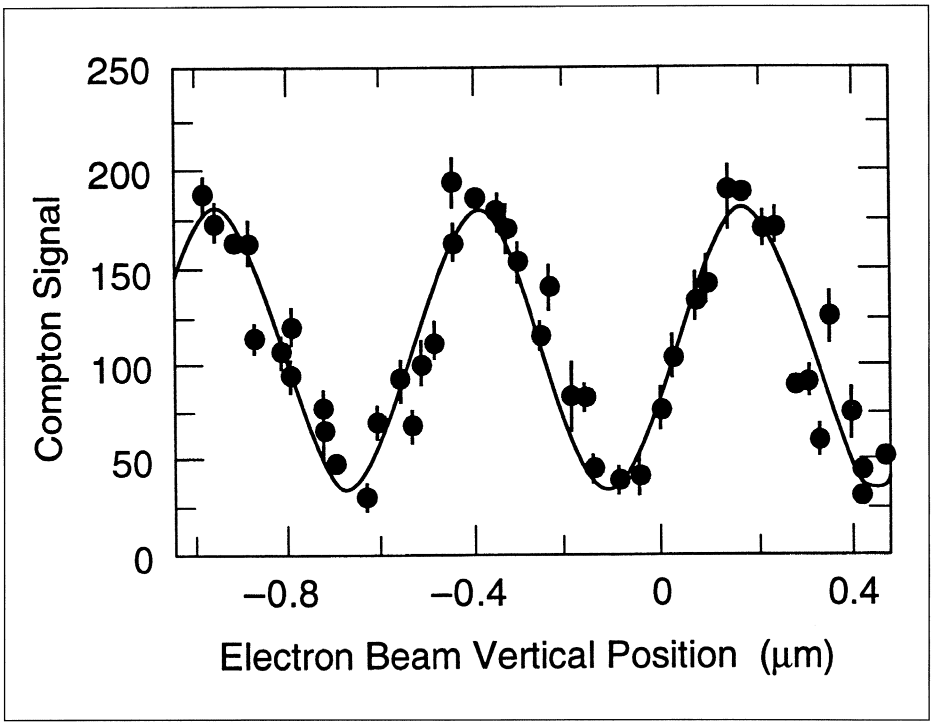
Scattering of laser photons by high-energy electrons as the beam is swept vertically across a laser interference pattern. The measured peak spacing agrees with the 500 nanometres expected from the wavelength of the laser light. The modulation depth (valley to peak) determines the height of the electron beam - 73 nanometres this particular case.



agreement with the FFTB design parameters, testifying to the craftmanship involved in the fabrication, installation and testing of its components. In May a low-emittance beam of 46 GeV electrons generated by the damping ring and linac of the Stanford Linear Collider SLC was injected into the FFTB and reduced by a factor of almost 1000 in the vertical dimension, successfully validating many of the principles needed to design focusing systems for future linear colliders.

The actual measurement of such tiny beam sizes was a major challenge. The electron beam is first compressed to a height of one micron, after which it is further reduced by chromatically corrected telescopic sections to the final spot size. Wire scanners like those used in the SLC are used to monitor the micron-size beam, but completely new instrumentation had to be developed to measure beam spots only several tens of nanometres high. Interactions of the densely focused electrons with jets of gas ions injected into the beam path allow rough tuning of the FFTB optics and provide a first estimate of the beam size.

Precision measurement of the smallest spots is made using an optical interference pattern. This innovative technique uses a laser beam, split along two paths and redirected to a common overlap, to create a "target" of light and dark fringes. Laser photons are Compton scattered by high energy electrons as the beam is swept across this pattern; the modulation of this process gives physicists an accurate determination of the beam size.

FFTB experiments continue with the goal of producing 50-60 nanometre beam sizes and developing techniques to control these narrow beams over extended running periods.

PROTVINO
Mass-production of scintillator tiles by injection moulding

The technique of the segmented sandwich-calorimeters with wavelength-shifting readout, especially its large-scale application in big detectors, requires enormous quantities of a cheap scintillator tiles of moderate dimensions (20 x 20 cm^2).

