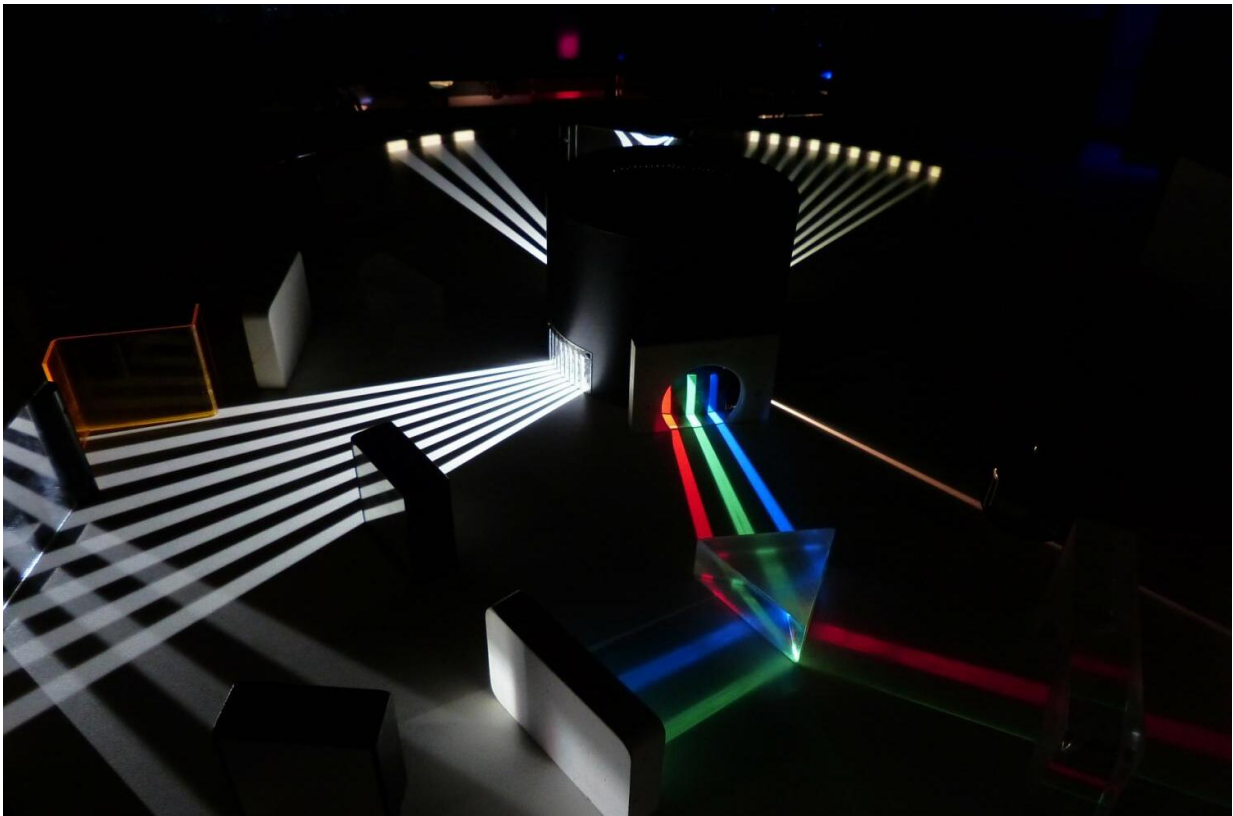


# Researchers model new method of generating gamma-ray combs

June 1 2021

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Skoltech researchers used the resources of the university's Zhores supercomputer to study a new method of generating gamma-ray combs for nuclear and X-ray photonics and spectroscopy of new materials. The

paper was published in the journal *Physical Review Letters*.

A gamma-ray [comb](#) is a series of short bursts that, when plotted as intensity versus frequency, look like sharp and equally spaced teeth of a comb. Generating these combs at high brightness in the gamma-ray domain has been challenging because of something called ponderomotive spectral broadening—an effect that destroys the monochromaticity that allows gamma-ray sources to be used in nuclear spectroscopy, medicine, and other applications.

Sergey Rykovanov and Maksim Valialshchikov from the Skoltech High Performance Computing and Big Data Laboratory as well as Vasily Kharin from Genity LLC offered a way to avoid this effect. To obtain the calculations needed to support this result, they used the Zhores supercomputing cluster at Skoltech.

"Our idea relies on a method that is very well known in the attosecond community—to use [laser pulses](#) with temporally varying polarization (with [circular polarization](#) in the wings and linear polarization only in the middle of the [pulse](#)) to gate emission of harmonics only to the part of the pulse where the [polarization](#) is linear," the authors write.

"Polarization gated pulses limit harmonics emission only to the region around the center of the pulse, where intensity gradients are smaller and harmonics emission efficiency is higher. Both of these lead to smaller ponderomotive broadening," Rykovanov says.

Maksim Valialshchikov adds that, to run the tests necessary to confirm their results, the scientists needed a simulation with large number of particles. "Zhores provides a large number of CPUs, and using part of them allows completing a single simulation orders of magnitude faster than using a single laptop," he notes.

According to Rykovanov, the authors plan to conduct additional research regarding the impact of radiation friction and [quantum effects](#) on the visibility of gamma comb. "This will allow us to move towards the experimental observation of the proposed effect in the nearest future," he says.

The authors say their proposed method can be used in photonuclear experiments as well as nonlinear quantum electrodynamics experiments planned at DESY, the German particle accelerator research center, and SLAC National Accelerator Laboratory in the US.

**More information:** M. A. Valialshchikov et al, Narrow Bandwidth Gamma Comb from Nonlinear Compton Scattering Using the Polarization Gating Technique, *Physical Review Letters* (2021). [DOI: 10.1103/PhysRevLett.126.194801](#)

Provided by Skolkovo Institute of Science and Technology

Citation: Researchers model new method of generating gamma-ray combs (2021, June 1) retrieved 25 April 2024 from <https://phys.org/news/2021-06-method-gamma-ray.html>

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