After 100 years of Einstein's first prediction, gravitational waves (GW150914) have been detected by aLIGO (advanced Laser Interferometer Gravitational-Wave Observatory) [1]. Korean review articles are published in a special volume of *New Phy.: Sae Mulli* (새물리 특집호, 2016, March) [2–6] (you can obtain the PDF files of the references by simply clicking the references below).

Even though the source of the first GW detection GW150914 was a black hole-black hole binary, binary neutron stars (neutron star-neutron star binaries) are among the major GW sources. Recently, two solar mass ($2M_\odot$) neutron stars have been observed, so the maximum mass of neutron stars has to be bigger than 2 solar mass.

Let's assume that you're designing your own laser interferometer GW detector in Korea with the following constraints.

- Arm length : 3 km each (distance between two test masses in each arm)
- Laser power (Nd:YAG, 1064nm): 500 kW Circulating Power (laser power within two test masses) [1]
- Test masses (fused silica) are made such that the photons circulates about 280 times (same as current aLIGO) between two test masses before going out to the Photodetector.

With your own laser interferometer, estimate the maximum distance you can detect the gravitational waves from a binary neutron star with a total mass $4M_\odot$ ($2M_\odot$ NS + $2M_\odot$ NS).

Hint: In order to make rough estimates, you can use the strain noise curve in Fig. 1 and the rough estimates provided in the Korean references [2–6] and lecture notes (will be provided later).

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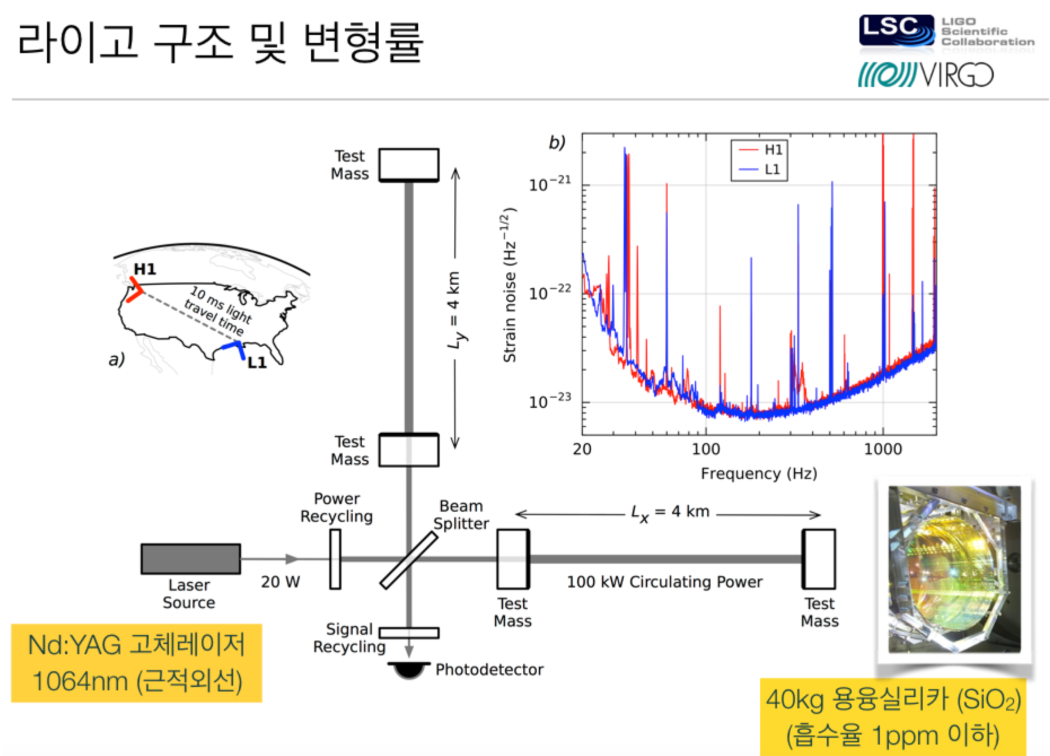

Fig. 1. Basic design concepts of aLIGO for the first GW detection, GW150914 [1] (a slide in the lecture note).