Precision counting of black hole microstates

- Any theory of quantum gravity should provide a microscopic origin of the macroscopic entropy of black holes:

$$\Omega \sim e^{S_{\rm BH}} \ , \qquad S_{\rm BH} = \frac{\mathcal{A}}{4G_N} + \dots$$

Bekenstein Hawking 1970s

- This relation is known to hold in string theory for large BPS black holes. Micro-states are D-brane bound states described by some conformal field theory, dual to near-horizon AdS throat.

$$\Omega \sim \exp\left(2\pi\sqrt{cN/6}\right)$$

Strominger Vafa 1996

- Can one check agreement for finite size black holes ?

Black hole bound states and wallcrossing

- For fixed charges, a spherically symmetric black hole may not be the only solution, multi-centered solutions may also contribute:

- The total number of states Ω can be expressed in terms of indices Ω^S associated to single centered black holes:

$$\Omega(\gamma; z) = \text{“} \sum_{\gamma=\sum \alpha_i} g(\{\alpha_i\}, z) \prod_i \Omega^S(\alpha_i) \text{”}$$

- The prefactor $g(\{\alpha_i\}, z)$ counts the bound state degrees of freedom. It is computable exactly using localization, and non zero only in certain chambers of moduli space.

Manschot BP Sen

Other research projects

- Computing all quantum corrections to the hypermultiplet moduli space in $\mathcal{N} = 2$ string vacua.
  - A first step before understanding more realistic $\mathcal{N} = 1$ vacua
  - Closely related to precision counting of $\mathcal{N} = 2$ BPS black holes
  - Rich mathematical structure, beyond standard mirror symmetry

Alexandrov, Manschot, Persson, BP, Vandoren, . . .

- New methods for computing theory amplitudes
  - CFT correlators F must be integrated over a fundamental domain $\mathcal{F} = H/\Gamma$ of the Siegel upper-half plane
  - If F can represented as a Poincaré series $\sum_{g \in \Gamma/\Gamma_\infty} f|_\gamma$, then $\mathcal{F}$ can be unfolded into the strip $\mathcal{S} = H/\Gamma_\infty$:

$$\int_{H/\Gamma} F = \int_{H/\Gamma_\infty} f = \sum [\text{field theory amplitudes}]$$

Angelantonj Florakis BP