1 - 1 Progress of Theoretical Nuclear Research in 2016 at IMP

Zuo Wei

In 2016, the researchers of Theoretical Physics Group at IMP have carried out their research work on nuclear physics, heavy ion physics and hadron physics. Some important results have been obtained.

Based on the nuclear transport model, the effect of the high-momentum cutoff parameter λ on the π and hard photon productions in heavy ion collisions has been investigated and by comparing the calculated π^+ and hard photon productions with experimental data, a constraint of high-momentum cutoff value $\lambda \leqslant 2$ is obtained[1]. The neck dynamics in Fermi-energy heavy-ion collisions has been explored to probe the nuclear symmetry energy in the domain of subsaturation density, and the ratios of the energetic isospin particles are shown to strongly depend on the stiffness of symmetry energy[2]. By analyzing two unrelated Au + Au experimental measurements at a beam energy of 400 MeV/u, it is shown a mildly soft symmetry energy with a slope parameter of $L(\rho_0) = 37$ MeV is favorable[3]. Nuclear fragmentation and charge-exchange reactions induced by pions at the Δ-resonance energies have been studied, and the excitation energy transferred to the target nucleus has been obtained[4]. The formation mechanism of fragments with strangeness in collisions of antiprotons on nuclei has been investigated within the LQMD transport model, and a coalescence approach is developed for constructing hyperfragments in phase space[5]. Hollow nuclear matter is also explored based on the isospin-dependent Boltzmann transport model[6].

In nuclear astrophysics, the effects of the Fermi surface depletion in beta-stable nuclear matter on the cooling properties of neutron stars have been investigated, and it is found that the cooling rates of young neutron stars are significantly slowed due to the depletion of nuclear Fermi surface[7]. The stellar structure of magnetars has been calculated together with the magnetic field configuration in a self-consistent procedure[8]. It is shown that the mass and radius of magnetar are weakly enhanced by the strong magnetic fields, and the magnetic field is unable to violate the mass limit of neutron stars.

In hadron physics, the $\overline{\mathrm{D}}\Sigma_{\mathrm{C}}^*(2520)$ and $\overline{\mathrm{D}}^*\Sigma_{\mathrm{C}}(2455)$ interactions have been investigated, and the results suggest that the Pc(4380) and Pc(4450) are good candidates of the $\overline{\mathrm{D}}\Sigma_{\mathrm{C}}^*(2520)$ and $\overline{\mathrm{D}}^*\Sigma_{\mathrm{C}}(2455)$ molecular states, respectively[9]. The $\mathrm{K}\overline{\mathrm{K}}^*$ interaction has been studied in a quasipotential Bethe-Salpeter equation approach combined with the one-boson-exchange model, and the results indicate in the hadronic molecular state picture the $\mathrm{f}_1(1285)$ and $\mathrm{b}_1(1235)$ are the strange partners of the X(3872) and $\mathrm{Z_c}(3900)$, respectively[10]. The pion-induced production of the $\mathrm{Z_c}(3900)$ off a nuclear target has been explored. Based on the obtained results, the experimental study of the $\mathrm{Z_c}(3900)$ by using high-energy pion beams with a nuclear target has been suggested[11]. The partial widths for the radiative and pionic transitions from the $\mathrm{D}_{s1}(2460)$ to the $\mathrm{D}_{s0}^*(2317)$ have been estimated in a molecular scenario[12].

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