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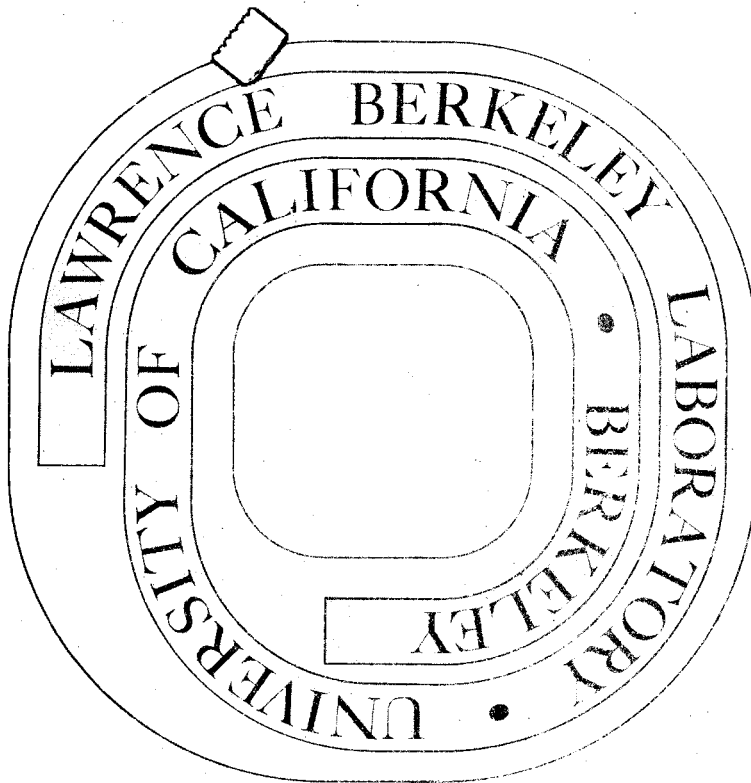
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SLOPE OF THE FORWARD PEAK IN pp SCATTERING AND THE REGGE-POLE MODEL*

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ABSTRACT

A recent Regge-pole model based on pp and $\bar{p}p$ cross sections and polarizations is extrapolated to determine the slopes of the pp differential cross section for the energies and momentum transfers just measured at the CERN Intersecting Storage Rings. The slopes thus predicted come close to the published experimental values, and show a strong t dependence. The average Pommeranchuk slope (α_p') for our several fits was $0.31 (\text{GeV})^{-2}$.

The new CERN Intersecting Storage Ring (ISR) data¹ on the slope of the pp differential cross section (DCS) can be compared with the predictions of Regge-pole fits² to high energy pp and $\bar{p}p$ elastic scattering data available through early 1970.

All of the fits (3-, 4-, and 5-pole) give good representations of all the existing pp and $\bar{p}p$ elastic data in the range

$$0 \leq |t| \leq 0.6 (\text{GeV}/c)^2,$$

$$6.0 \leq P_{\text{lab}} \leq 70.0 \text{ GeV}/c.$$

The constraints placed on the parameters by fitting total cross

sections, DCS, polarizations and the ratio of real to imaginary part of the forward amplitude for pp and $\bar{p}p$, plus the pp DCS slope data, were quite severe. In particular, the slope of the Pommeranchuk trajectory, α_p' , was confined to the range

$$0.25 \leq \alpha_p' \leq 0.38 (\text{GeV})^{-2},$$

regardless of the number of trajectories included in the fit, the type of ghost-eliminating mechanism chosen, or the functional forms of the residue functions investigated.

It seems reasonable to expect that the extrapolation to higher energies (as represented by the ISR data) should be nearly independent of the detailed structure of the terms from the low-lying trajectories.

The DCS slope predictions, given by

$$b = \partial/\partial t (\ln(d\sigma/dt)),$$

are similar for all the fits. The curves in Fig. 1 for b_{pp} are an amplification of Fig. 8a of Ref. 2 (for $t = -0.064, -0.125, \text{ and } -0.27 (\text{GeV}/c)^2$, extended to $P_{\text{lab}} = 2000 \text{ GeV}/c$). They represent the prediction for the 4-pole fit which had

$$\alpha_p(t) = 1.0 + 0.31 t.$$

(Note: The data points in Fig. 1 have been lowered by a systematic error of 3%, as in Ref. 2.) The predictions are within 1 or 2 standard deviations of the ISR points. The strong t -dependence of the slope is evident. Figure 2 shows the same predictions for $b_{\bar{p}p}$, with a few data points added for orientation. As expected, the t -dependence for $b_{\bar{p}p}$ is much weaker than for b_{pp} .

