

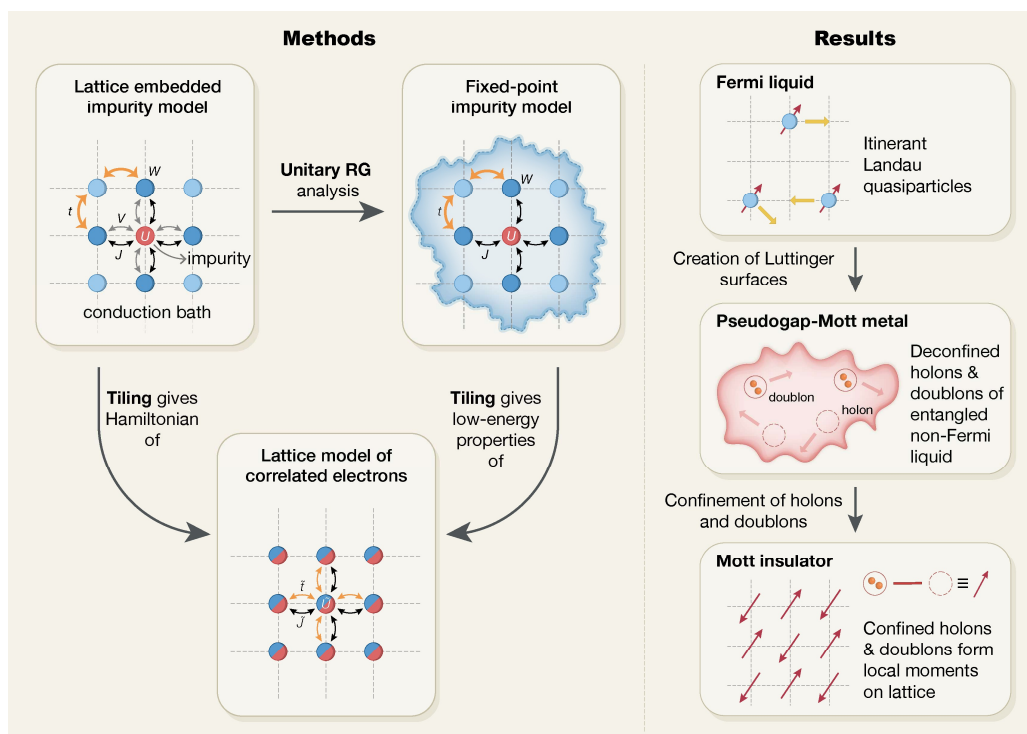
To,  
Editorial Office,  
Nature.  
Springer Nature Limited.

18<sup>th</sup> July 2025.

Dear Editors,

We submit the manuscript “**Mott Criticality as the Confinement Transition of a Pseudogap-Mott Metal**” for consideration as a regular article in Nature.

Understanding the nature and origin of the pseudogap and strange metal phases of hole-doped Mott insulators is a central challenge in strongly correlated quantum matter. The difficulty lies in answering two key questions. First, is the pseudogap related to a precursor to a symmetry-preserved Mott insulator (Taillefer, Annu. Rev. Condens. Matter Phys. 2010.1:51–70)? Second, is the strange metal a novel scale-invariant form of long-range entangled strongly interacting electrons (Phillips et al., Science 377, eabh4273 (2022))? Gained from a new theoretical framework developed here, we provide rigorous answers that display their origin in a Mott transition of a particle-hole symmetric model.



#### Technical advances (Methods panel of Figure)

- An auxiliary-model strategy that captures both local correlations and non-local interactions: a finite-dimensional lattice embedding of an Anderson impurity augmented with inter-site spin exchange and minimal bath correlations.
- Tiling via a many-body Bloch’s theorem yields an equivalent correlated-electron lattice that inherits all interactions.
- Zero-temperature renormalization-group analysis delivers impurity low-energy physics, then maps it directly onto the lattice—no self-consistency loops needed.

- High-resolution  $77 \times 77$  Brillouin-zone spectra obtained on a desktop workstation already exceed cluster-DMFT resolution; scaling to larger grids on HPC resources is straightforward and does not alter qualitative results.
- Analytically transparent and readily transferable to other correlated systems.

**Breakthrough insights (Results panel of Figure)**

- Systematic momentum-dependent depletion of Kondo screening suppresses quasiparticle weight and generates antinodal Luttinger surfaces, signalling onset of pseudogap.
- Pseudogap emerges as a long-range-entangled “Mott metal” with nodal arcs, Luttinger surfaces and holon-doublon non-Fermi-liquid excitations.
- Continuous confinement of holon-doublon pairs realises Mott’s vision of a repulsion-driven insulator.
- Exactly solvable (Hatsugai–Kohmoto) model describes scale-invariant nodal non-Fermi liquid metal at Mott critical point, displaying features universal throughout the pseudogap phase.
- Unified symmetry principle links Fermi and Luttinger surfaces, providing a clear organisational framework for pseudogap phenomena, strange metals and Mott criticality.
- The continuous Mott transition we uncover differs fundamentally from local quantum-critical scenarios inferred from other auxiliary-model methods.

We expect these results to interest a broad readership in the condensed matter and quantum materials communities, and to inspire new experimental and theoretical studies. We confirm that this manuscript has not been published elsewhere and is not under consideration by another journal. All authors have approved the manuscript and agree with its submission to Nature. Supplementary Materials include extended data and detailed derivations.

Thank you for considering our manuscript for publication in Nature. We welcome the opportunity to provide further information or revisions.

Sincerely,

A handwritten signature in black ink that reads 'Siddhartha Lal'.

SIDDHARTHA LAL

Professor

Department of Physical Sciences,

IISER Kolkata, India

Email: [slal@iiserkol.ac.in](mailto:slal@iiserkol.ac.in)

(On behalf of all authors: Abhirup Mukherjee, S. R. Hassan, Anamitra Mukherjee,  
N. S. Vidhyadhiraja, A. Taraphder, and Siddhartha Lal)