# Improved method for phonon lasers 'locks' sound waves into a more stable and powerful state

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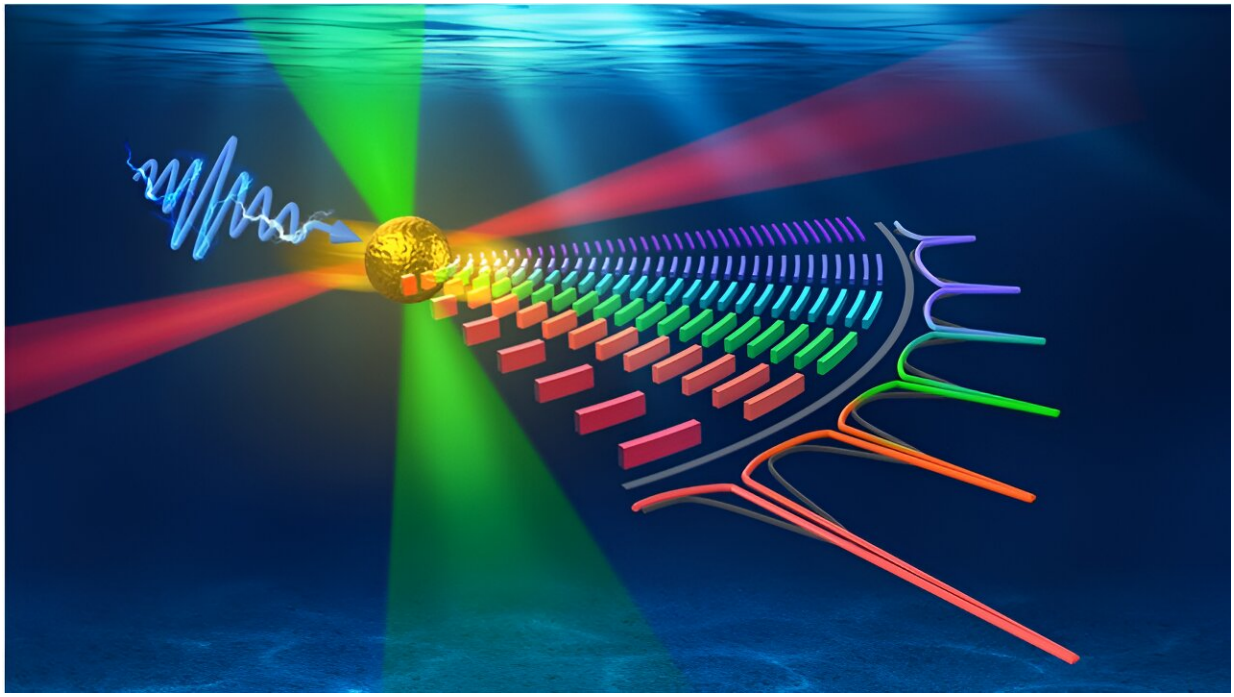
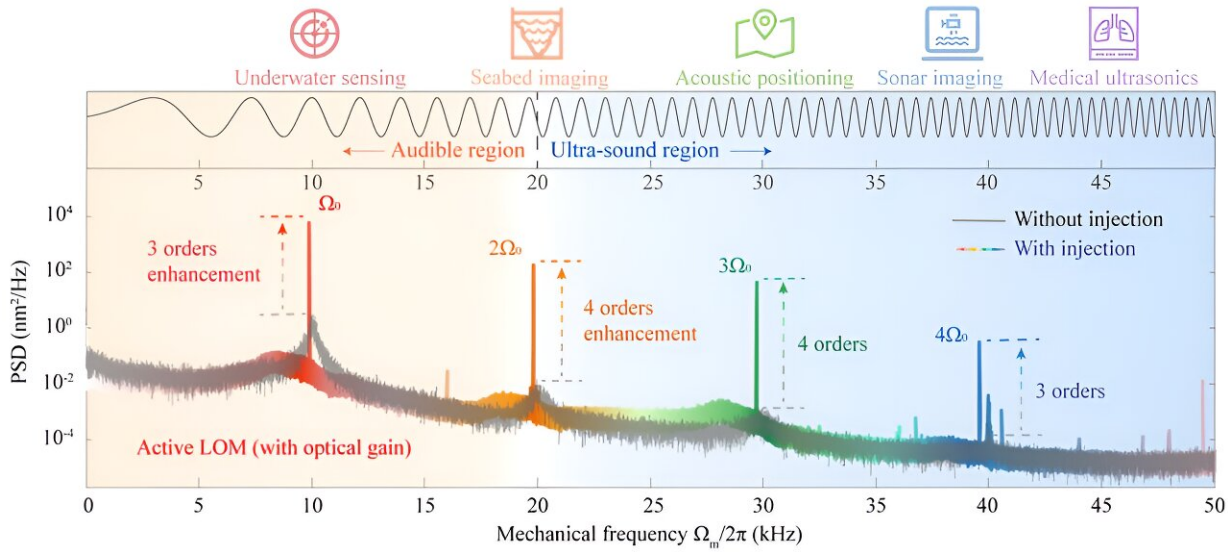


