



ACCADEMIA NAZIONALE DEI LINCEI

CONVEGNO

THE VISION OF SERGIO DOPLICHER IN MATHEMATICS AND PHYSICS

22 SETTEMBRE 2026

ABSTRACT

Comitato organizzatore: Sebastiano CARPI (Università di Roma Tor Vergata), Corrado DE CONCINI (Linceo, Sapienza Università di Roma), Roberto LONGO (Università di Roma Tor Vergata), Gerardo MORSELLA (Università di Roma Tor Vergata).

Comitato ordinatore: Enrico ARBARELLO (Linceo), Corrado DE CONCINI (Linceo, Sapienza Università di Roma), Giovanni GALLAVOTTI (Linceo, Sapienza Università di Roma), Giovanni JONA LASINIO (Linceo, Sapienza Università di Roma), Roberto LONGO (Università di Roma Tor Vergata), Giorgio PARISI (Linceo, Sapienza Università di Roma), Claudio PROCESI (Linceo, Sapienza Università di Roma).

PROGRAMMA

The workshop is devoted to the interplay between Operator Algebras in Mathematics and Quantum Field Theory in Physics, pioneered by Sergio Doplicher.

Tuesday, September 22

- 9.30 Registration
- 10.00 *Welcome addresses* (Presidency of the Accademia Nazionale dei Lincei)
- 10.15 Roberto LONGO (Tor Vergata Università di Roma): *Sergio Doplicher: Mathematician, Physicist and Poet*
- 10.45 Klaus FREDENHAGEN (University of Hamburg): *Remarks on neutrino oscillations*
- 11.15 *Coffee break*
- 11.35 Alain CONNES (Collège de France): *Zeta Spectral Triples*
- 12.20 *Lunch break*
- 14.00 Arthur JAFFE (Harvard University): *Some New Relations between Mathematics and Quantum Information*
- 14.30 Javier MAGAN (Universitat de Barcelona): *Why there is an abelian group describing confinement order parameters in particle physics?*
- 15.00 David RUELLE (Institut des Hautes Études Scientifiques): *The Spin-Statistics Problem*
- 15.30 *Coffee break*
- 15.50 Joachim CUNTZ (Universität Münster): *Hilbert spaces in operator algebras*

16.20 Giorgio PARISI (Linco, Sapienza Università di Roma): *The unexpected link between matrices and probability in replica theory*

16.50 *Recollection talks*

Speeches by Giovanni GALLAVOTTI (Linco, Sapienza Università di Roma), Masaki IZUMI (Kyoto University), Giovanni JONA LASINIO (Linco, Sapienza Università di Roma), Giovanni LANDI (Università di Trieste), Nicola PINAMONTI (Università di Genova), Giorgio VALLORTIGARA (Università di Trento).

Il convegno è organizzato con il contributo di Tor Vergata Università di Roma, Sapienza Università di Roma, Centro di Matematica e Fisica Teorica – CMTP, Roma, e Accademia Nazionale delle Scienze detta dei XL

ROMA – PALAZZO CORSINI- VIA DELLA LUNGARA, 10

Segreteria del convegno: convegni@lincei.it – <http://www.lincei.it>

Tutte le informazioni per partecipare al convegno sono disponibili su:

<https://www.lincei.it/it/manifestazioni/vision-sergio-doplicher-mathematics-and-physics>

Per partecipare al convegno è necessaria l'iscrizione online

Fino alle ore 10 è possibile l'accesso anche da Lungotevere della Farnesina, 10

I lavori potranno essere seguiti dal pubblico anche in streaming

L'attestato di partecipazione al convegno viene rilasciato esclusivamente a seguito di partecipazione in presenza fisica e deve essere richiesto al personale preposto in anticamera nello stesso giorno di svolgimento del convegno

Sergio Doplicher: Mathematician, Physicist and Poet

Roberto LONGO (Tor Vergata Università di Roma)

This talk concerns the scientific and cultural legacy of Sergio Doplicher, whose work ranges across mathematics, physics, and the humanities. A pioneer of the operator-algebraic approach to quantum field theory, Sergio made fundamental contributions to the conceptual understanding of quantum field theory and to the mathematical description of superselection sectors, particle statistics, and internal symmetries.

I will discuss the Doplicher–Haag–Roberts theory, which provides an intrinsic framework for describing localized charges via localized endomorphisms of the algebra of observables, and for classifying their statistics. I will then consider Doplicher–Roberts duality, which characterizes compact gauge groups in terms of abstract C*-tensor categories and provides the tool for constructing the field algebras. Another important work is the Doplicher–Fredenhagen–Roberts model of quantum spacetime, in which spacetime coordinates become noncommuting operators and quantum uncertainties prevent arbitrarily precise localization.

The talk will also recall Sergio's collaborations, his influence as a mentor, and his enduring impact on algebraic quantum field theory. Finally, I will mention his literary vocation as a Dante scholar and poet. His scientific and humanistic activities together illustrate an authentic interdisciplinarity, guided by rigor, curiosity, and intellectual passion.

Remarks on neutrino oscillations

Klaus FREDENHAGEN (University of Hamburg)

Neutrino oscillations are due to the fact that neutrinos couple to other fields via non conserved currents, the leptonic flavor currents.

The standard explanation is that neutrinos are created in flavor eigen states which are superpositions of mass eigen states for different masses.

But the flavor charge is not a well defined operator, and there are no flavor eigen states.

In a simple model of two free Majorana fields with different masses, we show how oscillations can be derived, and we reproduce the standard formulas with small corrections. This is based on joint work with Michael Dütsch.

Some New Relations between Mathematics and Quantum Information

Arthur JAFFE (Harvard University)

Sergio Doplicher always dreamt of connecting different frontier ideas in mathematics to the physical world. In that spirit, I describe two quantum versions of classical mathematics that relate to the theory of discrete quantum information. The first one yields a quantum central limit theorem. The second one involves a quantum version of the family of uniformity norms introduced by Gowers, that became important in pure number theory. Their quantum generalization turns out to characterize a familiar algebraic notion of the complexity of unitary gates in quantum computing. Both these projects are joint work with Kaifeng Bu and Weichen Gu.

Why there is an abelian group describing confinement order parameters in particle physics?

Javier MAGAN (Universitat de Barcelona)

Some of Sergio Doplicher's most important contributions include the formulation of Doplicher-Haag-Roberts sectors, the Doplicher-Roberts duality and reconstruction theorems, and the notion of split inclusions with direct application to Noether's theorem in Quantum Field Theory. In this talk we describe a generalization of these results that is able to explain the abelianity of confinement order parameters, in agreement with the case of Yang-Mills theories (Wilson and 't Hooft loops), and the strong version of Noether's theorem.

The Spin-Statistics Problem

David RUELLE (Institut des Hautes Études Scientifiques)

In three dimensions elementary particles of half-integer spin obey Fermi-Dirac statistics and particles of integer spin obey Bose-Einstein statistics.

The proof is rather intimidating and mysterious.

We present here a heuristic argument for this spin-statistics result.

Hilbert spaces in operator algebras

Joachim CUNTZ (Universität Münster)

The idea of a Hilbert space inside an operator algebra played a very important role in the work of Sergio Doplicher and John Roberts.

I plan to explain how this notion was used by them and also discuss how it appears in other circumstances such as in C^* -algebras associated with structures in number theory.