Validation and uncertainty quantification are two important areas to investigate when developing methods. Current work to produce a nuclear forensics methodology that uses machine learning techniques to attribute the reactor-type of origin, burnup, and time since irradiation (TSI) of separated plutonium samples is entering that stage of development. The forensics signature used for this attribution is a set of isotope ratios present in the separated plutonium. For the purposes of model validation, a small quantity of LEUO¬2 was irradiated at the Missouri University Research Reactor (MURR) and the produced plutonium was separated using PUREX chemical process. The isotopic composition was characterized using both destructive and nondestructive techniques. The data collected from this sample presents an additional opportunity to test the performance of the nuclear forensics methodology, to ensure that the conclusions drawn by the models developed with values from simulation are indeed reflective of the reality of the physical samples. The predictions made by the methodology that uses machine learning were also compared to predictions made with a legacy methodology, which uses a maximum likelihood method to attribute the samples. Additional intra-element isotope ratios using cerium were also investigated for their potential use as an additional way to discriminate a sample's TSI.

On the topic of uncertainty quantification, a study was devised to quantify the effect of measurement uncertainty on the performance of the attribution methodology. With the validation data that have been produced via experimental irradiations at MURR as will as the High Flux Isotope Reactor (HFIR), a dataset is produced which samples each isotope ratio from a normal distribution characterized by the measured isotope ratio and measurement uncertainty. The distribution of possible measured values can then be used to determine how the model performance is affected by the natural variation in measured isotope ratio values.