

Europe unveils world's most powerful X-ray laser

Level 1 • Pre-intermediate / Intermediate

1 Warmer

Choose the best answer to the questions.

1. When were X-rays invented?
 - a. 1895
 - b. 1955
2. When was the first laser invented?
 - a. 1960
 - b. 1990

2 Key words

Complete the sentences using these key words from the text. The paragraph numbers will help you.

image

facility

pulse

beam

laser

1. A _____ is a piece of equipment that produces a powerful narrow line of light. (para 1)
2. A _____ is an area or building used for a particular purpose. (para 1)
3. An _____ is a picture you see, for example, in a photograph or on a computer screen. (para 2)
4. A _____ is a line of light or other form of energy. (para 2)
5. A _____ is an amount of electricity, light or sound that something produces for a short time. (para 4)

magnet

enzyme

melting point

accelerator

absolute zero

6. An _____ is a natural chemical produced by animal and plant cells that helps reactions and other processes to start. (para 6)
7. An _____ is a machine used in scientific research that makes particles move faster. (para 7)
8. _____ is minus 273 degrees Celsius. (para 7)
9. A _____ is a piece of metal that can make iron or steel objects come to it so that they seem to stick to it. (para 7)
10. The _____ of a substance is the temperature at which it changes from a solid to a liquid. (para 9)

3 Find the information

Find the following information in the text as quickly as possible.

1. What is XFEL?
2. Where is XFEL?
3. Where are the other two major X-ray laser facilities?
4. How many pulses per second can XFEL send?
5. What is the temperature of the tunnel used in XFEL?
6. What pressure can be produced by XFEL?

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1 September, 2017

- 1 The world's most powerful X-ray laser has started working at a facility near Hamburg. Scientists will use the laser to try to recreate the conditions deep inside the Sun and make films of viruses and cells.
- 2 The machine, called the European X-ray Free Electron Laser (XFEL), works like a high-speed camera. It makes images of individual atoms in a few millionths of a billionth of a second. The X-ray laser is different from a normal camera because everything it films is destroyed. Its beam is 100 times stronger than all the sunlight hitting the Earth's surface concentrated on just one square centimetre.
- 3 XFEL will allow scientists to examine the structure of viruses and cells, create films of chemical reactions, and recreate conditions deep inside stars and planets.
- 4 XFEL is the world's third major X-ray laser facility. There are two other facilities in Japan and the US, and scientists have already learnt a lot from them. The European beam is more powerful but, most importantly, it sends out pulses much faster than the others. "They can send out 100 pulses per second; we can send 27,000," said Robert Feidenhan'l, chairman of the XFEL management board.
- 5 This is important because to study chemical reactions or biological processes, the X-ray makes images of the same system at different points in time and this can be made into a film. At XFEL, scientists will be able to collect data much more quickly and miss less of the action between images. Up to now, scientists have been able to measure the crystal structure of the beginning and end-product but now, they will be able to see what happens during reactions and processes.
- 6 UK scientist Allen Orville is one of the first people using XFEL to collect data. Orville is trying to understand how enzymes make antibiotics, such as penicillin, so he can develop new ways of producing antibiotics in the future.
- 7 At the centre of the facility is the world's longest accelerator, which produces the energy you need to make X-rays a billion times brighter than normal radiation sources. The tunnel's temperature is 2 degrees Celsius above absolute zero. The electrons in the accelerator pass between a series of magnets and move quickly from side to side. With each sideways movement, they produce X-rays and these make a powerful laser beam.
- 8 XFEL will also have a powerful optical laser next to the X-ray accelerator. Scientists will use this to put very big pressures on materials to reproduce conditions similar to those at the centre of the Earth or inside the Sun – or simply to change materials into shapes never seen before.
- 9 Justin Wark, a physics professor at the University of Oxford, said: "The pressures you can produce are enormous; 10 million atmospheres and above, which is more than three times the pressure at the centre of the Earth." Wark and others will use the laser to hit samples with the optical light and then take a picture with the X-ray beam to answer previously unanswered questions. "We still don't know exactly what the centre of the Earth looks like," said Wark. "You could also study the melting point of iron up to pressures found on much larger planets."
- 10 In theory, extremely high pressures could also produce completely new materials, including a new form of diamond with a crystal structure that would be even harder than a normal diamond. Scientists are also planning to use the X-ray beam's very high heat – the point of the beam can reach 200 million degrees within a millionth of a billionth of a second.

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4 Comprehension check

Match the beginnings and endings to make statements about the text.

- | | |
|---|--|
| 1. XFEL is different from a normal camera because ... | a. ... change materials into shapes never seen before. |
| 2. XFEL can collect data ... | b. ... a temperature of 200 million degrees. |
| 3. Scientists want to use XFEL ... | c. ... it destroys everything it films. |
| 4. The powerful optical laser will ... | d. ... materials that are completely new, including a harder form of diamond. |
| 5. Very high pressures could produce ... | e. ... much faster than the X-ray laser facilities in Japan and the US. |
| 6. The point of the X-ray beam can reach ... | f. ... to study what happens during chemical and biological reactions and processes. |

5 Chunks

Rearrange the words to make phrases from the text.

- side to from side
- data to able be collect
- harder normal than even diamond a
- of the centre Earth the
- laser a beam powerful
- such antibiotics penicillin as

6 Two-word phrases

Match the words in the left-hand column with the words in the right-hand column to make expressions from the text.

- | | |
|-------------|--------------|
| 1. melting | a. reaction |
| 2. end- | b. beam |
| 3. chemical | c. pressure |
| 4. laser | d. product |
| 5. high | e. professor |
| 6. physics | f. point |

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7 Word-building

Complete the table using words from the text.

	noun	adjective
1.	power	
2.	biology	
3.	chemistry	
	verb	noun
4.	react	
5.	manage	
6.	move	

8 Discussion

- Are lasers useful? Why? Why not?

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KEY

1 Warmer

1. a
2. a

2 Key words

1. laser
2. facility
3. image
4. beam
5. pulse
6. enzyme
7. accelerator
8. absolute zero
9. magnet
10. melting point

3 Find the information

1. an x-ray Free Electron Laser
2. near Hamburg
3. Japan and the US
4. 27,000
5. 2 degrees Celsius above absolute zero
6. 10 million atmospheres and above

4 Comprehension check

1. c
2. e
3. f
4. a
5. d
6. b

5 Chunks

1. from side to side
2. be able to collect data
3. even harder than a normal diamond
4. the centre of the Earth
5. a powerful laser beam
6. antibiotics such as penicillin

6 Two-word phrases

1. f
2. d
3. a
4. b
5. c
6. e

7 Word-building

1. powerful
2. biological
3. chemical
4. reaction
5. management
6. movement

8 Discussion

Teacher's note: To stimulate discussion, you could mention or elicit that lasers are used for cutting hard substances, directing the paths of missiles and in medical operations (including cancer and eye surgery).