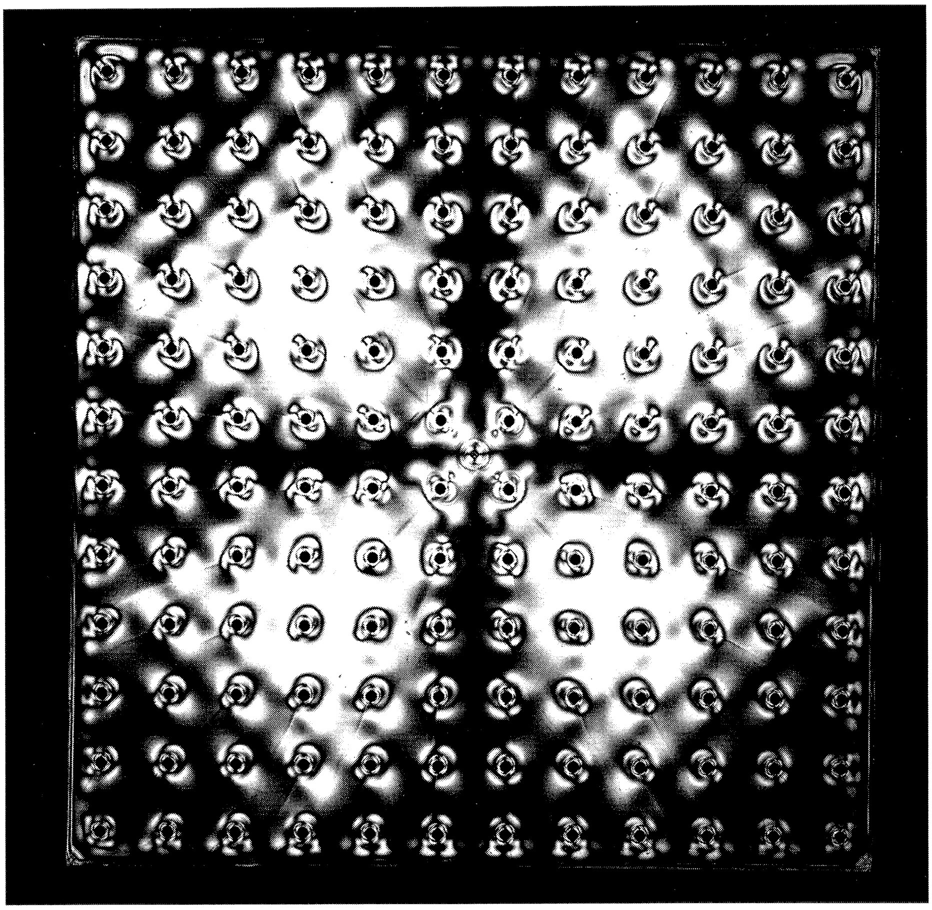
Initial trials carried out in the Institute for High Energy Physics (IHEP), Protvino, Russia almost ten years ago showed that manufacturing such scintillator tiles was possible using an ordinary commercially-available granulated optical polystyrene, an existing technology of plastic dyeing, and a well-known process of the injection moulding, used to produce plastic goods (like buttons!).

More than five tons of such "moulded" scintillator, representing about 150,000 tiles, have been produced at IHEP in recent years, where they were used for the hadron and electromagnetic calorimeters in the "Sphinx" and "Tagged Neutrino" experiments at the 70 GeV IHEP proton synchrotron, as well as in the "NEPTUN" experiment for the future UNK accelerator.

The light output, transparency, and uniformity of the new scintillator is comparable with that of the standard polystyrene-based scintillator manufactured by mechanical cutting and polishing from big blocks, produced by high temperature mass polymerization of styrene. Some important characteristics like aging, radiation hardness are better, not to mention cost and speed of production.

The new technology appeared to be especially suited for "Shashlyk", a

Moulded scintillator tiles with precision-positioned holes are mass produced in Russia for use in the "Shashlyk" sampling calorimeters with wavelength-shifting fibre readout developed recently by IHEP with INR (Moscow), and becoming of increasing interest for new detector applications.



type of sampling calorimeter with wavelength-shifting fibre readout developed recently by IHEP with INR (Moscow), where "perforated" scintillator tiles (see cover photograph, April 1993) with many precision-positioned holes.

The first Shashlyk-type calorimeters are in final phase of the construction and tests for the E-865 experiment at Brookhaven and for the STIC luminosity-measuring electromagnetic calorimeter for the Delphi detector at LEP. More ambitious Shashlyks are in the design stage for the Phenix set-up at Brookhaven's RHIC heavy ion collider and for CMS, one of the major detectors planned for CERN's LHC proton collider.

Recently the other proposed major detector for LHC, ATLAS, has tested a hadron calorimeter prototype with scintillator tiles moulded in sophisticated shapes. These were also produced in Protvino. The technique has also been used for grooved tiles, such as those once considered for the central calorimeter of the SDC detector at SSC.

It is claimed that this techology has not yet been adopted by any Western firm.

GRONINGEN/ORSAY First AGOR beam

AGOR (Accélérateur Groningen-ORsay) delivered its first beam on at Orsay on 12 April. This small-scale superconducting machine, to be used for nuclear physics studies, is the result of a particularly fruitful collaboration between the French Institut de Physique Nucléaire et de Physique des Particules (IN2P3/CNRS) and the Netherlands' Fundamenteel Onderzoek der Materie (FOM).

Built at a cost and on a schedule close to original estimates despite the innovative nature of the project, the facility is shortly due to be dismantled and reinstalled for use at the Kernfysisch Versneller Instituut (KVI) at Groningen, where French physicists will have 20% of the beam time.

AGOR's debut marked the entry into service of Europe's first superconducting cyclotron, with a beam of double-charged helium atoms accelerated to 200 MeV.

As well as being a second-generation machine, AGOR is the only facility of its type in the world capable of supplying the whole range of ion beams, from hydrogen to the heaviest (lead, uranium) in a very broad energy range, attaining 200 MeV for hydrogen and 6 MeV per nucleon for the heaviest ions.

AGOR's capacity to accelerate beams of light ions such as protons that can be polarized as well as alpha particles has broadened the scope for research into nuclear structure. In the heavy ion field, it supplements a series of European facilities, notably GANIL at Caen and the Gesellschaft für Schwerionenforschung (GSI) at Darmstadt.

AGOR incorporates a number of technological innovations, in particular the use of superconducting coils of niobium/titanium alloy, superconducting at liquid helium temperature (4 K) to produce the magnetic field.

In addition, the superconducting wire is wound round a mandrel and the windings impregnated with resin,