DE LA RECHERCHE À L'INDUSTRIE

ELASTIC SCATTERING ANGULAR DISTRIBUTIONS IN THE FAST ENERGY RANGE

WPEC/SG-35

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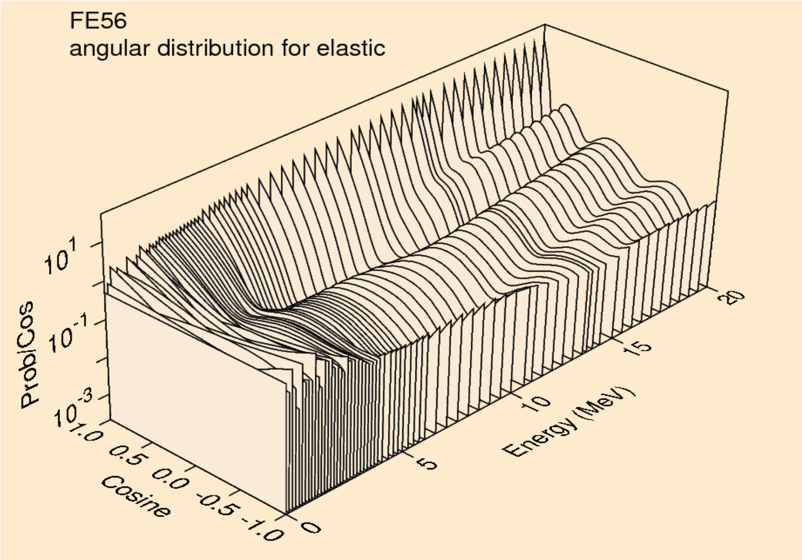
Outlines

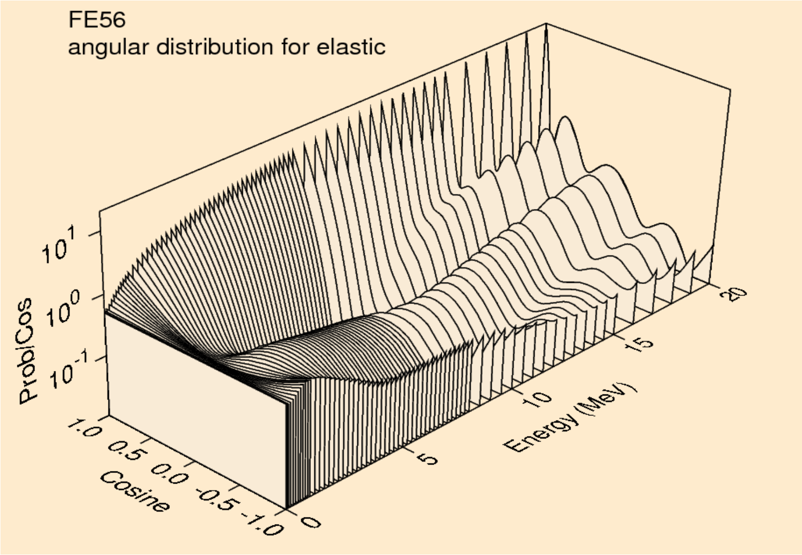
- Impact of the elastic scattering angular distributions on **keff**
- Impact of the elastic scattering angular distributions on **sodium void reactivity effect (SVRE)**
- Impact of the a_l coefficients on **shielding benchmarks**

Reich-Moore approximation vs. Optical Model



SAD calculated with the resolved resonance and optical model parameters

(CONRAD + ECIS codes)

