# Amplified spontaneous emission source in a co-pumping, single-frequency Raman fiber amplifier

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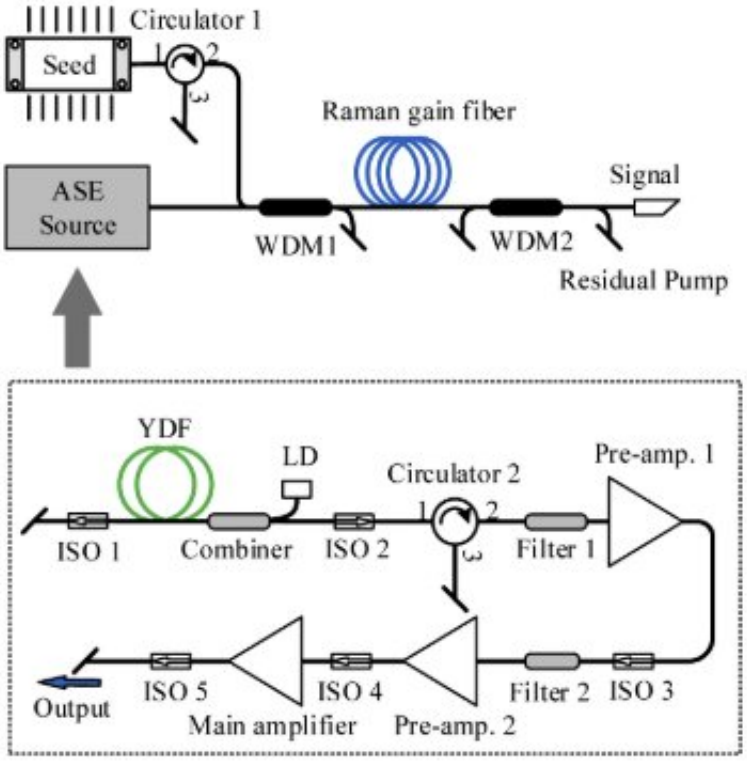


Fig. Schematic of the single-frequency RFA in co-pumping configuration. Credit: SIOM

Recently, researchers from the Shanghai Institute of Optics and Fine Mechanics (SIOM) of the Chinese Academy of Sciences (CAS) have

provided the new idea of co-pumping single-frequency Raman amplifiers. Relevant result was published in *Optics Express* on May 7.

Special wavelength, single-frequency, high-power fiber lasers have a wide range of applications in the fields of astronomy, geophysics, and quantum information technology. Raman fiber amplifier (RFA) technology is an effective approach to obtain these high-power special wavelength lasers. The counter-pumped manner traditionally used in RFAs has a complicated structure and the power increase is limited by stimulated Brillouin scattering and related high-power devices. The co-pumping manner can overcome these shortcomings. However, in co-pumping RFAs, the noise characteristics of the pump laser are easily transferred to the signal laser, which causes the linewidth of the signal light to broaden.

Due to the relatively low intensity noise of amplified spontaneous emission (ASE) sources, the full width at half maximum linewidth of the signal laser increases negligibly. But there is significant increase in relative intensity noise (RIN) and spectral wings due to the noise transfer at high frequency from the ASE source during the Raman amplification. For this reason, the method of co-pumping single-frequency Raman amplifier using a low noise ASE source was proposed.

In the experiment, the ASE seed source with a center wavelength of 1,065 nm was amplified through three amplifiers to obtain a power output of 20 W. The seed laser was a single frequency diode laser with a central wavelength of 1,122 nm and output power of 10 mW.

The ASE source and the seed laser were delivered into a co-pumped RFA after a wavelength division multiplexer. The noise characteristics of the ASE source were tested in detail, and the researchers found that the ASE source with a full width at half maximum of 10 nm has lower RIN noise than which of 3 nm.

They further found that the 10 nm ASE source can achieve linewidth retention characteristics when amplifying the 1,122 nm single-frequency laser source, but the relative intensity noise of the signal light is significantly improved, which is closely related to the magnification of the co-pumped Raman amplifier.

If the spectral width, noise characteristics, and power of the ASE source are further optimized, it is expected to achieve lower noise and higher power single-frequency laser amplification.

**More information:** Xin Cheng et al, Spectral and RIN properties of a single-frequency Raman fiber amplifier co-pumped by ASE source, *Optics Express* (2021). DOI: 10.1364/OE.424063

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