1 - 12 Hadron Physics at High Energy Nucleon Physics Group

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In 2014, researchers in the high energy nuclear physics group at IMP have carried out their research work on hadron physics. Several interesting results were obtained and published.

The meson and baryon excited states have been studied in a large number of formation and production experiments. The study of meson resonances and the search for glueballs, hybrids, and multiquark states have remained an active and interesting field of hadron physics, while for baryons, the investigation of the baryon spectrum and the baryon couplings from experimental data are also the most important issues in hadronic physics and they are attracting much attention. Studying hadron resonances is crucial to understand deeply the QCD theory at nonperturbative energy region, and it is also important for nuclear physics and particle physics.

On the experimental side, there were many facilities on the world with the physical aim to study hadron physics, such as: LHC at CERN, RHIC at Brookhaven, Jefferson Lab in USA, MAMI and ELSA in Germany, Spring-8 in Japan. In China, we have BEPC in Beijing and CSR in Lanzhou. At the same time, there are also plans to build new facilities, for example, FAIR-PANDA in Germany, Super-B factory in Japan, JPARC at Japan, and HIAF in China. Those facilities have the physical aim to study the hadron physics, and different research flat are given by them to study different topics of the hadron physics.

Using an effective Lagrangian approach and the isobar model, based on experimental data, researchers in our group have studied phenomenologically the properties of some meson resonances, $f_0(2200)$, $f_2(2200)$, $h_1(1800)$, and baryon excited states, N(2120), $\Delta(1940)$ and $\Sigma(1380)$, in γp, $\bar{p}p$, pp, and Λp scattering processes and J/ψ decays[1−7]. Choosing the right scattering process by the conservation laws, we take the contributions of the resonances into account, and easily calculate the observables that can be compared with the experimental data[8−10], then we can obtain some properties of the including resonances which are not well established as shown in the review particle data book[11]. Besides, the parton distributions in the proton are evaluated dynamically starting from three valence quarks as input at the low scale by the DGLAP equation with the ZRS corrections. It is shown that negative nonlinear corrections improve the perturbative stability of the QCD evolution equation at low energy transfer. This approach provides a powerful tool to connect the quark models of the hadron with various non-perturbative effects[12,13]. In Ref. [14], based on the leading-power approximation, the Sudakov factor in deep inelastic scattering of the gluonic current off a large nucleus at one-loop order has been calculated. It is found that there are various types of divergences at one-loop order, and the divergences must be separated out from the Sudakov resummation.

On the other hand, with the parameters fixed by the current experimental data, the invariant mass distribution and the Dalitz Plot of those reactions are also predicted by our model which can be tested by the future experiments.

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