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Searching for $X(3872)$ and $Z_c(3900)$ using lattice QCD[1] SONG-HAENG LEE, CARLETON DETAR, Department of Physics Astronomy, University of Utah, FERMILAB LATTICE AND MILC COLLABORATIONS COLLABORATION — In the past decade, many excited charmonium states have been discovered that cannot be explained within the conventional quark model. Among those, the narrow charmonium-like state $X(3872)$ and the charged charmonium-like state $Z_c(3900)$ have been examined using various phenomenological models. Since $X(3872)$ mass is within 1 MeV of the $D\bar{D}^*$ threshold and $Z_c(3900)$ must contain at least four quarks, one strong candidate of these states is a $D\bar{D}^*$ molecular state. However, such molecular state cannot be directly studied by perturbative QCD in a low energy regime. Numerical simulation with lattice QCD can provide a non-perturbative, *ab initio* method for studying these mysterious meson states. In this talk, I present simulation results for $X(3872)$ and $Z_c(3900)$ with quantum numbers $J^{\rm PC} = 1^{++}$ in the isospin 0 and $J^{\rm PC} = 1^{-+}$ in the isospin 1 using lattice QCD, respectively. We use interpolating operators including both the conventional excited P-wave charmonium state and the $D^0\bar{D}^{0*}$ open charm state for $X(3872)$ and $J/\psi\,\pi^{\pm}$ and the $D^{\pm}\bar{D}^{*0}$ open charm state for $Z_c(3900)$. We find an $X(3872)$ candidate close to and below the $D\bar{D}^*$ threshold, however, only scattering states for $Z_c(3900)$.

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