

**Thursday, October 3, 2024**

Refreshments at 3:15pm outside PSF 101  
Colloquium from 3:30pm - 4:30pm in PSF 101

## **Scattering Theory Redux: Supercolliders, Fluid Dynamics, and Black Holes**

**Professor Clifford Cheung**  
**Caltech**



### **Abstract:**

Scattering amplitudes are fundamental observables that encode the dynamics of interacting particles. In this talk I describe how to systematically construct these objects without reference to a Lagrangian or Hamiltonian. The physics of real-world particles like gravitons, gluons, and pions are thus derived from the properties of amplitudes rather than vice versa. Remarkably, the expressions gleaned from this line of attack are marvelously simple, revealing new structures long hidden in plain sight. In particular, I describe how gravity serves as the "mother of all theories" whose amplitudes secretly unify, among others, all gluon and pion amplitudes. These ideas have far-reaching theoretical and phenomenological connections, e.g. to fluid mechanics and to new approaches to the black hole binary inspiral problem.

### **Biography:**

Clifford Cheung is a theoretical physicist at the California Institute of Technology. He received his B.S. from Yale University in 2004 and his Ph.D. in physics from Harvard University in 2009 before joining the faculty at Caltech. He is a recipient of an Early Career Research Award from the Department of Energy and is a fellow of the Alfred P. Sloan foundation. Prof. Cheung's research explores fundamental puzzles in particle physics, cosmology, and quantum field theory. This work makes contact with open questions regarding the origin and nature of dark matter as well as the properties of the nascent universe during cosmic inflation. Prof. Cheung is also interested in the study of scattering amplitudes, which are fundamental observables encoding the dynamics of interacting particles. At a basic level, these efforts are dedicated to understanding why the laws of physics are as they are—in particular, discerning which aspects of the natural world are inevitable purely from consistency with basic physical principles.

Host: Prof. Matthew Baumgart

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