



**Key words:**Cutting Edge Astronomy, major science questions

<p><b>ESOCast Episode 194: Cutting Edge of Contemporary Astronomy</b></p>	
<p><b>00:00</b>  <b>[Visual starts]</b>  <b>[Narrator]</b>          1. Our Universe is full of mysteries. Astronomers have always tried to decipher the night sky and gain a better understanding of the cosmos. But what are the hottest topics right now in astronomy?</p>	<p><b>00:00</b></p>
<p><b>00:00</b>  <b>New ESOCast intro</b></p>	<p><b>00:00</b>          New ESOCast introduction</p>
<p><b>00:00</b>  <b>[Narrator]</b>          2. Every night, telescopes like ESO's are used to investigate a host of astronomical mysteries. We asked astronomers to identify some of the most exciting questions in cutting-edge astronomy.</p>	
<p><b>00:00</b>  <b>[Narrator]</b>          3. These scientists are part of the team who review thousands of observing proposals every year. They make sure that only the most interesting science is done with ESO's telescopes.</p>	
<p><b>00:00</b>  <b>Statement</b>          4. <i>“One of the major science questions at the moment in cosmology is trying to understand the dark side of our Universe. We know that there are two entities on the dark side: something called dark matter, which is a strong gravitational force in our Universe, and something called dark energy, which is</i></p>	<p>Text slate: Catherine Heymans          Astronomer, University of Edinburgh</p>

*mysteriously causing the expansion of our Universe to get faster and faster each and every day. Now, if we want to understand these dark components of the Universe, then what we have to do is to take really large surveys of the sky to really map out where the dark matter is and really constrain how dark energy is changing, how those structures of dark matter evolve with time.*

*On the more, sort of, galaxies side, one of the big new science areas that has been coming out is a really exciting science case that looks at very distant quasars. Now it looks at the light from these distant quasars, and as that light travels towards us on Earth, it gets absorbed by some of the clumps of gas and stuff that's in between us and them. And so they can use these observations to map out where all of the gas is in our Universe between us and those quasars. This is a really newly-emerging field where you can use this information to look at how that gas is moving and how it's funnelling in and feeding galaxies and creating new stars.”*

**00:00**

**[Narrator]**

5. These distant quasars can also be used to understand an era in the very early Universe — an era known as reionization.

**00:00**

**Statement**

6. *“The Universe nowadays is ionized since almost the beginning of the Universe with the Big Bang. After the Big Bang there was a period of neutral Universe, we call it the dark times, and after that the reionization started. And we don't know very well what produced that reionization. It can be quasars, it can be galaxies. So, many teams are devoted to that kind of science. Another hot topic is: what is the life cycle of a galaxy? A galaxy is formed by gas which accretes gravitationally into a potential well. But then you may ask the question how do the metals, the heavy*

Text slate: Sebastian Lopez  
Astronomer, University of Chile

<p><i>elements that we see in the circumgalactic medium and perhaps also in the intergalactic medium, get there? How are these metals transported back from the galaxy to the surroundings of the galaxies?"</i></p>	
<p><b>00:00</b>  <b>[Narrator]</b>  7. Galaxies aren't the only structures we don't yet fully understand. Astronomers are also investigating globular clusters: spherical groups of stars which orbit the cores of galaxies.</p>	
<p><b>00:00</b>  <b>Statement</b>  8. <i>"Globular clusters were thought to be all very monotonic, all the same types of stars, born at the same time with the same metallicity, living the same life. But it turns out, in fact, there are multiple populations of stars, which means they were either born at different times, or they lived a slightly different life, or maybe they came in from the outside, and so trying to understand this process, that's a lot of proposals on this particular subject at the moment. There's also a lot of interesting proposals on what are called transient objects, which are objects that go off, and then that's it — and you want to catch them when they go off. There are proposals which are trying to look for candidates, to see them, to see where they are and then when they go off you know what they were before. And some of these transients they go off and they have an afterglow. And you want to be able to catch these with different sorts of instrumentation to find out what's happening to them afterwards, because then you can figure out what they are."</i></p>	<p>Text slate: Katrina Exter  Astronomer, VLIZ</p>
<p><b>00:00</b>  <b>[Narrator]</b>  9. A particularly interesting type of transient event is supernovae. These dazzling explosions can fade from view after only a matter of weeks — but which stars do they</p>	

originate from?	
<p><b>00:00</b> <b>Statement</b></p> <p>10. <i>“Supernova type 1a progenitor! It’s a kind of supernova which are important because astronomers believe that the energy produced during such an event is more or less the same for all of them, so they are used in cosmology as standard candles. We know how big is the Universe, how it evolves, we know all this by using these objects as these distance calibrators. These objects provide this information, but yet, we don’t know their progenitors. We have never seen a star which has erupted as such as supernova before the eruption. That’s something which people are very interested in, and we hunt for them.”</i></p>	<p>Text slate: Joanna Mikolajewska Astronomer, Astronomical Center of Polish Academy of Sciences, Warsaw</p>
<p><b>00:00</b> <b>[Narrator]</b></p> <p>11. Supernovae aren’t the only mysterious objects in our Universe — in fact, more and more are being discovered.</p>	
<p><b>00:00</b> <b>Statement</b></p> <p>12. <i>“There are a number of very interesting topics that people are trying to pursue at the moment. Some deal with the supermassive black holes that reside in the galaxy — in the centre of galaxies, and how they connect with the rest of the galaxy. Others are about very small and very faint galaxies, that we actually discovered only a few years ago that they exist and just trying to get their properties is a very difficult and challenging task. There are also proposals to deal with things that we’ve known for many years, but the explanation of the physical processes that are happening is eluding us.”</i></p>	<p>Text slate: Davor Krajnović Astronomer, Leibniz-Institute for Astrophysics Potsdam (AIP)</p>
<p><b>00:00</b> <b>[Narrator]</b></p> <p>13. Many astronomers are also excited about what we will discover much closer to home.</p>	

<p><b>00:00</b> <b>Statement</b></p> <p>14. <i>"I think the hot science is really in the field of extrasolar planets, in particular observations. There are two things happening with them. The first is observations through either direct or indirect means of smaller and smaller planets around dimmer and dimmer stars, you know, so you're looking, we're on the hunt now really for Earth-like planets around Solar-type stars as well as red dwarfs, right? And then also at the same time, we have the capability now at ESO to really actually study their atmospheres directly, right? Which is absolutely mind-boggling."</i></p>	<p>Text slate: Subhanjoy Mohanty Astronomer, Imperial College London</p>
<p><b>00:00</b> <b>[Narrator]</b></p> <p>15. These topics are being investigated by astronomers around the globe using world-class facilities like ESO's. Their findings will deepen our understanding of the Universe.</p>	
<p><b>00:00</b> <b>[Outro]</b></p>	<p><i>Produced by ESO, the European Southern Observatory. Reaching new heights in Astronomy.</i></p>