

CERN Courier Archive: 1968

A LOOK BACK TO CERN COURIER VOL. 8, MAY 1968, COMPILED BY PEGGIE RIMMER

DARESBURY

Symposium on intensity measurement

A symposium on beam intensity measurement was held at Daresbury on 22–26 April bringing together about 45 specialists from accelerator laboratories throughout the world. (V Agoritsas, CD Johnson and H Wachsmuth attended from CERN.)

The most reliable method of measuring beam intensity is still the long-established ‘Faraday cup’, though it has become more sophisticated with advancing years. The beam is fired into the thick base of a cup-shaped block of metal. A small magnetic field is applied to bend any electrons scattered from the base into the walls of the cup. The cup sits in a vacuum box with a protruding snout, at the end of which is the window through which the beam passes. A magnet around the snout prevents any secondary electrons from the window reaching the cup. Measuring the charge collected and knowing the unit of charge carried by the particles gives the number of particles in the beam directly; simple but effective. People believe in the accuracy of these devices to be considerably better than 1%.

Calorimeters could also give a direct measurement by recording the rise in temperature produced when the beam strikes the calorimeter, but they have proved rather cumbersome. A large block of metal is needed to absorb all of the beam and it takes many beam pulses to give a reasonable rise in temperature.

All other devices measure the intensity

indirectly with the readings converted into absolute measurements by calibration against a Faraday cup. ‘Quantameters’ are used to measure the intensity of photon beams. They consist of thick metal plates where the photons produce showers of electrons. Twelve to twenty plates sit in a gas such as argon with the spacing between the plates specially arranged so that the read-out of the charge they receive gives a Simpson integration of the beam intensity. The conventional gas-filled quantameter is not, however, suitable for high intensities.

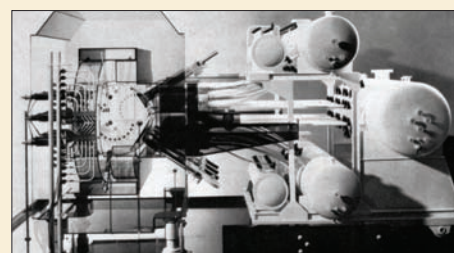
Another method using electron emission from a metal, which is suitable for high intensities, is the ‘secondary emission chamber’. Here, very thin foils are set up in vacuum and the number of electrons knocked out of the foils is recorded. These devices are used for proton as well as electron beams – for example, to monitor the ejected proton beams at the CERN synchrotron. They are, however, very sensitive to contamination of the foil surface.

All of the above devices destroy or interfere with the beam they are measuring. Two types which are transparent to the beam are toroid and cavity monitors. Toroids use the beam as a single turn of a transformer, passing it through a ferrite ring with windings to tap off the current induced as a pulse of particles goes through. Cavity monitors are tuned to a harmonic of the beam radio frequency structure and the voltage induced on the cavity can be measured as the beam passes through. Both of these methods

are very useful for setting up beams and for rough measurements but are not accurate beyond about 10%.

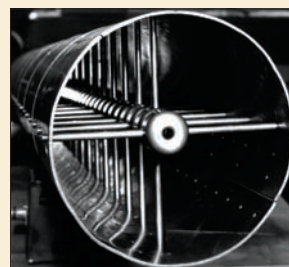
● Compiled from p105.

Modelling at CERN



A 1/8 scale model of Gargamelle [above] constructed of transparent coloured Plexiglas is used to show the way in which the different components fit together. On the right are the pressure system units culminating in the diaphragms in the chamber (they look like two pistons pointing in directions almost along the diagonals of the photograph). The optical system views the chamber through fish-eyes lenses set in the diaphragms. The chamber, magnet and coils can be picked out and on the left is the illumination system.

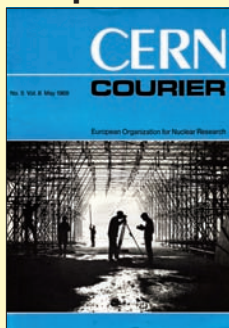
[Right] A scale model linear accelerator cavity (15 cm in diameter) is being used in the Intersecting Storage Rings ISR



Department to optimize future cavity design. It has a ‘cross-bar’ structure – the stems supporting alternate drift-tubes are at right angles (for the first drift-tube they are horizontal, for the second vertical and so on). By changing the orientation and size of the stems it is possible to considerably improve cavity performance compared with the conventional Alvarez structure. Advantages include making it easier to cope with beam loading, more uniform accelerating fields and less stringent mechanical tolerances.

