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A GAS MIXTURE FOR MULTI-WIRE CHAMBERS WITH HIGH PROPORTIONAL GAIN

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October, 1971

ABSTRACT

We describe a gas mixture for multi-wire proportional chambers which increases the maximum gain that can be reached with full proportional operation.

We describe in this note gas mixtures that produce gains five times larger than those obtained from Ar - CO₂ and Ar - CH₄ and which preserve proportionality of the output pulse height. This gain is achieved by the addition of a small amount of xenon.¹

Figure 1 shows the chamber gain as a function of applied voltage for several percentages, p (by volume) of xenon added to 7% CO₂ and (93 - p)% Ar. We made a rough check (to ±15%) of the proportionality, as the voltage was raised, of the signals from ⁵⁵Fe X-rays and from minimum-ionizing particles. Figure 2 shows, as a function of Xe concentration, the maximum gain that can be reached while still preserving proportionality. (At each point, the highest possible voltage consistent with proportionality was used.) Figure 3 shows the gain at constant voltage as a function of Xe concentration. Here, in addition, we show data using 7% CH₄ in place of 7% CO₂ (dotted curves). The peak is similar for both quenching gasses and is sufficiently broad so that no significant gain variations are introduced by normal variations in the Xe concentration. All these measurements were made using a 20 X 20 cm² chamber with an anode plane of 20μm diameter stainless-steel wires spaced 2 mm apart and with 4 mm anode-cathode plane gaps.

Some comparisons with the "magic mixture"^{2,3} might be useful. The main advantage of the magic mixture is its higher gain -- a saturated output (independent of the initial ionization) of over 6×10^8 ion-pairs has been reported³. The maximum proportional gain from the Ar - Xe mixtures of 10⁵ typically produces about 10⁷ ion-pairs from minimum-ionizing particles. The Ar - Xe mixtures provide proportional rather than saturated operation, and the absence of electro-

negative gasses permits operation with larger wire spacings. These two properties can be either advantageous or disadvantageous depending on the application. Proportional gain is often useful for medical applications⁴ and in the measurement of $\frac{dE}{dx}$ from ionization. If high spatial resolution is not essential, an increase in the anode wire-to-wire spacing permits the construction of large chambers that do not require support wires across the anode plane⁵. In addition, Ar - Xe mixtures (particularly the 86% ar - 7% Xe - 7% CO₂ combination) reach useful gains at far lower voltages, also reducing the need for support wires. Finally, the absence of complex organic gasses should prove useful in chambers that are to be exposed to large amounts of radiation.

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FIGURE CAPTIONS

1. Chamber gain as a function of applied voltage for Ar - Xe - 7% CO₂
mixtures. Percentages indicated refer to the Xe concentration.
2. Maximum gain that can be achieved without losing proportionality
as a function of Xe concentration. The applied voltage increases
with increasing Xe concentration.
3. Gain at constant voltage as a function of Xe concentration. The
solid lines are for gas mixtures using 7% CO₂ for quenching and
the dotted for 7% CH₄.

XBL7III-4763

Figure 1

XBL719-4448

Figure 2

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Figure 3

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