

CATALOGUE OF CERN SC BEAMS

	(MeV/N)	intensity (Parts./sec)
Proton	602	$> 3 \times 10^{13}$
$^3\text{He}^{++}$	303	$> 3 \times 10^{12}$
$^3\text{He}^+$	85	$> 10^{13}$
$^{12}\text{C}^{4+}$	85	$> 10^{12}$
$^{15}\text{N}^{5+}$	85	$> 10^{11}$
$^{18}\text{O}^{6+}$	85	$\sim 3 \times 10^{11}$
$^{16}\text{O}^{6+}$	107	5×10^9
$^{14}\text{N}^{5+}$	97	$\sim 10^9$
$^{20}\text{Ne}^{7+}$	94	$\sim 5 \times 10^9$
$^{20}\text{Ne}^{6+}$	70	8×10^9
$^{20}\text{Ne}^{5+}$	49	3×10^{11}
$^{12}\text{C}^{3+}$	49	$> 10^{12}$

gy heavy ion beam in the world, was delivered to the target of an experiment by a Berkeley / Corvallis / Studsvik team. This allowed detailed measurements of target fragmentation and incomplete fusion that were previously impossible.

The California-based contingent in this group (which includes Glenn Seaborg) has come to CERN to seek experimental treasures with 49 MeV/nucleon carbon ion beams and gold targets, and has earned the name 'the new forty-niners'.

As well as its high intensity, the new beam has a time structure permitting certain multi-detector experiments. There could still be a lot of gold in them thar SC hills!

(From Walt Loveland)

SIN Muon SINDRUM

Electrons and muons like to go their own separate ways, and in all weak interactions observed so far, 'muonness' and 'electronness' remain un-

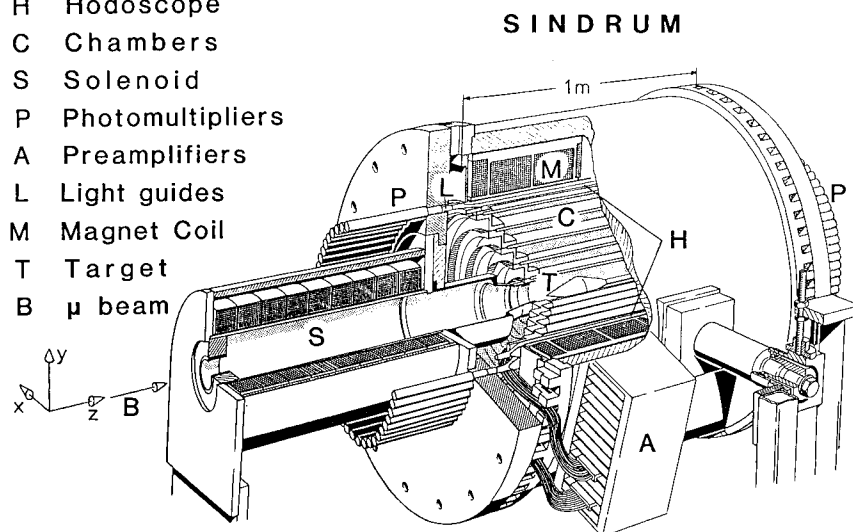
changed. However any sign of an electron-muon affinity would be valuable fuel for new theories seeking to extend our understanding of particle behaviour, and would immediately open up a new horizon of physics.

Over the past two years, the SINDRUM spectrometer has been built at the Swiss SIN Laboratory to search for the classically forbidden decay of a positive muon to three electrons, eventually down to a sensitivity of one part per million million. This would be a thousandfold improvement on the present limit of 1.9×10^{-9} from a 1976 Dubna experiment.

SINDRUM uses a solenoid coil producing a magnetic field of up to 0.6 T in a cylindrical volume 110 cm by 75 cm. The space and time coordinates of the decay electrons are measured in four concentric thin (30 mg/cm²) wire chambers and a

Below, layout of the SINDRUM detector used at SIN to search for signs of the classically forbidden decay of a muon into three electrons.

- H Hodoscope
- C Chambers
- S Solenoid
- P Photomultipliers
- A Preamplifiers
- L Light guides
- M Magnet Coil
- T Target
- B μ beam



scintillator hodoscope.

28 MeV momentum positive muons are brought to rest in a target. In the subsequent decays, any production of three electrons would be characterized by zero total momentum and by total energy adding up to the rest mass of the parent muon. Using a four-stage Fastbus fast electrons trigger, these criteria were applied in a first test experiment last September.

