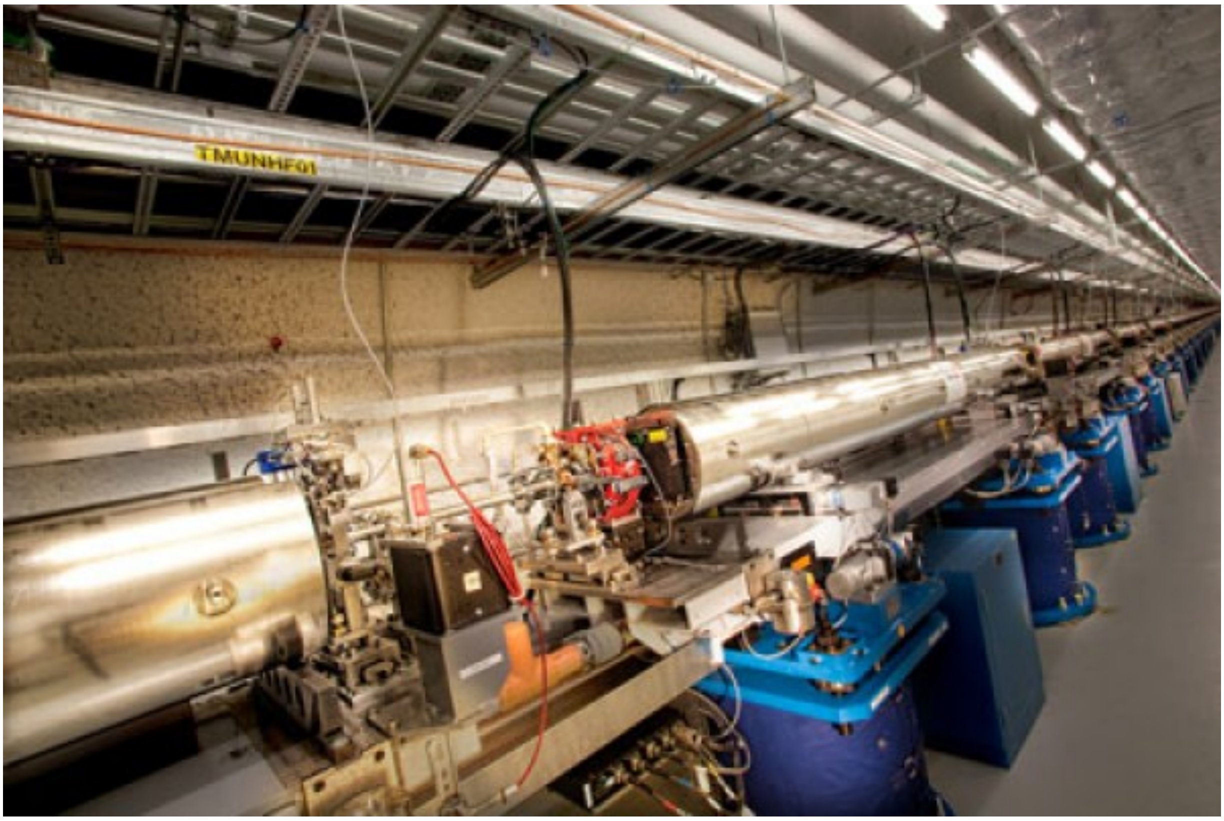

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Beaming. These specialized magnets, called undulators, are the heart of the x-ray laser, which produced its first beam last week.

World's First X-ray Laser Powers Up

By Adrian Cho (/author/adrian-cho) | 21 April 2009 (All day) | 4 Comments (/2009/04/worlds-first-x-ray-laser-powers#disqus_thread)

An x-ray laser may sound like something you'd only find in a James Bond movie, but scientists have made the device a reality. Today, physicists at the SLAC National Accelerator Laboratory in Menlo Park, California, announced that they have coaxed test beams out of their Linac Coherent Light Source (LCLS), the first laser working at "hard" x-ray wavelengths. With further refinement, the LCLS might be able to determine the structure of a protein by blasting just a single molecule with its beam; it also might be able to squeeze matter to high pressures and temperatures to simulate conditions in the centers of planets.

X-rays are key to probing the atomic-scale structure of materials. In recent decades, physicists have built hugely intense x-ray sources that have been a boon to condensed matter physics, materials science, and structural biology. These sources rely on circular particle accelerators called synchrotrons; the particles circulating in them radiate x-ray photons as they whirl around. The LCLS could eventually be a billion times brighter than these sources. What's more, it will produce bona fide x-ray laser beams, meaning that all the photons in them will march in quantum-mechanical lockstep and give the beam especially useful properties.