● Compiled from pp96 and 100.

Compiler's Note



The chamber of the real Gargamelle, which famously detected neutral currents in 1973 is on show in the garden next to the Microcosm exhibition at CERN. Inside Microcosm is the real first cavity of Linac 1, used at the Proton Synchrotron from 1958 to 1992. As well as protons, this linac accelerated deuterons and alpha particles for the Intersecting Storage Rings and oxygen and sulphur ions for the Super Proton Synchrotron.

At the LHC, thousands of sophisticated instruments monitor the size and position of the counter-rotating beams around the ring but they cannot be placed in the most critical locations, namely the collision points deep within the experimental detectors. This has led to some novel interactions between the experiments and machine operators, with

high-precision inner detectors being used online to generate 3D profiles of the beam-crossing spots that are sent to the LHC control room in real time.



All-metal Angle Valves

Series 57 for UHV applications from DN 16 to DN 160



**Maintenance-free
for 10,000 cycles**

Maintenance-free

Unique «hard-to-hard»
metal sealing

Pneumatic actuators available

Spring closing or double acting

User-friendly

Overtorque protected
manual actuator (DN 16 - 40)

Swiss Headquarters
Tel ++41 81 771 61 61
CH@vatvalve.com

VAT Benelux
Tel ++31 30 6018251
NL@vatvalve.com

VAT France
Tel 01 69 20 69 11
FR@vatvalve.com

VAT Germany
Tel (089) 46 50 15
DE@vatvalve.com

VAT U.K.
Tel 01926 452 753
UK@vatvalve.com

VAT USA
Tel (781) 935 1446
US@vatvalve.com

VAT Japan
Tel (045) 333 11 44
JP@vatvalve.com

VAT Korea
Tel 031 662 68 56
KR@vatvalve.com

VAT Taiwan
Tel 03 516 90 88
TW@vatvalve.com

VAT China
Tel 021 5854 4300
CN@vatvalve.com

VAT Singapore
Tel 0065 6252 5121
SG@vatvalve.com

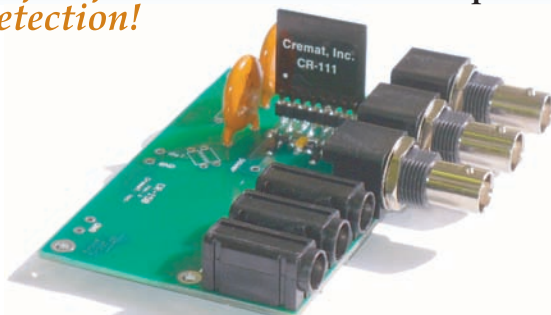
www.vatvalve.com



Charge sensitive preamplifiers

*perfect for radiation
detection!*

Gaussian
shaping
amplifiers



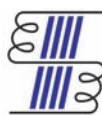
all product specifications can be found online at:

<http://cremat.com>

Cremat's charge sensitive preamplifiers (CSPs) can be used to read out pulse signals from radiation detectors as diverse as semiconductor detectors (e.g. Si, CdTe, CZT), scintillator-photodiode detectors, avalanche photodiodes, gas-based detectors such as ionization chambers and proportional counters, microchannel plate detectors, and photomultiplier tubes (PMTs).

Our CSPs and shaping amplifiers are rendered as small epoxy-sealed plug-in modules less than 1 in² in area. Cremat also provides evaluation boards and application notes for these modules, allowing users to easily and quickly integrate them into their instrumentation.

cremat
45 Union St
Watertown, MA
02472 USA
+1(617)527-6590
info@cremat.com



Stangenes Industries

For over 36 years Stangenes Industries has been manufacturing critical components for government, industry, and research. As an OEM supplier to major medical equipment manufacturers, we have developed a reputation for quality and reliability at globally competitive prices. The foremost government and institutional particle accelerator facilities and research laboratories in the world rely on Stangenes Industries for innovation and excellence.

- Transformers
- Pulse Transformers
- Pulse Modulators
- Inductors
- Electromagnets
- Solenoids
- High Voltage Power Supplies
- Magnetic Components
- Diagnostics



"The Best in Custom Transformers"

1052 East Meadow Circle, Palo Alto, CA 94303
650-493-0814 www.stangenes.com