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Development of innovative methods for a fission trigger construction

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The development of innovative methods for fission trigger construction addresses the challenge of recognising fission signature in very complex detector's response functions.
The fission recognition approaches available today have intrinsic limitations.
To draw a clearer picture, the existing dedicated detectors for fission triggering present constraints regarding experimental setup geometry and fissioning mechanism compatibility.
The numerical alternatives for fission signature recognition, such as calorimetry or n-fold gamma coincidence, if applicable, can cause a major loss in statistics.
Despite the fission tag approach, in fissioning systems that require the use of a primary beam, fission can become a minor nuclear reaction compared to other processes.
Additionally, with the increasing size of nuclear physics experimental setup and the need to recognise rarer reaction mechanism, one of the main challenges in nuclear physics is to develop more and more selective data analysis methods for more and more complex datasets.
With this scenario in mind, we envisaged an AI-based fission trigger model that recognises fission solely based on the detector response function, improving event recognition statistics and without the need of an ancillary detector. This AI model could be used to evaluate the impact of each observable into identifying fission.

This AI-based fission trigger (classification model) is being developed for the ν-Ball2 gamma spectrometer (PARIS configuration) to study correlations measured with the use of a spontaneous ^{252}Cf fission source. A dedicated training dataset was acquired using an ionisation chamber for a clean fission classification label. Another neural network model was developed to predict the fission event timing with enhanced time resolution (regression model). This result was achieved thanks to a user-custom loss function that allows to improve the ionisation chamber time resolution from 5-6 to ~3 ns with reduced computational cost. Further details will be presented at the talk.

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