

The physics of everything

The astrophysicist Kevin Schawinski wants to find out how galaxies with habitable planets have developed since the Big Bang. *By Christian Weber*

What do you do if you're supposed to be looking at a million galaxies, but you're actually still planning to do other things with your life? Whilst still a 26-year-old doctoral student at the University of Oxford, the astrophysicist Kevin Schawinski from Zurich had an idea that was as simple as it was brilliant. He organised a few hundred thousand helpers to do the work for him, free of charge and in their free time.

That was the story that first got Schawinski the attention of the media. He is 36 today and teaches at ETH Zurich. He is one of the founders of Galaxy Zoo, one of the very first citizen-science projects in which amateurs help the experts. Back then, Schawinski had the task of classifying galaxies: Was this or that galaxy a spiral galaxy or a barred spiral galaxy? Or a star cluster? Or a new form altogether? After a week, he'd only managed 50,000 galaxies and had had enough. When he was out having a beer with a colleague, he stumbled on the idea of setting up the website galaxyzoo.org, where anyone can categorise galaxies with the click of a mouse. After just one day, his volunteers were classifying 70,000 galaxies per hour. Today, more than 350,000 citizen scientists are working on Galaxy Zoo.

"The most important thing in science is creativity", says Schawinski. And he doesn't just mean the intuition of the researcher, but specifically an openness to all kinds of new approaches and methods, including looking at other disciplines. Such mental flexibility is probably the reason why Schawinski's career has been so meteoric.

Success, 21st century style

He sits in his small, glass-walled office on ETH's Honggerberg Campus. A toy robot - NP5357 - looks down on him from the bookshelf. An art book lies on his coffee table, along with a book on free will by the US author Sam Harris. "A great book!", says Schawinski, insisting that "it's really, really important to have broad interests: philosophy, neurosciences, computer sciences, politics, business! I always tell my students: they have to get to grips with such things too, if they want to have success in the 21st century".

Schawinski's manner is dry, but there's emotion in his voice when he answers a question about the sublimity of the starry sky: "I don't have so much of a sensual connection to the heavens". Nor is he overly impressed by the dimensions of the cosmos: "You get used to it". He once told the New York Times that he'd be able to find the moon and the constellation of Orion, but probably not much more.

It's elsewhere that Schawinski's passion lies. "I'm fascinated by the natural laws behind everything", he cries. "I want to use the laws of physics to explain how a tiny quantum fluctuation after the Big Bang turned into a galaxy with habitable planets".

This astrophysicist is especially interested in the role of black holes, which - as we know today - lie at the heart of every galaxy and are between 10,000 and several billion times heavier than our Sun. They develop such gravitational powers that they don't let out any light at all. If the Earth were a black hole, its mass would be concentrated in the form of a marble less than a centimetre in diameter.

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Schawinski suspects that black holes played a vital role in the evolution of the universe. But precisely what role they played is still anyone's guess. Nevertheless, he is excited about the current 'golden era of astrophysics' - ours is a time in which every new telescope is discovering "completely new phenomena". The age of the universe has meanwhile been calculated to be 13.81 billion years exactly; and in Schawinski's opinion, the existence of dark matter has also been confirmed. His own team is currently developing new approaches to the problem of black holes.

Telescopes or computers?

A fundamental insight is that extremely different timescales are relevant in the universe. For example, 100 million years can be a normal timespan for a significant change to take place in a whole galaxy. In a quasar, on the other hand, only 100,000 years are needed to bring forth something relevant. "The question is now how we are going to link all this together and incorporate it in our models", says Schawinski. And also, of course, how to get measurement data at all for such vast timespans.

"We develop a model and then look to see where it functions and where it doesn't", he explains. And you can observe the echoes of past events - after all, the light from the central quasar in the Milky Way takes several tens of thousands of years to reach the Earth. Schawinski is looking forward to the launch of the James Webb Space Telescope

(JWST) in 2018, which should enable us to look even further back into the past. "It will trigger a scientific revolution".

Schawinski does see the problems that such projects raise. "The cost of the JWST is already nearly nine billion dollars, so of course we've got to justify that". Kevin Schawinski is doing his best to convince the general public of the significance and fascination of his discipline - he appears at science festivals, makes YouTube videos, and meanwhile has 22,500 tweets on Twitter.

All the same, he knows that even astrophysics can't rely simply on ever bigger, more expensive telescopes. He himself is focussing on collaborations with computer scientists. In future, the neuronal networks of artificial intelligence (AI) will be used to analyse data and categorise galaxies (see 'Augmented science', p. 13 above). But what about the enthusiastic hobby astronomers on Galaxy Zoo? "We still need them", Schawinski assures us. They could start creating training maps for Deep Mind computers - in other words, they could catalogue small groups of galaxies from which the AI image recognition programs would learn, so that these could ultimately carry out the same work on an automated basis. "This way, we'll be able to catalogue billions of galaxies in future".

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A meteoric Anglo-American career

The astrophysicist Kevin Schawinski, 36, was born in Zurich. He is the son of the radio pioneer and media entrepreneur Roger Schawinski. He studied physics and mathematics at Cornell University in Ithaca, USA, and took his doctorate in astrophysics at Christ Church at the University of Oxford, UK. After a research visit to the University of Yale, USA, he was appointed to an SNSF professorship at ETH Zurich in 2012.