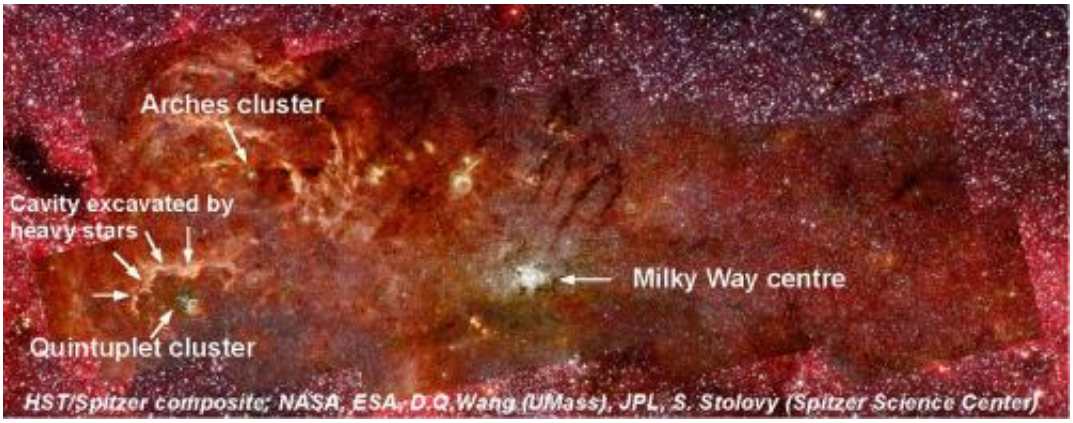
Cosmic dust discs withstand hellfire

March 10 2015



The star clusters „Arches“ and „Quintuplet“ in the centre of the Milky Way: Intense wind and radiation forces of massive stars in the Quintuplet excavated the dense gas clouds surrounding the cluster, as indicated by the arrows. The dust discs around smaller stars living in these clusters are exposed to the same harsh environment and should not survive for long periods of time. Credit: HST/Spitzer composite: NASA, ESA, D.Q. Wang (UMass), JPL, S. Stolovy (Spitzer Science Center)

A team of scientists led by astronomers at the University of Bonn discovered an unusual phenomenon in the centre of the Milky Way: They detected about 20 rotating dust and gas discs in each cluster hosting exceptionally large and hot stars. The existence of these discs in the presence of the destructive UV radiation field of their massive neighbours came as a surprise. The science team is pondering how these rotating discs are able to withstand evaporation under these extreme conditions. The results are published in the most recent edition of the

journal *Astronomy & Astrophysics*.

The centre of the Milky Way is a nursery for young stars: In its very heart, more young stars are born in dark clouds than in any other place in the Galaxy. These stars form in rich groups such as the "Quintuplet" and "Arches" clusters which were the research focus of a science team under leadership of the University of Bonn's Argelander Institute for Astronomy. Both star clusters are merely a few million years young and contain stars as massive as 100 times the mass of the Sun. "We expected that the enormous radiative energy of these giant beasts evaporate the material around their smaller neighbours in less than one million years," says Dr. Andrea Stolte of the Argelander Institute for Astronomy at the University of Bonn.

Discovery of rotating discs contradicts theories of disc survival

Together with the Max-Planck-Institute for Astronomy, the Astronomical Calculation Institute of the University of Heidelberg and US-Colleagues located in Los Angeles, Honolulu, Dearborn and Baltimore, Dr. Stolte and her PhD students at the University of Bonn discovered an unexpected number of dusty discs surrounding stars in the "Quintuplet" and "Arches" clusters. "In such a hostile environment, we did not expect to find any circumstellar discs after more than a few hundred thousand years, and yet we found more than 20 discs in each cluster at ages of a few million years," says Dr. Stolte who coordinated the project. This surprising discovery contradicts the standard theories of disc survival in stellar nurseries and hints towards unrevealed processes taking place in these rich Galactic centre clusters.

The unexpected phenomenon could be observed with the European Southern Obervatory's (ESO) Very Large Telescope (VLT) in the

Chilean Atacama desert and the Hubble Space Telescope (HST). "We would not have been able to glimpse through the dense layers of dust into the heart of the Milky Way with visual light," explains Dr. Maryam Habibi. It was the VLT's and HST's capability to capture infrared light that allowed the science team to penetrate deep into the core of our Galaxy. Dr. Habibi carried out her PhD thesis at the University of Bonn during the Emmy Noether project funded by the German Science Foundation (DFG).

Dr. Andrea Stolte (right) and Dr. Maryam Habibi of the Univeristy of Bonn's Argelander Institute for Astronomy in front of ESO's Very Large Telescope „Yepun" in Chile. Credit: Andrea Stolte/Uni Bonn

Resistibility or a continuous supply of matter?

How these rotating discs survive the hellfire of their giant neighbours is puzzling. The astronomers considered two possibilities: Either the gas and dust discs display an unprecedented resistibility to their hostile environment, or a previously unobserved mechanism recharges the discs. The solution may lie in the companion stars. When two stars circle each other, the bigger companion may provide fuel to its smaller twin, possibly refueling disc material at a rate large enough to make up for the evaporated losses caused by the intense UV radiation surrounding the couple. Dr. Stolte considers the latter theory the most likely solution: "Many unknown processes take place in these rich, young star clusters. The tight interaction and mass flow between numerous close twins observed in other star-forming environments might also be the explanation for the dusty discs we found in these massive clusters."

Uncharted territory for planetary science

An even more unexpected possibility emerges with the presence of these discs, that was not considered possible in these extreme regions of the Milky Way: If dense discs of gas and dust are capable to survive for extended periods of time in this hostile environment, they may provide the conditions for planet formation. "If their is enough material – who knows?" asks Dr. Stolte. That, however, remains speculation. One way or the other – the heart of the Milky Way offers ample opportunities for unexpected discoveries from her astronomer's perspective.

More information: "Circumstellar discs in Galactic centre clusters: Disc-bearing B-type stars in the Quintuplet and Arches clusters," *Astronomy & Astrophysics*, DOI: 10.1051/0004-6361/201424132

Provided by University of Bonn