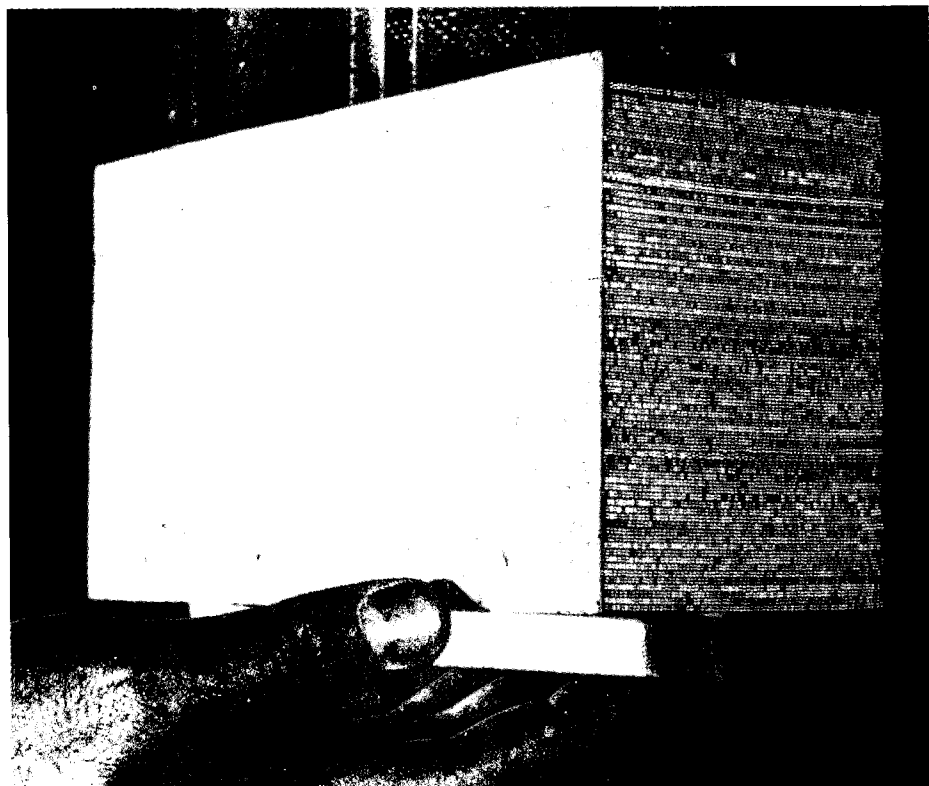
With 2.6×10^6 positive muons brought to rest per second, only 1.6 candidate events per second survived the initial selection and were written onto magnetic tape. From a total of 2.5×10^5 such events, 16 were found to be due to the rare but allowed decay into three electrons and two neutrinos (electron-type neutrino plus muon-type antineutrino), in agreement with the theoretically expected level. No neutrinoless events were found, giving a limit on the three electron decay of 1.6×10^{-10} .

This year, further SINDRUM experiments will use a fifth wire chamber and an improved muon flux (10^7 stopped positive muons per s), to improve this sensitivity by another two orders of magnitude.

SACLAY Scintillating calorimetry

The development at Saclay of specially clad scintillating fibres provides a new technique for fine grain calorimetry. The most promising approach consists of immersing regularly positioned fibres in a non-destructive, low melting point alloy. This gives a high density block, and the use of contiguous blocks would permit a large continuous surface to be covered.

The approach offers several po-



Second Saclay prototype of scintillating fibres held in a lead alloy matrix. It contains 6400 1 mm-diameter fibres in 80 layers. The visible imperfections, due to the experimental method of construction, will disappear with large scale techniques.

(Photo Saclay)

tential advantages: its smaller radiation length allows high energy showers to be contained in a limited space, it tolerates irradiation, and with appropriate light guides a reduced photosensitive area can be used. On the other hand, it is a new technology which still has to be carefully studied before large scale production can be undertaken.

Design and construction of two prototypes are under way at Saclay for the electromagnetic forward detector and small angle tagger for the DELPHI experiment at the LEP electron-positron ring at CERN. Tests and Monte Carlo computations were carried out by a collaboration including also Bergen, CERN, Padua, Santander, Torino and Valencia.

The scintillating fibres made in the laboratory use doped polystyrene. Usually they are 1 mm in diameter and give an average of six photoelectrons for a particle crossing at 1 m

from the phototube. Typical attenuation length is one metre. They are immersed in a lead alloy (Wood's Metal) with a density of 9.75 and a radiation length of 7 mm. This is fluid at 80°C, while the fibres soften only at 90°. The attenuation length of the fibres is unchanged by this treatment.

A prototype unit contained 6400 1 mm-diameter fibres, with a measured filling factor of 51 per cent by volume. This leads to an overall density of 5.3 and global radiation length of 14.5 mm. Emerging fibres were cut to allow a lucite light guide to be used. This prototype was tested in a CERN electron beam from 5 to 26 GeV, without magnetic field.

The results are in good agreement with the simulation. The block produced about 5000 photoelectrons per GeV and the linearity of the pulse height was good. Energy resolution ranged from 9 to 13 per cent times