It would seem that models incorporating a fixed-pole Pomeron singularity (see, for example, Ref. 3) must reproduce the strong t -dependence of b_{pp} through some other mechanism since this feature of Regge-pole fits is determined by the small $|t|$ behavior of the DCS and polarization data.⁴ Further, extrapolating DCS data to the optical point to determine total cross sections⁵ would seem a rather risky business if, as we surmise, the existing data for these reactions demand this strong t -dependence.

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FOOTNOTES AND REFERENCES

- * Work supported in part by the U. S. Atomic Energy Commission.
- † Visiting scientist.
1. M. Holder et al., Phys. Letters 35B, 355 (1971).
 2. Donald M. Austin, William H. Greiman, and William Rarita, Phys. Rev. D2, 2613 (1970).
 3. V. Barger, K. Geer, and R. J. N. Phillips, preprint (June 1971).
 4. A new 5-pole fit with α_p' fixed at zero was tried, using all the available data. The best fit obtained had $\chi^2 > 2 \times$ number of degrees of freedom, and even then the P' intercept climbed to 0.8.
 5. M. Holder et al., Phys. Letters 35B, 361 (1971).

FIGURE CAPTIONS

Fig. 1. The pp differential cross-section slope (b_{pp}) for the Serpukhov and CERN data. The t values are the midpoint of the range measured at Serpukhov and at CERN.

Fig. 2. The pp differential cross-section slope (b_{pp}) predicted by the 4-pole fit with a few data points. The t values are explained in Fig. 1.

