"AIR" SPARK CHAMBERS FOR THE REGISTRATION OF PARTICLE SHOWERS

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"AIR" spark chambers, unlike neon filled chambers, have a long "memory." This property is, on the one hand, an essential shortcoming of air spark chambers, since it prevents their use in intense particle fluxes. In some cases, however, it is very valuable, for example, if the triggering pulse is strongly delayed for physical or technical reasons.

By way of a specific example we can cite experimental arrays in which the spark chambers are combined with an ionization calorimeter and are triggered by a pulse from the calorimeter. Air spark chambers are very simple to construct even when the dimensions are large, since they do not call for evacuation of the working volume.

Spark chambers filled with a mixture of air, argon (30–50%), and alcohol vapor with a total pressure equal to atmospheric have been described previously[1,2]. They also have a long memory, but operate at lower voltage and give appreciably better accuracy of localization of the sparks near the trajectory.

We note that the technical realization of such chambers is only slightly more complicated than that of air chambers, since there is no need to evacuate the working volume.

An essential shortcoming of air and air-argon spark detectors has been so far the very low efficiency for the registration of several particles, due to the large fluctuations and the time of detachment of the electrons that initiate the sparks from the oxygen molecules. If several particles pass through the spark gap, then usually only one spark is produced in the place where the spark channel was first to develop; the resultant voltage drop prevents formation of other sparks. The same property appears also in air spark chambers which have several gaps: the breakdown is produced as a rule in only one of the gaps. In order to produce a spark in each gap, it is necessary to "decouple" the gaps by means of resistances or inductances[3].

In the present paper we describe an attempt to produce an air-argon chamber capable of registering several particles. To this end, one of the electrodes of each gap was isolated from the working gas by a layer of dielectric.

Figure 1 shows the diagram of a chamber consisting of 6 discharge gaps; one of the electrodes of each gap is metallic (Al), and the other is a metallic layer deposited on the exterior of glass. Aluminum foil is pressed against the metallic layer over its entire area, and this foil is continued away from the electrode in the form of a broad ribbon and connects with the foils of the other electrodes. The chamber is fed by exponential pulses from an Arkad'ev-Marx discharge generator (output capacitance ~ 3300 pF, load resistance R ~ 60 Ω). 12–14 kV were applied to the discharge gap and two or three sections of the gap were used. The chamber was triggered by pulses (delayed up to 200 microseconds) from triple coincidences of the discharges in the Geiger-Muller counters of the telescope.

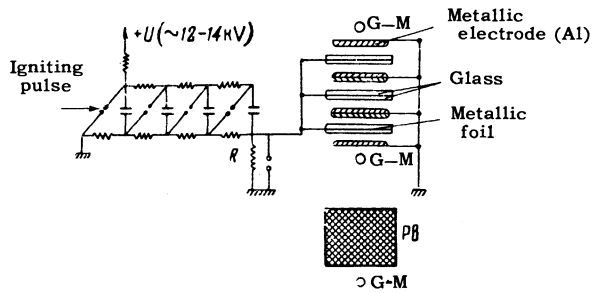

FIG. 1

Under these conditions (the measurements were carried out also at different amplitudes and pulse durations), bright sparks situated near the trajectory are produced as a rule in all six gaps (see Fig. 2). In addition to these, a background of weak sparks is visible to the eye and sometimes also on the photographs. To get rid of the background, a regulating spark discharge is connected parallel to the resistor R and cuts off the trailing front of the pulse, which is thereby narrowed down. In

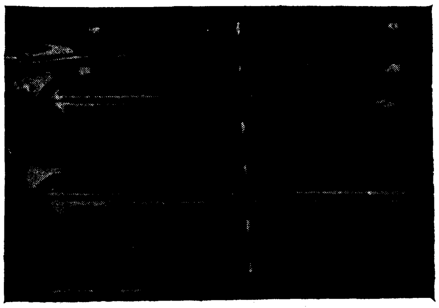

FIG. 2

practice one chooses first the chamber operating conditions, after which the discharge gap is adjusted to reduce the background of the extraneous sparks.

The table lists the data we obtained on the efficiency of each gap for different delays of the high-voltage pulse[1]. It is seen from the table that chambers with dielectric have a large "memory," good accuracy of trajectory localization, and a high particle registration efficiency (the measurements were made with the trajectories inclined < 10° to the vertical).

Interelectrode distance, mm	τ_{del}, sec	Efficiency of one gap, %	Mean square deviation of the spark from the trajectory, mm
3.5	2	99	~0.2 (for ~98% of the sparks)
5	2 20 50	99	~0.2 (for ~97% of the sparks)

We note that the registration of one particle in our chamber, which has six gaps, is equivalent to simultaneous registration of six particles (separated from one another by 5–15 cm) in a single discharge gap having six times the area of one chamber gap. From this point of view, our results indicate high efficiency of registration for showers of particles in "air" spark detectors with dielectric. We are planning to obtain in the nearest future more direct and more complete quantitative data on this question.

In conclusion we indicate that after this work was performed and reported by the Nor-Amberd School of Physicists [4], Matsukawa [5] published a paper devoted to an investigation of air chambers, in which he noted that he was unable to construct air chambers for the registration of particle showers by introducing a dielectric layer between the electrode and the working gas, since the glow of the entire working volume prevented the occurrence of localized sparks. It is this communication by Matsukawa which has induced us to write this letter. We have overcome this difficulty in air-argon chambers by increasing somewhat the interelectrode gap, increasing appreciably the working voltage, and "cutting off" the high-voltage pulse.

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A 4 mm FABRY-PEROT MASER

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In shortening the working wavelength of beam masers a great deal of interest has been drawn to the use of a Fabry-Perot interferometer as a resonator,[1)] the investigation of the characteristics of beam masers with this type of resonator, and above all the construction of the corresponding state separators and beam sources.

We have developed and operated a Fabry-Perot maser using the $1_{01}-0_{00}$ transition of the CH_2O molecule at a frequency of 72 838 Mc. The figure gives an idea of the construction used. The resonator consisted of two flat brass disks 6.5 cm in diameter, which were polished to an accuracy of the order of one micron. Gaskets made of vacuum rubber were placed between the disks, and the disks were drawn together by three screws, with the aid of which the parallelism and size of gap could be adjusted. The separation between the disks was $\lambda/2$ (about 2 mm), and the Q was 2000. This could be accurately adjusted by the pressure on the disks. Coupling was effected by means of two waveguides of like polarization whose ends opened into the resonator (see the figure). The resonator was fed with one flat beam of active molecules. The separator was a variant of the "ring" system suggested earlier by one of the authors.[1] It consisted of two plates, each of