

SCIENCE FUNDING IN THE FORMER SOVIET UNION NEEDS THE BOTTOM-UP APPROACH

The fall of the Berlin Wall in 1989 and the subsequent collapse of the Soviet Union have greatly changed the structure of the world. We should all be thankful that the confrontation between West and East, which reached dire heights during the long cold war, could be resolved peacefully. For Eastern scientists however, the difficult transition currently faced by the countries of the former Soviet bloc raises enormous funding and adaptability problems. The very survival of brilliant scientific schools in the former Soviet Union (FSU) is at stake.

Since the 1950s, scientists in the West have retained contact with their colleagues in the East despite great difficulties. Now, Western aid is desperately needed lest science in the FSU suffer greatly. In response to the critical state of research in Russia, many Western universities sanctioned the migration of many leading Russian scientists, particularly to the US but also to Western Europe (see figure 1).

Such an acquisition might be considered a great bonus, but there is a clear danger in Western institutions viewing the situation in shortsightedly selfish terms. During the present rather turbulent transition period in the FSU, it is perhaps just as important for them to support the lively research groups trying to survive there. The scientists there are eminently informed, open-minded and well connected, both among themselves and with their Western colleagues. They represent a vital base of direct and stable contact for Westerners. However, they need financial support to stay alive scientifically.

To actively channel aid from official agencies to needy researchers, some Western scientists have established a direct bottom-up approach. The stunning success of recent bottom-up efforts, outlined below, could serve to persuade more Western institutions of the vital need to increase similar activities. The bottom-up approach deserves greater recognition and possible extension beyond science to other fields of communal endeavor.

Fund people, not bureaucracies

In 1991, the European Physical Society (EPS)—which since its origin in 1968 included Western and Eastern

Western physicists have learned that researchers in the post-cold war East need direct support of research projects that promote healthy East-West collaborations, in place of bureaucratically diffused ‘top-down’ funding.

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physics societies under a single umbrella and functioned as a society of societies as well as of members—was approached by its Central and Eastern European member societies to convene a special meeting to present Western research organizations and funding bodies. At that time, there was a strong and urgent determination among former Soviet bloc members

to depart from the Soviet system, which, except in Poland, had imposed a rigid separation between higher education provided in universities and research undertaken in academy or government institutes.

The meeting took place in Dagstuhl, Germany. (See figure 2.) Funding difficulties were candidly aired, and the large research institutions from the West presented their funding models with a mixture of pride and despair. No model seemed exemplary. Still, thoughts and experiences could be shared. (One spin-off was that the Western organizations, engaged by this exchange of views, later moved for the creation of a European Physics Research Organization.)

The message from our Eastern colleagues came through loud and clear: If you want to provide us with funding, don't trust our existing system and don't provide help at the higher administrative levels. Money injected at the top, they explained, would just disappear in the hierarchy. Instead, the West should provide help at the bottom, financing individual research groups for specific projects, especially in cases involving Western collaboration.

During that 1991 meeting, the coup in Moscow erupted, and we followed events directly on shortwave radio, thanks to our many Russian-speaking colleagues present. It became quickly evident that the need for aid to Central and Eastern Europe would be dwarfed by a broader need for aid to the FSU. All present deeply felt the urgency to keep alive the great Soviet centers of scientific excellence, particularly those involved in theoretical physics, solid-state physics, particle physics and astrophysics. Here again, it was felt that help could best be provided by means of the bottom-up approach.

Key elements of a “bottom-up” approach

- ▷ Aid specific projects formulated by research groups.
- ▷ Grant this aid based on peer reviews involving both the granting and receiving sides.
- ▷ Channel the granted aid directly to the researchers.

One small step for science . . .

