Celebrating a century of progress

Physics Uspekhi was set up 100 years ago to support the fledgling physics community in the Soviet Union. A century later, the journal's current editor-in-chief **Valery Rubakov** talks to Matin Durrani about the future of Russian physics

How did your interest in physics begin?
I studied physics at Moscow State University, graduating in 1978 and then was awarded a PhD at the Institute for Nuclear Research of the Russian Academy of Sciences in 1981. I have been affiliated to both institutions ever since, working in areas such as quantum field theory, elementary particle physics and cosmology.

What has been your most notable achievement?
Hard to say, but what I am probably best known for is the idea of baryon number non-conservation in the early universe within the Standard Model of particle physics and its extensions. This result, obtained together with Vadim Kuzmin and Mikhail Shaposhnikov, was initially widely debated because under conditions that can be reached in the laboratory this effect is totally negligible. Yet we claimed that it becomes relevant at extremely high temperatures that were most likely present in the very early universe. Today this idea is widely accepted in the community and is a basic ingredient towards explaining the matter–antimatter asymmetry in the universe. A review on this topic (*Physics Uspekhi* **39** 461) was published in the issue dedicated to the 75th birthday of Andrei Sakharov who, among other things, pioneered the study of matter–antimatter asymmetry.

What are you currently working on that you find most exciting?
I think studying the "extremely early" universe is very exciting, i.e. the time just a tiniest fraction of a second after the Big Bang (possibly 10^{-35} s). Observations of the cosmic microwave background (CMB) unequivocally show that the hot cosmological epoch was not the first one – it was preceded by another epoch in which matter density inhomogeneities were generated. What was that epoch? The best guess is inflation, but this is not yet proven. There are competing theories such as a "bouncing" scenario in which the universe starts contracting, then stops before a hot expansion begins. But are there theoretically consistent models that agree with existing observational data? And can one discriminate between different scenarios on the basis of future observations?


Valery Rubakov

Serving the community
Theoretical physicist Valery Rubakov is editor-in-chief of the reviews journal *Physics Uspekhi*.

So what's your verdict?
It appears that the answer to all these questions is yes. I find it fascinating that observations at cosmological scales can tell, at least in principle and most probably in reality, what the universe was like at these very early times at extremely high energy density and high expansion rate. This is a rapidly developing area, and we regularly publish reviews on this and related topics in *Physics Uspekhi*.

After communism, science in Russia suffered badly and many researchers moved abroad. Were you ever tempted to leave?
Yes, I seriously considered various offers from the US and Europe in the 1990s and 2000s. But in all cases I found that I felt a lot more comfortable in Moscow. It paid off. I am now a member of an excellent group of theorists at my institute and have several former students worldwide with whom I keep in contact.

If I compare today's situation with the 1990s then we are a lot better off now

Research funding plummeted in Russia in the early 1990s, but slowly began to pick up and the country has been spending about 1% of its gross domestic product on research and development. Do you think this is enough?
If I compare today's situation with the 1990s then we are a lot better off now. However, doing fundamental science is still difficult. I have no idea of the share of fundamental science in overall research and development spending, but I definitely feel that fundamental science is either underfunded or funded improperly, or, most likely, both.

In 2014 Russian president Vladimir Putin called for all state research funding to be distributed via a competitive grants system. What happened to this plan?
I think it is impossible to distribute *all* state research funding via a grants system. Therefore such a proposal could not work – and indeed it didn't. In fact, this idea would be very destructive, especially in view of a large network of research institutions in Russia. And I think it would be destructive anywhere: fighting for grants instead of doing science is not a good use of a scientist. On the other hand, it makes sense to distribute some, fairly substantial, part of state funding in the form of grants. Today, there are two foundations in fundamental science that do this in Russia: the Russian Foundation for Basic Research and the Russian Science Foundation. Overall, I think the balance between institutional and grant funding is reasonable in Russia. I emphasize the balance, rather than the amount of funding or the ways the money is spent.

Is Russian physics competitive?
My experience with *Physics Uspekhi* shows that physics in Russia is reasonably healthy and may become even more competitive internationally in the foreseeable future.

Are you happy with the amount of international collaboration Russian physicists have with other countries?
I think the level of international collaboration is very uneven. It strongly

depends on the topic, institution and even the research group in the institution. Sometimes the collaboration is very strong, but often it barely exists. Overall, I think Russian physicists should take more advantage of international partnership.

