

## Charmonium decays at BESIII

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The BESIII Experiment at the Beijing Electron Positron Collider (BEPC2) has accumulated the world's largest samples of  $e^+e^-$  collisions in the tau-charm region. Using a sample of 106 million  $\psi(3686)$  decays, the branch fractions of  $\psi(3686) \rightarrow \gamma \chi_{c0}$ ,  $\gamma \chi_{c1}$ ,  $\gamma \chi_{c2}$  are determined to be  $(9.389 \pm 0.014 \pm 0.332)\%$ ,  $(9.905 \pm 0.011 \pm 0.353)\%$ , and  $(9.621 \pm 0.013 \pm 0.272)\%$ , respectively. The branching fraction and the angular distributions of  $J/\psi$  and  $\psi(3686)$  decays to  $\Lambda$  anti- $\Lambda$  and  $\Sigma^0$  anti- $\Sigma^0$  final states are measured.  $J/\psi$  and  $\psi(3686)$  decays to  $\Sigma(1385)^0$  anti- $\Sigma(1385)^0$  and  $\Xi^0$  anti- $\Xi^0$  are measured. The decays to  $\Sigma(1385)^0$  anti- $\Sigma(1385)^0$  are observed for the first time, and the angular parameters of these decays are also measured first time. Observation of  $hc$  radiative decay  $hc \rightarrow \gamma \eta'$  and evidence for  $hc \rightarrow \gamma \eta$ . The branching fractions are measured to be  $(1.52 \pm 0.27 \pm 0.29)/10^3$  and  $(4.7 \pm 1.5 \pm 1.4)/10^4$ , respectively. Both of them are the first observations. Measurement of higher-order multipole amplitudes in  $\psi(3686) \rightarrow \gamma \chi_{c1,2}$  with  $\chi_{c1,2} \rightarrow \gamma J/\psi$  and search for the  $\eta_c(2S) \rightarrow \gamma J/\psi$  transition. The normalized magnetic-quadrupole (M2) amplitude for  $\psi(3686) \rightarrow \gamma \chi_{c1,2} \rightarrow \gamma \gamma J/\psi$  and the normalized electric octupole (E3) amplitudes for  $\psi(3686) \rightarrow \gamma \chi_{c2}$ ,  $\chi_{c2} \rightarrow \gamma J/\psi$  are determined. The decays  $\psi(3686) \rightarrow e^+ e^- \chi_{c0,1,2}$  and  $\chi_{c0,1,2} \rightarrow e^+ e^- J/\psi$  are searched, and they are observed for the first time. Improved measurements of branching fractions for  $\eta_c \rightarrow \phi \phi$  and  $\omega \phi$ . The branching fraction of  $\eta_c \rightarrow \phi \phi$  is measured with improved precision. No significant signal for the double OZI-suppressed decay of  $\eta_c \rightarrow \omega \phi$  is observed, and the upper limit on the branching fraction is determined.

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