



**THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY**

**Department of Mathematics**

**SEMINAR ON PDE**

**Gravitational instantons and harmonic maps**

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Stony Brook University

**Abstract**

Axisymmetric stationary black holes in general relativity admit a classical reduction to axisymmetric harmonic maps into the hyperbolic plane  $H^2$ . In a Riemannian analogue, four-dimensional Ricci-flat metrics with torus symmetry can likewise be described locally by harmonic maps to  $H^2$ , now subject to an additional tameness condition that encodes regularity of the metric. We study such harmonic maps and application includes a construction of infinitely many new complete, asymptotically flat, Ricci-flat 4-manifolds with arbitrarily large second Betti number  $b_2$ . If time permits, I will also briefly describe how the same framework can be run in the opposite direction: in low degree one can classify such tame axisymmetric harmonic maps based on our study of gravitational instantons. Joint work with Song Sun.

**Date: 13 March 2026 (Friday)**

**Time: 9:30am**

**Zoom Meeting: <https://hkust.zoom.us/j/93250277484> (Passcode: 399689)**

*All are Welcome!*