Russia's prize fighter

When Zhores Alferov won a share of this year's Nobel Prize for Physics, he restored pride to Russian science. But can he exploit his celebrity status to move research up the political agenda? Quirin Schiermeier investigates.

On 10 October this year, Zhores Alferov received a phone call from Stockholm that propelled him out of the lab and into the headlines. But it was the phone call that followed which could prove the key to boosting the prospects of Russian science.

The first call made Alferov a Nobel physics laureate, in recognition of his pioneering work in developing semiconductor heterostructures, now widely used in the microelectronics industry. The other came from the Russian president, Vladimir Putin, offering his congratulations and paving the way for Alferov's increasing influence on Russian science policy.

A few days after the announcement, at a confidential meeting, Putin accepted Alferov's suggestion to set up an advisory council of science and technology experts. Although the full significance of this move remains unclear, Russian researchers are monitoring keenly Alferov's emerging status as Putin's unofficial science adviser.

Could it be that a Nobel prize — Russia's first in science since 1978, when Pyotr Kapitsa won for his work on low-temperature physics — will help restore science and technology to the centre of political thinking in Moscow? If so, it will be fitting that Alferov was at the centre of events. For his story, and that of the centre he directs, the Ioffe Physico-Technical Institute in St Petersburg, exemplifies the roller-coaster ride that Russian science has experienced.

Scientists of status

Researchers such as Alferov became a privileged élite after the Second World War, only to see their empires crash when the Soviet Union collapsed. Today, his is just one of many Russian labs that depend largely on western agencies and companies for their financial survival.

A proud and eloquent man who is still loyal to Soviet traditions — he is a Communist member of the Duma, or state parliament — Alferov's western contacts and his reputation for scientific excellence have ensured the Ioffe institute's survival. "I hope the Nobel prize will help us further to recover before it is too late," he says.

The institute was founded in 1918 by Abram Ioffe, a student of Nobel laureate Wilhelm Conrad Röntgen — who won the first physics Nobel in 1901 for his discovery of X-rays. It quickly became a premier centre for physics. But the strongest growth came during the postwar competition with the United States for global superpower status.

Alferov chooses not to emphasize the Cold War factor. "The Soviet leadership was clever enough to support science and scientific education in general as an important branch of human activity," he says. But much of this investment was designed to underpin the powerful military–industrial complex. Alferov's prizewinning work, conducted at the Ioffe institute in the 1960s and 1970s, benefited from the largesse. And by the time he took over as director in 1987,

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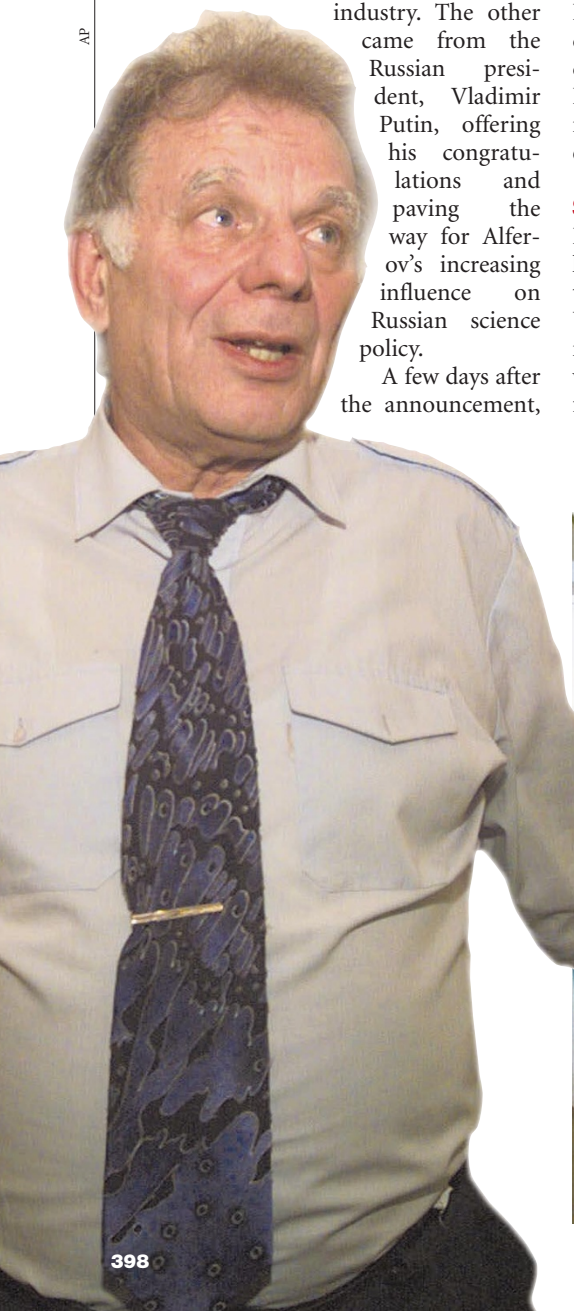