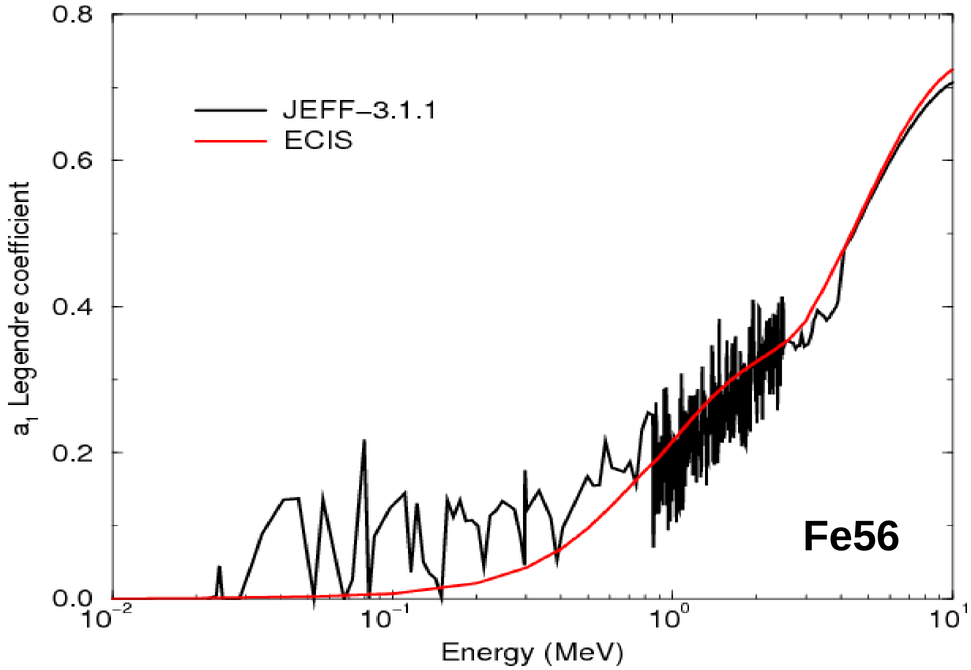


SAD calculated with optical model parameters

(ECIS code)

Reich-Moore approximation vs. Optical Model

Impact on integral calculations of the mean anisotropy μ obtained from Optical Model ?



Keff

Impact on the keff values:

The impact of the elastic SAD on keff values was investigated with EOLE, MASURCA and ZPPR integral experiments:

- •Fe56 Stainless steel heavy reflector (PERLE experiment in the EOLE facility)
- •Al27 Aluminium mock-up benchmark (AMMON experiment in the EOLE facility)
- •Na23 Interpretation of several MASURCA and ZPPR experiments

Summary of the results calculated with the Monte-Carlo code **TRIPOLI**

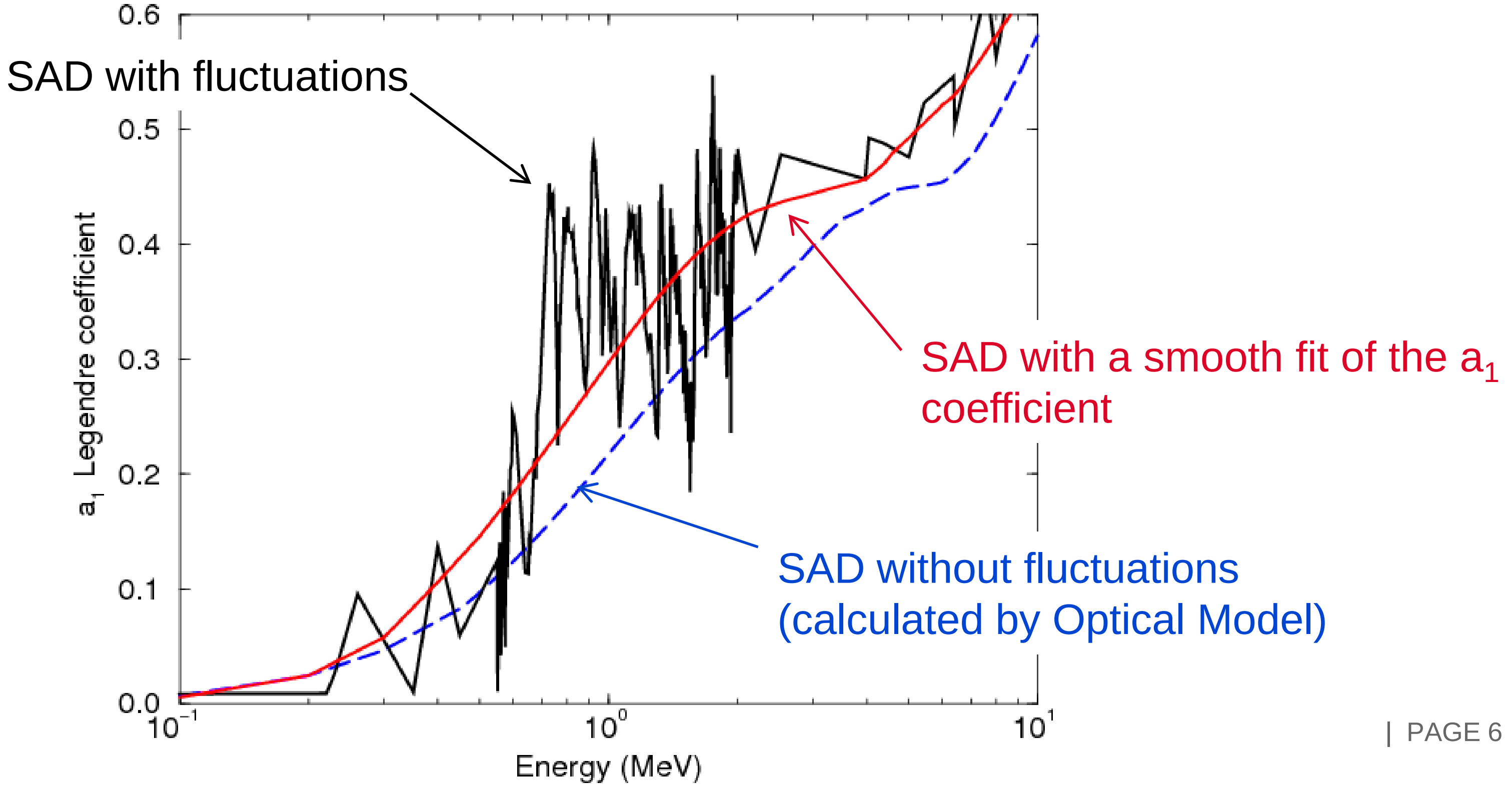
		Mock-up benchmark	Large core configuration
Impact of the elastic SAD	(anisotropic vs. isotropic law)	800 – 1300 pcm	
Impact of the energy mesh	(broad vs. fine energy mesh)	< 100 pcm	
Impact of the model	(optical model vs. Reich-Moore model)	< 200 pcm	< 10 pcm

