

Laudatio by Ruth Durrer
The Tomalla Prize 2009 is awarded to
Alexei Starobinsky
and
Viatcheslav Mukhanov
for their outstanding contributions to the theory of
cosmological inflation

Dear Alexei, dear Slava, dear colleagues, students and friends

I am very happy to greet you here today at the Tomalla Prize ceremony 2009.

Let me first say a few words about the Tomalla Prize:

The Tomalla Foundation for Gravity Research has been founded in 1982 according to the testamentary wishes of Dr Walter Tomalla, an Engineer from Berlin, who had moved to Switzerland after the second world war. With his foundation, Dr Tomalla wanted to promote gravity research in Switzerland and in the world.

The foundation periodically awards prizes for exceptional research in gravitation and it funds research fellows and visitors for gravity research at Swiss Universities. It can also promote research on gravity by other activities. It participated, for example in the edition of the collected papers of Albert Einstein, in an experiment to measure the gravitational constant G and in other scientific activities which study gravitation.

The Tomalla Prize is awarded to a leading scientist in his field which may concern any aspect of gravity be it experimental or theoretical work, be it in cosmology, relativistic astrophysics, gravitational waves or on mathematical problems of general relativity.

It is a very prestigious award, this can be seen already from the fact that two of the previous eight Tomalla Prize laureates (Subrahmanyan Chandrasekhar and Joseph Taylor) have afterwards been awarded the Nobel Prize in physics and one (Andrei Sakharov) had obtained the Nobel Prize for peace.

This year, we are most proud to attribute the Prize to two eminent scientists, Professor Alexei Starobinsky and Professor Viatcheslav Mukhanov for their outstanding contributions to the theory of cosmological inflation.

Let me first introduce **Alexei Starobinsky**. He studied in the famous Landau Institute for Theoretical Physics in Moscow, where he submitted his PhD (under the supervision of Ya.B. Zel'dovich) in 1975. Alexei, even though he repeatedly visited other places, especially Cambridge, Paris and Tokyo as short time visitor and as visiting professor, remained at the Landau Institute in Moscow. Apart from his research he is also active in Science publishing as Editor of several journals and he has obtained numerous awards and honors.

Alexei Starobinsky worked on particle creation in cosmology and by rotating black holes already in his early career. In 1979/80 he developed the first working model of inflation and calculated the generation of gravitons during inflation. The detection of these gravitons is one of the big challenges of the Planck satellite which has been launched early this summer. Inflation was re-discovered a year later and it received a lot of attention because an early inflationary phase of expansion can address some of the most basic questions in cosmology:

Why is the Universe so large and so homogeneous and isotropic?

Why is it so flat, (nearly) vanishing spatial curvature?

Why is the entropy of the Universe so high?

After his seminal discovery, Alexei went on to make very important contributions to inflation. He developed different models of inflation which are presently under investigation. He also works on the problems of dark matter and dark energy and he even participated in an experiment measuring the anisotropies of the cosmic microwave background. Such measurements are presently our key to the very early Universe and we hope that they will eventually lead to the discovery of the gravitational waves predicted by Alexei.

This leads me to the second prize winner of this evening: **Viatcheslav Mukhanov**. Also Slava has studied in Moscow, he submitted his PhD 1982. His adviser was Vitaly L. Ginzburg. After his PhD he stayed on for some years in the Institute for Nuclear Research. He then went abroad to the US and then to Europe. Our ways actually crossed when we were both post-docs in Zürich. Since more than 10 years, Slava is full Professor at the Ludwig Maximilian University in Munich. Apart from his research and teaching, also he is active in editing, especially as Scientific Director of JCAP, the electronic cosmology journal. Also he has already obtained several honors and awards.

During his PhD Slava investigated the generation of density perturbations which grow out of quantum fluctuations of the scalar field that governs

inflation and of the scalar metric degrees of freedom, and which turn into classical density fluctuations after inflation. Slava has calculated the spectrum of these fluctuations and claimed that they be the origin of the observed large scale structure in the Universe, the galaxies, clusters, voids and filaments observed in our Universe. This was quite a bold claim: the largest known structures in the Universe should have originated from tiny quantum fluctuations.

Observations of the anisotropies in the cosmic microwave background beautifully confirm the main predictions of this idea: the fluctuations do have the correct spectrum and (as far as we can tell) deviations from Gaussianity are small, as is expected. The Nobel prize 2006 has been awarded to George Smoot for the discovery of these fluctuations and it is this confirmation of Mukhanov's prediction which has convinced most astro-physicists that the idea of inflation is basically correct.

Also Slava has continued to make many important contributions to cosmology. He has worked on tools like cosmological perturbation theory which are important to calculate the anisotropies in the cosmic microwave background; he has developed different models of inflation and new ideas concerning dark energy.

There is still a lively debate going on about which of the many inflationary models is realized in nature and how to distinguish them observationally, but that we see amplified quantum fluctuations when we look up into the night sky has become the conviction of most astrophysicists.