An early example of the bottom-up approach was the “Journals for Russia” scheme, organized by the EPS at the explicit request of our colleagues in the FSU. Since

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FIGURE 1. ONE LEFT, ONE STAYED. Physicists Mikhail Voloshin (left) and Boris Joffe, both from the Institute for Theoretical and Experimental Physics (ITEP) in Moscow, attended the American Physical Society's Forum on Physics in the FSU, held in Washington, DC, in April 1992. Subsequently, Voloshin settled in the US, making visits to Moscow, while Joffe stayed on at ITEP.

the Soviet library system had been deprived of requisite funding, the EPS enabled 50 FSU institutes to receive 30 European physics journals free of charge for two years, 1993–95. During the 1992 meeting in Budapest, the EPS coordinated its efforts with the American Physical Society (APS), which did the same with American journals (see figure 3). In Europe, financial help came from the International Association for the Promotion of Cooperation with Scientists from the New Independent States of the former Soviet Union (INTAS), after the EPS convinced seven commercial European publishers to grant a 50% rebate on journals bought under that scheme.

Another welcome bottom-up effort was organized jointly by Russian and Western scientists. Starting in 1993, the International Centre for Fundamental Physics in Moscow (ICFPM) awarded research grants using European Union, Swiss and Swedish government funds, complemented later by INTAS funding (see figure 4). It was gratifying to see famous research institutes in Moscow, such as the Landau, Lebedev and Kapitsa institutes and the Institute for Theoretical and Experimental Physics, put aside their traditional competitiveness and collaborate actively to make effective use of this aid. Thanks to the offices of then-Science and Technology Minister Boris G. Saltykov, funding was channeled in a tax-free way, and vital matching Russian funds were granted. In the typical year of 1995, this program directly funded 12 conferences and supported 102 promising young scientists.

In addition to these relatively modest programs, two international funding agencies were set up and became active by 1993: INTAS and the International Science and Technology Center (ISTC). Both agencies chose the bottom-up approach, supporting research projects involving East–West collaboration and selected on the basis of East–West peer review. Very happily for science in the FSU, the International Scientific Foundation created and funded by George Soros acted with great efficiency as a stopgap solution, providing, in particular, survival salaries for thousands of researchers when urgently needed.

The bottom-up approach, proposed and organized by scientists for scientists, is what I wish to illustrate further (using INTAS and ISTC as examples) and advocate as the route to pursue generally in the provision of aid. It

sharply contrasts with the top-down approach that is used lavishly—and less effectively—by governments and banks. Yet it succeeds in channeling crucial financial aid directly to researchers.

After the Iron Curtain dropped

INTAS was created in 1993, thanks to the strong support of President François Mitterrand. The desire to save centers of scientific excellence in Russia, particularly in physics, was the basic motivation of INTAS's earliest proponents, including Lev Okun and Carlo Rubbia. However, Western governments wished neither to separate Russia from the other new independent states (NIS) nor to single out a particular field of science. Consequently, INTAS evolved into a flexible partnership, extended to all NIS and covering all the sciences, including the social sciences. Physics accounts for 25% of INTAS-supported projects.

The main purpose of INTAS is now to allow scientists in the NIS to continue their research, and to build a network of scientific cooperation between the East and West. INTAS also funds specific grants, conferences and infrastructures. The Journals for Russia funding (mentioned above) fell under the infrastructure category, and amounted to US \$660 000, the largest award so far. [We have converted from 600 000 euros, and will do so throughout this article, at the late-February exchange rate of one euro to \$1.10.] INTAS has quickly become an information disseminator and operates in a bottom-up, peer review mode. A large proportion of INTAS funding covers salaries paid tax-free in the NIS, especially to top and promising young scientists.

Funding odds

INTAS has already played a vital role in funding a host of projects bringing European and NIS scientists together; its primary importance in helping young scientists in the NIS should not be underestimated. Over the association's first five years of operation, 1500 research projects were completed, and collaborative projects involved 5000 groups from 31 countries. (See figure 5.) About 80% of INTAS' funding went directly to nearly 20 000 scientists in the NIS. The focus has been on pure research, with individual grants being typically at the \$80 000-level. (See figure 5).

Table 1. Overview of Results of INTAS calls for proposals, 1993–96.