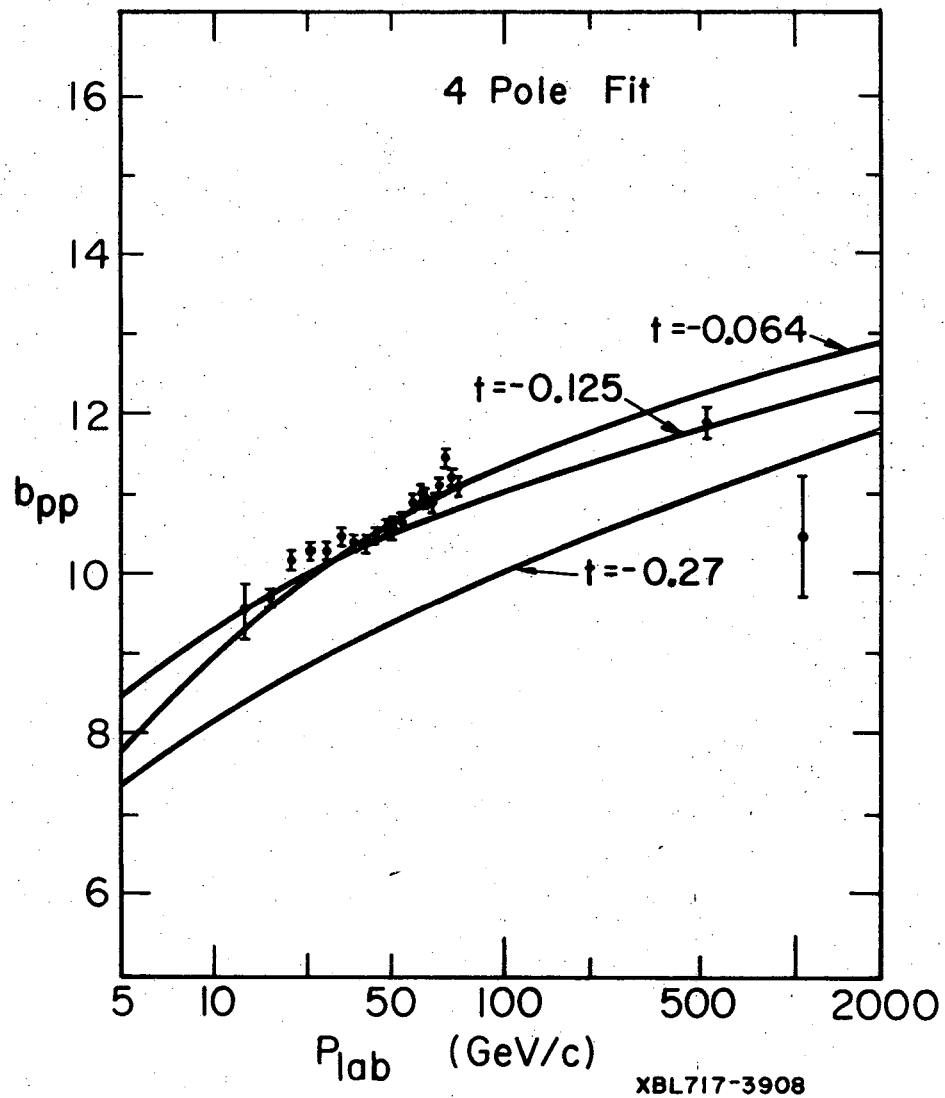


Fig. 1

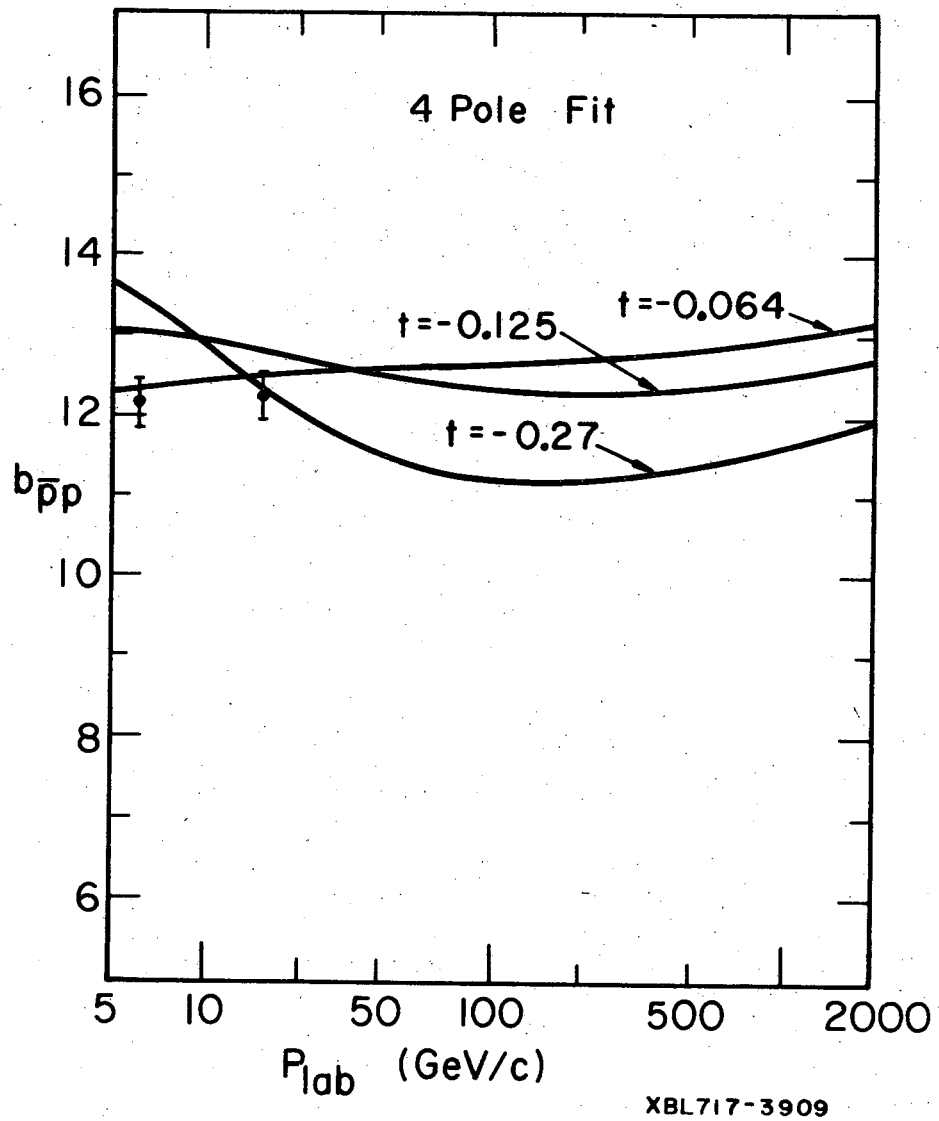


Fig. 2

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