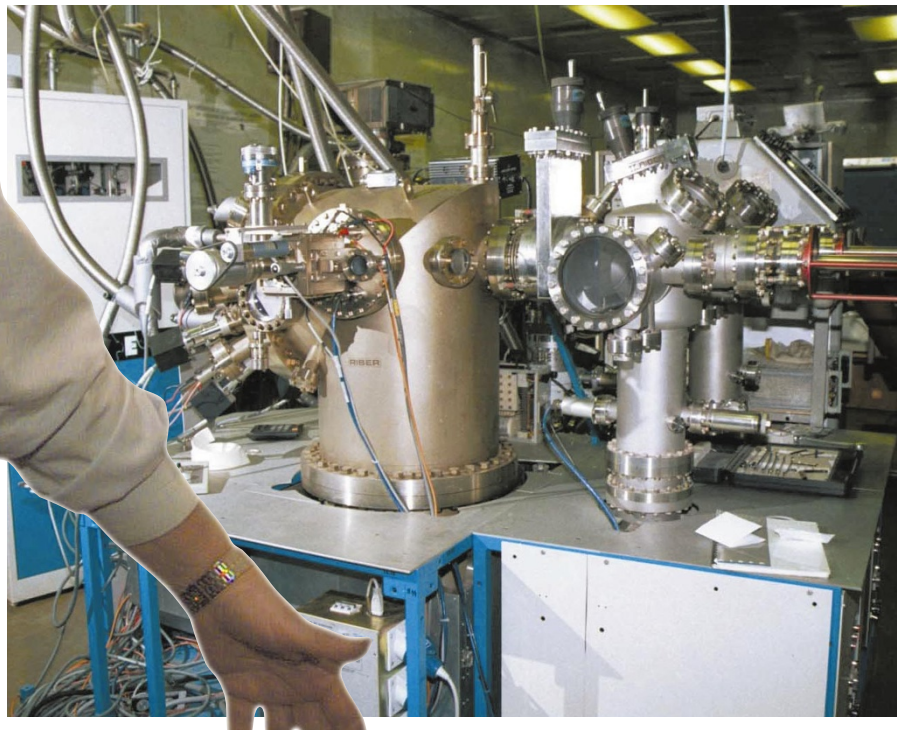

Man and machine: Zhores Alferov and the molecular beam epitaxy equipment used to make semiconductor heterostructures — these layered structures have revolutionized microelectronics.

the institute's annual budget had grown to US$80 million.

But the days of plenty ended abruptly with the collapse of the Soviet Union in 1991. As power passed to Boris Yeltsin's Russian Federation, science spending went into free fall. By 1992, the Ioffe institute's state funding had plummeted to around $4 million per year. Survival-level salaries ate up this budget — buying new equipment was out of the question.

Survival skills

So what kept the institute going? "We would not have made it alone," says Andrei Zabrodskii, a solid-state physicist and vice-director of the institute. Foreign help was very important, with Hungarian-born billionaire and currency speculator George Soros leading the way. Between 1994 and 1996, scientists at the Ioffe institute received 80 research grants worth a total of $2 million from his International Science Foundation.

Sources of foreign funding have since diversified. Today, about a third of the institute's annual budget of around $8 million comes from abroad. Here, Alferov's international reputation was invaluable. At the height of the Cold War, he was one of the trusted élite of young scientists who were given permission to visit the West. In 1970, Alferov spent six months in the lab of Nick Holonyak at the University of Illinois at Urbana-Champaign. There he carried out groundbreaking work on the structure and properties of semiconductor lasers.

