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Towards the design of gravitational-wave detectors for probing neutron-star physics[1] HUAN YANG, Perimeter Inst for Theo Phys, HAIXING MIAO, DENIS MARTYNOV, University of Birmingham — The merger of binary neutron star encodes rich physics of extreme states of matter. Probing it through gravitational-wave observations requires the detectors to have high sensitivity above 1 kHz. Here we propose a detector design that pushes down the high-frequency quantum noise with an active optomechanical filter, frequency-dependent squeezing, and high optical power. The resulting noise level from 1 kHz to 4 kHz approaches the current facility limit, and is a factor of 20 to 30 below the design of existing advanced detectors at these frequencies. It will allow for precision measurements of (i) the post-merger signal of binary neutron star, with electromagnetic counterparts such as short gamma-ray burst and kilonovae, and possible detection of (ii) late-time inspiral, merger, and ringdown of low-mass black hole-neutron star systems, and possible detection of (iii) high frequency modes during supernovae explosions and/or magnetar giant flares. This design tries to maximize the science return of current facilities by achieving a sensitive frequency band that is complementary to proposed longer-baseline third-generation detectors: 10 km Einstein Telescope, and 40 km Cosmic Explorer.

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