Calls for Proposals	Number of Proposals Received	Number of Proposals Selected	Number of Partners (Institutions)	Funded projects		
				Average Number of Partners per Project	Total Financing, (dollars)	Average Financing per Project (dollars)
Open call 92	300	50	235	4.7	4 268 113	85 362
Open call 93 (+ extension)	3395	477	2675	5.6	33 588 965	70 418
Open call 94	4783	448	2692	6.0	21 883 895	48 848
Joint call 95 with Russia	1321	144	770	5.3	7 271 000	50 493
Joint call 95 with Ukraine	313	64	316	4.9	3 960 000	61 875
Joint call 95 with Kazakhstan Phase I+II	Phase I 72	15	72	4.8	979 000	65 266
	Phase II 70	17	88	5.2	1 001 000	58 883
Open call 96	2309	315	1575	5.0	19 800 000	62 700
Total	12 563	1530	8423	5.5	92 751 974 ¹	60 622 ¹

¹Including contributions made by participating states of the former Soviet Union, totaling \$6.6 million.

But is the funding enough? The overall INTAS budget was at the level of \$16.5 million a year. Yet it fell markedly short of the demand.

For instance, the response to the 1997 INTAS call for proposals consisted of close to 2200 proposals with a total funding request of \$189 million. Funding granted in 1997 was at the level of \$14.0 million for “open call” proposals (financed by INTAS exclusively) and \$10.5 million for “joint call” proposals (cofinanced by the partners from the NIS), resulting in a success rate of only 13%. This may illustrate the high selectivity of the peer review system, but it also points up the low probability of being funded. A success rate of 30% might be deemed healthy and highly competitive, but a success rate of only 13% threatens the very stability of the system.

It must be noted that open-call proposals, presented directly by scientists and more numerous than can be supported, are selected on the basis of excellence in a fully bottom-up way. But joint-call proposals, although also selected on the basis of excellence, involve some top-down factors since they are graded additionally by the participating NIS and, occasionally, by the Western organizations involved. INTAS has to ensure, therefore, that the scientific quality of joint-call projects

approaches the high standards set by open-call projects. Since joint-call projects are supposed to generate extra matching funds (as 50–50 ventures), one has also to ensure that their cofinancing is not based on mere rubber-stamping within fixed global budgets for research.

Table 1 gives an overview of the results of the INTAS calls for proposals to date. In addition to the projects listed, \$2.1 million has been used to support infrastructural activities such as holding conferences, disseminating the latest research papers in the NIS and preserving unique collections of data.¹

In recognition, perhaps, of the low funding-to-proposal ratio, the funding granted to INTAS’ budget for the next



FIGURE 2. BOTTOM-UP ONLY. Members of Central and Eastern European physics societies and representatives of Western research organizations and funding agencies got together at Dagstuhl, in Germany’s Saarland, in August 1991 to review the funding process for physics research and find ways to get financial assistance directly to researchers in the then-crumbling Soviet bloc.

four years shows a welcome increase of 13% over the previous four-year budget. But the question of sufficiency of funding remains. Is it likely that highly deserving proposals (requiring considerable investments of time and energy) will continue to be submitted when so low an expectation of success prevails, given that a sizable fraction of the top proposals will have to be rejected, albeit reluctantly? This is a serious problem. Although most of the funding for INTAS comes from the Commission of the European Union, the association is also supported by the member countries represented in its General Assembly, which acts as governing body advised by its Council of Scientists.

Sharing know-how

The creation of the ISTC followed a request from the Russian government in 1991. With the end of the cold war and the impairment of military-related research, it was feared—in both the East and West—that sophisticated Soviet military know-how and secret technology used to

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build weapons of mass destruction ran the risk of being haphazardly disseminated unless provision were made for orderly technology transfer. Funding was pledged by Western countries and Japan, and the ISTC created in 1992. The aim was to keep hitherto military-oriented high-technology centers in the FSU active

while directing their diversification toward civilian ends.

