JOINT INSTITUTE FOR NUCLEAR RESEARCH, DUBNA
Preprint P-2711

GAS TARGET FOR SLOW MESON EXPERIMENTS

P.F. Ermolov, V.I. Lepilov and A.I. Mukhin

Dubna, 1966

Translated at CERN by B. Hodge
(Original : Russian)

(CERN Trans. 69-29)

Geneva
November, 1969

In order to investigate a number of processes brought about by pions or muons when stopped in a material of low density, use is made of gas targets[1-3]. The main difficulty is that of isolating the event of meson stopping in the working medium, since, when high gas pressures are used the walls of the vessel must be thick. For example, when using hydrogen at a pressure of 50 atm, contained in a vessel whose linear measurements are of the order of 10 cm, the proportion of the beam meson stoppings (with a beam energy spread of 10 g/cm^2) in the gas and walls does not exceed 1%. These conditions may result in a considerable background when recording the products of beam particle interaction with the working medium of the target.

One method of increasing the efficiency with which the stoppings in the gas are recorded is to place scintillation counters in the target volume. The target we produced is based on the design shown in Fig. 1.

The target is designed to operate with gases at a pressure of up to 100 atm. It is in the form of a stainless steel vessel (8). The length of the casing is 40 cm, the inside diameter 130 mm and the wall thickness 8 mm. The beam of mesons is detected by the scintillation counters 1 and 2, placed in front of the end wall of the target. A polythene moderator 5, to reduce meson expulsion due to scattering, is placed inside the casing. Copper collimators 9 and 10 serve to limit the beam dimensions and prevent the particles from hitting the light pipe 13.

The basic components of the target are the scintillators 3 and 4. The absorption of mesons in scintillator 3 simulates stopping in a gas. It must therefore be sufficiently thin. On the other hand it should give out a sufficient quantity of light for photomultiplier recording. In view of these conditions, we selected a thickness of 0.25 mm for scintillator 3. Its diameter is 85 mm. It is bonded to an aluminized mylar film 6, 5 microns thick, which in turn is fixed to the end face of scintillator 4. A similar film is glued on to the end face of collimator 9. The surfaces of these films together with the

chromium plated surfaces of the half-ring 9 and collimator 10, form a sealed light enclosure. The light from scintillator 3 is reflected from the surfaces of the enclosure, passes through the perspex light pipes 13 and hits the cathode of the photomultipliers. On of the light conductors 13 is a target plug and is fixed tight by means of a pressure flange and teflon washers 12. The extremity of this light conductor is clamped, by the internal gas pressure, against the surface of the main flange 11, and enables the light conductor to withstand higher pressures. Flange 11, in turn, is held tightly against the casing of the vessel by bolts and a teflon washer.

The scintillator 4 is designed in the form of a beaker 150 mm long with an inside diameter of 100 mm and a wall thickness of 5 mm. The internal surface of this beaker limits the working volume of the gas to 1200 cm^3. The scintillations caused by particles passing through the beaker 4 are recorded by a second photomultiplier 17. The clamping device of this counter is the same as that of counter 3. The scintillators and light conductors, as well as the internal surface of the casing, are polished.

The target is filled with gas by means of the filling control panel, which enables the target to be evacuated, the gases mixed in the required concentration, the gas to be purified and the pressure controlled. On the control panel, diaphragm-type valves are used.

In order to detect meson stoppings in the gas, counter 4 is switched on for anti-coincidence with counters 1, 2 and 3. To record the secondary products of mesons in the gas, counter 4 may be switched on for coincidence or anti-coincidence with another detector outside the target, depending on the process being investigated.

At the point where the detector is located, as show in Fig. 1, the wall thickness of the target casing was reduced to 5 mm.

At present the target is being used in mu-atom experiments on a mu-meson channel[4]. The efficiency of the thin counter 3, for recording muons stopped in the working volume of the gas target, is estimated to be close to 100%. The voltage plateau on the photo-

multiplier of counter 3 for 1234 coincidences is fully satisfactory; the variation in counting speed is 1% for a variation of voltage of 100 V.

