

## Recent progress of coherent beam combining Kumgang Laser (0.4J@10kHz/10ns)

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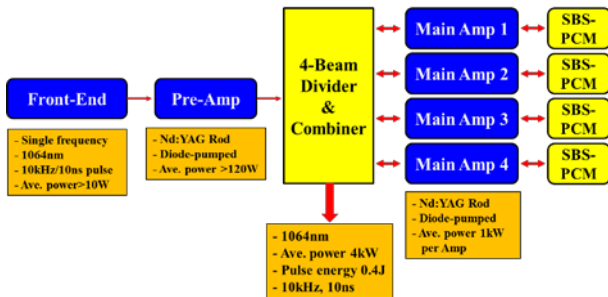
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A coherent beam combining is the most promising technique to achieve a high output energy and a high repetition rate laser system with a good beam quality [1]. It has been demonstrated experimentally that the coherent beam combination using self-phase-controlled stimulated Brillouin scattering phase conjugate mirror (SC-SBS-PCM) is the simplest coherent beam combination method [2-3]. For an average output power of a kW range, the experimental verification of coherent beam combination is now underway by the Kumgang laser [4-5].



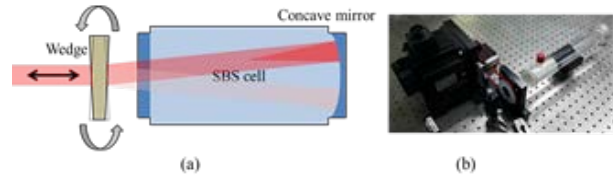
**Figure 1.** A schematic diagram of the Kumgang laser system

Figure 1 shows the schematic diagram of the Kumgang laser system. The front end (FE) produces a single-frequency seed beam of 1064 nm at a repetition rate 10 kHz. The average output power of the FE is 11 W (1.1mJ@10kHz/8.5ns), and the M2 of the out-put beam of the FE is 1.31.

The seed laser beam from the FE is amplified by the pre-amplifier (PA) from 11 W (1.1mJ@10kHz/8.5ns) to 128 W (12.8mJ @10kHz/8.5ns), and the M2 of the output beam of the PA is 1.8.

After the amplification process, the laser beam is divided into 4 sub-beams by the coherent beam divider/combiner. The wave-front distortion of the each sub-beam is compensated by SBS-PCMs.

The main amplifier stage is composed of a diode-pumped Nd:YAG rod amplifier chain and an SBS-PCM.



**Figure 2.** rotating wedge self-phase-controlled SBS-PCM (RW-SC-SBS-PCM); (a) a schematic diagram, (b) A picture of the RW-SPL-SBS-PCM.

For high average power operation of the SBS-PCM, thermal effect at a focus point should be released to keep high reflectivity. In Kumgang laser, the rotating wedge is used to reduce the thermal effect at its focal point. Figure 2 shows the schematic diagram of the rotating wedge self-phase-controlled SBS-PCM (RW-SC-SBS-PCM). The input laser beam is refracted by the rotating wedge, and reflected by the self-phase-controlled SBS-PCM.

After the reflection at the SBS-PCM and after passing through the main amplifier module (MA) again, the sub-beams will be combined by the coherent beam divider/combiner. The MA module can amplifies the laser beam from 128 W (12.8mJ@10kHz/8.5ns) to 640 W (64mJ @10 kHz/8.5ns) for single-pass amplification. In this case, the M2 of the output beam is 1.9. The reflectivity of the SBS-PCM is 56.9% at the input power of 500 W (50 mJ@10kHz/8.5ns).

### References

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