Pole counting and pole classification

L. Y. Dai[(a)], X. G. Wang[(b)], H. Q. Zheng[(a)],

[(a)] Department of Physics and State Key Laboratory of Nuclear Physics and Technology, Peking University, Beijing 100871, P. R. China.
[(b)] Institute of High Energy Physics, Chinese Academy of Science, Beijing 100049, P.R. China

We analyze $\pi\pi - K\bar{K}$ and $\pi\eta - K\bar{K}$ couple channel [1,1] matrix Padé amplitudes of $SU(3) \times SU(3)$ chiral perturbation theory. By fitting phase shift and inelasticity data, we determine pole positions in different channels ($f_0(980)$, $a_0(980)$,$f_0(600)$, $K_0^*(800)$, $K^*(892)$, $\rho(770)$) and trace their N_c trajectories. We stress that a couple channel Breit–Wigner resonance should exhibit two poles on different Riemann sheets and meet each other on the real axis when $N_c = \infty$. Poles are hence classified using this criteria and we conclude that $K^*(892)$ and $\rho(770)$ are unambiguous Breit–Wigner resonances. For scalars the situation is much less clear. We find that $f_0(980)$ is a molecular state rather than a Breit–Wigner resonance, while $a_0(980)$, though behave oddly when varying N_c, does maintain a twin pole structure.

[1] L.Y. Dai, X.G. Wang, H.Q. Zheng, arXiv:1108.1451 [hep-ph]

E-mail: zhenghq@pku.edu.cn