Black holes play an important part in determining how a galaxy ends up looking. For example, over two...
We have never known more about the Universe than we do today, yet there remain a number of mysteries in astrophysics that we still cannot explain.

Decades ago, it was discovered that the mass of the central black hole is related to the number of stars in a galactic bulge, the central part of a galaxy, yet the reasons for this link are still not fully understood.

In a paper in 2012, Dr Hlavacek-Larrondo and a team of astronomers looked at the jets coming from supermassive black holes in galaxies located at the centers of galaxy clusters, more distant than ever before. The paper found the black holes in these galaxy clusters formed relatively early in the history of the Universe and have been the same for billions of years. “My major contributions have been to study black hole feedback in the most distant clusters, more distant than ever before. The new images showed the jets from the black hole at the center of the cluster were helping to shape the galaxy through its host galaxy, but it was able to reach and plough through a neighboring galaxy.

For example, in 2017 she was author of a paper that presented clearer images of the Perseus galaxy cluster (see top left image), more than 250 million light-years from Earth, which revealed new features astronomers had not seen before. At the centre of the cluster, there is a pool of extremely fast particles that emit radio waves, a structure known as a mini halo.

The halo was the largest ever seen, more than 1.3 million light-years in diameter. At these distances away from the central particle, particles are expected to stop producing radio waves, so the observations were a bit of a mystery. The new images showed the jets from the black hole at the centre of the cluster were helping to keep the particles producing radio waves, by giving them a kick of energy. This helped to solve the mystery as to why the halo was so large and provided more insight into the way black holes can affect the structure of the clusters of galaxies they inhabit.

WOMEN IN SCIENCE

While studying black holes is her main passion, Dr Hlavacek-Larrondo also feels strongly about increasing diversity in science. She is half-Chilean and half-Tcheque, was born in Calgary, Canada but raised in Montreal. As a young girl, Dr Hlavacek-Larrondo was never exposed to the false belief that science was not for girls; her mother was a scientist herself. “Having been raised by two extraordinary women, my mother and grandmother, I have always believed that women and men can contribute equally to science,” says Dr Hlavacek-Larrondo.

“I think this is a key reason that led me to science.”

Q&A

How do you think your upbringing influenced your career as a scientist?

Growing up, I had not realised the importance that mentors can have in your life and in the decisions you take. Now, looking back, I realise that I probably would not have been able to accomplish so much without their constant support. My mother and grandmother – the most important mentors in my life – taught me two very important things that I continue to apply every day and that no doubt had a very important influence in my career: always work very hard, and especially, don’t be afraid to seize opportunities.

Was there a moment when you realised black holes would be a fascination throughout your career?

Yes and no. The extreme Universe has always fascinated me, extraterrestrial around neutron stars and black holes, the mysterious (and still unknown) nature of dark matter, etc. So yes, in a way, I always knew I wanted to study objects like black holes. However, it was during my undergraduate studies in physics that I started to realise just how fascinating black holes were. In particular, I remember reading a press release about a black hole so powerful that its jet was not only able to pierce through its host galaxy, but that it was able to reach and plough through a neighboring galaxy.

To what extent do the different categorisations of galaxies (elliptical, irregular, spiral-armed, barred etc.) depend on the presence and nature of their central black hole? Actually, not that much. We are pretty certain that every elliptical galaxy hosts a supermassive black hole at its centre, and that this black hole plays a fundamental role in shaping its properties. However, spiral-arms, bars, etc. are thought to be caused by interactions of the galaxy with, for example, a small neighbouring galaxy. This causes instabilities that eventually lead to the creation of spiral-arms, bars, irregular morphologies, so not related to the black hole.

Do you think there’s any hope of ever understanding what lies beyond the event horizon of a black hole? I sure hope so. For now, our understanding of physics is not good enough to describe what goes on inside the event horizon, but maybe one day it will be good enough. And hopefully, it will be a woman who makes this discovery hehe!

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“I think this is a key reason that led me to science.”

CONTACT

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RESEARCH OBJECTIVES

Dr Hlavacek-Larrondo’s work aims to understand the role that supermassive black holes play in the formation and evolution of galaxies.