**International
Mathematical
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Short citation:

Hugo Duminil-Copin is awarded the Fields Medal 2022 for solving longstanding problems in the probabilistic theory of phase transitions in statistical physics, especially in dimensions three and four.

Long citation:

Hugo Duminil-Copin has transformed the mathematical theory of phase transitions in statistical physics and solved several longstanding open problems, in particular in the dimensions three and four as well as in the non-integrable cases in dimension 2. His work has opened up several new research directions. Here we describe only a few of his many results in this field.

The most striking results of Duminil-Copin are for Ising-type models in dimensions three and four. Together with collaborators, he has established the continuity and sharpness of the phase transition in dimension three, problems open since the eighties. In dimension four, together with Aizenman, he has proved mean field critical behavior of the Ising model and remarkably, the triviality of the four-dimensional Euclidean scalar quantum field theory, an open conjecture in physics since the 70s.

Likewise, in two dimensional dependent Fortuin–Kasteleyn (FK) percolation, Duminil-Copin and collaborators have proven continuity or discontinuity of the transition for all parameter values, and universality in the critical FK model on isoradial graphs. Furthermore, by proving rotational invariance at large scale for the critical FK models, he has taken an important step towards establishing their large-scale conformal invariance, which in turn would provide the missing ingredient for connecting them rigorously to the world of 2D conformal field theories.