LISE++ version 9.4.1

- Asymmetry for Gaussian-like momentum distributions
- Asymmetry parameter “alpha”
- Extracting the asymmetry coefficient from the Convolution model (Universal parameterization)
- Example at low energy
- $^{82}\text{Se}$ momentum distribution results (will be soon)
Asymmetry for Gaussian-like momentum distributions

\[
\begin{align*}
symmetric & \\
\text{symmetric} & \\
f(x) = A \cdot e^{-\frac{(x-x_0)^2}{2\sigma^2}} & \\
\text{asymmetric} & \\
f(x) = A \cdot e^{-\frac{(x-x_0)^2}{2\sigma_{\text{low}}^2}}, \text{ if } x < x_0 & \\
& \text{ and } A \cdot e^{-\frac{(x-x_0)^2}{2\sigma_{\text{high}}^2}}, \text{ if } x > x_0 \\
CS = A \cdot \sqrt{2\pi} \cdot \sigma & \\
\text{where } \sigma = \frac{\sigma_{\text{low}} + \sigma_{\text{high}}}{2} & \\
\text{asymmetry coefficient } \alpha = \frac{\sigma_{\text{low}}}{\sigma} - 1 = 1 - \frac{\sigma_{\text{high}}}{\sigma} & \\
-100\% < \alpha < +100\% & \\
\end{align*}
\]

\[
\begin{align*}
x_{\text{peak}} = x_0 & \\
<x> = x_0 & \\
\end{align*}
\]

\[
\begin{align*}
<x> &= \\
& \int_{-\infty}^{x_0} \frac{-e^{-\frac{(x-x_0)^2}{2\sigma_{\text{low}}^2}}}{x \cdot A} \, dx + \int_{x_0}^{\infty} \frac{-e^{-\frac{(x-x_0)^2}{2\sigma_{\text{low}}^2}}}{x \cdot A} \, dx \\
& \int_{-\infty}^{x_0} \frac{-e^{-\frac{(x-x_0)^2}{2\sigma_{\text{high}}^2}}}{A} \, dx + \int_{x_0}^{\infty} \frac{-e^{-\frac{(x-x_0)^2}{2\sigma_{\text{high}}^2}}}{A} \, dx \\
& = x_0 - \frac{4\alpha \sigma}{\sqrt{2\pi}}
\end{align*}
\]
The asymmetry coefficient “alpha” is applied for models [1-3].

Asymmetry coefficient “\( \alpha \)” (in %) and reduced width “\( \sigma \)” are used to describe an asymmetrical Gaussian momentum distribution.
Fragment mean velocity is calculated with the chosen model

then the peak position will be calculated using the asymmetry coefficient “alpha” and the momentum distribution width “sigma”
Asymmetry coefficient from the Convolution model (1)

To obtain distribution characteristics from different models for the current configuration (beam, target, fragment)

See the next slide
Asymmetry coefficient from the Convolution model (2)

Convolution Model: #1 [dSurface]; Parameter: "Asymmetry"

$^{40}\text{Ar (140.0 MeV/u) + }^{9}\text{Be } \rightarrow \text{ N=0-200}$

Convolution Model: #1 [dSurface]; Flag of Exceeding: YES; $A_{beam}/2$ symmetry: YES

Sigma$^{Conv}$ = 91.5; Coef$^{Conv}$ = 3.000; Shift$^{Conv}$ = 0.149

Moments distributions

Velocity: Convolution -> v0(mean) = 0.992 and Calculation(V.Borer) -> v0 = 0.993 BE = 8.0 MeV SNR/V0 = 0.000

Momentum width: "Convolution" & "[1]D.J.Morrissey"; SigmaM = 87.0; Correction: Coulomb energy = No, Projectile mass = No

Convolution: 500x500x500 500x1x500 500x500x500x500

Calculation: 500x1x500x11.1 500x1x500x500x500x500

P [MeV/c]

Yields [%]

Neutrons (N)

Protons (Z)
Example at low energy ($^{40}\text{Ar} \ 40 \text{ MeV/u}$), #1
Example at low energy ($^{40}$Ar 40 MeV/u), #2
Example at low energy ($^{40}\text{Ar}$ 40 MeV/u), #3

“Distribution” method

Monte Carlo method
$^{82}$Se momentum distribution results (will be soon)