

Singularities and Horizons: From Blackholes to Cosmology

11 – 14 June 2019 @Snellius

We would like to report on an extremely fruitful workshop, which was held at the Snellius (Lorentz Center) from 11-14 June on "Singularities and horizons: from blackholes to cosmology". There were roughly 25 participants, including 5 female researchers, 5 postdoctoral fellows, 4 Phd students, and 2 undergraduate students. The workshop attendance fluctuated a bit over 4 days. However, the core participants were always present. The workshop was inaugurated by world leading scientist, 1989 Nobel prize winner Prof. Gerard 't Hooft, and concluded by Prof. Henio Falcke (PI of the Event Horizon Telescope).

The workshop was primarily aimed at understanding the information-loss paradox in the context of blackhole event horizon and, addressing cosmological and blackhole singularity problems. The talks were aimed at semi-technical level with lots of discussions lasted almost every day late in the evenings. There were two main theoretical proponents which have emerged after the discussions: one based on string theory perspective (fuzz-ball states), and the other based on bottom-up approach to ameliorate blackhole singularity and also the avoidance of an event horizon (infinite derivative gravity). In both the approaches the presence of non-locality seemed to play a critical role along with the large number of micro states at the scale of new physics, which would be the string scale in this context. We discussed various challenges surrounding fuzz ball approach, such as time dependent aspects, various gravitational corrections, strong coupling regime, and dynamical formation of a fuzz balls. We also discussed various challenges for bottom-up phenomenological toy models within infinite derivative gravity, which do not necessarily rely on supersymmetry, therefore well probed in the region of time dependent backgrounds, but face various challenges from both classical and at a quantum level. Besides information-loss paradox, we also had vigorous discussions on cosmological aspects of understanding singularities, initial conditions for primordial inflation, and the presence of cosmic horizon on blackhole thermodynamics.

One of the most exciting session was experimental confrontation of theoretical models for fuzz balls and other horizonless compact objects. The consensus was that it would be extremely hard to probe any observable departures from the standard blackhole mergers. The searches so far being performed are very model dependent, and search for a unique feature which can distinguish from a standard blackhole scenario with a horizonless compact object remains a big challenge. Overall, the participants were extremely happy to have a platform for a debate on various challenges faced on both theoretical and at the observational front, and hope to continue the dialogue between the communities for future research directions.

Anupam Mazumdar (Groningen, the Netherlands)

Robert Brandenberger (Montreal, Canada)

Valeri Frolov (Edmonton, Canada)

Samir Mathur (Columbus, USA)