Comment on "Determining the Phase of a Strong Scattering Amplitude from its Momentum Dependence to Better than 1°"

The papers [1,2] suggest that in this experiment (E773) [1] the phase ϕ_{+-} has been *measured* with a precision of less than 1°. This is misleading. The experiment determines the difference of phases $\phi_{+-} - \phi_f$, where $\phi_f = \arg[i(f - \overline{f})]$ is the phase of the nuclear regeneration amplitude $i(f - \overline{f})$. The experiment value of $\phi_{+-} - \phi_f$ and its error are not even quoted in Ref. [1]. The phase ϕ_f can be measured directly [3], or calculated via dispersion relations from the momentum dependence of the amplitude $f - \overline{f}$.

Assuming the validity of dispersion relations, the phase ϕ_f can be calculated *provided that* the amplitude $f - \overline{f}$ is known experimentally over a momentum range from about one decade below to one decade above the value of p_0 of momentum at which the phase is to be calculated. Here, the values of $f - \overline{f}$ above momenta of 160 GeV/c are *completely unknown* experimentally. For this reason, the authors of Ref. [4] have explored the uncertainty in the determination of the phase ϕ_f due to this missing knowledge in the unexplored momentum range, and estimate this uncertainty at about ±3°.

On the other hand, Briere and Winstein [2] make strong theoretical assumptions, namely, that the amplitude $(f - \overline{f})/k$ belongs to a certain class of entire functions, as required [5] to prove a "derivative analyticity relation" relating the regeneration phase to the local power law of the amplitude. The assumptions needed "severely restrict the validity of the result to certain mathematical models," as stated in Ref. [6]. Predictions from "derivative analyticity methods" can be at variance with exact evaluations of the dispersion relation [7]. Therefore a phase ϕ_f derived in this way is a theoretical or—at most—semiempirical number, certainly not an experimental number.

Assuming [2] that "regeneration off carbon comes only from ω meson Regge exchange," the exponent of the power law for the momentum dependence is found [1] to be $\alpha - 1 = -0.572 \pm 0.007$, leading to a regeneration phase of $\phi_f = -38.52° \pm 0.63°$(stat). In [2] from the same data, the ω intercept is found to be $\alpha = 0.437 \pm 0.007$, leading to a phase $\phi_f = -39.33° \pm 0.63°$(stat). There is a systematic difference of 0.81° between these two values, and the statistical error of 0.63° is larger than the one quoted for the phase ϕ_{+-} (0.58°) obtained from the combination of the two measurements of the interference phase $\phi_{+-} - \phi_f$ and of ϕ_f.

The paper [2] addresses several less important side effects but does not discuss the main point, namely, what experimental information justifies the assumption that the regeneration amplitude falls with a constant-exponent power law at momenta above 160 GeV/c. The question is not whether it is "likely" that there are no further breaks in the exponent of the power law behavior above 160 GeV/c kaon momentum, but whether one can prove experimentally that there are no breaks.

In summary, there is a *fundamental* difference between the value of the regeneration phase and its error derived (but not quoted as a number) in this paper [2] and a truly *experimental* measurement of ϕ_f with an experimental error [3]. This fact is not made clear in the paper [1], but the semiempirical value of ϕ_f is treated as if it was a real measurement.

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