The ISTC, therefore, provides funding for R&D projects that bring together teams from the US, Western Europe or Japan with teams from the NIS. (Funding focuses on R&D projects, as opposed to production.) In practice, Western or Japanese teams can propose a collaboration with colleagues in those NIS that have signed the ISTC agreement (so far, they are Russia, Armenia, Belarus, Georgia, Kazakhstan and Kyrgyzstan) on a particular R&D program involving some center or centers of the former military-industrial complex. To be funded, though, each such proposal has to first be approved by the host FSU country. The ISTC makes decisions on support and pays tax-free funds directly to researchers on approved projects.

The ISTC offers a mutually satisfactory arrangement. On the one end,

FIGURE 4. SURVIVAL OF RUSSIA'S CENTERS OF SCIENTIFIC EXCELLENCE was the mission of these members of the founding committee of the International Centre for Fundamental Physics in Moscow (ICFPM). They are seen in front of the Ministry of Science and Technology Policy in Moscow, prior to meeting with Minister Saltykov in November 1993. At the right is Mikhail A. Vasiliev (secretary), next to him is Lars Brink (chair), and in the center is Leonid V. Keldysh (vice chair).

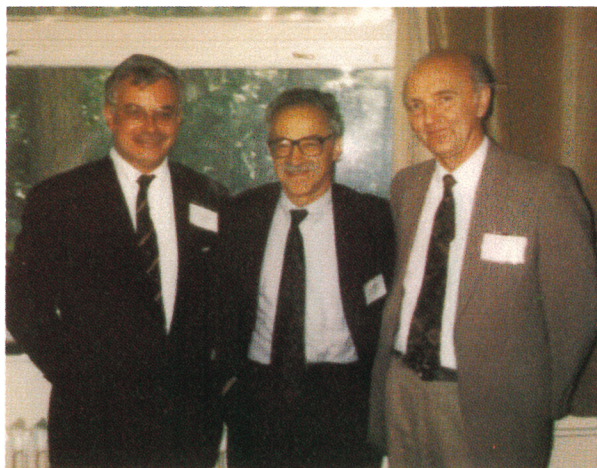


FIGURE 3. MEETING TO DISCUSS AID to scientists in the former Soviet bloc, in Budapest in May 1992 were, from left to right: Maurice Jacob, president of the European Physical Society (EPS), Ernest Henley, president of the American Physical Society, and Norbert Kroo, vice president of the EPS. They were joined by representatives of the physical societies of central and eastern Europe.

the participating NIS collect monetary dividends from long-established military investments, thereby enhancing their own economic development while avoiding disruption of day-to-day operations in high-technology centers. On the other end, Western countries and Japan have much to gain from effecting an orderly military-to-civilian transition, preventing the erratic dispersal of Soviet know-how to unstable regions of the world. They also benefit from the actual high-technology transfers.

As the main partners, the US and the European Union each contribute two-fifths of the ISTC budget, and Japan covers most of the rest. Although, in principle, supported projects are jointly selected on merit, each of the three funding partners shows particular interest in those involving its own scientists, which results in the distribution of the collaborative projects roughly following the contributions.

During the first two years of ISTC activity (1994–96), 9% of funding went to projects involving fundamental research. Projects in fundamental physics were intended

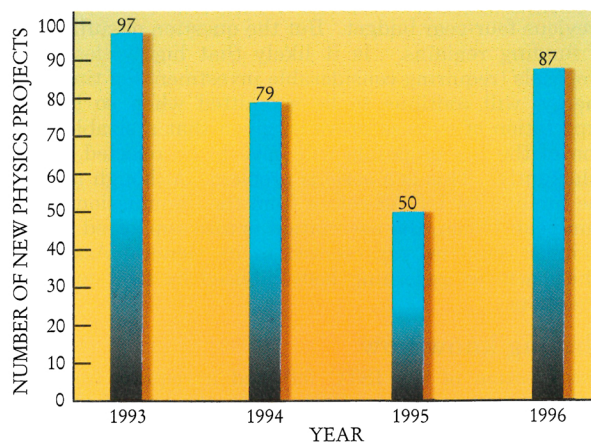
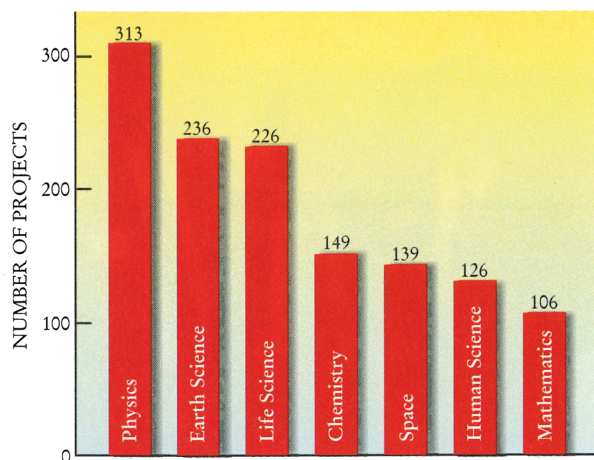