Sodium void reactivity effect (SVRE)

Impact on the SVRE:

The impact of the elastic SAD on the SVRE was investigated with MASURCA and ZPPR integral experiments. The calculations were performed with the deterministic code **ERANOS**

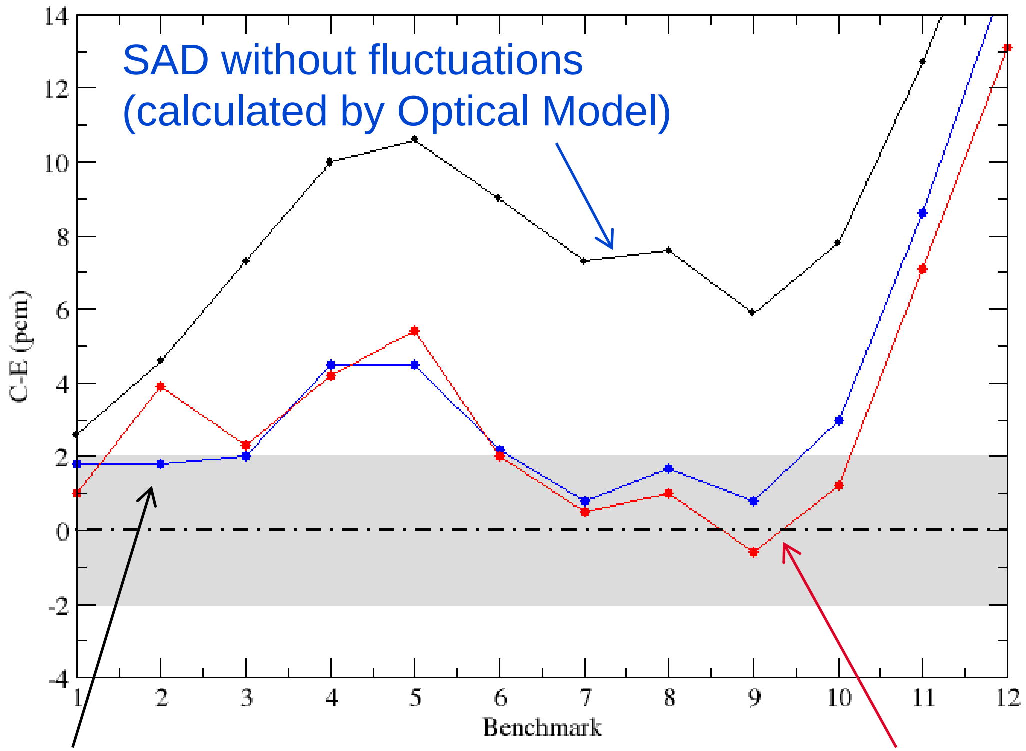
Those calculations were carried out using 3 different **Na23** elastic scattering angular distributions:



Sodium void reactivity effect (SVRE)

Impact on the SVRE (ZPPR-10A benchmark):

Significant improvement of the C-E results by using SAD calculated by optical model + fit of a_1



SAD with « fluctuations »

SAD with a smooth fit of the a_1 coefficient

Shielding benchmark

- The use of “optical model + fit of a_1” is a good solution when no SAD data exist (or when no correct Reich-Moore analysis of the SAD is available)

- However, this approach is **valid only for small penetration** when the flux attenuation is dominated by the a_1 coefficient.

