EVIDENCE FOR TWO BODY BREAK UP AT A UNIQUE TEMPERATURE
IN HIGH ENERGY P-Xe AND P-Kr COLLISIONS*

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This experiment was conducted at FNAL. Using the newly developed warm gas jet facility, hydrogen-noble gas mixtures were injected into the circulating proton beam. During injection, the beam was accelerated between 20 to 400 GeV/c. The target mixtures reported here were 90% H₂ - 10% Xe and 82% H₂ - 18% Kr by partial pressures. Fragments, emerging from the interaction region, were accepted if they satisfied the ΔE·E·VETO trigger. A typical mass spectrum is shown in Fig. 1. In attempting to find a mass independent disintegration temperature, we plotted the kinetic energy distributions for each fragment mass emerging from Xenon and Krypton. To our surprise, the inverse logarithmic slope, (temperature) varied between 15 and 20 MeV, about a factor of two larger than the nuclear binding energy shown in Fig. 2. There is a clear break in the mass dependence of the temperature in the Carbon-Nitrogen mass range. In trying to understand the origin of this mass dependence, we were able to show that those fragments which are heavier than Carbon had emerged as a decay product of a common parent (progenitor). The mass of this progenitor is denoted by A_p and it is about twenty nucleon masses less than the target mass (A_p ≈ A-20).

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In other words, we showed that

\[ p + A \rightarrow A^*_p + X \]

\[ (A_f > A_{\text{Carbon}}) \]

If all fragments heavier than carbon emerged as the result of a two body decay of their progenitor \( A^*_p \), they can be lumped together, after kinematic corrections, to determine a single excitation function of \( A^*_p \). In a two body breakup, the total breakup kinetic energy \( (E_p) \) in terms of the masses \( (A_p, A_f) \) and the kinetic energy of one of the fragments \( (E_f) \) can be given as

\[ E_p = \frac{A_p}{A_p - A_f} \cdot E_f \]

Thus,

\[ \frac{dn}{dE_p} \sim \exp \left( -\frac{E_p}{kT_p} \right) = \exp \left( -\frac{E_f}{kT_p} \cdot \frac{A_p}{A_p - A_f} \right) = \exp \left( -\frac{E_f}{kT_f} \right) \]