

Nondestructive assay techniques are widely used in nuclear safeguards to identify and determine the composition of SNM samples. Measured time series of escaping neutrons yield neutron multiplicity moments which are used in conjunction with theoretical models to infer sample properties such as mass and multiplication. Supporting computational work to date has relied on simplistic point kinetic models, costly Monte Carlo simulations, or ad hoc implementations in deterministic transport codes. We present a rigorous phase-space deterministic formulation for the moments of the probability distribution of neutrons leaking from an SNM sample of arbitrary geometry which has been implemented in the LANL transport code, PARTISN. Specifically, time-gated central and reduced factorial moments of the multiplicity distribution, and hence the Feynman-Y function, are computed for multiplet-emitting spontaneous fission source with energy discrimination enabled through an energy dependent detection efficiency. Leveraging reconstruction methods previously developed by the authors, a small number of computed factorial moments are used to recover the multiplicity distribution in its entirety. Numerical results are compared against MCNP code simulations and point kinetic model results to assess accuracy and efficiency and to establish the importance of incorporating finite sample size as well as neutron energy and direction dependence in computation of the moments.