

# Research team observes hot dust rings around stars in a new wavelength range

October 6 2020, by Julia Siekmann

---



The observing instrument MATISSE of the European Southern Observatory (ESO) combines data from four infrared telescopes to achieve an extremely high resolution. Researchers from Kiel have co-developed it and now use it to study hot dust rings around stars. Credit: John Colosimo (colosimophotography.com)/ESO

The phenomenon of hot dust rings—an accumulation of submicrometer-sized particles in the immediate vicinity of stars—was first discovered outside our solar system in 2006. They form so close to stars that they can reach temperatures of up to 1,000 degrees Celsius. However, the dust particles are difficult to observe due to their small size, and their origin is still unknown.

For the first time, this phenomenon has now been observed in a new wavelength range with the extremely high resolution of the instrument MATISSE (Multi AperTure mid-Infrared Spectro Scopic Experiment) at

the Paranal Observatory of the European Southern Observatory (ESO) in Chile. Also involved was the working group Star and Planet Formation of Kiel University. Their results, recently published in the journal *Monthly Notices of the Royal Astronomical Society Letters*, provide a central basis for further studies to explain the phenomenon of these [dust](#) rings.

## **Unique observations in a wavelength range not previously accessible**

Dust rings, also known as "dust disks" or "debris belts," are a result of collisions of debris and small bodies that remain after the formation of planets—this has been known for several decades. In our solar system, for example, such an accumulation can be found between the orbits of Mars and Jupiter, the so-called "asteroid belt." However, the hot dust rings close to stars discovered in 2006 are a mystery. How could they form and survive for billions of years under the extreme conditions to which they are exposed?

Precise information about their spatial structure and material composition could help to understand the phenomenon of hot dust rings and their formation better. The now published observations with MATISSE are a central step towards this, the researchers hope. "We were able to observe the hot dust rings not only with a high resolution but also in the wavelength range around 3 micrometers, where these rings are particularly bright," says Sebastian Wolf, Professor of Astrophysics and Head of the research group Star and Planet Formation at Kiel University. "This area was not accessible with previous observing instruments and it now allows us a unique insight into this phenomenon."

Wolf's research group is part of an international consortium of scientists from Germany, France, the Netherlands and Austria who had developed

the observing instrument MATISSE over a period of twelve years. In 2019, the world's most powerful mid-infrared interferometric instrument went into operation at the VLTI (Very Large Telescope Interferometer) of the European Southern Observatory (ESO) in Chile. Up to four telescopes can be used to record the infrared radiation of celestial objects—this measuring method is known as interferometry. This means that the researchers do not receive direct images of the objects, but from the technical measurement, conclusions can be drawn about their appearance and properties. By combining four telescopes, MATISSE achieves an enormous resolution, which would correspond to that of a 200-meter telescope. With MATISSE's unprecedented precision, insights into the earliest development of planets and ultimately the formation of the solar system are possible.

The research team, which included researchers from the University College London, the Large Binocular Telescope Observatory in Tucson (U.S.) and the Universities of Arizona, C<sup>o</sup>te d'Azur and Jena, as well as Kiel, observed the star Kappa Tucanae. It is located in the constellation "Tukan," which is only visible from the southern hemisphere. The star is about two billion years old—less than half as old as our Sun—and about 69 light-years away from Earth. Based on the now collected data, the researchers were able to determine the exact position of the dust ring around "Kappa Tucanae" and the properties of the dust.

## **The results allow further research for the origin of the dust rings**

"That information are important requirements for finding the origin of the phenomenon," says Dr. Florian Kirchschrager, first author, former research assistant in Wolf's group and now employed at University College London. "We are of course particularly happy that these are also the first data from the instrument to have been published at all." As part

of his research at Kiel University, Kirchschrager carried out the feasibility study on the observations of "Kappa Tucanae." Because dust rings are not only tiny in the astronomical sense but also relatively faint. "This was challenging, even for MATISSE. The fact that the observations were nevertheless successful underlines the unique potential of the instrument," emphasizes co-author Dr. Steve Ertel, who was a Ph.D. student in Wolf's research group and now works at the University of Arizona.

"The [observational data](#) now collected and evaluated form the basis for our further research on an explanatory model for the hot dust rings," says Wolf, deputy spokesman in the Research Unit FOR 2285 "Debris Disks in Planetary Systems," which is based at the Friedrich Schiller University Jena under the leadership of Professor Alexander Krivov.

**More information:** Florian Kirchschrager et al. First L band detection of hot exozodiacal dust with VLTI/MATISSE, *Monthly Notices of the Royal Astronomical Society: Letters* (2020). [DOI: 10.1093/mnrasl/slaa156](https://doi.org/10.1093/mnrasl/slaa156)

Florian Kirchschrager et al. Modeling of mid-infrared interferometric signature of hot exozodiacal dust emission, *Monthly Notices of the Royal Astronomical Society* (2017). [DOI: 10.1093/mnras/stx2515](https://doi.org/10.1093/mnras/stx2515)

Florian Kirchschrager et al. Constraints on the structure of hot exozodiacal dust belts, *Monthly Notices of the Royal Astronomical Society* (2017). [DOI: 10.1093/mnras/stx202](https://doi.org/10.1093/mnras/stx202)

Provided by Kiel University

Citation: Research team observes hot dust rings around stars in a new wavelength range (2020,

October 6) retrieved 25 April 2024 from <https://phys.org/news/2020-10-team-hot-stars-wavelength-range.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.