Physics Uspekhi was founded in 1918 shortly after the First World War had ended for the Soviet Union. What role would you say the journal has played in Russian physics over the last 100 years?

If I want to learn something beyond my current expertise, I've always turned to *Physics Uspekhi*, as well as to other review journals like it. The fact that it is a Russian journal is, of course, important as well. In the Communist era, publishing abroad, especially review papers, was quite difficult, so the journal served as a bridge between Russian physics and the outside world. Indeed, this year we are celebrating not only 100 years of the journal, known officially as *Uspekhi Fizicheskih Nauk*, but also 60 years of its English translation. The English-language version was originally entitled *Soviet Physics Uspekhi* before being renamed *Physics Uspekhi* in 1993 and is now published in partnership with IOP Publishing.

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How does the journal serve the Russian physics community?

I think this journal still has a place not only in Russian science but also internationally. After all, it is a good review journal that publishes excellent authors. Yes, they are mostly Russians, but they are writing for the whole community. *Physics Uspekhi* is one of a few Russian physics journals that sets the standard and, I hope, also at international level.

When I was starting my career, it was my dream to publish in *Physics Uspekhi,* and I am confident that having a review paper published in the journal is still considered prestigious. The journal also serves the Russian physics community in various other ways such as by publishing biographical notes and conference proceedings.

When _Physics Uspekhi_ celebrated its 90th birthday, then editor-in-chief Vitaly Ginzburg called on the editorial board to commission more papers to ensure the journal stays "relevant". Were his wishes fulfilled?

One can never be satisfied with what is done, but I think Ginzburg's wishes did become reality. In the last 10 years we have attracted more quality papers and the current list of accepted papers is impressive. But we certainly continue our efforts to remain even more relevant.

Do you think the journal will still be around in another 100 years? And, if so, what changes do you envisage?

I think *Physics Uspekhi* has a good future for another 100 years and more but its role will change. The journal *per se* will no longer be a major source of information and that is already partially true today. The easiest way to retrieve a paper will be through arXiv, with the journal serving as a quality stamp. The role of review journals, including *Physics Uspekhi*, will increase, I think. As the amount of information will grow, searching for good authors and persuading them to write reviews for the benefit of community will become more important. As for content, I expect many more interdisciplinary papers and technological advances will be incorporated too such as 3D images and animations.

Would you still study physics if you were a student again?

Yes. But I think I would try to be more diverse. Besides studying particle physics, astroparticle physics and cosmology, I would try to become an expert in condensed-matter physics, biophysics and other areas.

Publishing

Study reveals up to 17% citation boost for physicists who move abroad

Physicists who migrate receive up to 17% more citations than colleagues who stay at home, an analysis of the careers of more than 26 000 physics researchers has revealed. Moving abroad boosts your citation record because it diversifies your research interests and collaborations, the study claims, which in turn leads to research with a higher scientific impact.

The study has been carried out by Alexander Petersen, a complex-systems physicist at the University of California, Merced in the US, who analysed data on papers published in American Physical Society (APS) journals between 1980 and 2009. He identified 26 170 researchers who had published 10 or more research articles in APS publications, and who met additional career longevity and productivity criteria.

Using information indicating an author's geographical location, Petersen was able to compare the citation records of "mobile" researchers — focused on a 10-year period centred around each mobility event – with those of "non-mobile" researchers. Moving abroad has a significant positive effect on citation impact, Petersen found, and increases the diversity of a scientist's research topics, co-authors and geographical collaborations.

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Happy travellers Going abroad could boost your citation record by as much as 17%, according to new research.

In particular, he discovered that articles published by mobile researchers in the five years after they migrate receive 9%–17% more citations than papers published by non-mobile researchers. This adds up to around 100 additional citations, Petersen claims.

Published in the *Journal of the Royal Society Interface*, the study also finds that physicists move around a lot in their careers, with two-fifths of those in the study having migrated at least once. Another observation is that 10% of physicists end all former international collaborations following a move abroad, while 34% of those who emigrate go to a country with which they have had no previous collaboration.

According to Peterson, moving abroad makes it easier to exchange not only scientific information but also the "organizational" knowledge that is needed to do research effectively and efficiently. "This is particularly true for the exchange of 'tacit knowledge' that isn't so easily written down or codified," he says. Peterson adds that the impact of mobility extends to physicists of all productivity levels, which could have implications for policy-makers.

Michael Allen