SECOND INTERNATIONAL WORKSHOP DICE 2004
— The Proceedings —

These proceedings are based on the Invited Lectures and Contributed Papers of the **Second International Workshop on Decoherence, Information, Complexity and Entropy – DICE 2004**, which was held at Castello di Piombino (Tuscany), September 1–4, 2004.

The aim of these proceedings is to document the stimulating exchange of ideas at this interdisciplinary workshop and to share it with the wider physics community. It successfully continued where DICE 2002 left [1]. This time, there were united more than sixty participants from more than a dozen different countries. Discussions under the wider theme **"From Emergent Classicality to Emergent Quantum Mechanics"** took place in a very pleasant and productive atmosphere, concerning the diverse yet strongly overlapping topics

- Quantum Information, Decoherence and the Quantum-to-Classical Transition
- Gravity, Cosmology and the "Problems of Time" – Implications for Quantum Theory
- Interpretations and Extension of Quantum Theory
- Emergent Quantum Theory

The, by now, traditional public opening lecture was given by M. Maggiore (Université Genève), *"L'esplorazione dell'Universo con le onde gravitazionali: dai buchi neri al Big Bang"*, keeping the enthusiastic audience captivated during the first evening, and the speaker busy in the following question-and-answer session. This lecture, as well as those by J. B. Hartle (University of California and ITP, Santa Barbara), *"Generalizing quantum mechanics for quantum gravity"*, and by K. V. Kuchar (University of Utah), *"Spacetime diffeomorphisms and history action in general relativity"*, unfortunately, cannot be reproduced here. However, the invited lecture by T. Padmanabhan (IUCAA, India), which could not be given, is fortunately fully included.

Co-organizers of this workshop have been S. Boccaletti (Firenze), H.-T. Elze (Rio de Janeiro, chair), J. Halliwell (London), L. Diosi (Budapest), L. Fronzoni (Pisa), and G. Vitiello (Salerno). Our excellent conference secretary has been M. Pesce-Rollins (Pisa).

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Above all, we must thank the citizens and the Comune di Piombino for hosting with wonderful hospitality also the second workshop in this series. Support by Associazione "Amici di Populonia" and Idearte-Cooperativa di Servizi Culturali is acknowledged. For most essential help with the local arrangements and excellent collaboration on the infrastructure, we thank Servizio Promozione Culturale di Piombino, particularly Dott. A. Falchi, Dott.ssa M. Gianfranchi, C. Boggero, L. Grilli, P. Venturi, and Arch. L. Giannoni and T. Ghini (Ufficio Beni Culturali del Comune).

The research presented at the workshop, including further developments since then, is collected in two separate volumes of the **Brazilian Journal of Physics**, the Invited Lectures here and separately the Contributed Papers. In the name of all participants, I would like to express our gratitude to Professor S. Salinas, chief editor, for encouraging and strongly supporting this interdisciplinary project, which reflects the latest developments in the area covered by the DICE meetings. Senhora N. M. Martin of the Brazilian Physical Society we thank warmly for her experienced advice and help with the editing process.

Rio de Janeiro and Campiglia Marittima, January 2005 — Hans-Thomas Elze

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[1] *Decoherence and Entropy in Complex Systems*, H.-T. Elze (ed.), Lecture Notes in Physics, Vol. 633 (Springer, Berlin, 2004).