Modified theories of gravity: cosmology and astrophysics

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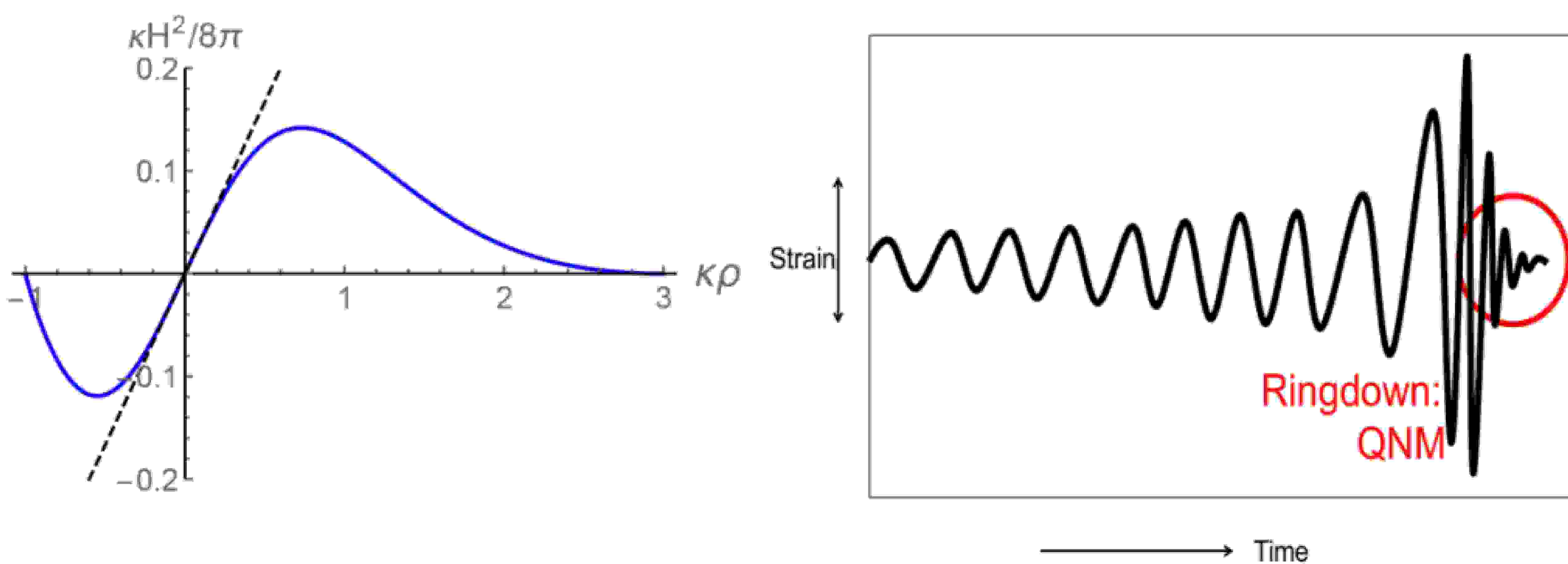**Institution**: LeCosPA, National Taiwan University

