A Century of General Relativity

The 'Renaissance' of General Relativity in History: Assessing Einstein's Legacy in Post-World War II Physics

In the century following Einstein's ultimate formulation in 1915, the general theory of relativity has evolved from a revolutionary mathematical theory with limited contact with the empirical world to an observationally and experimentally based cornerstone of modern physics and cosmology. This momentous shift started around the mid-1950s. While in the previous decades general relativity was perceived as a highly formalistic subject involving only few theorists, by the mid-1960s Einstein's theory has become an extremely vital research stream of theoretical physics, at the same time sparking entirely novel fields such as relativistic astrophysics – a process that came to be known as "renaissance of general relativity." The revitalization of general relativity, moreover, crossed the boundaries of science, and had a large social impact as well as a significant influence on philosophical debates.
In occasion of the 100th anniversary of Einstein's formulation of general relativity in Berlin, the **Max Planck Institute for the History of Science** promotes a conference, which aims at exploring the overall process related to the renaissance of general relativity as well as the various ways through which this process affected different branches of theoretical and experimental physics in the second half of the twentieth century. The organizers believe that deeper insights into the historical dynamics can be attained in joining historians, philosophers, and physicists in dialogue. Topics will include the mathematical and conceptual evolution of the theory, social and geo-political considerations, co-evolution with quantum mechanics and elementary particle physics, incorporation of relativistic astrophysics, history of cosmology, history of numerical relativity, history of gravitational waves, history of quantum gravity, history of institutions devoted to gravitational research, philosophical issues.

The first day (Wednesday December 2) will be a joint event with the **Max Planck Institute for Gravitational Physics** (or *Albert Einstein Institute*) with talks about the past, present and future of General Relativity. Before the historical conference, the **Max Planck Institute for Gravitational Physics** will host a physics conference (November 30-December 1) devoted to a review of recent development and future perspectives for General Relativity and its connection to particle physics, cosmology and astrophysics.

Local Organizing Committee
Alexander Blum, Max Planck Institute for the History of Science
Roberto Lalli, Max Planck Institute for the History of Science
Jürgen Renn, Max Planck Institute for the History of Science

Scientific Advisor:
Diana Kormos-Buchwald, Einstein Papers Project at California Institute of Technology

Location: Harnack Haus Conference Venue of the Max Planck Society
http://www.harnackhaus-berlin.mpg.de/2316/en

Wednesday December 2

Joint conference AEI-MPIWG

9,00 - 10,00 Thibault Damour, (Institut des Hautes Études Scientifique)
The Problem of Motion in General Relativity: A Centenary Assessment

10,00 - 10,30 Daniel Kennefick, (University of Arkansas)
Waves without Energy - Einstein and the Enigma of Gravitational Waves: Do They Actually Transport Energy?

10,30- 11,00 joint Q&A and discussion: T. Damour and D. Kennefick

11,00 - 11,30 *Coffee break*

11,30 - 12,30 David Gross, (Kavli Institute for Theoretical Physics)
The Enduring Legacy of Albert Einstein

12,30 - 13,00 Alexander Blum, (Max Planck Institute for the History of Science)
The Making of a Legacy: How Einstein's Insights Slowly Permeated Physics in the Course of the 20th Century

13,00 - 13,30 joint Q&A and discussion: D. Gross and A. Blum

13,30 - 14,30 *Lunch break*

14:30- 15:00 Yvonne Choquet-Bruhat (Université Pierre et Marie Curie/Sorbonne):
Some Memories from Meeting Einstein, 1951-1952

15,00 - 16,00 Reinhard Genzel, (Max Planck Institute for Extraterrestrial Physics)
Testing the Massive Black Hole Paradigm in the Center of the Milky Way

16,00 – 16,30 Luisa Bonolis, (Max Planck Institute for the History of Science)
From "Dark Stars" to Gravitational Collapse within Einstein's Theory: The Emergence of Relativistic Astrophysics

16,30 - 17,00 joint Q&A and discussion: R. Genzel and L. Bonolis

17:00 - 17:30 Hanoch Gutfreund (Hebrew University, Jerusalem):
Highlights of the Exhibition – A Combination of Science and History
An Introduction to the Exhibition "Einstein's Road to General Relativity"

17,30 *Closure of the AEI conference*

18,30 – 19,15 Opening of the MPIWG conference
Abhay Ashtekar, (Pennsylvania State University)
Dinner lecture: *The Renaissance of General Relativity*

19,30 Dinner speakers MPIWG conference

Thursday December 3

9:15 – 9:30 Jürgen Renn (Max Planck Institute for the History of Science)
Welcome and Introduction

