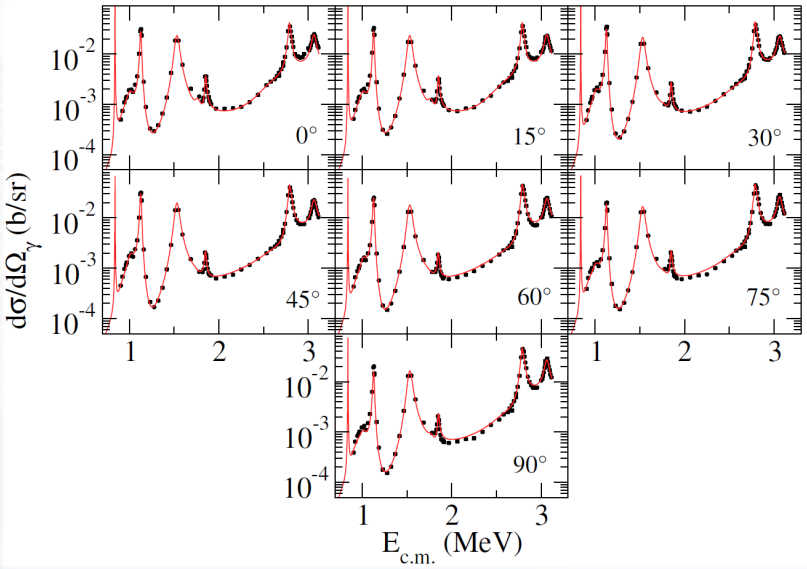
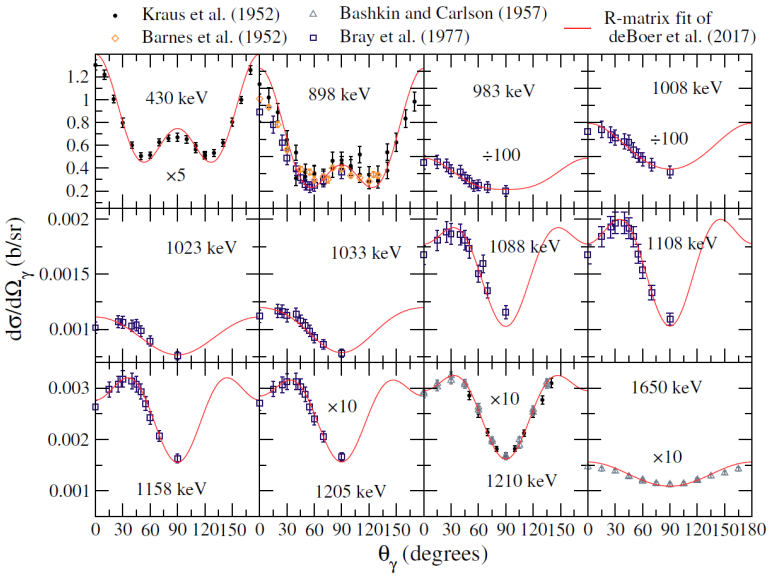
Investigation of secondary γ-ray angular distributions using the $^{15}N(p,\alpha_1\gamma)^{12}C^*$ reaction

The observation of secondary γ-rays provides an alternative method of measuring cross sections that populate excited final states in nuclear reactions. Their angular distributions also provide information on the underlying reaction mechanism. Despite a large amount of data of this type in the literature, publicly available R-matrix codes do not have the ability to calculate these types of angular distributions. The mathematical formalism for these types of calculations, as derived in Brune and





deBoer (2020), was implemented in the R-matrix code AZURE2, and calculations are compared with previous data from the literature for the $^{15}N(p,\alpha_1\gamma)^{12}C^*$ as well as new measurements, made at the University of Notre Dame Nuclear Science Laboratory using the Hybrid Array of Gamma Ray Detectors (HAGRiD). Excellent agreement between data and the phenomenological fit is obtained up to the limit of previous fits and the fit is extended to explore a higher energy region as well.

deBoer *et al.* PRC **103**, 065801 (2021)
NSF Grant No. PHY-2011890 and PHY-1430152 (JINA-CEE)