STRONG-INTERACTION PHYSICS IN THE 25-FT BUBBLE CHAMBER

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ABSTRACT

The utilization of a large bubble chamber for strong-interaction physics is discussed.

Previous studies \(^1\-^2\) have concluded that a 25-ft bubble chamber would be useful in extending our present knowledge of hadron interactions into energy regions immediately above those accessible at existing accelerators (20-40 GeV), particularly as regards the classification of resonant states and the measurement of their branching ratios, and the study of the production characteristics of two-body and many-body final states. They also stress the usefulness of the chamber as a survey tool in determining which interactions may be worth the considerable effort involved in undertaking more detailed measurements by electronic and/or hybrid spectrometer technique.

In this respect we wish to emphasize that multiparticle final states are likely to be of great importance in understanding particle systematics. Resonant states with masses \(\leq 1 \text{ GeV}\) decay primarily into relatively simple \(2\pi, 3\pi, K\pi,\) and \(KR\) final states. In the mass range \(1-2 \text{ GeV}\), decays such as \(\rho\pi, \omega\pi, \eta\pi, f\pi, K^0\pi,\) and \(\rho\rho\) become important, and above \(1.5 \text{ GeV}\) are dominant. In the \(2-4 \text{ GeV}\) mass range we may expect heavier decay products, beginning with \(A\pi, B\pi, \omega\omega, K^0K^0,\) etc., and of necessity one will study events of high multiplicity. Similarly, in the study of production mechanisms the investigation of multiparticle exchange will require the analysis of final states of high multiplicity. Bubble-chamber analysis with "cuts" to select appropriate regions of phase space should be particularly effective in these studies.

The possibility of running a large, track-sensitive hydrogen target in a neon-hydrogen mixture for gamma conversion will be extremely useful in understanding the
physics of resonant particle systematics. Branching into $2\pi^0$ and multi-$\pi^0$ final states will be a useful indicator of isotopic spin, intrinsic spin, and parity. This type of chamber operation puts a premium on chamber size. To pair the photons from $2\pi^0$ decay, for example, one would like to have angle and momentum information on at least three of the four gammas. The proposed 25-ft chamber could contain a hydrogen target up to twelve feet long in the beam direction, and still have room for at least 5 radiation lengths in the forward direction of neon-hydrogen (50 mole-% mixture), with 90% probability of conversion of all five gamma rays. In this respect, the 25-ft chamber would be a unique instrument for strong-interaction physics at NAL.

Otherwise, our main concern at present, in the utilization of the proposed 25-ft chamber for strong-interaction physics, are questions such as the following:

1. How soon after beam turn-on will the 25-ft chamber be available for hadron physics?

The extension of present "survey" knowledge of hadron interactions to energies above 20 GeV, and the study of multi-Regge and other reaction mechanisms at energies in which multiperipheralism should dominate, are obviously areas of investigation that should begin at beam turn-on. If the 25-ft chamber is not then available, as seems will almost surely be the case, another chamber should be made available to begin this work.

2. Will the 25-ft chamber achieve the advertised design specifications as regards precision of track reconstruction?

The proposed 25-ft chamber will, by providing track length x magnetic field, long decay path for produced hyperons, range measurement of (trapped) protons up to 1.5 GeV/c, and the possibility of detailed analysis of secondary interactions and decays, permit a high order of precision in the kinematic fitting of hadron interactions. It is essential, nonetheless, that the optics, expansion, delay time, and temperature gradient control permit measurements with an overall setting error $\epsilon \leq 500\mu$ in the chamber. The picture quality must be such as to permit automatic measuring at least at the POLLY level. Work now in progress at BNL with the 7-ft chamber, and at ANL with the 12-ft chamber, should provide within 6 months much better indications than we now have as to how easy or how difficult the achievement of the stated figures will be.

3. Will the 25-ft chamber be available for strong-interaction physics with a full 40-kG field?

It has been proposed that the magnet gap on the 25-ft chamber be opened up and the field reduced to 28 kG to avoid "flooding" the chamber with neutrino-induced $\mu$'s and neutrons in the weak-interaction studies. This would significantly reduce the
momentum resolution of the bubble chamber and seriously impair its effectiveness for strong-interaction studies. We suggest the need for wide gaps be studied more carefully before any decision is made in this regard.

REFERENCES

