

SCALE INVARIANCE, From Phase Transitions to Turbulence

During a century, from the Van der Waals mean field description (1874) of gases to the introduction of renormalization group (RG techniques 1970), thermodynamics and statistical physics were just unable to account for the incredible universality which was observed in numerous critical phenomena. The great success of RG techniques is not only to solve perfectly this challenge of critical behaviour in thermal transitions but to introduce extremely useful tools in a wide field of daily situations where a system exhibits scale invariance. The introduction of scaling, scale invariance and universality concepts has been a significant turn in modern physics and more generally in natural sciences. Since then, a new "physics of scaling laws and critical exponents", rooted in scaling approaches, allows quantitative descriptions of numerous phenomena, ranging from phase transitions to earthquakes, polymer conformations, heartbeat rhythm, diffusion, interface growth and roughening, DNA sequence, dynamical systems, chaos and turbulence. The chapters are jointly written by an experimentalist and a theorist. This book aims at a pedagogical overview, offering to the students and researchers a thorough conceptual background and a simple account of a wide range of applications. It presents a complete tour of both the formal advances and experimental results associated with the notion of scaling, in physics, chemistry and biology.

L'introduction des concepts d'invariance d'échelle et d'universalité a marqué un tournant de la physique moderne et des sciences de la nature en général. Depuis lors, la nouvelle "physique des lois d'échelle" (ou *scaling*) a permis des descriptions quantitatives communes à des phénomènes aussi divers que les transitions de phases, les tremblements de terre, la conformation des polymères, le rythme cardiaque, la diffusion et la croissance d'interfaces, les séquences d'ADN ou la turbulence.

Écrit à quatre mains par un théoricien et un expérimentateur, cet ouvrage vise à présenter le sujet de façon simple et complète, tout en donnant de solides bases théoriques à l'étudiant comme au chercheur. Il offre un vaste panorama sur l'ensemble des résultats formels et expérimentaux associés à la notion de *scaling*, en physique, mais aussi en chimie et biologie.

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<http://link.springer.com/book/10.1007/978-3-642-15123-1>