The microsphere, levitated by the dual beam optical tweezer (green), is driven by the active optomechanical system (red) to generate nonlinear phonon lasers (colored waves). Meanwhile, the injected electrical signal, represented by the white lightning mark, acts as a simple but powerful way to enhance the quality of the nonlinear phonon laser, shown as the colored spectrum. Credit: Guangzong Xiao, Tengfang Kuang, Yutong He, Xinlin Chen, Wei Xiong, Xiang Han, Zhongqi Tan, Hui Luo, Hui Jing

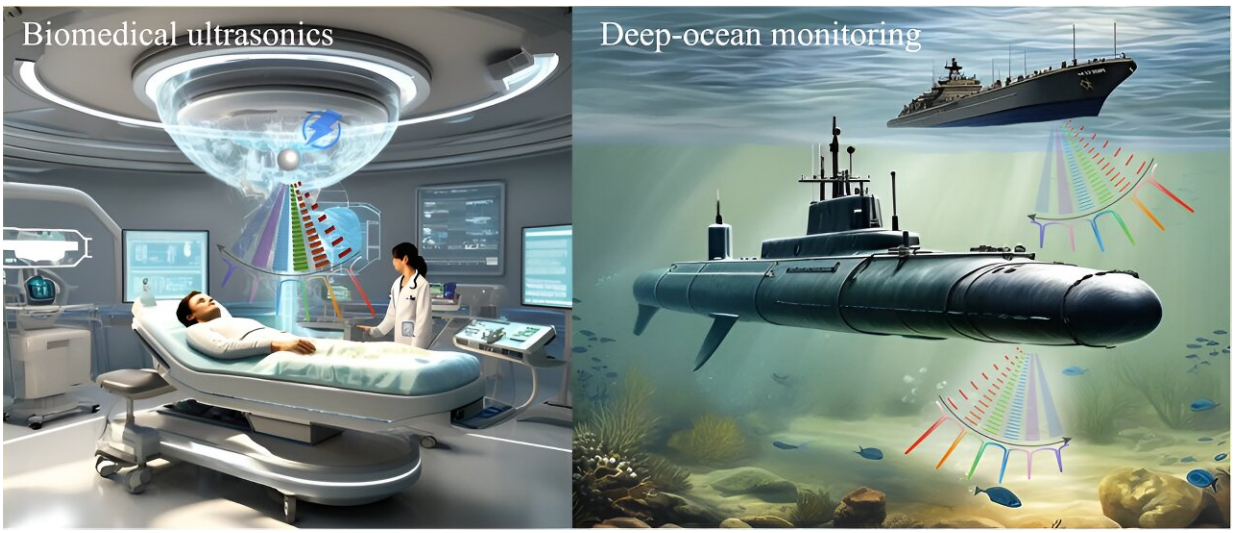
Scientists have made a significant leap in developing lasers that use sound waves instead of light. These phonon lasers hold promise for advancements in medical imaging, deep-sea exploration, and other areas.

The findings are published in the journal *eLight*.

The new technique involves a tiny electronic nudge that dramatically enhances the power and precision of the sound waves produced by the laser. This paves the way for future devices that could utilize sound for a broader range of applications.




The measured power spectrum (PSD) of phonons shows more than 3 orders enhancement in brightness and narrowed linewidth, revealing wide application scenarios covering audible and ultra-sound scope. Credit: Guangzong Xiao, Tengfang Kuang, Yutong He, Xinlin Chen, Wei Xiong, Xiang Han, Zhongqi Tan, Hui Luo, Hui Jing




The phonon laser boosts the phononics to coherent regime with wider frequency range, thus can achieve higher accuracy and further broaden the application scenarios, such as lesion identification of multiform organs and tissues, deep-sea detection of flora and fauna. Credit: Guangzong Xiao, Tengfang Kuang, Yutong He, Xinlin Chen, Wei Xiong, Xiang Han, Zhongqi Tan, Hui Luo, Hui Jing

Previously, phonon lasers made from small objects suffered from weak and imprecise sound waves, limiting their usefulness. The new method overcomes this challenge by essentially "locking" the sound waves into a more stable and powerful state.

This breakthrough paves the way for powerful and precise phonon lasers suitable for real-world applications, such as medical imaging and deep-sea exploration. Phonon lasers can create more sensitive and less harmful medical imaging techniques, while deep-sea vehicles could implement improved communication and navigation.

Phonon lasers could also have applications in material science, quantum computing, and other fields. This research represents a significant step

forward in phonon laser development, potentially unlocking a range of new technologies.

**More information:** Guangzong Xiao et al, Giant enhancement of nonlinear harmonics of an optical-tweezer phonon laser, *eLight* (2024). DOI: 10.1186/s43593-024-00064-8

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