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# **Giant bubbles discovered close to the center of the Milky Way**

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**Observatoire de Paris - PSL Centre de recherche en astronomie et  
astrophysique**

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**An international team of astronomers, including a French scientist at the Paris Observatory - PSL has discovered, using the MeerKAT radio-telescope in South Africa, one of the largest objects ever observed in the center of the Milky Way : a pair of enormous bubbles emitting radio waves. This work has been published in the September 11th 2019 issue of the journal Nature.**

MeerKAT is a radio-telescope which was inaugurated in 2018 at the South African radio-astronomical observatory (SARAO) : it is made up of 64 antennas situated in an 8km diameter area in the North Cape province in South Africa.



**Radiotélescope MeerKAT © South African Radio Astronomy Observatory**

With its help, a team of scientists led by a scientists from Oxford University has mapped huge regions in galactic center, carrying out observations at wavelengths close to 23cm.

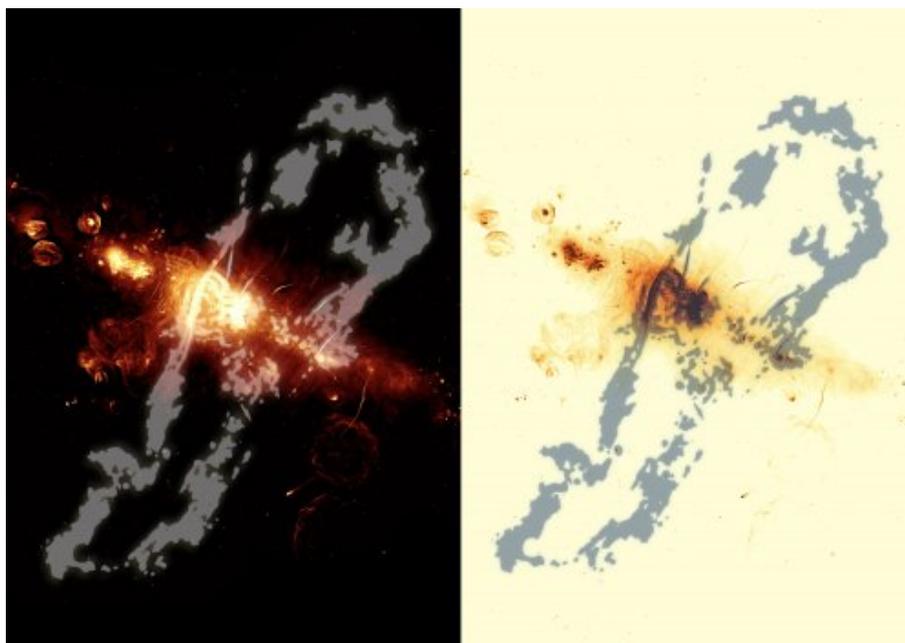
This type of radio emission is due to a mechanism referred to as synchrotron radiation, in which electrons moving at speeds close to that of light interact with magnetic fields. This leads to a characteristic radio signal which can be used to map energetic regions in space.

MeerKAT has the capacity to penetrate easily the clouds of dust which are in the galactic center, in contrast to the instruments which are used to observe this region in the visible domain.

According to Fernando Camilo of the SARAO, at the Cape in South Africa, co-author of the paper in the journal Nature "until now, these enormous bubbles were masked by the extremely intense emission of the galactic center".

### A structure not unlike that of an hour glass

The bubbles are spread over hundreds of light years above and below the center of our galaxy.



**Bulles radio observées avec le radiotélescope MeerKAT.** Image radio des parties centrales de la galaxie de la Voie lactée. Le plan de la galaxie est marqué par une série d'éléments brillants, de résidus d'explosions d'étoiles (supernovae) et de régions où de nouvelles étoiles sont en train de naître. Le trou noir au centre de la Voie Lactée est caché dans la plus brillante de ces régions étendues. Les bulles radio découvertes par MeerKAT s'étendent verticalement au-dessus et au-dessous du plan de la galaxie. De nombreux filaments magnétisés peuvent être vus parallèlement aux bulles © *South African Radio Astronomy Observatory*

According to Ian Heywood from Oxford University, leading co-author of the paper which has been published in the journal Nature, "the center of our galaxy is relatively calm compared to other galaxies which have active central black holes. Nevertheless, the Milky Way black hole can, from time to time, become exceptionally active, and brighten as it regularly devours huge masses of dust and gas. It is quite possible that this kind of feeding frenzy resulted in gigantic explosions which created this enormous structure unknown till now."

