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Birefringence measurement of a sapphire mirror for KAGRA

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The four sapphire mirrors in KAGRA will be cooled down to 20K to reduce thermal noise. We selected substrates with the lowest thermal absorption for the input mirrors. As for birefringence, we conducted an X-ray analysis to determine the direction of the crystal axis so that the effect of birefringence on to the laser beam is negligible. However, when we operated the interferometer with the sapphire mirrors, we found that the reflected light contains alternative polarization components.

Although we did not examined the non-uniformity of the birefringence before installing the mirrors in KAGRA, we happened to measure the transmitted wavefront error map with rotating the input polarization at each 45 degrees, from which we can estimate the birefringence map.

It is essential to verify the effectiveness of this method. We have been developing a system to measure the birefringence distribution at NAOJ so that we can compare the birefringence map deduced from the transmitted wavefront error map measurement and the directly measured birefringence map using a sample substrate.

In my poster, I will introduce the method to estimate the birefringence map from the transmitted wavefront error maps and explain the experiment to measure the birefringence map.

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