The inefficiency of counter 4 for recording muons which strike it does not exceed 1%. In working conditions, this results in the fact that with a hydrogen pressure of 50 atm in the target, about 30% of the count (1234) are due to the muon stoppings in counter 3 and to the inefficiency of the anti-coincidences, whilst the remaining 70% concern stoppings in the working volume of the gas.

In conclusion, the authors wish to express their gratitude to V.P. Dzhelepov for his collaboration in the present work, and S.G. Basiladze, V.G. Zinov, A.D. Konin and K.O. Oganesyan, who assisted in the callibration measurements.

REFERENCES

1. K. Ziok, V.W. Hughes, R. Prepost, V. Bailey and W. Cleland, Phys. Rev. Letters 8, 103, 1962.
2. V.I. Petrukhin and U.Yu.D. Prokoshkin, Proceedings of the 12th International Conference on High Energy Physics, Dubna, 1964, vol.1, p.885
3. S.G. Basiladze, P.F. Ermolov and K.O. Oganesyan, Zh. Eksper. Teor. Fiz. 49, 1042 (1965).
4. Yu.N. Grashin, B.A. Dolgoshein, V.G. Kirillov-Ugryumov, A.A. Kropin, V.S. Roganov, A.V. Samojlov and S.V. Somov, Preprint P-1902, Dubna 1964.

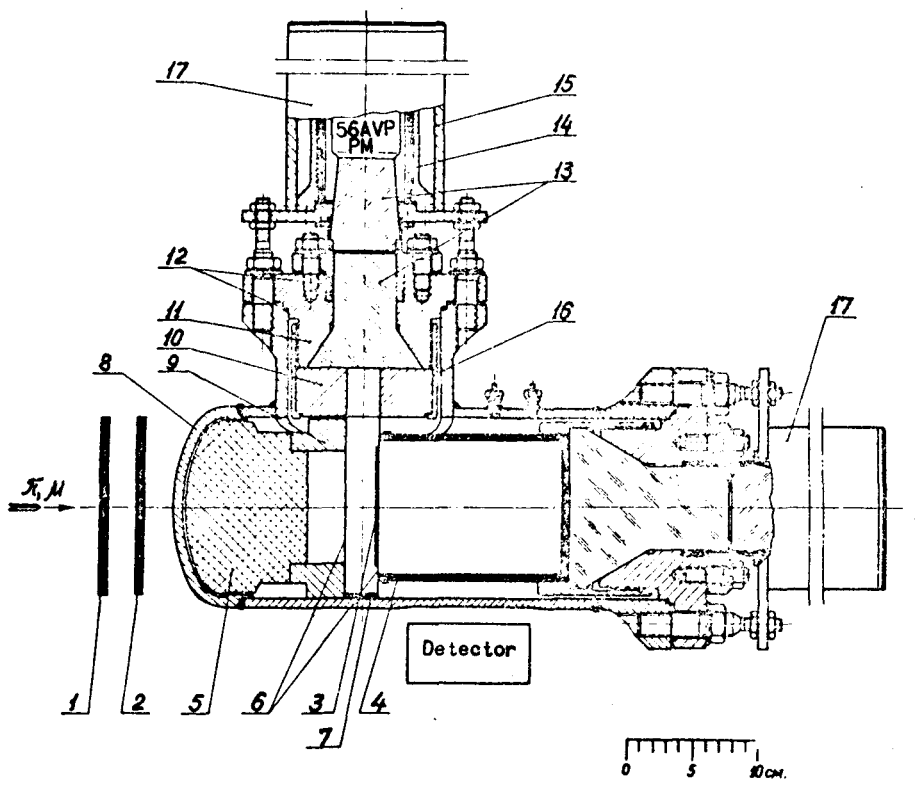

Fig. 1. Diagram of the target.