FIGURE 5. INTAS BY THE NUMBERS. The International Association for the Promotion of Cooperation with Scientists from the New Independent States of the former Soviet Union was established in 1993. Through 1996 (left), it funded projects in seven areas of research, with physics having the most activity. The number of new physics projects funded each year (right) varied considerably during that period.

to facilitate the integration of Russian scientists into the international research community, which proved to be a successful endeavor. Within the first two years of operation, the number of proposals with projects completed, under way and approved exceeded 700, with the mean invested support per project being on the order of \$330 000. By the end of 1996, \$106 million was engaged on 324 projects. Table 2 brings the situation up to date.

The ISTC program can already be considered a success. It has resettled 15 000 FSU scientists in civil activities, notably aiding 3000 previously involved in hard-core military research. Also unveiled to academic researchers is the intellectual and technological capital of laboratories until recently shrouded in military secrecy. The most important domains covered to date have been instrumentation and materials research (27%), and nuclear energy research (25%).

The European Union's present involvement in the ISTC is comparable to its role in INTAS (at the level of \$16.5 million, in 1996). Within the European Union, the program is financed by the Technical Assistance to Countries of the Former Soviet Union (TACIS) project, aimed at supporting the transition toward a market economy.

CERN as an East-West bridge

The founding of the ISTC created new partnership opportunities for CERN, which has its own tradition of international collaboration, primarily among its member states but increasingly on a world-wide basis. The number of CERN's scientific users, has accelerated from 1500 to nearly 6500 over the past 20 years, and one-third of the current users are scientists from non-member states. Among them are about 600 Russian physicists.

CERN has always acted as a bridge between East and West, even at the peak of the cold war. Thanks to much goodwill, fundamental research brought people together despite political cleavage. Collaborations, although imperfect, worked. CERN

signed several cooperative agreements with the Soviet Union and the Joint Institute for Nuclear Research (JINR) in Dubna, which allowed Western scientists to participate in the Dubna and Serpukhov programs but above all facilitated the involvement of an increasing number of Soviet scientists in CERN programs. Worth a special mention is the joint CERN-JINR School of Physics which has, every other year, brought 100 young physicists from the East and West together, highlighting the value of communication through times of tension.

New prospects opened by the ISTC attracted CERN's attention right from the start. Cold war collaborations often wore the guise of academic research to succeed. With the Iron Curtain dividing Europe demolished, joint ventures so triggered could definitely expand onto a wider technological front. CERN-related activities could help

Table 2. Overview of ISTC projects, 1994-98.

Technology area	Number of projects	Funding (millions of US\$)
Environment	131	44.8
Fission reactors	82	28.8
Physics	96	23.6
Biotechnology and life sciences	88	18.5
Materials science	66	19.7
Instrumentation	48	15.5
Space, aircraft and surface transportation	41	11.7
Fusion	26	8.3
Information and communications	25	6.7
Chemistry	24	5.9
Nonnuclear energy	12	3.9
Manufacturing technology	12	1.8
Other basic sciences and technology	5	0.4
Total	656	189.7

Scintillation tiles from Portugal, Russia for CERN

A fascinating example of CERN-ISTC collaboration comes from the scintillation tiles project. When the ATLAS detector at CERN required production of large plastic scintillator tiles with high optical quality for use in radiation tracking, several world players came together. ISTC Project 515 involves Lisbon's Laboratório de Instrumentação e Física Experimental de Partículas (LIP-Lisbon), Michigan State University and, on the Russian side, the Institute of High Energy Physics (IHEP) in Protvino and two formerly secret laboratories, one in Moscow and the other in Podol'sk with the code names ARI of Chemical Technology and SPO "Luch," respectively. Indeed the project includes, as required, industries that were originally part of the Soviet military-industrial complex.

