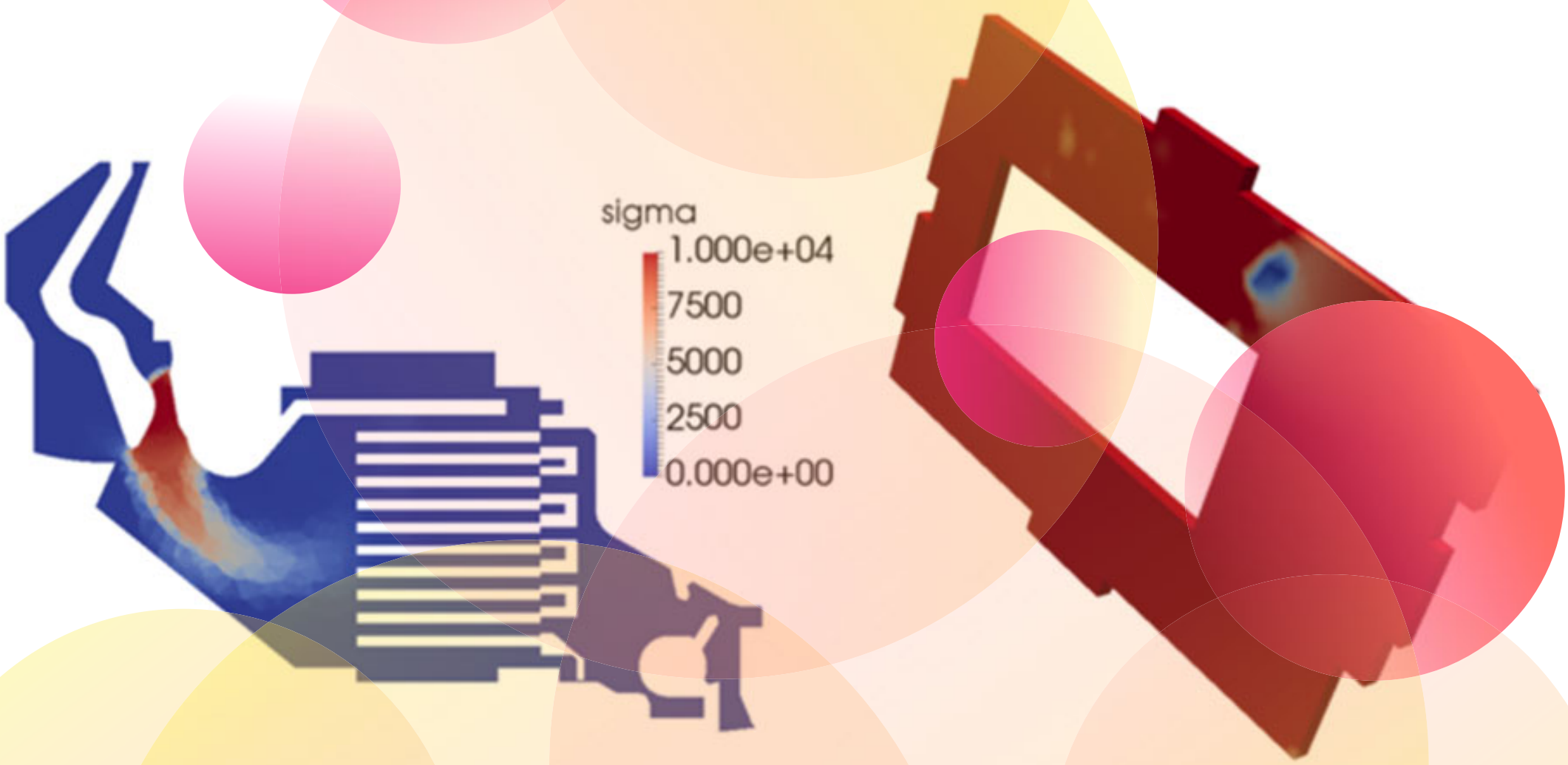
PHYSICS COLLOQUIA 2025



JAN
21

GABRIELE D'ANTONA | Politecnico di Milano (ITA)

Measuring the Untouchable: from Estimation Theory to Noninvasive Diagnostics

3:00 pm | Classroom A | **Via Celoria 16** | Milan

To estimate means to associate numerical values, along with appropriate measurement units, to quantities of interest at specific time instants.
This process relies on data provided by instruments, reference materials, and the relationships between quantities
as defined by the physical model of the observed process.
However, because measurement instruments, reference materials, and physical models are inherently imperfect, unavoidable errors are introduced.
These errors necessitate careful data handling to ensure the resulting estimates are as accurate and reliable as possible.
This challenge has been studied extensively and analyzed from multiple perspectives across various disciplines, where it is referred to by different names:
inverse problems, data fusion, data assimilation, and optimal estimation.
Despite the differing terminologies, the fundamental concept remains the same:
combining information from both the model of the observed process and the available data to derive the best possible estimate,
even when the quantities of interest cannot be directly measured.
This unifying concept has broad applications in fields such as physics, engineering, geoscience, and environmental studies.
In this seminar, the foundational principles underlying estimation will be introduced,with an emphasis on understanding how models and data interact to produce reliable results.
Practical examples will be discussed to illustrate the real-world application of estimation techniques,
particularly in cases where the quantities of interest cannot be directly measured.
These examples include reconstructing the shape and position of electrical arcs in circuit breakers,
estimating tearing mode instabilities in tokamak nuclear fusion plasmas, and geoelectric prospecting to explore subsurface structures.

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