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Associahedra, cluster algebras, and scattering amplitudes

The past several years have seen a flurry of activity in the physics of scattering amplitudes, in part motivated by a new geometric approach to the problem, which finds the solution encoded in a geometrical object, most famously in the amplituhedron of Arkani-Hamed and Trnka for N=4 super Yang-Mills. I will discuss a version of this approach for a simpler quantum field theory (biadjoint scalar φ³ theory), where the geometrical object encoding the answer at tree level has recently been shown by Arkani-Hamed et al. to be an associahedron, a polytope originally defined by Jim Stasheff in the context of homotopy theory, and now well-known thanks to its connection to type A, cluster algebras. In recent work with my students Bazier-Matte, Chapelier, Douville, Mousavand, and former student Yıldırım, we showed that the construction of the associahedron developed by Arkani-Hamed et al. for their purposes is also applicable to other finite type cluster algebras, yielding simple constructions both of generalized associahedra, and, unexpectedly, of the Newton polytopes of the cluster variables. Time permitting, I will discuss the possibility (which we are investigating with Arkani-Hamed) that this construction in other types also has a physical interpretation.