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Eugen Merzbacher
Department of Physics and Astronomy
University of North Carolina, CB3255
Chapel Hill, NC 27599-3255
Tel. 919/962-3021
Fax. 919/962-0480
merzbach@physics.unc.edu

Report on the Expert Meeting on Particle Physics

OECD Megascience Forum

Villigen, Switzerland, 16-18 May 1994

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I was asked by Wilmot M. Hess, Associate Director for High Energy and Nuclear Physics in the U.S. Department of Energy, to participate in this meeting as a member of the U.S. delegation. Although I am not a particle physicist, conversations with some high-energy physics colleagues on the delegation and with Washington officials, including John H. Gibbons, persuaded me that as an observer with a somewhat different perspective my participation in this meeting might be useful. This report reflects my personal, somewhat disjointed, views based on my own observations at the Expert Meeting. The background document for the meeting, commissioned by the OECD and entitled *Perspectives on Particle Physics and International Co-operation*, is an excellent comprehensive source of up-to-date information on the status and the prospects of particle physics. (In the remainder of this report I will refer to this document briefly as *Perspectives*.) At the meeting, each of its co-authors presented a chapter of this report in a form that was accessible to the nonexperts in the audience, including a substantial number of middle-to-upper-level government officials responsible for science policy.

The premises underlying this meeting can be summarized as follows:

1. Particle physics, which has flourished for decades through international collaboration, addresses a number of fundamental questions about the universe and its history. The answers to these questions concern all of us. There is a large global community of extremely talented and highly trained young scientists whose careers are entwined with particle physics.

2. Particle accelerators, based on conventional principles of acceleration, are for the foreseeable future the only devices that can achieve the high particle beam energies and luminosities needed for advances beyond the "standard model" (a strangely colorless term for a discipline that has relished an imaginative and sometimes whimsical terminology). Experiments with enormous detectors at these accelerators (and also in non-accelerator particle astrophysics) must be conducted in the megascience mode.

3. In the future, the construction of accelerator and detector facilities will require the early mobilization of the resources of more than a single (host) country. In view of the mega-costs of these projects to society at-large, new forms of international partnership have to be developed to insure efficient utilization of scarce resources. For the time being, there are only three regions with the capacity to be significant underwriters of such a partnership: Europe (with the FSU), Japan (and the Pacific Rim), and North America.

4. There is an understanding that in the quest for new accelerator facilities the Large Hadron Collider (LHC) at CERN is now at the top of the agenda. At least one electron-positron linear collider (EPLC, or NLC for Next Linear Collider, or ILC for International Linear Collider) in the 500 GeV to several TeV range is next on the list, but its feasibility is not yet established, and its likely cost cannot be known for several years, perhaps not until 1998. In the more remote future one sees the outlines of a proton-proton circular collider, perhaps exceeding the SSC in energy.

5. In spite of the SSC history, the U.S. particle physics program, funded by DOE and NSF, still occupies a commanding and respected position. All interested parties, in the U.S. and abroad, share the hope that in the future it will be possible for the U.S. to undertake partnerships in megascience projects based on commitments with a longer time frame than just one year.

As far as I could determine, the meeting was quite successful in providing reasonably full discussions of these issues in a forum that brought physicists together with the custodians of the public purse in many concerned countries, or their representatives. The able chair of the meeting, P. A. J. Tindemans, was generally successful in keeping the attention of the participants focused on the essentials. (His decision to include presentations from high-energy astrophysics and nuclear physics in the meeting, and references thereto in the final report, was debatable. Both of these areas deserve high priority, more funding, and a global perspective, but they are not the only important scientific cousins of particle physics, and concern with them at this particular meeting tended to dilute the discussion of the megascience aspects of accelerator-based particle physics.)

