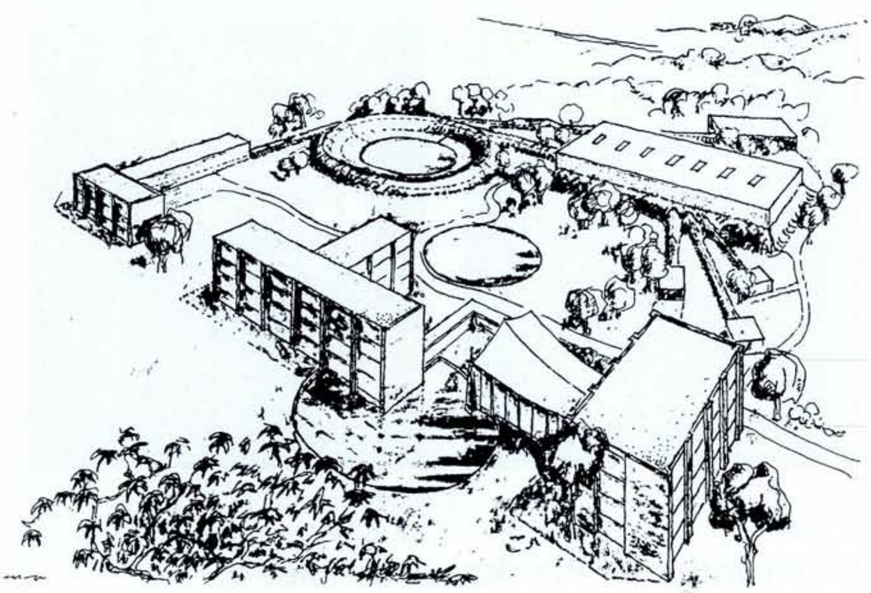
AUSTRON

A Pulsed Neutron Source for the Future

The right project at the right time — this is what AUSTRON promises to be for the scientific world in the near future. AUSTRON aims to create in Austria an international centre based on a pulsed neutron spallation source. The main impact of the AUSTRON project lies in its interdisciplinary application to a wide range of research topics. Apart from studies in physics and medicine, the new source will encompass fundamental and applied aspects of biology, chemistry, materials science, and technology development.



In October 1991, a panel of experts representing more than 50 European research institutes unanimously supported the construction of a neutron spallation source based upon a rapid-cycling proton synchrotron (RCS). The AUSTRON project was born, which in the words of M. Regler, the initiator of AUSTRON, "....will join east and west European countries in a collaborative scientific effort." His commitment, as well as the support of P. Skalicky, the Rector of the Technical University of Vienna, and of 15 other world-renowned Austrian scientists convinced the Austrian Government of the importance of the project.

At the end of December 1992, Dr. E. Busek, Austria's Vice-Chancellor, officially declared that the Austrian Government would support AUSTRON. From then on the political effort has concentrated on finding funds to cover the estimated construction cost of about 220 MECU (3100 MATS), plus eventually another 80 MECU to double the beam intensity. Austria is prepared to pay one-third providing that partner countries contribute the remainder, while a town in lower Austria has offered a site and the necessary infrastructure for the new centre.

The AUSTRON Concept

A workshop held in the Federal Chamber of Commerce in Vienna at the beginning of May 1993 considered in further detail the scientific possibilities of the AUSTRON centre as well as the urgent need for a new, powerful spallation source in Europe. Over 100 scientists from 15 countries participated and the 22 presentations gave invaluable information on AUSTRON's structure and research goals.

To be attractive, a new neutron spallation source must offer a performance equal to or better than that of the present world leader — the ISIS facility at the Rutherford-Appleton Laboratory in the United Kingdom. The overall concept is based on an accelerator with a specially tailored design, and the complex consists of an ion source, a radio-frequency quadrupole, a drift-tube linac, and a rapid-cycling synchrotron. Construction would take five to six years.

The principle advantage of the AUSTRON concept lies in the use of proven accelerator technology in order to minimize costs and the risk of delays. The design nevertheless allows a high beam power to be reached while maintaining a relatively simple target based on an edge-cooled design. By avoiding direct contact of the proton beam with the liquid coolant (water), the compact design facilitates manipulation of the target and the cooling circuit because hydrolysis of the cooling water, resulting in aggressive chemical attack of the target material, is reduced.

