# 格点系统的物理与计算

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# 摘要

We review the developments in the past decade on holographic entanglement entropy, a subject that has garnered much attention owing to its potential to teach us about the emergence of spacetime in holography. We provide an introduction to the concept of entanglement entropy in quantum field theories, review the holographic proposals for computing the same, providing some justification for where these proposals arise from in the first two parts. The final part addresses recent developments linking entanglement and geometry. We provide an overview of the various arguments and technical developments that teach us how to use field theory entanglement to detect geometry. Our discussion is by design eclectic; we have chosen to focus on developments that appear to us most promising for further insights into the holographic map.

This is a preliminary draft of a few chapters of a book which will appear sometime in the near future, to be published by Springer, as part of their Lecture Notes in Physics series. The book in addition contains a discussion of application of holographic ideas to computation of entanglement entropy in strongly coupled field theories, and discussion of tensor networks and holography, which we have chosen to exclude from the current manuscript.

# 致谢

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Chapter 1

# 经典格点系统

## 1.1 Ising model

在固体中，我们通常会遇到晶格结构，这些晶格结构很大程度上促使我们把系统想象为处于格点上。不需要严格的量子力学的情况下我们实际上就已经接触过这种描述了：Ising model。考虑一个晶格，上面格点标号 $i$。每一个格点上面有一个变量 $\sigma_i$，只有两个分立的取值 $\sigma_i = \pm 1$。Ising mode 认为，系统的 Hamiltonian 可以很好地描述为

$$H = -J \sum_{\langle i,j \rangle} \sigma_i \sigma_j \tag{1.1.1}$$