研究重點

In the scope of black hole spectroscopy, several attempts have been made in the past decades in order to test black holes or gravitational theories via black hole quasinormal modes (QNMs). Within this context, we investigate the QNMs of black holes in several modified theories of gravity by studying the perturbations of these black holes. Some particular models are the Palatini-type gravity, energy-momentum-squared gravity, and the non-singular black holes in conformal gravity. We obtain the master equations describing the QNMs and exhibit how the QNM spectra of these black holes deviate from those of their GR counterparts.
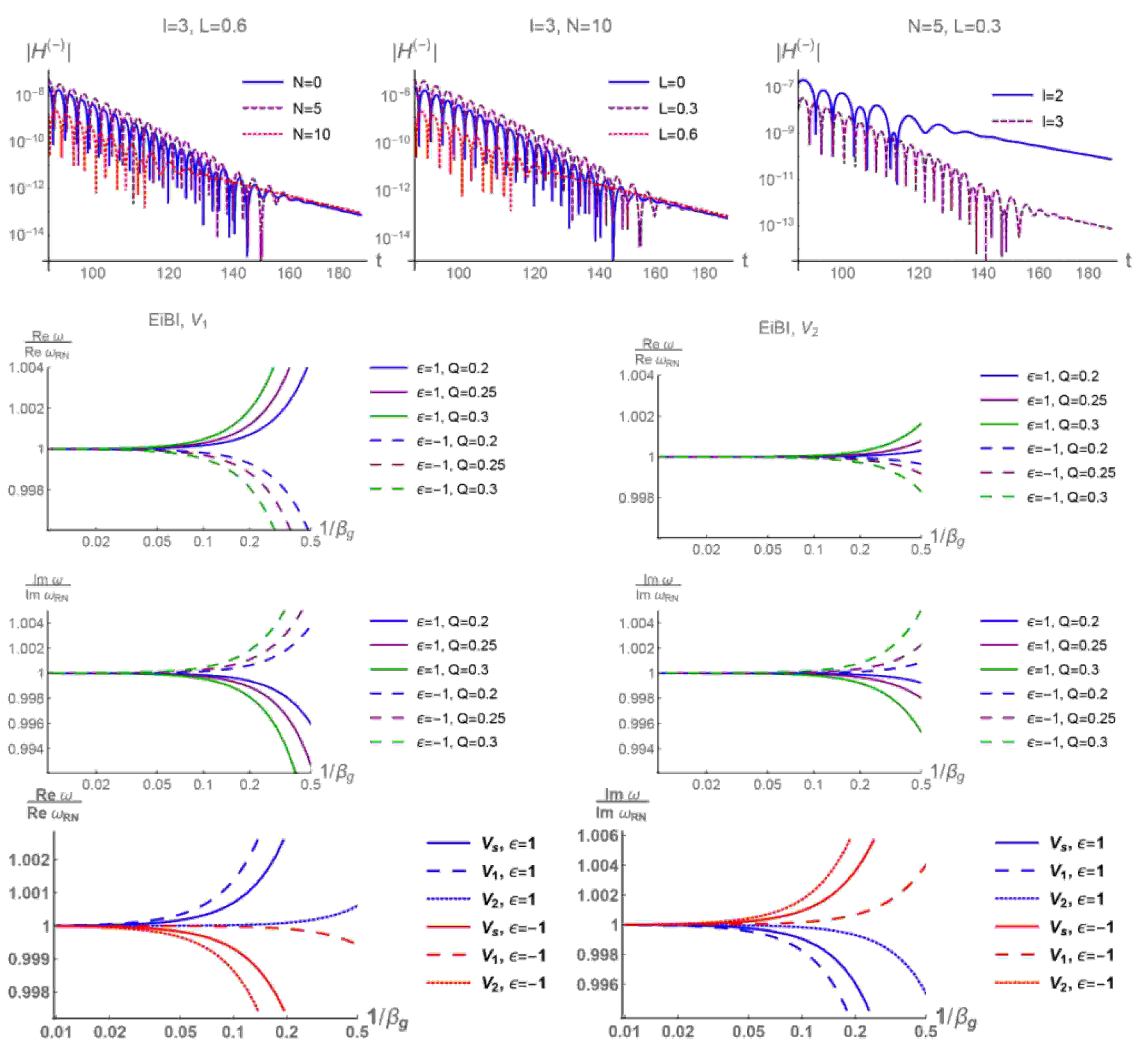
研究成果

Motivations

1. Spacetime singularity: Big Bang, Big Rip, Black holes
2. Testing gravity theories using gravitational waves

Results

Master equations

EiBI
$$\frac{d^2 H_1^{(-)}}{dr_*^2} + \omega^2 H_1^{(-)} = \left[\frac{S_{,r,r_*}}{S} + (\mu^2 + 2)\frac{e^{2\nu}}{r^2}\left(\frac{\sigma_+}{\sigma_-}\right) + \frac{4Q_*^2}{r^4\sigma_+}e^{2\nu}\right]H_1^{(-)} - \frac{2Q_*\mu e^{2\nu}\sqrt{\sigma_-}}{\sigma_+ r^3}H_2^{(-)}$$

$$\frac{d^2 H_2^{(-)}}{dr_*^2} + \omega^2 H_2^{(-)} = \left[-W\left(\frac{W_{,r_*}}{W^2}\right)_{,r_*} + \frac{e^{2\nu}\mu^2}{r^2}\frac{\sigma_-}{\sigma_+}\right]H_2^{(-)} - \frac{2Q_*\mu e^{2\nu}\sqrt{\sigma_-}}{\sigma_+ r^3}H_1^{(-)}$$

gEMSG
$$\frac{d^2 H_1^{(-)}}{dr_*^2} + \omega^2 H_1^{(-)} = \left[\frac{1}{2\sqrt{\sigma_+}}\left(\frac{\sigma_{+,r_*}}{\sqrt{\sigma_+}}\right)_{,r_*} + (\mu^2 + 2)\frac{e^{2\nu}}{r^2}\Gamma + \frac{4Q_*^2}{f_R r^4\sigma_+}e^{2\nu}\right]H_1^{(-)} - \frac{2Q_*\mu e^{2\nu}}{r^3\sqrt{f_R}\sigma_+}H_2^{(-)}$$

$$\frac{d^2 H_2^{(-)}}{dr_*^2} + \omega^2 H_2^{(-)} = \left[-Z\left(\frac{Z_{,r_*}}{Z^2}\right)_{,r_*} + \frac{e^{2\nu}\mu^2}{r^2}\right]H_2^{(-)} - \frac{2Q_*\mu e^{2\nu}}{r^3\sqrt{f_R}\sigma_+}H_1^{(-)}$$

研究生活及心得

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1. CYC, PC, Physical Review D **99**, 104003 (2019)
2. CYC, MBL, PC, Eur. Phys. J. C (2019) 79:63