





ESOcast Episode 69: Revolutionary ALMA Image Reveals Planetary Genesis	
<p>00:00</p> <p>1. A new ALMA image has revealed extraordinarily fine detail that has never been seen before in the planet-forming disc around a young star.</p> <p>These are the first observations that have used ALMA with its antennas at almost their maximum extent. This has resulted in the sharpest picture ever made at submillimetre wavelengths.</p> <p>The new results are a huge step forward in the observation of how protoplanetary discs develop and how planets form.</p>	 <p>ALMA footage Zoom-in at HL Tauri region</p> <p>ALMA footage</p>
<p>00:43</p> <p>ESOcast intro</p> <p>2. This is the ESOcast! Cutting-edge science and life behind the scenes at ESO, the European Southern Observatory.</p>	 <p>ESOcast introduction</p>

01:01

[Narrator]

3. ALMA, the Atacama Large Millimeter/submillimeter Array is the world's most powerful telescope for observing the cold Universe.

It consists of 66 high-precision antennas that can be placed in different configurations.

For the first time, the ALMA array has now been configured with the antennas up to 15 kilometres apart. This is close to the maximum possible baseline of 16 kilometres and allows ALMA to discern much finer detail than has been possible up to now.



ALMA footage

ALMA animation showing large configuration

01:46

[Narrator]

4. For ALMA's first observations in this powerful new mode, researchers pointed the antennas at HL Tauri — a young star about 450 light-years away, which is surrounded by a dusty disc.

The resulting image exceeds all expectations and is sharper than images routinely obtained by the NASA/ESA Hubble Space Telescope.



HL Tauri zoom

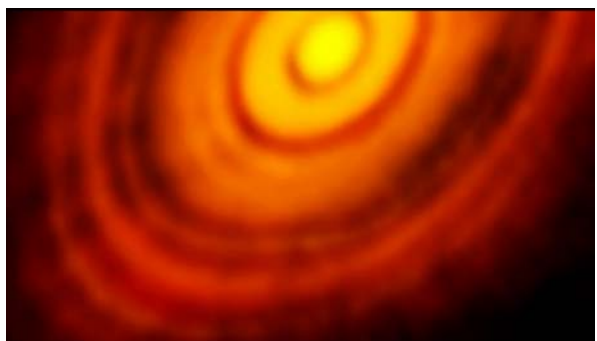
02:18

[Narrator]

5. It reveals unexpected fine detail in the HL Tauri protoplanetary disc, which consists of material leftover from the birth of the star.

The image shows a series of concentric bright rings with enigmatic dark patches.

These structures are clear signs of the presence of multiple planets, as they sweep up material from the disc.



Annotated ALMA image of protoplanetary disc

HL Tauri animation

02:53

[Narrator]

6. HL Tauri's disc appears to be a lot more developed than would be expected from the age of the system. This suggests that the process of planet formation may be faster than previously thought.



HL Tauri animation

03:10

[Narrator]

7. Young stars like HL Tauri are born in clouds of gas and fine dust, in regions which have collapsed under the effects of gravity.

Dense hot cores form and eventually ignite to become young stars. These baby stars are initially cocooned in the remaining gas and dust, which eventually settles into a protoplanetary disc.



Animations of star forming regions

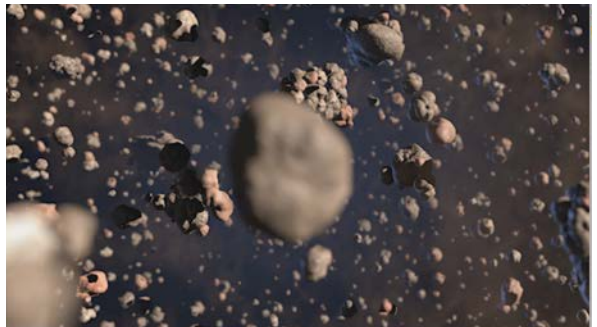
Protoplanetary discs animation

03:40

[Narrator]

8. Through many collisions the dust particles will stick together, growing into clumps the size of sand grains and pebbles. And ultimately, asteroids, comets and even planets can form in the disc.

The young planets will then disrupt the disc and create rings, gaps and holes such as those structures now observed by ALMA.



Computer animation of young planetary system

HL Tauri computer animation

04:09

[Narrator]

8. The investigation of these protoplanetary discs is essential to our understanding of how Earth formed in the Solar System.

Observing the first stages of planet formation around HL Tauri may show us how our own planetary system may have looked during its formation more than four billion years ago.



Protoplanetary disc animation

HL Tauri zoom

04:33

[Narrator]

9. By operating in its close to final configuration, ALMA has demonstrated its enormous observational potential. This starts a new era in our exploration of how stars and planets form.



ALMA footage

04:56

[Outro]

ESOCast is produced by ESO, the European Southern Observatory.

ESO, the European Southern Observatory, is the pre-eminent intergovernmental science and technology organisation in astronomy designing, constructing and operating the world's most advanced ground-based telescopes.

The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership of Europe, North America and East Asia in cooperation with the Republic of Chile.