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ORGANIZER:
Austrian Academy of Sciences

CONTACT:
Natalie Kapfer-Rupp, Austrian Academy of Sciences, *natalie.kapfer-rupp@oeaw.ac.at*

This event will be held in English.

Photos: Shutterstock, Jan von Plato, W. Hugh Woodin, Luiza Puiu

We would like to inform you that photos and film recordings (image and sound) will be made during the lecture.

ÖAW AUSTRIAN ACADEMY OF SCIENCES

WEDNESDAY, OCTOBER 9, 2024
START: 5 P.M. CEST
AUSTRIAN ACADEMY OF SCIENCES
SITZUNGSSAAL
DR. IGNAZ SEIPEL PLATZ 2, 1010
VIENNA
AND VIA LIVE STREAM

YOUNG ACADEMY DISTINGUISHED LECTURE SERIES

THE BOUNDARIES OF MATHEMATICS –

FROM GÖDEL TO THE STUDY OF LARGE INFINITES

JAN VON PLATO | *University of Helsinki*

W. HUGH WOODIN | *Harvard University*

SANDRA MÜLLER | *TU Wien & Austrian Academy of Sciences*

Mathematics is known as an exact science: Every statement seems to be true or false in the sense that it can be proven or disproven. Kurt Gödel shocked the mathematical community in the 1930s by showing that this is false. There are mathematical statements that can be neither proven nor disproven. While his example was of theoretical nature, today we know several examples from mathematical practice. In particular, the study of large infinities is full of statements that can be neither proven nor disproven.

The Young Academy Distinguished Lecture Series brings cutting-edge scientific topics to the public, presented by distinguished experts and a member of the Young Academy. This series of three talks followed by a discussion takes place on the 100th anniversary of Gödel's matriculation at the University of Vienna.

Jan von Plato's early work was in the foundations and development of probability theory, highlighted by the book Creating Modern Probability, published by Cambridge University Press in 1994. He later specialized in proof theory and became the second author of the celebrated monograph Structural Proof Theory of 2001, by the same publisher. In 2018, he was a plenary speaker at the International Congress of Mathematicians. His most recent work is about the shorthand manuscripts of the founder of modern proof theory, Gerhard Gentzen, and about Kurt Gödel's notes on logic and foundations of mathematics, the latter written in a forgotten shorthand which he is one of a mere handful of scholars to have mastereds. The studies on Gödel's manuscripts have been conducted within the ERC Advanced Grant GODELIANA, 2018–2024, which he has led.

W. Hugh Woodin is Professor of Philosophy and Mathematics at Harvard University, the first ever in Havard's history. He has made many invaluable contributions to the study of large infinities in set theory and a type of large infinity, the Woodin cardinals, is named after him. He received the Karp Prize in 1988 and the European Set Theory Society's Hausdorff Medal in 2013. Woodin held the Gödel Lecture in 2008, was the Tarski lecturer in 2018, and gave three invited talks, including one plenary talk, at the International Congress of Mathematicians. He is a member of the American Academy of Arts and Sciences and was recently elected to the National Academy of Sciences (US).

Sandra Müller is Associate Professor of Mathematics at TU Wien, where she currently leads the world's largest research group in inner model theory. Her main contributions are in connecting inner model theory, determinacy, and descriptive set theory. She was a L'Oréal Austria Fellow as well as an FWF Elise Richter Fellow in 2020. Müller received the prestigious FWF START prize and the prize of the Austrian Mathematical Society in 2022. The same year, she was elected to the Young Academy of the Austrian Academy of Sciences.

PROGRAMME

5:00 p.m. WELCOME

Portrait of the Young Gödel
Jan von Plato

Gödel belonged to a great scholarly tradition in which science is combined with a deep interest in philosophy. The recent study of his shorthand notebooks shows that his scientific and philosophical convictions were formed early on, at the time he entered the University of Vienna exactly a hundred years ago. After initially studying physics, in the summer of 1928 he began his career in logic, which in half a year led to his first result, proof of the completeness of the usual logic of the connectives and quantifiers, then to the insight that there cannot be any definitive complete formalization of mathematics. The story of Gödel's young years is accompanied by numerous illustrations from his shorthand notebooks.

The Necessity of Truth beyond Proof
W. Hugh Woodin

The most basic question in the Philosophy of Mathematics is arguably the question of whether all mathematical truth is simply the product of formal proofs from formal axioms. Gödel's incompleteness theorems argue that the answer is no. But the extent to which this is actually a compelling answer is debatable. An extreme view is that the Gödel's theorems simply define the limits of mathematical truth. However, there are new proofs of the incompleteness theorems which are based on computational complexity, and which definitively show that mathematical truth does transcend mathematical proof. Nowhere is the issue of truth versus proof more central than in Set Theory, the mathematical study of infinity. Here many of the most basic questions, such as that of Cantor's continuum hypothesis (CH), are known to be not only beyond the reach of proofs from the accepted ZFC axioms of Set Theory, but also beyond the reach of proofs from those axioms augmented by any possible additional axioms of infinity. So any resolution of the problem of CH must genuinely involve truth beyond proof.

A Scenario for Solving Gödel's Problem
Sandra Müller

After proving that not all statements in mathematics can be proven or disproven from the accepted ZFC axioms, Gödel raised the question whether natural statements, such as Cantor's continuum hypothesis, can be decided via extending the axiomatic framework by axioms of large infinities. While this question has been answered in the negative, the problem of finding good axioms that decide natural mathematical statements remains open. There is a compelling candidate for an axiom that could solve Gödel's problem: V = Ultimate L. We motivate and describe this candidate together with strong evidence provided by recent advances in Set Theory indicating that it is indeed the likely candidate Gödel was aiming for.

The discussion will be moderated by philosopher Anne Sophie Meincke, member of the Young Academy and FWF Elise Richter Fellow at the University of Vienna.

7:00 p.m. RECEPTION