Staring at stardust

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Credit: NASA

Dust particles in space form the basis for new stars and planets. But what do these particles consist of and how do they behave? Sascha Zeegers studied this. Ph.D. defence 1 November.

Take a walk outside on a clear evening and look up. What do you see? The moon probably, and quite a number of stars. And if you have a keen eye, you might just be able to make out Mars or the International Space Station. Apart from that, nothing else, save the endless, pitch-black night.

Dust and gas

Yet that space you are peering into is not nearly as empty as you think. The space around the celestial bodies is teeming. The space between those stars and planets – the interstellar medium – is filled with gas and dust. All that material floats aimlessly through space, until it clumps together to form new stars and planets. But what that substance consists of precisely is still largely unknown.

Sascha Zeegers from the Leiden Observatory and the Netherlands Institute for Space Research (SRON) offers a look behind the scenes in her thesis: she discovered that the constituent dust she researched consists largely of olivine, olive-green gemstones probably produced by stars. "We rather expected to encounter this silicate," says Zeegers. "But it is unique that we have been able to measure it so clearly."

Fingerprint

Zeegers discovered this by studying so-called X-ray binaries, two stars that revolve around each other, with one star taking mass from the other star. In this process, a massive amount of energy is released in the form of X-rays. The X-ray binaries shine like a lantern through the interstellar medium and the X-rays traverse gas and dust. If you capture this radiation using a space telescope, you can use the light spectrum to determine what material the intermediate star dust consists of. Because every material produces its own, unique structures in the spectrum. "The spectrum functions as a fingerprint, as it were," says Zeegers.

For her research, Zeegers used observations from the Chandra X-ray Observatory, a satellite that detects X-rays. That is not possible on earth, because X-rays do not penetrate our atmosphere. Originally, the intention was to compare these observations with the observations of the Hitomi satellite that was launched in 2016, but the satellite soon lost contact with Earth due to technical problems.

Still much to discover

"I hope that my data will be linked to new observations in the short term, because there is still so much to be discovered about cosmic dust," Zeegers states. "Take iron for example. We know that it is being ejected into space in huge quantities by stars. Yet it is hardly observed in the interstellar medium. Is it perhaps hiding between other minerals, such as silicates? With the new space telescopes that are now under development, we will soon be able to determine that."

Provided by Leiden University

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