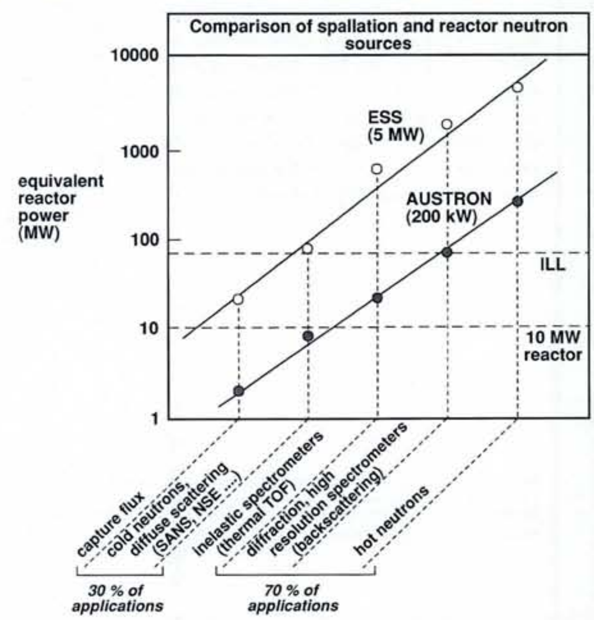
Applications

Even with the basic machine design, AUSTRON will offer protons, neutrons, pions, and muons over a wide energy range up to approximately 1 GeV (a separate target of a simple design is needed for pions and muons). It will also be able accelerate each second some 10^9 light ions up to energies of 400 MeV/nucleon which can be used in a centre for cancer therapy research attached to AUSTRON.

Light-ion therapy (*e.g.*, with carbon) promises treatment of the 20% of the difficult-to-cure tumours which are radio-resistant when treated with electrons or photons. Light ions travel in virtually straight lines, depositing a large fraction of their energy at the end of their penetration range in the so-called Bragg peak [see *Europhysics News* **23** (1992) 3]. Precise targeting of the dose given to a tumor is possible because the depth distribution of the deposited particles is well defined.

Boron neutron capture therapy is the second of the techniques which appear to offer the most interesting possibilites for treating cancer tumors (indeed, the interest in light-ion and boron capture therapies coincides the European Communty's interests). The nuclear reaction of neutrons with boron-10, which has a very large neutron capture cross-section, results in the release of alpha and lithium particles with high kinetic energies. They are stopped by tissue of less than a fraction of a millimetre in thickness, and tumour cells are destroyed in the process. This approach is very valuable for those tumours (*e.g.*, brain tumours) which accumulate boron compounds.

Regarding technology and engineering, the residual stress and temperature of components can be measured, and cracks and fatigue (*e.g.*, in turbine blades or reactor vessels) detected. In biological research, there will be possibility to analyse the structure and dynamics of the basic building



blocks of life such as DNA and RNA molecules, and cell membranes. For the chemical sciences, AUSTRON's main applications will focus on the structure and dynamics of polymers and molecular films where physicists expect to obtain valuable and unique information.

The Present Situation

Negotiations to internationalize and finance the project began in May 1993 and are coordinated by Dr. F. Hamburger, who heads the Vice-Chancellor's cabinet. The Planning Office, headed by M. Schuster, is located at the Atomic Institute of the Austrian Universities in Vienna, while the Accelerator Study Group, led by Ph. Bryant, is based at CERN. Contracts between the main partners (including both international research centres and industry) have already been signed and the feasibility study will be finalised by the end of May 1994, following a short pre-feasibility study that finishes in October 1993. Specialists from the Paul Scherrer Institute (Zurich), the Rutherford-Appelton Laboratory, CERN, the Elettra Synchrotron (Trieste), the Hahn-Meitner-Institut (Berlin), the Central Research Institute for Physics (Budapest), and the Technical University, Bratislava, are contributing to the latter. A detailed technical design study will follow the feasibility study. With the construction period planned to be only 5 to 6 years from project approval, commissioning of AUSTRON could begin in the year 2000 if technical planning and international negotiations progress rapidly enough (experiments will start to be prepared during the construction phase).

The project has been presented in several European capitals (*e.g.*, Trieste, Budapest, Paris, Bratislava, and Brussels) where it was met with great interest. A fund-raising team will start discussions in Germany and Italy this autumn, and further meetings by the end of the year are scheduled for Switzerland, France and eastern Europe.

AUSTRON is based upon an European partnership inspired by a favourable geographical situation at a bridge between east and west. It responds to Europe's need for a greater availability of neutrons, especially from pulsed sources, and it represents a major first step towards a future next-generation European Spallation Source [ESS – see *Europhysics News* **24** (1993) 67] while providing the world with its leading pulse neutron facility for use by scientists well into the next century.

AUSTRON: the principle design parameters

Beam power on the target:	150 - 200 kW
Repitition rate:	≤ 25 Hz
Pulse length:	< 1 μs
Proton energy:	1.6 GeV
Proton injection energy:	≈ 130 MeV
Ions up to Ne can be accelerated (up to 400 MeV/nucleon)	

Further information is available from:
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