Near-Extremal Limits of de Sitter Black Holes

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Women in Theoretical Physics - Premio Milla Baldo Ceolin

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About me

FWO **PhD** fellowship at Ghent University
Supervisor: Thomas Mertens

Master in Physics, University of Milano Bicocca

Master Thesis research at IoP - University of Amsterdam
Supervisors: Alejandra Castro and Chiara Toldo
Internal Supervisor: Silvia Penati

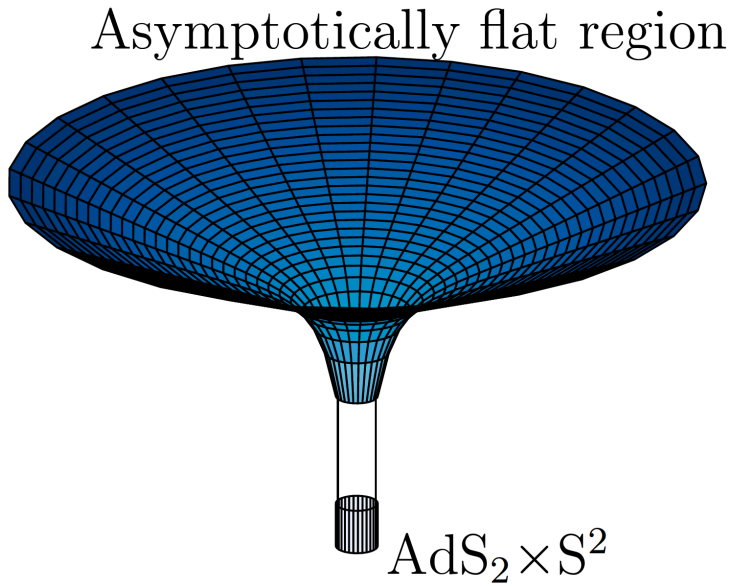
Bachelor in Physics, University of Milano Bicocca

Research interests

Lower-dimensional quantum gravity models & connection with higher-dimensional black holes

Jackiw- Teitelboim (JT) gravity

- 2D dilaton gravity model
- Describes dynamics of higher-dim near-extremal black holes
- Fully solvable model!
- Connections with condesed matter systems: describes low energy sector of SYK model



$$I_{\mathrm{JT}} = \int_{\mathcal{M}} \sqrt{g}\Phi(R+2) + \frac{1}{2}\int_{\partial_{\mathcal{M}}} \sqrt{h}\Phi(K-1)$$

Master Thesis Research

Near-Extremal Reissner-Nordström black holes in de Sitter space

Solutions of Einstein-Maxwell theory with a positive cosmological constant ($\Lambda > 0$):

$$I = \frac{1}{16\pi G_4} \int d^4x\sqrt{-g}(\mathcal{R} - 2\Lambda - F_{\mu\nu}F^{\mu\nu})$$

Extremal black holes: coincident horizons, $T_H = 0$

Near-extremal black holes: horizons slightly separated , $T_H \neq 0$

- How does the presence of the cosmological horizon modifies our description of near-extremal black holes?
- Thermodynamics at the cosmolgical horizon

$$dM = -T_c dS_c + \Phi_c dQ + \Omega_c dJ$$

  $\rightarrow$ to what extent can we treat r_c as a thermal entity in its own right?
- Excitations above extremality: dimensional reduction of Einstein-Maxwell to 2D $\rightarrow$ JT gravity

Future directions

Main goal of my PhD: studying quantum black holes from a lower dimensional perspective using 2D quantum gravity models (e.g. JT gravity)

- Kerr black holes in de Sitter space: impact of J on the description of near-extremal black holes
  $\rightarrow$ work in progress with C. Toldo (Harvard U.)

- Supersymmetric JT model: exact amplitudes for SUSY black holes from a group theory perspective. See arXiv[2310.04245] in collaboration with A. Belaeys and T. G. Mertens (Gent U.)

Thank you for your attention!