- The interpretation of the PERLE experiment performed in the EOLE facility (iron Benchmark) shows that such an approach can be used **below a penetration of 20 cm**.

- This rather arbitrary limit was confirmed by C. Jouanne with the Total Monte Carlo interpretation of an ASPIS benchmark (iron benchmark):

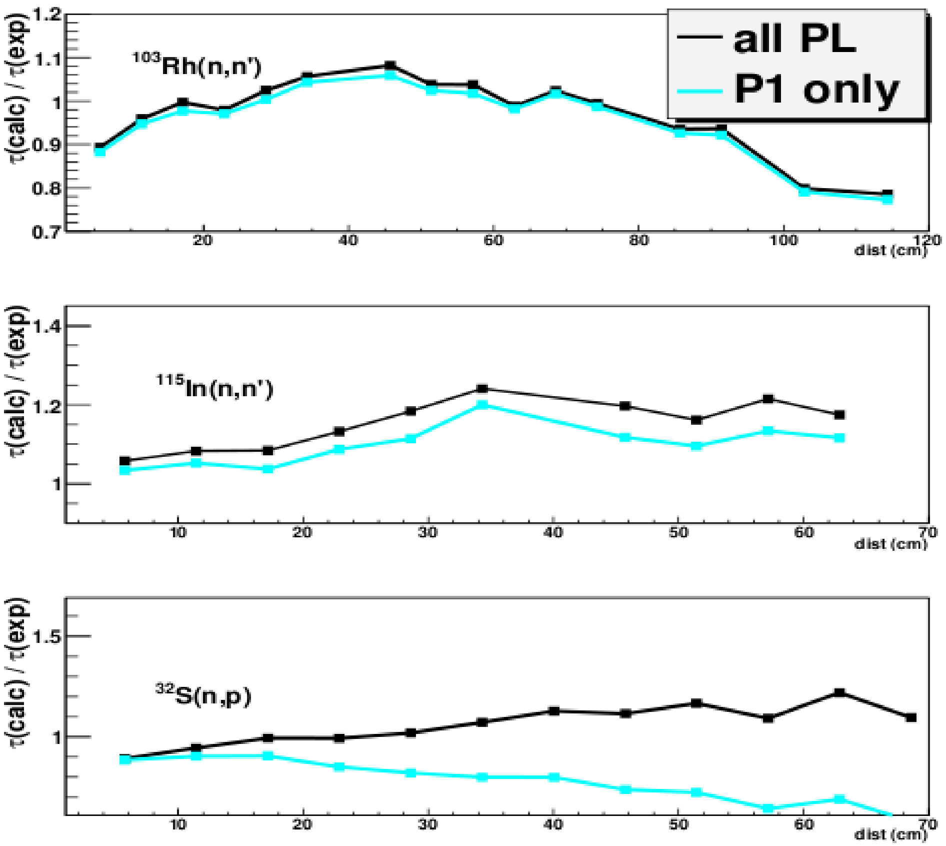
C. Jouanne, “Sensitivity of the shielding benchmarks on variance-covariance data for scattering angular distributions ”, ND2013.

“This article is intended to present the use of the covariance matrices of the scattering cross sections and scattering angular distributions of the elastic scattering on Fe56 using a benchmark of neutron propagation in an iron bulk”

Shielding benchmark

ASPIS benchmark (iron)

Total Monte Carlo results obtained with the TRIPOLI code shows that **above 20 cm**, the flux attenuation is dominated by higher order polynomial coefficient uncertainties



Conclusions

Below a penetration of ~20 cm

•Optical model + fit of a_1 can be used to simulate the average behavior of the mean anisotropy (in order to solved the problems of fine/broad energy mesh and the problems linked to the Reich-Moore description of the SAD)

Above a penetration of ~20 cm

•The a_1 coefficients are not able to account for the impact of the anisotropy