قطب علمی سیستم‌های پیچیده و ماده چگال

سمینار هفتگی گروه اطلاعات کوانتومی

سه‌شنبه ۱۳۹۳/۱۱/۲۸، ساعت ۱۵:۰۰، آمفی تئاتر د انشکده‌ی فیزیک

Quantum Algorithms for Simulating Quantum Field Theories

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Abstract

Relativistic quantum field theory describes all of the fundamental interactions in nature, with the possible exception of gravity. In this talk I discuss the computational complexity of these theories. In particular, I will describe the quantum algorithm of Jordan, Lee, and Preskill for simulating real-time evolution in an interacting massive scalar quantum field theory in four and fever space-time dimensions. The run time of the algorithm scales polynomially in the number of incoming particles, their energy and the desired precision. Hence the algorithm achieves an exponential speedup relative to the best existing classical algorithms. This result supports the conjecture that all physical process in nature can be simulated effectively using a universal quantum computer.

References

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