



Gravity and Black Holes Conference and Symposium

DAMTP, Cambridge, July 2-5

This International Conference and associated Public Symposium, organized by the Centre for Theoretical Cosmology (DAMTP, Cambridge), was held in honour of the 75th birthday of Stephen Hawking. About 180 participants attended the scientific conference from 3rd to 5th July, while the preceding symposium, on Sunday July 2 was attended by 450 people and reached a much larger public audience. The meeting was particularly relevant in light of the recent LIGO Scientific Collaboration's discovery of gravitational waves from black hole mergers and, consequently, the new window on the universe that this has opened.

The Public Symposium consisted of four popular lectures delivered by very well-known science communicators: Professors Brian Cox, Gabriela González, Martin Rees and Stephen Hawking himself. The afternoon meeting had remarkable impact through live-streaming videos of the lectures to the Discovery Channel social media websites across Europe, USA, Africa and Asia. Viewing figures indicated that, during the four hours the meeting was running, approximately 3.75 million people accessed the relevant Discovery Facebook and YouTube pages; this far exceeded the impact of all previous Discovery live-streaming events and sets a new benchmark in science engagement with general public. All the lectures were of exceptionally high quality. Brian Cox eloquently described the development of modern concepts in physics which have defined the perception of our place in the Universe. Gabriela González described the exciting discovery of gravitational wave events by the LIGO team, while looking forward to a new era of gravitational wave astronomy. After the break for refreshments, Lord Rees, the Astronomer Royal, took the audience on a fascinating journey from small-scale exoplanets out beyond the observed universe to the so-called "multiverse." Finally, Stephen Hawking recounted his own life in physics and his contributions to momentous developments in our understanding of black holes and cosmology, which continue to remain at the heart of key theoretical and experimental programmes to the present day.

The scientific conference which followed was roughly divided across days into topical themes. The talks on Monday were mostly devoted to cosmology. Both Eiichiro Komatsu and Hiranya Peiris explained how observational data from the CMB and galaxy surveys can be used to constrain theories of inflation and fundamental physics, while also describing future prospects for experimental programmes seeking to discover primordial gravitational waves (tensor modes) in CMB polarization data. Slava Mukhanov, argued that standard inflation makes definite predictions, in contrast to some criticisms of the theory, and that current data does not necessitate elaborate extensions to inflation. After a brief overview, Andrei Linde discussed "attractor" solutions of inflationary theories for which the kinetic term has a pole in field space. After lunch Jim Hartle discussed multiverses in quantum cosmology and Thomas Hertog described ongoing work with Stephen Hawking on obtaining a smooth exit from eternal inflation. Raphael Bousso argued that theorems in classical GR can be used to motivate conjectures about quantum

field theory. He explained how one such conjecture can be proved for a class of quantum field theories. Finally, Renata Kallosh discussed amplitudes and finiteness of maximal supergravity, motivating models of inflation from fundamental theory. The day ended with a dinner at Trinity College at which Fay Dowker and Jim Hartle gave speeches recalling their time spent working with Stephen.

Tuesday morning's talks were devoted to gravitational waves, following LIGO's sensational discovery of gravitational waves from merging black holes. Pablo Laguna discussed black hole kicks and possible observational signatures. Harald Pfeiffer describing different approaches to the modeling of gravitational waves from black hole binaries. Gabriela González then gave an overview of LIGO's results so far. Bruce Allen discussed how Stephen and Gary Gibbons made serious attempts to build a gravitational wave detector in Cambridge. In the afternoon, Frans Pretorius argued that by combining the observations of multiple binary black hole mergers it might be possible to extract information about several quasinormal modes during the "ringdown" phase of the final black hole and thereby test the no-hair theorem. He also emphasized the challenge in modeling gravitational wave sources in alternative theories of gravity to further observational tests of general relativity. Mihalis Dafermos gave an overview of the cosmic censorship conjectures. Finally Ted Jacobson reviewed the subject of Hawking radiation from "analogue" black holes and Jeff Steinhauer described his experimental work aimed at detecting analogue Hawking radiation in a system involving a Bose-Einstein condensate.

On Wednesday, Douglas Stanford discussed his work on traversable wormholes in the AdS/CFT correspondence. Gary Gibbons discussed the gravitational memory effect, and its relation to work he did with Stephen. Andy Strominger gave an overview on his work on infrared effects in QED and quantum gravity. Gary Horowitz argued that the AdS/CFT correspondence implies that it is impossible to pass through certain types of singularity in quantum gravity. He also discussed a new type of supersymmetric black hole solution, with topology outside the horizon, and explained why it presents a puzzle for microscopic calculations of black hole entropy.

The conference ended with some closing remarks by Bob Wald. After praising Stephen's many contributions to gravitational physics, Bob explained in some detail why Stephen's paper "Particle Creation by Black Holes" is such a monumental achievement. However, he did identify one flaw in the paper: the word "gauge" is misspelled four times!

Professor Harvey Reall