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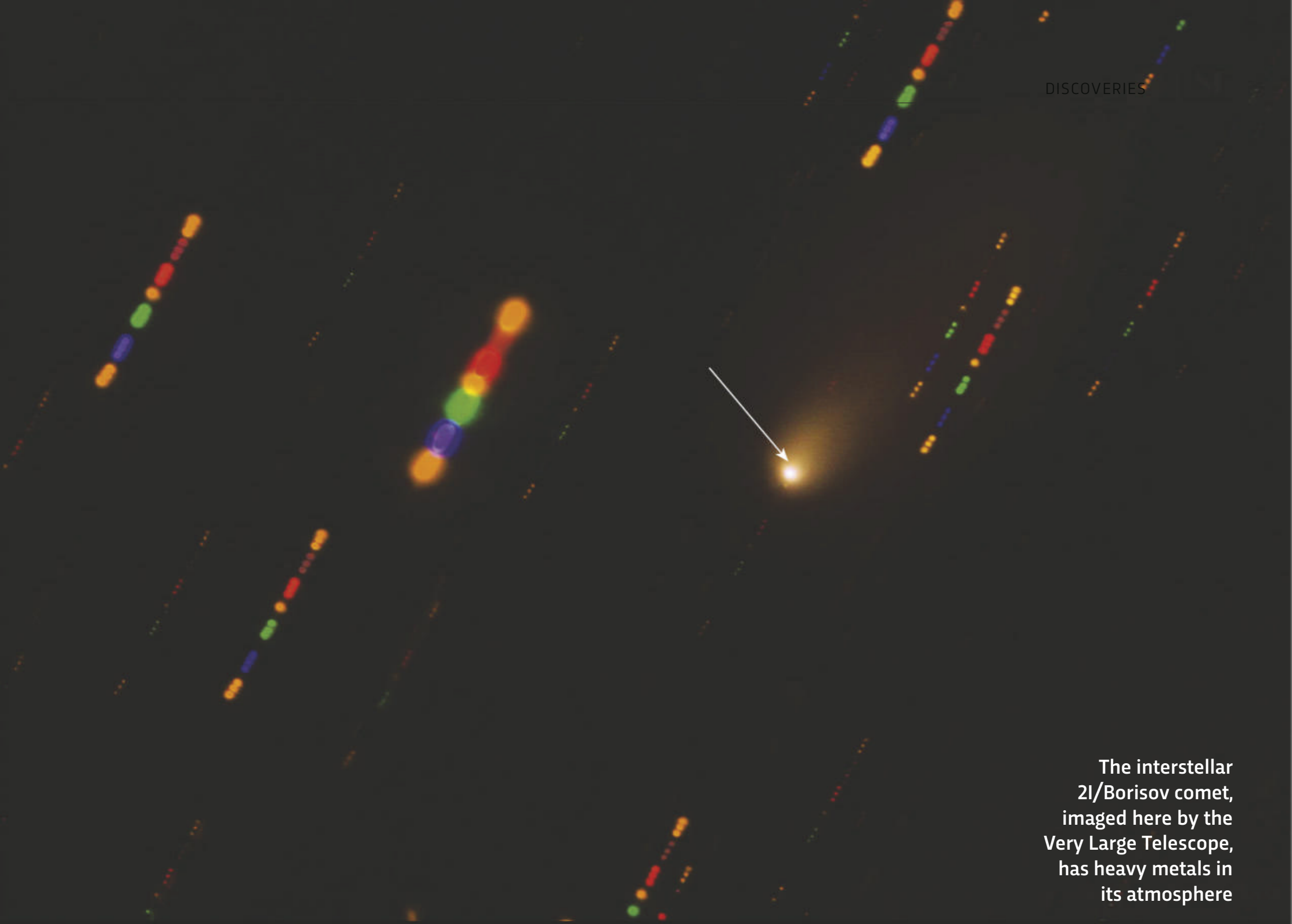
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The interstellar 2I/Borisov comet, imaged here by the Very Large Telescope, has heavy metals in its atmosphere

SPACE

Heavy metals unexpectedly found in comets' atmospheres

Iron and nickel vapours in comets' atmospheres reveal a hole in our understanding of early Solar System

Astronomers have found traces of heavy metals in the atmospheres of all of the comets they have studied over the last 20 years – including 2I/Borisov, the first comet to visit from another solar system.

Heavy metals like iron and nickel are often found in comets, but only in their dusty and rocky interiors. However, solid metals usually don't sublimate – turn from solid directly to gas – at the low temperatures found in the atmospheres of

distant comets. Heavy metals as gases had only previously been observed in much hotter environments, such as evaporating comets as they passed by the Sun, or in the atmospheres of ultra-hot exoplanets.

Belgian scientists were therefore surprised to find trace amounts of the two heavy metals in comet atmospheres throughout the Solar System, including those more than three times further from the Sun than the Earth's orbit.

Jean Manfroid, from the University of Liège, Belgium, led the study on Solar System comets, which was published in *Nature*. "It was a big surprise to detect iron and nickel atoms in the atmosphere of all the comets we have observed in the last two decades, about 20 of them, and even in ones far from the Sun in the cold space environment," he said.

Usually, material from our Solar System contains about 10 times more iron than nickel. However, these comets had roughly equal amounts of iron and nickel.

"We came to the conclusion they might come from a special kind of material on the surface of the comet nucleus,

sublimating at a rather low temperature and releasing iron and nickel in about the same proportions," said Damien Hutsemékers, also a member of the team from the University of Liège.

Since comets formed so early in the lifetime of the Solar System, the researchers say they are like "fossils for astronomers". So, these discoveries suggest that there is a hole in our understanding of early Solar System.

The scientists hope that future research with the upcoming Extremely Large Telescope can help to answer some of these questions, including what the material on the surface of the comet nucleus might be.

A second paper, published by a Polish team, describes the discovery of nickel in the atmosphere of 2I/Borisov. "At first we had a hard time believing that atomic nickel could really be present in 2I/Borisov that far from the Sun. It took numerous tests and checks before we could finally convince ourselves," said study author Piotr Guzik from the Jagiellonian University in Poland.