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A new python-based phenomenological R-matrix code

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We have recently begun developing a new phenomenological R-matrix code with the aims of exploring (a) how to optimize the evaluator's use of the code, and (b) how to integrate machine learning approaches to assist with R-matrix analysis.

We use the Wigner-Eisbund parameterization of the R-matrix [1], with a user-adjustable boundary condition [2]. The data included in the calculation can be filtered using a flexible system, similar to the data segments used in AZURE [3], with calculations performed only for the currently selected subset of data. The entire calculation object can be serialized and saved to (or loaded from) a compressed JSON format file. This includes the particle pairs and channels, the R-matrix pole parameters, the data sets being analysed, and all the required Coulomb wave functions (which then only need to be calculated once).

The code is written in python and can be used interactively via jupyter notebooks. A graphical user interface has been written to allow editing of the R-matrix pole energies and widths, with real-time updates to the calculations and plotting of the results. The use of python means the calculations can be very easily scripted to add, edit and remove poles. This allows, for example, easy generation of training data for machine-learning-based models such as convolutional neural networks.

We will give an overview of the code, its design, preliminary results and benchmarking, and future plans.

[1] A. M. Lane and R. G. Thomas, Rev. Mod. Phys. 30, 257 (1958)
[2] F. C. Barker, Aus. J. Phys 25, 341 (1972)
[3] R. E. Azuma, Phys. Rev. C 81, 045805 (2010)

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