Not surprisingly, the cancellation of the SSC cast a heavy shadow over the meeting. The U.S. delegation encountered a wide spectrum of reactions, ranging from genuine sympathy and commiseration to ill-concealed *Schadenfreude*. Still, in spite of all the currents, cross-currents, and under-currents that are detectable in all serious discussions of science policy matters between smart individuals who have diverse and sometimes divergent agendas, I came away from the meeting with an appreciation of the camaraderie and common understanding among the global community of particle physicists. In practical terms, this unity of purpose became evident in the brief reports to the meeting on the internationally coordinated R&D efforts that are proceeding at DESY in Germany, KEK in Japan, SLAC in the U.S., at CERN, and even in Novosibirsk, toward proving the feasibility of an electron-positron linear collider as described above. These preparatory studies are being conducted with modest investments; they promise, and in some cases have already produced, valuable technical advances. In the midst of all these harmonious interchanges, the director of KEK in Japan provided some unexpected excitement by announcing, rather casually, that Japan is prepared to go it alone in planning its own e^+e^- collider, with specific plans to be forthcoming around 1996.

The contentious views of some, but by no means all, science policy officials were articulated by Robin Ritzema from the U.K. in expanding on his prepared discussion paper on *Government and Consultation*. He argued in favor of involving government at an earlier stage than in the past in the planning of scientific mega-projects, but at the same time he seemed impatient with scientists for sometimes shifting their design preferences after the initiation of a project. Exhibiting a measure of exasperation, he appeared to be asking for firmer and more timely signals from the scientific community on mega-projects even as he urged broader and more deliberate democratic participation by bench scientists in the setting of priorities. With the memories of the SSC so fresh in everyone's mind, it was hard to take issue with these propositions, and in any event Ritzema escaped a confrontation with a few irritated physicists by leaving the meeting early.

Partly in the open session and partly *sotto voce* at the coffee breaks there was conversation about the wisdom of building two B factories in the world, in the U.S. and Japan, although these projects are *faits accomplis* and not really in the megascience league, and thus could be deemed to be outside the compass of this meeting's agenda. Chapter 6 of *Perspectives* provides the physics arguments for building two B factories.

The LHC, on the other hand, is not yet quite an accomplished fact, and its projected cost in the \$2B range places it in the megascience category. For details on its status *Perspectives* is also an excellent source. If CERN has to rely entirely on its members for construction funds, the (still hypothetical) target date for its completion would have to be stretched, perhaps from 2002 to 2005. The U.S. delegation took strong exception to the CERN proposal that access to experimentation at the LHC by scientists from non-CERN nations be made contingent on monetary or in-kind contributions to the construction of this facility. Such an unprecedented linkage, apparently mandated by the CERN Council, would fly in the face of past practices and might well mark the beginning of a reciprocal "trade war" - something which should be avoided at almost all cost. Burton Richter presented the U.S. objections to the CERN proposal clearly and persuasively, and the meeting ended with intimations that CERN would review its position on the question of access.

Once this obstacle is removed, there is every reason to back the concept of a substantial U.S. contribution to LHC construction (as also urged by the Drell subpanel report on *Vision for the Future of High-Energy Physics*, released after the Expert Meeting). The meeting confirmed my impression that the American particle physicists, who are still disoriented by the SSC shut-down, tend to underestimate the collegial support from the broader physics community on which they can now expect to draw. Indeed, such support, could make a critical difference when it becomes necessary to mobilize government agencies and the Congress to approve funds for an accelerator project on foreign soil like the LHC.

Behind the funding for the LHC lurks the e^+e^- -collider, the feasibility and probable cost of which remain to be determined. While it is certainly premature (and might even be inimical to the present well-conceived competitive R&D effort) to select one or two among the current concepts or choose a possible site, the experts at the meeting were unprepared even to entertain a discussion of procedures that could eventually be used in an interregional decision-making process. That, I and other members of the U.S. delegation had thought, was the main question posed by the Megascience Forum, but the assembled high-energy physics leaders, who were mostly directors of the large laboratories, were reluctant to "bite that bullet". I suspect that every one of them was hoping that, miraculously, the e^+e^- -collider might turn out to be feasible to build within a single region's budget - but only the Japanese had the nerve to say so. As a result, the formal *Chairman's Conclusions and Recommendations*, which the Expert Meeting endorsed for submittal to the Megascience Forum in July, look rather pale and do not adequately portray the real utility of this Expert Meeting as a vehicle for providing science policy makers - who hate surprises - with a broad international perspective on the large and expensive particle physics projects that are in the wind.

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Eugen Merzbacher
Department of Physics and Astronomy
University of North Carolina, CB3255
Chapel Hill, NC 27599-3255
Tel. 919/962-3021
Fax. 919/962-0480
merzbach@physics.unc.edu

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