Through a study of the extent and form of the accompanying bubbles, scientists believe that they have found convincing proof that their formation is due to a violent eruption in a short period of time crossed the interstellar medium in two opposing directions.

"The shape and the symmetry of what we have observed suggests strongly that a remarkably powerful event

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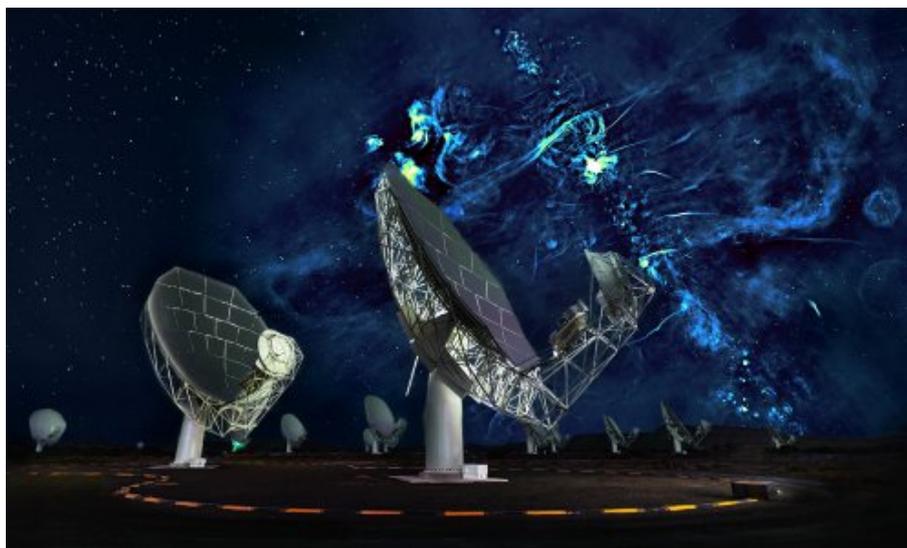
occurred a few million years ago close to the central black hole of our galaxy", claimed William Cotton, astronomer at the Charlottesville national radio astronomical observatory, in Virginia, and co-author of the paper.

This eruption was probably engendered by huge masses of interstellar gas falling onto the black hole, or by a period of intense stellar formation which sent shock waves into the galactic center. In fact, blown up bubbles in the hot ionized gas close to the galactic center, activates the latter and creates radio waves which could be detectable from the Earth.

## A mysterious region

The region surrounding the black hole at the center of our galaxy is mysterious and is very different to other regions in the Milky Way.

Very long and narrow filaments were discovered 35 years ago : such filaments have not been discovered elsewhere, and their origin is unknown. The filaments appear in the form of radio emitting structures extending over tens of light years about one light year thick.



**Montage montrant à l'arrière-plan du télescope MeerKAT, des bulles détectées dans le domaine radio.** En arrière-plan, image radio du centre de la Voie lactée marqué par une série d'éléments brillants, d'étoiles éclatées et de régions de formation de étoiles sont en train de naître. Le trou noir au centre de la Voie Lactée est dissimulé dans la plus brillante de ces régions étendues. Les bulles radio s'étendent de part et d'autre. De nombreux filaments magnétisés peuvent être vus parallèlement aux bulles.

The authors suggest that the close association of the bubbles with the filaments implies the energetic event which created the radio bubbles was also responsible for the acceleration of the electrons, required to produce the radio emission of the magnetic filaments.

The discovery of such bubbles not far from the center of our own galaxy informs us about the spectacular activity which takes place in galaxies not unlike the Milky Way, but nevertheless on much larger spatial scales in the Universe.

MeerKAT

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Installed in the Karoo desert, in South Africa, MeerKAT is the central part of the future Square Kilometer Array (SKA) which, when entirely deployed during the coming decade, will consist of 2 000 antennas in South Africa and in Australia. It will be the most powerful of its kind in the world.

The Paris Observatory, via its Nançay radio-astronomical station, is involved in the setting up and exploitation of MeerKAT.

## Reference

Inflation of 430-parsec bipolar radio bubbles in the Galactic Center by an energetic event, I. Heywood et al.