Preface

In recent years the interaction between geometry and theoretical physics has become remarkable and had a deep influence on new ideas in these fields. One fairly recent meeting point between the two disciplines is the discovery in 1997 of the AdS/CFT (Anti de Sitter/Conformal Field Theory) correspondence by Maldacena, Witten, and others.

The mathematical side was initiated in 1985 by Fefferman and Graham: the aim was to find new conformal invariants by using a correspondence between (asymptotically hyperbolic) Einstein metrics and their conformal boundaries (the standard model being the real hyperbolic space with boundary the standard conformal structure on the sphere). On the physical side, the original statement provides a duality between the partition functions of a d-dimensional theory of quantum gravity and a $(d-1)$-dimensional conformal field theory. As the reader probably already guessed, the mathematical object underlying quantum gravity is Einstein manifolds (possibly with additional fields), and CFTs live on conformal manifolds.

The field has now become extremely active both in mathematics and in physics since remarkable results and generalizations emerged from these ideas. That is why Vladimir Turaev and I organized in September 2003 the 73rd session of the traditional series of 'Meetings between Physicists and Mathematicians' on this subject. The meeting took place at the Institut de Recherche Mathématique Avancée (IRMA) in Strasbourg. The present volume contains solicited and refereed contributions based on this meeting.

Whilst it is almost impossible to include all the aspects of the AdS/CFT correspondence and its variants (e.g. dS/CFT), especially on the physical side, this volume endeavours to present at the same time survey papers giving a wide overview of the subject with results and questions (see the article of Anderson on the mathematical side, and the article of De Boer, Maoz and Naqvi on the physical side) and also more specialized papers.

The topics covered in the Riemannian case include conformal invariants (the obstruction tensor of Graham and Hirachi, related to the celebrated Fefferman–Graham asymptotic expansion), a new Hamiltonian method for holographic renormalization (Papadimitriou and Skenderis) and the mass (Herzlich). In the Lorentzian case, Solodukhin focuses on holographic description for Minkowski space, Anderson, Chruściel and Delay on static de Sitter Einstein solutions, and group theoretical methods for constructing Lorentzian AdS space-times are explored by Frances. Finally, Gauntlett, Martelli, Sparks and Waldram study a different aspect: supersymmetric AdS_5 solutions of M-theory, resulting in the construction of the first examples of irregular Sasaki–Einstein metrics.

Despite the progress of the recent years and the abundant literature, lots of fundamental mathematical and physical questions in the field remain open. It is my hope that this volume may serve as a bridge from mathematicians to physicists and from physicists to mathematicians, and also may focus the attention on this rich and fruitful area of mathematics and physics.

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Strasbourg, February 2005 *Olivier Biquard*