Approved by ISTC, with funding at the level of \$330 000, the project covers the development of the injection molding technique for the production of scintillation tiles. Through LIP members then engaged in work on the scintillation tiles of the ATLAS calorimeter, CERN was apprised of Portugal's globally reputable plastic molding industry, which follows an old tradition of glass molding and expanded several decades ago into toy manufacture.

Keen to approve this project, CERN was gratified to find encouragement from the Portuguese Ministry of Research. While Portuguese industry had to admit to being unable to produce injection-molded tiles of the requisite optical quality, LIP was advised to contact an industrial research institute in Braga, with which Portuguese industry had good contacts.

The LIP group approached this institute and met with much interest. Meanwhile, a Russian IHEP team at ATLAS that had previously developed molds on a smaller scale secured the interest of a formerly secret industry in Russia with know-how on optical-quality molds. Contacts between the Russians and the Braga institute were encouraging. Everything was in place for a good collaboration. The funding granted by the ISTC made it possible.

The end result is spectacular. SPO "Luch" is designing and producing the molds with Portuguese participation. It is also



A YOUNG SCIENTIST GAZES through 10 cm thick scintillating tiles of the hadronic calorimeter for the ATLAS detector at the LHC. The tiles are being produced in Portugal with Russian collaboration under the aegis of the International Science and Technology Center.

developing the polishing method and control equipment. Molding through injection is being developed in Portugal. Accelerator tests will be made at Protvino and at CERN by IHEP and LIP physicists, respectively.

Benefits resound across the board. ATLAS benefits in obtaining the plastic scintillators it needs. The Portuguese molding industry masters new, economically viable skills through a particularly interesting type of technology transfer from the former Soviet military. Russian industry is introduced to a new outlet for its brilliant technology and may also benefit from Portuguese know-how in molding. All parties gain.

prevent Russian science from being trapped within a scientific ghetto.

Consequently, the participation of CERN in a few ISTC programs proceeded in a fairly organic way. The possible teaming of Western and NIS scientists within CERN projects seemed optimal to the creation and follow-up of joint R&D projects. Such collaborations could efficiently connect Russian science to the world, while the access to expertise from formerly secret laboratories promised benefits to all. Thanks to strong involvement in various high-technology initiatives and already significant collaborations with Russian scientists, CERN could quickly act as a good partner, or at least a hub, on ISTC projects. By the beginning of 1997, CERN was involved in a cryostat for a krypton calorimeter used in an experiment looking for CP violation in K decay; Russian participation was helped by INTAS. Other projects under way are proceeding satisfactorily.

Currently, the ISTC enjoys the automatic follow-up built into every CERN-centered project. Both Western and Russian scientists are indeed working together within the necessarily collaborative framework associated with the preparation of the LHC experiments. Western partic-

ners are keen to ensure a successful outcome, despite their receiving no special support from the ISTC, funding being fully granted only to the Russian side.

By the end of 1997, CERN was involved in nine ISTC-supported projects. Two types of projects hold: one with CERN as major participant, sometimes in a joint venture; the other with a CERN member state group as major participant, outside CERN, but engaged in a CERN experiment. In the member state case, CERN can assist in formulating the ISTC proposal, pledge to provide needed elements (such as test beams) and trigger high-level support from relevant member state authorities.

The box above provides a glimpse of how much can be accomplished with just one joint project. It makes a strong case in favor of the bottom-up approach, as a highly efficient and mutually beneficial way to help our neighbors in turmoil.

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