

The Research Group
High-Energy Physics

has the honor to invite you to the public defence of the PhD thesis of

Dongming He

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

**Holographic defect conformal field theories:
top-down construction and bottom-up application**

Curriculum vitae

Dongming He finished his bachelor in physics at University of Science and Technology of China in 2020, then master in theoretical physics at University of Amsterdam in 2022. In the same year, he started the doctoral research at Vrije Universiteit Brussel under the supervision of Prof. Ben Craps and later Christoph Uhlemann as well.

His doctoral research focused on the AdS/CFT correspondence, which is a theoretical framework for the holographic realization of quantum gravity. More specifically, he focused on the effect of boundaries and defects in AdS/CFT in both string theoretical models and bottom-up toy models.

Supervisor:

Prof. dr. Ben Craps (VUB)

Co-supervisor:

Prof. dr. Christoph Uhlemann (VUB)

The defence will take place on

Monday, June 22, 2026 at 2.30 p.m.

VUB Etterbeek campus, Pleinlaan 2, Elsene,
Auditorium i 2.01

Members of the jury

Prof. dr. Yue Gao (VUB, chair)

Prof. dr. Alexander Sevrin (VUB)

Prof. dr. Alberto Mariotti (VUB)

Prof. dr. Nikolay Bobev (KU Leuven)

Prof. dr. Costas Bachas (ENS, FR)

Abstract of the PhD research

Unifying quantum mechanics and gravity is one of the fundamental goals of modern theoretical physics. An important breakthrough in this effort is the holographic principle, which states the equivalence between gravities on Anti-de Sitter spacetimes (AdS) and conformal field theories (CFT) on the boundary, known as the AdS/CFT correspondence. This correspondence provides powerful tools to study strongly interacting quantum mechanical systems by translating difficult problems into tractable ones on the gravity side, and vice versa.

While the correspondence was first introduced to quantum mechanical systems of infinite extent, realistic physical systems rarely extend infinitely; they are typically characterized by boundaries, defects, or interfaces. Extending the holographic principle to conformal field theories with boundaries (BCFTs) introduces rich dynamics and new geometric structures on the gravity side. This correspondence has been constructed in toy models with localized branes in spacetime, and in string theory with precise definitions. When the number of degrees of freedom on the boundary becomes large, the system admits an intermediate holographic description known as double holography, in which the localized brane becomes gravitational. This idea has recently found important applications in black hole studies.

Within this general program, this thesis adds three insights.

First, we study top-down doubly holographic BCFTs: four-dimensional $\mathcal{N} = 4$ Super-Yang-Mills theories (SYM) with 1/2-BPS boundaries and defects, engineered by D3-branes ending on or intersecting D5- and NS5-branes. Using supersymmetric localization, we identify the large- N saddle points of the resulting matrix models. These saddle points are shown to match the saddle points independently derived from the holographic duals with $AdS_4 \times S^2 \times S^2 \times \Sigma$ geometry, providing precision tests of the dualities. We then study one-point functions for four-dimensional 1/2-BPS chiral primary operators using the saddle points.

Second, we analyze bulk-cone singularities in BCFT two-point functions: artifacts of the large- N limit arising from reflected null geodesics in the gravity dual. We demonstrate the stringy resolution of these singularities in both bottom-up braneworld models and top-down D1/D5 holographic BCFTs.

Finally, we apply double holography to study black holes on localized branes in a bottom-up setup. We study quantum-corrected black hole microstates and entropy through computations in the higher-dimensional bulk.