

# Holographic thermodynamics

(lecture 1)

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## Outline:

- Basic thermodynamics
- CFT and  $\mathcal{N} = 2^*$  thermodynamics at weak coupling
- Gauge/gravity correspondence
- $\mathcal{N} = 2^*$  thermodynamics at strong coupling:
  - Effective action and EOMs
  - High-T thermodynamics
  - General thermodynamics and comparison to RHIC
  - Critical phenomena
- Cascading gauge theory thermodynamics
  - Field theory description
  - Effective actions,  $\dots$
  - Confinement-deconfinement transition
  - Chiral symmetry breaking phenomena

# Holographic hydrodynamics

(lecture 2)

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## Outline:

- Hydrodynamics as an effective field theory
- Kubo formula for shear viscosity and hydrodynamic modes
- Hydrodynamics of  $\mathcal{N} = 4$  SYM plasma
  - Kubo formula
  - Gauge invariant fluctuations
  - Sound mode
  - Shear mode
- Shear viscosity bound
- Nonconformal hydrodynamics
  - Sound mode
  - Bulk viscosity bound
  - Bulk viscosity at criticality

# Thermodynamics and hydrodynamics beyond strong coupling

(lecture 3)

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## Outline:

- 't Hooft coupling and finite- $N$  corrections
- Violation of the shear viscosity bound
- Causality constraints and hydrodynamics