LOW-LOSS FARADAY ISOLATORS

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A crucial aspect of gravitational-wave detectors that use squeezing is the reduction of optical loss in the squeezed path, necessary to maximize the benefits of squeezed light injection. Faraday isolators in the squeezed light path currently contribute optical losses of about 10%, a figure which must be drastically improved to meet the sensitivity goals of these detectors. These low-loss isolators in fact serve as circulators, three-port devices. The University of Florida and Montclair State University are developing the two Faraday isolator designs required for the A+ squeezer upgrades. One would replace the output Faraday isolator and the other is used in the squeezer. The goal for the designs is $< 1\%$ loss in single pass.

Some highlights of the designs are summarized here:

- Clear apertures of 20 mm (output Faraday isolator) and 5 mm (squeezer Faraday isolator).
- Use of KTF (KTb_3F_{10}) as a low-loss magneto-optical material.
- Temperature tuning of the Verdet constant of the KTF, following the lead of the Virgo design.
- A thermoelectric device for temperature tuning.
- A vacuum compatible magnet, similar that of the Advanced LIGO input Faraday isolator.
- A custom, zeroth-order half-wave plate, with high quality antireflection coatings.
- Use of prism polarizers, where the optical layout allows.
- Use of thin-film polarizers, in cases where the optical layout does not allow prism polarizers.

Supported by the National Science Foundation grant PHY-1707835.