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A Symplectic Look at İnönü's Large Group for Group Contractions

İnönü-Wigner group contractions were introduced in 1953 to explain how the symmetries of two systems connected by a limit in a parameter are related; for example the Poincaré group contracts to the Galilei group as the speed of light goes to infinity. In practice, a contraction is carried out on the Lie algebra $\mathfrak{g}$ of a Lie group G, by rescaling some of its generators with a parameter ε and taking the limit $\varepsilon \to 0$ of the Lie bracket. In 1956, answering a question of Cahit Arf, Erdal İnönü constructed a large group $L = \mathfrak{g} \rtimes_{\mathrm{Ad}} G$ that contains G together with its İnönü-Wigner contractions satisfying İnönü's condition (the rescaled generators span an $\mathfrak{h}$-invariant complement of the subalgebra $\mathfrak{h}$).

Recently, Khasanov and Kuperstein in 2011 described contractions through Lie algebra bundles; and Prinz, Schmeding and Schwartz in 2026 through germs of analytic curves. In this talk, we describe İnönü's construction of large algebra corresponding to the large group in both perspectives and show that every İnönü-Wigner contraction of $\mathfrak{g}$ is a subquotient of the large algebra $\mathfrak{l}$, the Lie algebra of L, and a subalgebra when İnönü's condition holds. Finally, for a contracted group K of G, we show that the phase spaces T^*G and T^*K of the original and the contracted systems both arise as symplectic reductions of T^*L, and discuss what this means for the corresponding Hamiltonian dynamics.