Electron Cyclotron Resonance (ECR) ion sources are an essential component of heavy-ion accelerators due to their ability to produce wide range of ions as required by these facilities. The ever-increasing intensity demands have led to remarkable performance improvements of ECR injector systems, due to advances in magnet technology as well as an improved understanding of the ECR ion source plasma physics. At the same time, enhanced diagnostics and simulation capabilities have improved the understanding of the injector beam transport properties. However, the initial ion beam distribution at the extraction aperture is still a subject of research. Due to the magnetic confinement necessary to sustain the ECR plasma, the ion density distribution across the extraction aperture is inhomogeneous and charge-state-dependent. In addition, the ion beam is extracted from a region of high axial magnetic field, which adds a rotational component to the beam; this leads to emittance growth. This talk will review the ongoing simulation and diagnostics efforts at LBNL to develop a consistent modeling tool for the design of an optimized beam transport system for ECR ion sources.