The Ladyzhenskaya Lecturer 2025

Professor Enrico Valdinoci (University of Western Australia)

Enrico Valdinoci was born in 1974. He is Professor of Mathematics and Australian Laureate Fellow at the University of Western Australia. He carried out his academic career in Pisa, Rome, Milan, Berlin, Melbourne, and Perth.

He is a highly cited researcher and has been awarded the James S. W. Wong Prize, the Mahony-Neumann-Room Prize, the Orazio Arena Prize, the Book Prize of the Unione Matematica Italiana, the Prize of the Bulletin of the Brazilian Mathematical Society, and the Amerio Gold Medal Prize.

Title of the Lecture: **Long-range interactions, phase coexistence, and minimal surfaces**.

Abstract: The theory of phase coexistence is a classical field, with foundational contributions, among the others, from Gibbs, van der Waals, and Lev Landau. The associated problem of phase separation connects to the theory of minimal surfaces, as exemplified by the seminal work of Ennio De Giorgi. In this context, phase coexistence is inherently interdisciplinary, encompassing aspects of physics, materials science, mathematical analysis, and differential geometry.

Recently, significant attention has been directed toward models where surface tension, which governs phase separation, emerges as a macroscopic average of long-range particle interactions. This becomes particularly relevant at molecular scales, where nonlocal interactions are not efficiently averaged out. This framework leads to the study of the nonlocal Allen-Cahn equation and fractional minimal surfaces. We will discuss recent results in these areas and highlight some open problems that remain to be addressed.

The Lecture will be held at the joint meeting of the V.I. Smirnov Seminar on Mathematical Physics and St. Petersburg Mathematical Society on March 10, at **16-00** (St. Petersburg time) in Zoom.