

Gravitational waves (GWs) have been detected directly and paved the way for testing general relativity in the cosmological and dynamical regime of gravity. From the coincident detection of GW170817 and GRB170817A, GW propagation speed has been measured so tightly that a class of gravity theories in which GWs propagate with the speed different from  $c$  has been ruled out. On the other hand, another conspicuous feature in modified gravity is the time variation of the gravitational constant, which affects the amplitude damping of GWs during propagation and is a key observable to test gravity in the future. In this presentation, I will report on the recent developments of a model-independent parametrized framework for testing gravity with GW propagation and show how precisely the future observations of GWs can measure the time variation of the gravitational constant and test the equivalence principle at cosmological distance.