MEASUREMENT OF \( p\bar{p} \) CROSS-SECTIONS AT LOW \( \bar{p} \) MOMENTA

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In this paper the progress and physics objectives of LEAR experiment 173 is reported.

We propose to measure \( p\bar{p} \) elastic and charge exchange (CEX) differential cross-sections over the full angular range, the \( p\bar{p} \) annihilation cross-section, and, via the optical theorem, the total cross-section. The momentum range of 700 MeV/c to 200 MeV/c (230 MeV to 21 MeV) will be covered. We hope to extend the measurement to 130 MeV/c (5 MeV) with a slightly different detector assembly, as will be discussed later.

By means of these measurements, we wish to study especially the following aspects of the \( p\bar{p} \) interaction: the energy dependence of the partial cross-sections; the relative size of \( T = 0 \) and \( T = 1 \) contributions; and the so-called S-meson region.

The energy dependence of the partial cross-sections is unknown below about 300 MeV/c (with the exception of a few points with poor statistics between 200 and 300 MeV/c). In particular, the region of pure s-wave scattering, which has proved so useful in understanding the nucleon-nucleon interaction, is completely unmeasured. Although even our lowest projected measurements at 130 MeV/c will probably still contain a few percent p-wave scattering, the region between 100 MeV/c and 200 MeV/c will be dominated by s-wave scattering.
Measurement of both the elastic and CEX differential cross-sections gives an indication of the relative sizes of the $T = 0$ and $T = 1$ contributions, since the elastic scattering amplitude is proportional to $|T_0 + T_1|$, whilst the CEX amplitude is proportional to $|T_0 - T_1|$. It should be noted here that both $T_0$ and $T_1$ are complex and the measured quantities are proportional to the moduli squared, so a unique determination of the amplitudes is not possible with only the differential cross-section measurements. Despite this, some information can still be gleaned from a comparison of the two cross-sections. For example, since the diffractive amplitude is not expected to have much isospin dependence, this amplitude should largely cancel in the CEX cross-section, leaving primarily the real amplitudes. The behaviour of the CEX cross-section as a function of energy is then sensitive to the behaviour of the exchange amplitudes. Figure 1 shows a comparison of the CEX and elastic differential cross-sections at an energy slightly higher than that proposed for our experiment. The diffractive pattern is clearly seen in the elastic cross-section, whilst the CEX cross-section falls off smoothly.

Fig. 1. Solid circles are $p\bar{p} + p\bar{p}$ at 790 MeV/c. Open circles are $p\bar{p} + n\bar{n}$ at 730 MeV/c.