

Viewpoint

Charting the future of European particle physics

Tatsuya Nakada considers what the updated European Strategy for Particle Physics needs to address.



Tatsuya Nakada.

The original CERN convention, which was drafted nearly 60 years ago, foresaw that the organization should have a role as co-ordinator for European particle physics, as well as operating international accelerator laboratories. Today, this role is more appropriate than ever: the long lead times usually required to prepare and construct facilities and experiments for modern high-energy physics, together with the increased costs for these activities, underlie the need for a general European strategy in the field. So it was natural for CERN Council to initiate the creation of a European Strategy for Particle Physics in June 2005 and to establish dedicated groups for reviewing the scientific status and producing a proposal. They consulted widely with the community, funding agencies and policy makers in preparing the strategy document, which was adopted by Council in July 2006 during a dedicated session in Lisbon.

The strategy consists of 17 concise descriptions, with action statements (*CERN Courier* September 2006 p29). It addresses not only scientific issues but also subjects such as the organization and social relevance of high-energy physics. The highest priority on the scientific programme was given to the LHC, followed by accelerator R&D for possible future high-energy machines, including the luminosity and energy upgrades of the LHC, linear e^+e^- colliders and neutrino facilities.

CERN Council adopted this strategy in 2006 with an understanding that it be brought up to date at intervals of typically five years. The first update is now being prepared for presentation to Council in 2013, the process having been postponed for two years to wait for data from the LHC at energies of 7 and 8 TeV in the centre of

mass. As a result, in addition to the recent discovery at the LHC of a new boson that is compatible with the Standard Model Higgs particle, the third mixing angle of the neutrino mass-matrix has become known through experiments elsewhere.

These new results generate more scientific questions compared with 2006, such as:

- How far can the properties of the Higgs(-like) particle be explored at the LHC, with the 300 fb^{-1} of data expected for Phase 1, and with the $1000\text{--}3000 \text{ fb}^{-1}$ ($1\text{--}3 \text{ ab}^{-1}$) that the high-luminosity upgrade should yield? Do we need other machines to study the particle's properties? If so, after taking into account factors such as the technical maturity, energy expandability, cost and location, what is the optimal machine: a linear or circular e^+e^- collider, a photon collider or a muon collider? As a more concrete question, what should the European reaction be towards the linear collider that is being considered in Japan?
- The European neutrino community is putting forward a short-baseline neutrino programme to search for sterile neutrinos, as well as a long-baseline one to measure neutrino-mass mixing parameters, to take place in Europe. In addition, R&D studies are underway for a "neutrino factory" as an eventual facility. But, what should the European neutrino programme be, and where does the global aspect start to play a role?
- What are the options for a future machine in Europe after the LHC? Will this be a machine to address physics at the 10 TeV energy scale? Will data from the LHC at the full design energy provide enough justification for this? When will be the right moment to take a decision, and what kind of R&D must be done to be ready for such a decision in the future?

Breakthroughs in science can emerge from unexpected corners. Therefore, the strategy must also have some flexibility to allow the fostering of unconventional ideas.

The process of updating the European strategy began formally in the summer of 2011 when Council set up a new European Strategy Group, which is assisted by the European Strategy Preparatory Group for scientific matters in preparing the proposal for the update. As with the process that led to the original strategy, the proposal will be based on the maximum input from the particle-physics community, as well as from other stakeholders – both inside and outside Europe. An important part of this consultation process was the Open Symposium recently held in Krakow, where the community expressed their opinions on the subjects outlined above, as well as on flavour physics, strong-interaction physics, non-accelerator-based particle physics and theoretical physics. Issues important for carrying out the research programme, such as accelerator science, detector R&D, computing and infrastructure for large detector construction, were also addressed. The meeting demonstrated that there is an emerging consensus that new physics must be studied both by direct searches at the highest-energy accelerator possible, as well as by precision experiments with and without accelerators.

The Preparatory Group is in the process of producing a summary document on the scientific status. The European Strategy Group will meet in January 2013 in Erice to draft the updated strategy – which must also take global aspects into account – for discussion by CERN Council in March. The aim is that Council will adopt the updated strategy during a special session to be held in Brussels in May.

● Further information on the update of the European Strategy of Particle Physics may be found at <https://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/>.

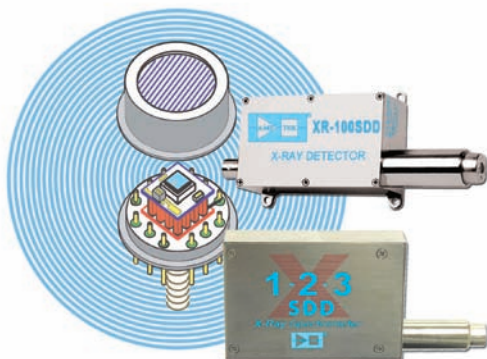
● Tatsuya Nakada, *École Polytechnique Fédérale de Lausanne*, is scientific secretary for the European Strategy Session of the CERN Council and chair of the European Strategy and Preparatory Groups.