Indeed, Alferov's first major award, the 1971 Stuart Ballantine Gold Medal of the Franklin Institute, came from the United States. Already a world leader in his field, Alferov was in hot demand to speak at international conferences. But unrestricted travel was impossible, even for someone of Alferov's growing status, and so the Ballantine medal had to be sent to him by mail.

Nevertheless, Alferov prospered within the Soviet system — the spaces between the bookcases in his vast, wood-panelled office are adorned with awards and certificates, and a conspicuous red flag. Visiting his institute, it is clear that junior colleagues regard him with a respect that approaches awe. He is engaging and charismatic, expansive in his gestures and quick to laugh. And although the Ioffe institute's current diminished circumstances must be an immense source of frustration, Alferov does not let it show. "Despite all our difficulties," he says, "the Ioffe institute is still home to some high-quality research, particularly in plasma physics, astrophysics and semiconductor physics."

Much of this research is financed by foreign grants. Projects in nanotechnology, for example, are supported by INTAS, an independent body formed by the European Union to promote East–West scientific cooperation. Similar support comes from the NATO Science Programme, and the Civilian Research and Development Foundation — a charity based in Arlington, Virginia, partly funded by the US government.

Past glories: the Ioffe institute established its reputation as a premier centre for physics.

Another important source of funds is the International Science and Technology Center (ISTC), established in 1992 by the European Union, Japan, Russia and the United States. The ISTC redirects activities formerly related to weapons research into civilian projects. The Ioffe institute's spherical Tokamak was completed in 1998 thanks to a $1 million grant from the ISTC. It is used to investigate the physical properties of spherical plasmas — aimed at decreasing the costs of fusion reactors.

But Germany is the Ioffe institute's most important international partner. At any one time, more than 25 Ioffe staff are working in Germany, many of them supported by the Alexander von Humboldt Foundation. Other support comes from the private Volkswagen Foundation, which, since 1993, has backed Alferov's research with a total of $250,000. Furthermore, the Ioffe institute is the only non-German institution affiliated to the German science ministry's NanOptics programme, which investigates the use of nanostructures in lasers and other optical devices.

Such grants — and support from foreign companies — have ensured that Alferov's own research area has remained buoyant. The institute's division of nanoheterostructure physics has contracts with companies in South Korea, Germany and China. For Alferov, the great disappointment is that his work is not benefiting a home-grown microelectronics industry. "The inability to transfer our results is the country's main problem," he says.

In 1985, Russia's electronics industry was the world's third largest, after those of the United States and Japan. But with little emphasis on consumer electronics, the industry was decimated by the collapse of the military–industrial complex. "It was destroyed," says Alferov, who hopes to use his influence to reverse the damage. On his initiative, the Duma earlier this month made a start by voting an extra $16 million into the 2001 budget to develop electronic technologies.

Faith in the future

Alferov believes Putin and the new science minister, Alexander Dondukov, will put more emphasis on research. They have already promised a 10% increase in funding, and deploying research to help rebuild Russian industry seems to be a high priority.

But in the long run, the future of Russian science might depend on its ability to exploit its human potential. In that regard, the Ioffe institute's educational centre, established in the 1930s, could provide a model. Ioffe's kindergarten, as it is known, takes talented secondary school students and tries to turn them into the researchers of tomorrow. Around a quarter of its intake stay in science, and the best graduates join the institute's staff. Thanks to this, the Ioffe institute still boasts a scientific staff of some 1,300. The school has already benefited from Alferov's previous political connections: in 1998, it moved into a new building near the institute, financed in large part by an $8 million donation from former prime minister Viktor Chernomyrdin.

In Russia, which has long suffered from a separation between the educational system and research — most of which is conducted in the institutes of the Academy of Sciences — the centre is highly unusual. Alferov believes such initiatives are vitally important, and he intends to spend a significant proportion of his Nobel prize money on the centre. "We may have an abundance of problems," he says, "but we certainly have no lack of scientific talents." ■

Quirin Schiermeier is *Nature*'s German correspondent.

- **http://www.nobel.se/physics/laureates/2000/public.html**
- **http://www.ioffe.rssi.ru**