The road to general relativity and the low-water-mark period

9:30 – 10:15 Chris Smeenk (University of Western Ontario)
All Roads Lead to General Relativity

10:15 – 11:00 Robert Schulmann
Isolation, Engagement, and Celebrity: Einstein's Path to General Relativity and Beyond

11:00 - 11:30 *Coffee Break*

11:30 – 12:15 Jean Eisenstaedt (Observatoire de Paris)
The Low-water Mark of General Relativity, a Theory Ahead of its Time

12:15 – 13:00 Dennis Lehmkuhl (California Institute of Technology)
On Different Approaches to the Problem of Motion in General Relativity

13:00 – 14:00 *Lunch Break*

14:00 – 14:45 Helge Kragh (Copenhagen University)
Attitudes to General Relativity in the Formative Phase of Modern Cosmology

14:45 – 15:30 David Rowe (Johannes Gutenberg University Mainz)
From Einstein to Schücking: Mach's Principle and Relativistic Cosmology

15:30 – 16:00 *Coffee Break*

16:00 – 16:45 Jim Ritter (Institut de Mathématiques de Jussieu-Paris Rive Gauche)
Unified Theories and the Road to Berne

16:45 – 18:30 Round table: Diana Kormos-Buchwald – Chair (California Institute of Technology, Einstein Papers Project)
Hanoch Gutfreund (Hebrew University), Anne J. Kox (University of Amsterdam), Christoph Lehner (MPIWG), Matthias Schemmel (MPIWG), Thomas A. Ryckman (Stanford University).

Friday December 4

The postwar renaissance of general relativity

9:30 – 10:15 Jürgen Renn, With A. Blum and R. Lalli (MPIWG)
The "Renaissance" of General Relativity: Social and Epistemic Factors

10:15 – 11:00 Phillip J.E. Peebles (Princeton University)
The Renaissance of Experimental Gravity Physics, 1955 to 1965

11:00 – 11:30 *Coffee Break*

11:30 – 12:15 Tilman Sauer (Johannes Gutenberg University Mainz)
Historical Remarks on the (non-)Discovery of Gravitational Lensing and the Cosmic Microwave Background Radiation in the Early Sixties

12:15 – 13:00 Jeroen van Dongen (University of Amsterdam and Utrecht University)
Can We Understand the Black Hole Information Paradox by Studying Its History?

13:00 – 14:00 *Lunch Break*

14:00 – 14:45 David Kaiser (Massachusetts Institute of Technology)
Cold War Curvature: Measuring and Modeling Gravitational Systems in Postwar American Physics

14:45 – 15:30 Dean Rickles (University of Sydney)
Institute of Field Physics, Inc: Private Patronage and the Renaissance of Gravitational Physics

15:30 – 16:00 *Coffee Break*

16:00 – 16:45 Hubert Goenner (University of Göttingen)
General Relativity and the Growth of a Subdiscipline "Gravitation" in the German Speaking Physics Community

16:45 – 17:30 Roberto Lalli (Max Planck Institute for the History of Science)
Building the Relativity Community During the Cold War: Communication Means and Institutional Frames in Transition

17,30 – 18,15 Adele La Rana (Sapienza University of Rome)
The Origins of Gravitational Wave Research in Italy

Saturday December 5

Theoretical tools and the renaissance of general relativity

9:30 – 10:15 Roger Penrose (University of Oxford)

10.15 – 11.00 Aaron Wright (Harvard University)
New Ways of Seeing (in) the Renaissance of General Relativity: Penrose Diagrams as Paper Tools

11:00 – 11:30 *Coffee Break*

11:30 – 12:15 John Stachel (Boston University)
Contravariant Metric Approach to General Relativity

12:15 – 13:00 Donald Salisbury (Austin College)
An Investigation and Analysis of Constrained Hamiltonian Approaches to General Relativity

13:00 – 14:00 *Lunch Break*

14:00 – 14:45 Domenico Giulini (University of Hannover)
Matter from Space

14:45 – 15:30 Markus Aspelmeyer *(University of Vienna)*
Past, Present and Future of Quantum Tests of Gravity

15:30 – 16:00 *Coffee Break*

16:00 – 18:00 *Round table*: Diana Kormos-Buchwald - Chair (California Institute of Technology, Einstein Papers Project),
Joshua Goldberg (Syracuse University), Phillip J.E. Peebles (Princeton University), Roger Penrose (Oxford University), Brian Pitts (Cambridge University), Remo Ruffini (International Center for Relativistic Astrophysics and Sapienza University), Kurt Sundermeyer (Free University of Berlin), Christian Wüthrich (University of Geneva),

18:00 – 18:30 *Closure of the MPIWG conference*