Uncertainty quantification of optical model parameters using Unscented Transform Kalman filter technique

Aman Sharma, A. Gandhi and A. Kumar

Department of Physics, Banaras Hindu University, Varanasi, India- 221005

Abstract:

Uncertainty quantification of the optical model parameters is important for the nuclear data evaluation because it allows us to calculate the uncertainties associated with the optical model predictions. These uncertainty estimates also provide us further insight about the uncertainties associated with the model itself. Model parameters are generally determined by comparing the model predictions and the experimental data. There have been few attempts for determining the correlations of the optical model parameters in past few decades, but these methods require to calculate the Jacobian of the model equations with respect to the model parameters, which is a difficult task and also approximates the uncertainties only up to the first order of the Taylor series expansion. In the present study we have used the Unscented Transform Kalman filter for the estimation of optical model parameters and their correlations. This method does not require to calculate the Jacobian matrix and also approximates the uncertainties at least up to the second order of the Taylor series expansion. We have estimated the optical model parameters and their correlations for the spherical nuclei of A~50 by comparing the experimental differential cross sections of the elastically scattered neutrons with the DWBA calculations. We have used the Talys nuclear reaction code to perform the DWBA calculations. Unscented Transform Kalman filter technique works well and provide good estimates of the parameters and also shows that some parameters are heavily correlated. This method also has the potential to be used for various nuclear reaction models other than the optical model and also it can be used for the charged particle reactions. Methodology and the results of this study will be presented in detail during the conference.