

Warsaw, 15 July 2013

GR20/Amaldi10: A time of great discoveries in understanding gravity is fast approaching

The secrets of the mysterious force of gravity should soon be coming unravelled. The results of work by scientists all over the world, presented during the grand GR20/Amaldi10 gravitational conference in Warsaw, indicate that a major turning-point is close on the horizon.

The global GR20/Amaldi10 gravitational conference in Warsaw has drawn to a close. A feeling of justified optimism prevailed among the nearly one thousand top-class physicists, astronomers and mathematicians from all over the world. In the opinion of many researchers, the coming years will bring significant progress in theoretical and experimental studies of gravity, stimulated by the rapid development of state-of-the-art techniques of gravitational waves and deep space observations.

International Conferences on General Relativity and Gravitation are held every three years under the auspices of the International Society on General Relativity and Gravitation. This year, the twentieth conference was held between 7-13 July together with the biennial Edoardo Amaldi Conference on Gravitational Waves by the Gravitational Wave International Committee. The Polish organizers of the GR20/Amaldi10 conference were the Faculty of Physics at the University of Warsaw and the Polish Society on Relativity. The patrons of the conference were the President of the Polish Academy of Sciences and the Rector of the University of Warsaw.

Researchers interested in gravity usually meet in small, highly specialized groups. The GR20/Amaldi10 conference was a rare opportunity for almost all the scientific community involved in research on gravity to gather together in one place. In Warsaw, debates and discussions took place among groups involved in purely theoretical research or focusing on the experimental aspects of observations of gravitational waves and exotic astronomical objects and phenomena such as neutron stars, black holes and the cosmic microwave background radiation.

"New results, concerning observational effects of Einstein's gravitational theory, are progressing at an amazing pace, and this conference included a number of marvellous presentations and lectures. But often just as important, if not more important, would be discussions that emerge on the sidelines. For me, some of these were particularly exciting and informative," said Professor Roger Penrose of the University of Oxford, one of the most famous contemporary scientists, who specializes in the study of the mathematical and physical aspects of the theories of gravity.

Professor Carlo Rovelli of Aix-Marseille Université, known for his work on the theory of quantum loop gravity, said, "In my childhood, black holes and gravitational waves seemed to be something completely unreal. It's absolutely fascinating that today we are almost capable of direct observation

of these objects. These observations will be of fundamental importance to our understanding of the world and for the development of current and future theories of gravity.”

Professor Tomasz Bulik of the Astronomical Observatory of the University of Warsaw stressed, however, that so far we have observed the Universe almost exclusively with electromagnetic waves. “We are increasingly confident that we are on the verge of gravitational astronomy where gravitational waves will take over the role of light. There is a great deal of enthusiasm among participants. We have reason to believe that the first observation of gravitational waves will occur within the next few years,” said Prof. Bulik.

“It is good that there were still several plenary lectures and parallel sessions focused on the classical aspects of the General Relativity,” stresses Professor Jerzy Lewandowski, Chairman of the Polish Organizing Committee. One of such classic issues is the gravitational collapse and formation of the black holes. Today, that physical process can be understood and described in a precise mathematical manner (Sergiu Klainerman from Princeton University). “Interestingly, the conclusion of the pioneering works of Steven Hawking that a general black hole in equilibrium is completely characterized by two parameters – mass and angular momentum – mathematically is still an open problem. Pessimistic news from Piotr Bizoń’s (Uniwersytet Jagielloński) lecture is that at the presence of a negative cosmological constant, an asymptotically empty universe is unstable with respect to a spontaneous formation of the black holes”, said Prof. Lewandowski.

Surprisingly, the mathematical methods developed within the General Relativity theory can be used to describe aspects of nongravitational physics including condensed matter. Professor Garry Horowitz (University of California at Santa Barbara) has applied the black hole solution to the Einstein equations to reproduce novel quantitative results of the new high temperature superconductors.

The quantum aspects of gravity, however, were also a part of the agenda. The rapid progress in that field strongly suggests that the goal of finding a working and predictive quantum theory of gravity is within reach. The participants have learned about that from Prof. Thomas Thiemann’s (Friedrich-Alexander-Universität Erlangen-Nürnberg) lecture on Loop Quantum Gravity.

Studies on gravity, especially quantum gravity, might seem to have no practical significance. However, this is simply not true. They are an important factor in the development of sophisticated mathematical methods, which, as the history of science and technology teaches us, will find practical application sooner or later. Advances in the techniques of observation needed to verify the theory will result in the emergence of new technologies. There is also the possibility of completely unexpected applications. When Albert Einstein was beginning to think about the speed of light and gravity, no one could even guess that a hundred years later people would find their way to the nearest ATM using satellites and the theory of relativity.

The next International Conference on General Relativity and Gravitation will be held in 2016 in New York. The Eleventh Edoardo Amaldi Conference on Gravitational Waves will take place in two years in the Korean city of Gwangju.

A detailed description of the GR20/Amaldi10 Conference can be found online at:

<http://gr20-amaldi10.edu.pl/>

Physics and Astronomy first appeared at the University of Warsaw in 1816, under the then Faculty of Philosophy. In 1825 the Astronomical Observatory was established. Currently, the Faculty of Physics’ Institutes include Experimental Physics, Theoretical Physics, Geophysics, Department of Mathematical Methods and an Astronomical Observatory. Research covers almost all areas of modern physics, on scales from the quantum to the cosmological. The Faculty’s research and teaching staff includes more than 200 university teachers, of which close to 80 are employees with the title of professor. The Faculty of Physics, University of Warsaw, is attended by almost 1000 students and about 140 doctoral students.

The Polish Society on Relativity (Polskie Towarzystwo Relatywistyczne – PoToR) consolidates the Polish relativistic community, promotes the achievements of Polish relativists worldwide and disseminates knowledge about the achievements of other communities in

the field of relativity in Poland. The PoToR's most important activities provide Polish undergraduates, doctoral students and young scientists the best possible conditions to help start their own research at the highest level in the modern fields of relativistic physics and the mathematics of space-time. Honorary members of the Society include the eminent physicists Professor Abhay Ashtekar and Professor Roger Penrose.

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RELATED LINKS:

<http://gr20-amaldi10.edu.pl/>
GR20/Amaldi10 Conference website.

<http://www.fuw.edu.pl/~potor/>
Polish Society on Relativity website.

<http://www.fuw.edu.pl/>
Faculty of Physics at the University of Warsaw website.

<http://www.fuw.edu.pl/informacje-prasowe.html>
Press Office for the Faculty of Physics at the University of Warsaw.

IMAGES:

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In Warsaw, the 20th International Conference on General Relativity and Gravitation (GR20), combined with the 10th Edoardo Amaldi Conference on Gravitational Waves (Amaldi10), has come to an end. (Source: Marianna Zadrozna)

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In Warsaw, the 20th International Conference on General Relativity and Gravitation (GR20), combined with the 10th Edoardo Amaldi Conference on Gravitational Waves (Amaldi10), has come to an end. Prof. Roger Penrose during his lecture. (Source: Marianna Zadrozna)

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In Warsaw, the 20th International Conference on General Relativity and Gravitation (GR20), combined with the 10th Edoardo Amaldi Conference on Gravitational Waves (Amaldi10), has come to an end. Prof. Carlo Rovelli's lecture. (Source: Marianna Zadrozna)

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