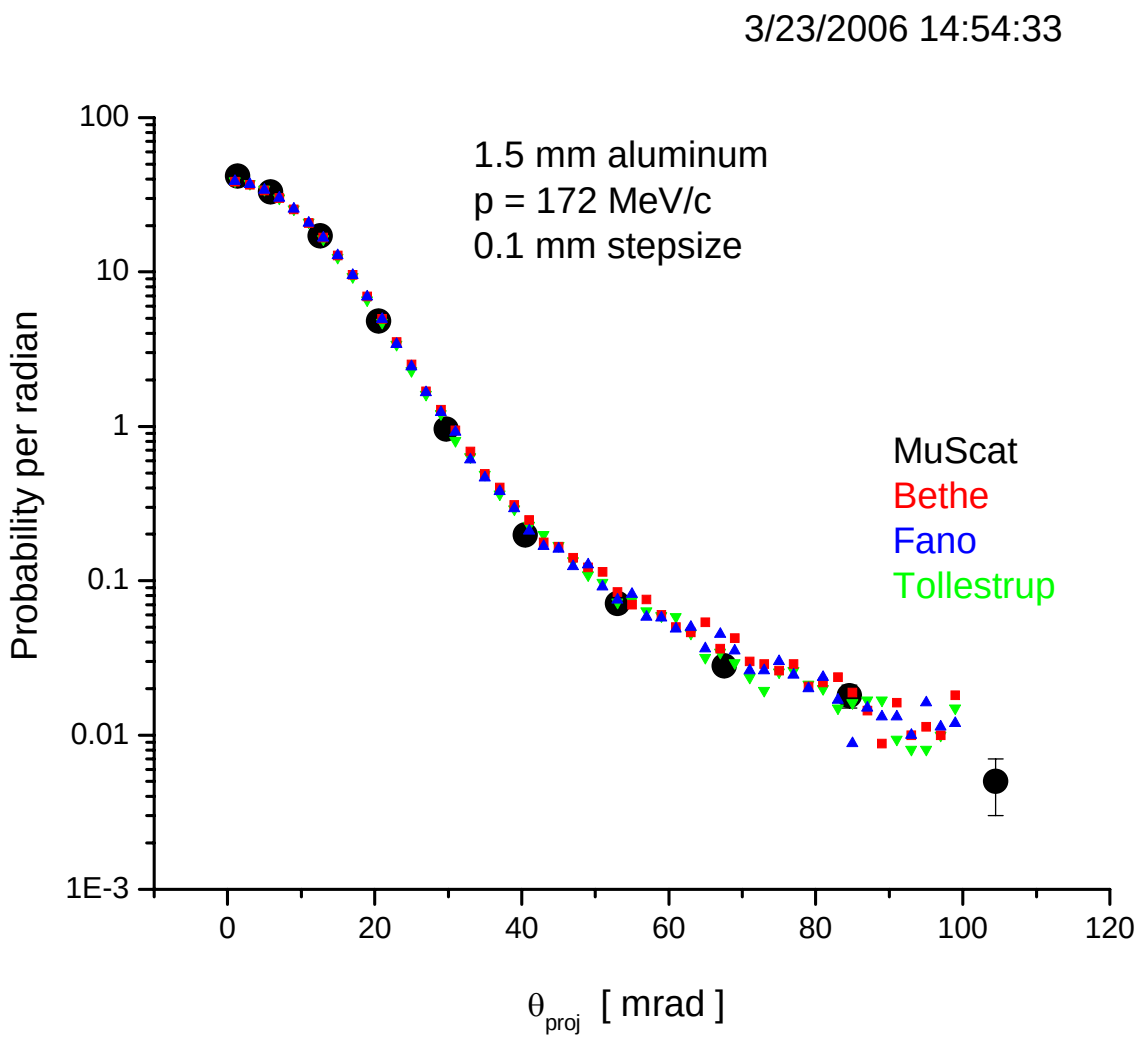

3/23/2006 14:00:22
3.73 mm beryllium
p = 172 MeV/c
0.3 mm stepsize
MuScat
Bethe
Fano
Tollestrup
Probability per radian
100
10
1
0.1
0.01
1E-3
0
20
40
60
80
100
θproj [mrad]

Carbon

3/24/2006 15:53:04



Aluminum


3/23/2006 14:54:33
1.5 mm aluminum
p = 172 MeV/c
0.1 mm stepsize
MuScat
Bethe
Fano
Tollestrup
Probability per radian
100
10
1
0.1
0.01
1E-3
0
20
40
60
80
100
120
θproj [mrad]

Effect on performance

- Fano and Tollestrup models have similar effect on performance
- μ_A /p increases by 5% for Study 2a
  LiH absorbers and Be windows
- M-factor increases by 66% for ideal RFOFO cooling ring
  liquid hydrogen absorbers