The LCLS works differently than most lasers. In a standard laser, a light-emitting material, such as a certain type of crystal, sits between two mirrors, and the light bouncing back and forth stimulates the atoms in the material to crank out lots more light in the form of a laser beam. There are no mirrors for x-rays, however. So instead, the LCLS relies on part of SLAC's 3-kilometer-long linear accelerator to fire a beam of electrons at light speed through specialized magnets called undulators. The magnets make the beam wiggle and produce some x-rays. The x-rays then travel along with the electrons and separate them into bunches, and the bunches produce x-rays far more efficiently. Thanks to that feedback, an x-ray laser beam emerges--as it did last week, SLAC officials report today.

The ultrashort, ultraintense pulses of an x-ray laser could be used for a variety of wild, new experiments. For example, current x-ray sources based on synchrotrons have been used to determine the structures of thousands of proteins. But those sources require samples with many individual copies of a molecule frozen into an orderly crystal. In principle, the LCLS should be able to do the same thing by blasting just one molecule.

The development of the $420 million LCLS signals a shift at SLAC from a focus on particle physics to a much broader program emphasizing x-ray studies. Just 2 years ago, the flagship machines at the lab were its PEP-II particle smasher and the jumbo BaBar particle detector it fed. At the time, SLAC researchers were locked in a race with their counterparts at Japan's KEK laboratory in Tsukuba to collect as much data as possible on fleeting particles called B mesons. But PEP-II shut down for good last April, bringing to an end the lab's 46-year-run as a center for particle physics experiments.

SLAC officials seem to be managing the lab's change of course with aplomb, says Samuel Aronson, director of Brookhaven National Laboratory in Upton, New York. "It certainly looks like they're doing all the right things," Aronson says. But Alfonso Mondragón, a structural biologist at Northwestern University in Evanston, Illinois, says it remains to be seen if the x-ray laser will live up to its billing, especially for single-molecule studies. "First they need somebody to show that it works the way they said it will work," he says. "That won't happen next week."

SLAC plans to run its first real experiments with the laser this September. In the meantime, researchers in Germany and Japan are building similar x-ray sources.

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Rick • 3 years ago

So my first experience with x ray lasers was in 1970, when the rag "LaserShere" was a few sheets of 8.5 x 11 Spectra Physics hosted it. It was a ruse, CU Sulfate in cover slips grown, a xtal converter laser of sorts, I think CO2 laser was the sim source, behind the cover slip was regular HS film, well after everyone got all excited it was discovered that it was triboelectric (static) Ha Ha. But the imagination was evoked instead of condemnation (Pons and Flieshman... Alverzes muon induced never had a chance thanks internet) Next experience was Lawrence Livermoore;(American Nuclear Society) in 1977, a big bull cannon of sorts with highly enriched Plutonium Hexaflorine gas, when you fire the cannon compress the gas it goes critical, the open end of the cannon is plugged with a special x ray brewster mirror same as slug. It can be reloaded over and over. It worked sorta, but went off the charts when it became classified. I don't think you can find a reference to it; SDI probably ate it up in the 1980's.

So whats the hub bub? What can you do with it besides shoot down missiles? Well you could do seismic exercises from space in 3d (Holograpy on a big scale), and find all the great stuff in the ground pin pointed, check out Schlumbergers back scatter xRAY tubes for oil logging, thats a dinggleberry compared to what I'm sayin. There alot more ya could do with it but at the risk of getting dissed more then I know I will; I'll keep insanely quiet...............

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bolagna • 4 years ago

In order to" lase" one need a monochromatic source (a pure wave) without any distortion, harmonics. To the best of my knowledge when a x-ray is produced, even at high, virtually pure DC, mega elctron-volts, many x-rays of varying wavelengths are produced, some are spikes at a designated alphabetical bands i.e. k,l,m.... Even these bands are not monochromatic, close, but not sufficient. Fliters are for the most part are useless. They create scatter and reduce the energy of the wave. An x-ray does not "go through" an absorber...it gives up energy and a with each collision a new x-ray is produced at a reduced eneregy and the remainder of the energy is either absorbed as heat, or produces "lighted" particles ...errr...get a old copy of "van der Plaats and an introduction in "Modern/Relativistic Physics".

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s8 • 5 years ago

http://www.spring8.or.jp/ja/cu...

• Reply • Share ›

jough • 5 years ago

Though an interesting article, I'm pretty sure theyre not actually shooting electrons through an accelerator AT light speed... might want to have a technical editor take a look at future submissions.

/just a pet peeve o mine

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