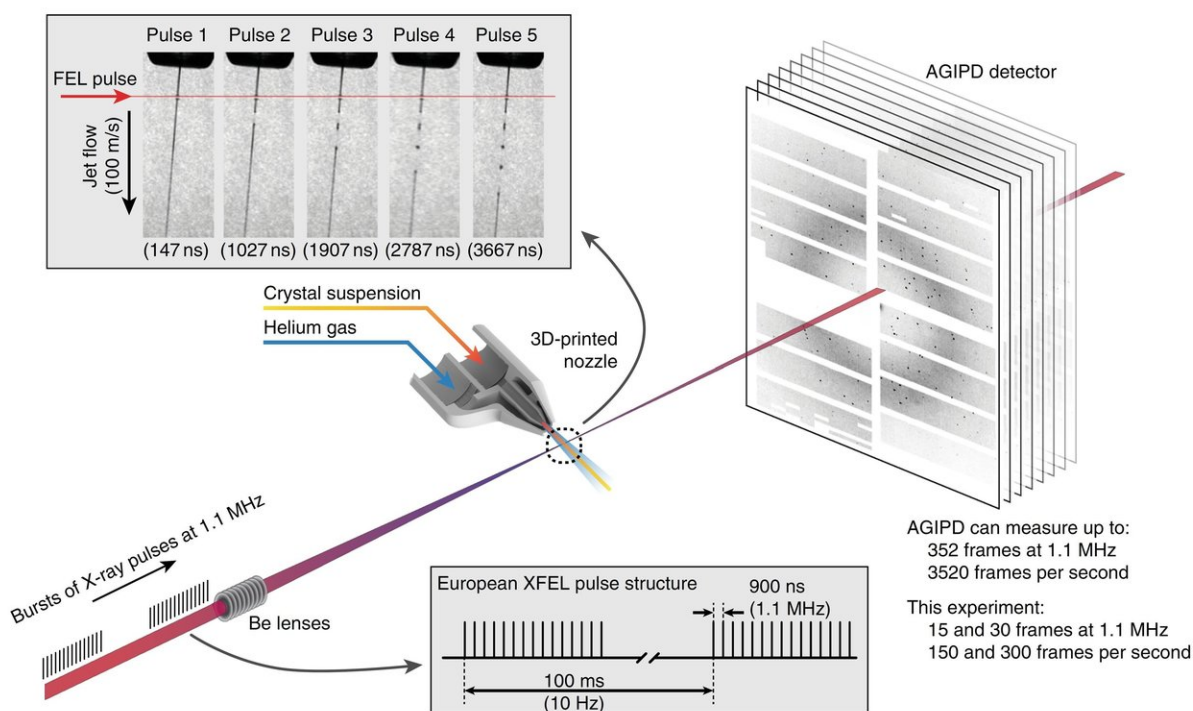


# New technology for the first experiment with the greatest source of X-rays in the world

November 27 2018



Flow Focusing technology (also known as GDVN, Gas Dynamic Virtual Nozzle).  
Credit: University of Seville

Flow focusing technology (also known as GDVN, Gas Dynamic Virtual Nozzle), has been one of the key elements in the success of the first experiments carried out by the European XFEL project, the greatest source of X-rays in the world today. It was created and developed by

Alfonso Gañán Calvo of the Higher Technical School of Engineering at the University of Seville. This technology has been used for the study of microscopic biological samples.

Among the fundamental advances of the European XFEL project is the increase in the amount of data that can be obtained per second in the analysis of a sample. This achievement is possible thanks to the use of a frequency of pulses of more than a megahertz. A high rate of renewal is necessary—that is, each pulse must have clean samples unaffected by the previous [pulse](#). Therefore, they require sufficient velocity.

"This means photographing or 'hunting' the molecules using an ultra-rapid and ultra-powerful flash before the samples disintegrate under the intensity of the ionising radiation that they receive," Gañán explains.

The biological samples (normally protein microcrystals) have to be in an aqueous environment. The challenge has been to present them in the correct way for them to be intercepted by X-ray pulses that are scarcely a few microns in diameter and that last for less than 10 femtoseconds (a hundredth of one thousand billionth of a second), and to generate the clearest and most coherent diffraction pattern possible.

To this end, GDVN technology has been capable of generating jets of liquid of less than 2.5 microns in diameter with speeds that reach 100 metres per second (260 km per hour), enough to transmit protein microcrystals and continually renew them at the point of impact. This has been achieved thanks to the use of helium as the a focusing gas for the micro-jet, as helium has [physical properties](#) allowing expansion speeds three times greater than those of air. In addition, highly precise 3-D nano-printing produced the device that emits the jet.

The combination of XFEL technology (trains of ultra-short and ultra-powerful X-ray pulses) with the flow focusing vehicle (GDVN) has

given rise to what is now known as serial femtosecond crystallography (SFX), a revolution in molecular biology.

GDVN [technology](#) has been adopted as the most efficient, robust and reproducible method for the introduction of samples for SFX and time-resolved SFX at the European XFEL (Hamburg, Germany), SACLA (Japan), LCLS (Stanford, USA), SwissFEL (Zürich, Switzerland), and the newly constructed Chinese and Korean XFELs, among others.

**More information:** Marie Luise Grünbein et al, Megahertz data collection from protein microcrystals at an X-ray free-electron laser, *Nature Communications* (2018). [DOI: 10.1038/s41467-018-05953-4](https://doi.org/10.1038/s41467-018-05953-4)

Provided by University of Seville

Citation: New technology for the first experiment with the greatest source of X-rays in the world (2018, November 27) retrieved 10 April 2024 from <https://phys.org/news/2018-11-technology-greatest-source-x-rays-world.html>

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