Molecular beam epitaxy is ideal for growing stacks of functional materials to utilize interfaces to create emergent phenomena such as magnetic skyrmions. Strontium ruthenate ($\text{SrRuO}_3$) and SrRuO$_3$-based heterostructures have been at the center of a debate on whether a hump-like feature appearing in Hall resistivities is sufficient evidence to prove the presence of skyrmions in a material.

Here, the PARADIM In-House Team synthesized a simple bilayer combining a positive anomalous Hall effect (AHE) layer ($\text{Sr}_{0.6}\text{Ca}_{0.4}\text{RuO}_3$) with a negative AHE layer ($\text{SrRuO}_3$). The bilayer shows a hump-like feature in the Hall resistivity that closely resembles the one often attributed to skyrmions. Multiple tests for skyrmions were performed, but no evidence of their existence was found.

In related work, the team demonstrated the highest residual resistance ratio, $\text{RRR} = \rho [300 \text{ K}] / \rho [4 \text{ K}] = 205$, for SrRuO$_3$ thin films ever achieved. RRR is a measure of film quality, and our results exceed the best films grown by others using machine learning (RRR = 80) as well as the best single crystals (RRR = 162). This achievement shows the power of a team-based approach to synthesis science.