TeV Hadron Physics in the 15' Bubble Chamber

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The advantage of the 15' Bubble Chamber is its efficiency for charged and neutral particle detection and its large volume for "first look" type of experiments at the new energy region.

The large volume of the 15' Bubble Chamber enables one to detect γ's with 10-15% efficiency (higher if in Ne-H2 mixture) and K's ($\Lambda, \bar{\Lambda}$) with good efficiency together with all the charged particles. It is therefore suitable to be used to study charge-neutral correlations ($K^0_S, \pi^-, \pi^+\pi^-\pi^0$, for example). If the new particles, which tend to decay with higher multiplicities and into mixtures of charged and neutral particles, is produced with finite cross section in the new energy region, the 15' may prove to be an efficient detector for them.

The value of these possibilities have to be realized in larger exposures (>5 pictures/μb). In a moderately large statistics exposure, other physics possibilities also appear. For example, the Δ^++ production with proton target is dominated by one-pion-exchange; a large exposure to π/K incident beams at one energy would enable one to study ππ/πK interactions at many energies (at $s = M_\Delta^2$, the square of the recoiling mass from the $\Delta\Delta^+$), in terms of the multiplicity, cross sections, neutral productions, etc.

As we reach a new energy region at 1 TeV, it is important to have a "first look" at the gross nature of the interaction and for the unexpected. The large volume of the 15' makes it the best detector for the multibody decay of the (unexpected) longer lived particles. The efficiency for both neutral and charged particle detection will also maximize the information for the exploratory runs.

As an example of an experiment in the 15 foot Bubble Chamber, let us look
at 1 TeV $\pi^-$p. A 1 TeV 2 meter track will have a 0.5 mm sagitta and thus can be measured with an error of $\Delta p/p \approx 50\%$. There is sufficient length in the chamber for the forward cone particles to separate and be track matched at the back of the chamber. Therefore multiplicities of charged and neutral particles can be obtained and neutral particles measured and identified. Figure 1 illustrates the multiplicity of charged and neutral particles expected, whereas figure 2 displays the cross section for $\Lambda$ production that can be expected (i.e., few millibarns).
Fig. 1
Fig. 2