A Diagram Software Tool for Undergraduate Particle Physics

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Introductory courses in particle physics contain many new concepts that undergraduate students are not very familiar with. Amongst the most significant of these are Feynman diagrams: diagrams that pictorially describe scattering processes that take place in colliders and fixed target experiments. While these diagrams are wonderfully pedagogical in many ways, their actual construction is riddled with subtleties that many students find a challenge to apprehend.

I will describe here some of the results of an ongoing study concerning a software tool that is in the process of development for a senior-level undergraduate course in particle physics at the University of Waterloo. The tool has a number of built-in features, including rules for a model scalar field theory, rules for constructing diagrams for the strong, weak and electromagnetic interactions, the ability to manipulate diagrams relative to one another (thereby demonstrating which processes are equivalent), and the ability to convert a diagram into its relevant mathematical expression.

I will give an on-line demonstration of the tool, showing how it works for each of the cases described above. I will highlight its virtues and current limitations, and I will also discuss proposals for its improvement, including extensions to optics and condensed matter physics.

I will furthermore describe the results of an ongoing study to determine the pedagogical efficacy of the tool. Students are provided with an in-class demonstration on how the tool works. The tool is accessible over the web, so students can make use of it at their leisure from their own computers. Take-home assignments involve a randomized use of the tool that that allows us to probe its effectiveness for enhancing the ability for students to learn the basics of modern subatomic physics.

The intended audience are any faculty members that teach particle physics, nuclear physics, or some other advanced undergraduate physics course.