Silicon Drift Detector

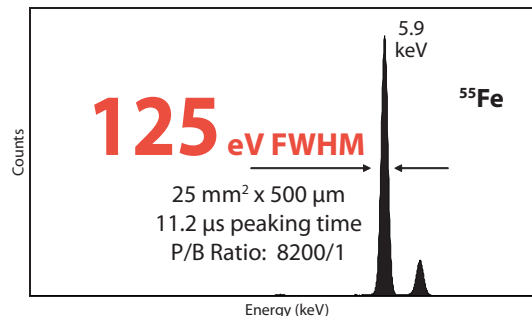
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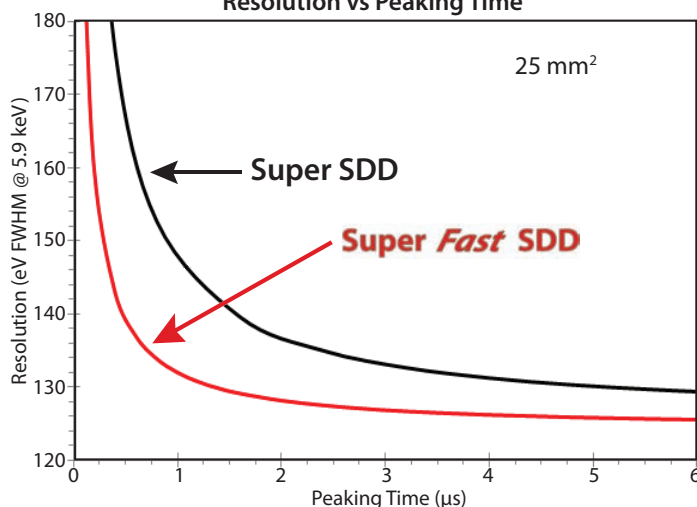
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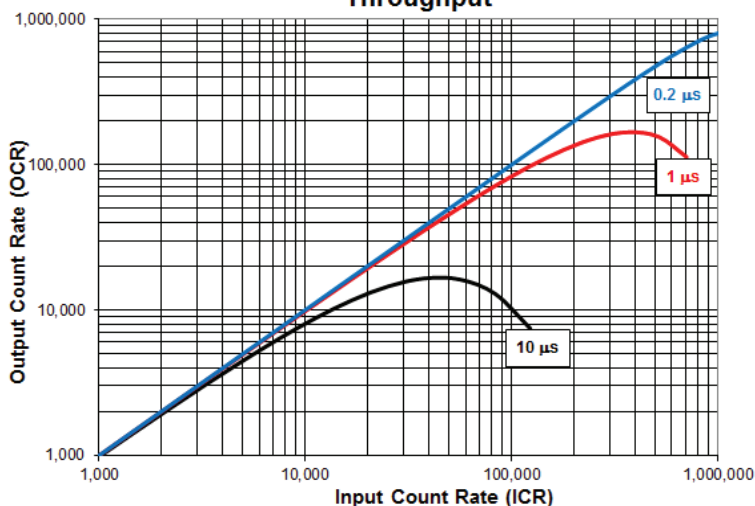
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Resolution vs Peaking Time

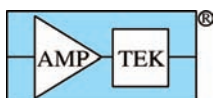


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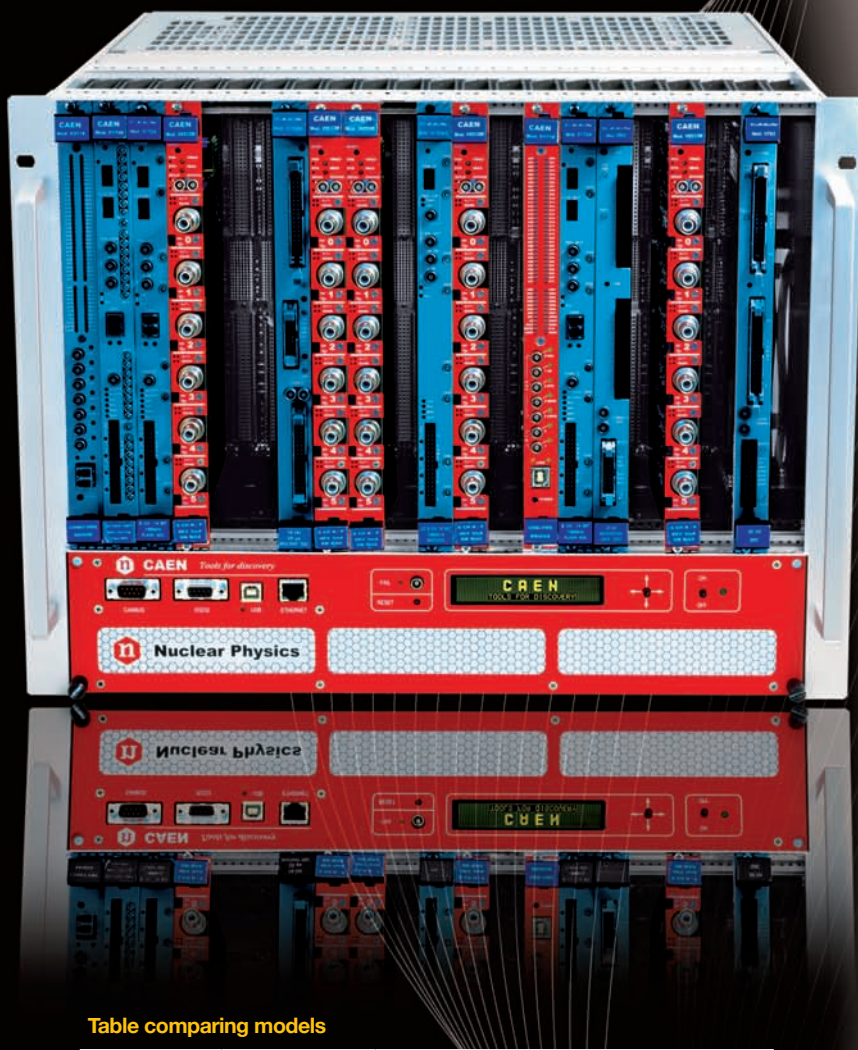
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V6521H P/N/M	6 kV	0.02 mA	1 nA (0.1 nA*)
V6533 P/N/M	4 kV	3 mA (9 W max)	50 nA (5 nA*)
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* Optional Imon Zoom x10

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