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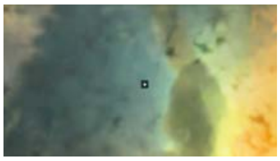
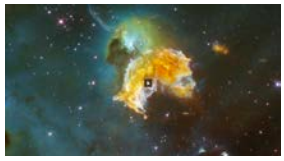
Hubblecast Episode 64: It All Ends with a Bang! — *The incineration of Dr. J*		
00:00 [Narrator] 1. Most stars in the Universe are small and insignificant, and they will – eventually – fizzle out without much drama. But a few light up the sky when they die. And in the process, they don't just tell us about the lives of stars: they create the building blocks of life, and help us to unravel the whole history of the Universe.		
00:30 [Hubblecast intro]		
00:58 [Dr J] 2. There are perhaps 200 billion stars in our galaxy, the Milky Way, although nobody really knows exactly how many.		
01:10 [Narrator] 3. One thing that is known, though, is that a tiny fraction of these stars has a disproportionate effect on the rest of the galaxy. Similar stars in other galaxies have taught us much of what we know about the evolution of the Universe. They are the stars that end their lives as supernovae – a topic in astronomy to which Hubble has made great contributions since it was launched in 1990.		
01:38 [Dr J] 4. Supernovae come in two broad categories. Now to understand what's going on in the first category, you have to realise that a star is actually a very finely balanced thing. The pressure from the nuclear reactions at the centre of the star is balanced by the star's gravity. Now when a really massive star runs out of nuclear fuel, the pressure in the centre drops dramatically and the star collapses in on itself, and then explodes. The other type of supernova involves white dwarf stars, which are remnants of stars like our own Sun. Now normally, a white dwarf is a pretty stable thing. But, if one lies close to another star it can actually pull		 

matter off its neighbour, thereby gradually increasing its mass… until finally… it reaches the critical mass… for a thermonuclear… explosion!		
02:39 [Narrator] 5. Supernovae are rare — a galaxy like ours can only expect a few every century. The last one to be seen in the Milky Way was in 1604, observed by the great astronomer Johannes Kepler, a few years before the invention of the telescope.		
03:02 [Dr J] 6. Now we know that since then, a number of supernovae events have taken place in the Milky Way, because we can see the debris left behind by the explosions. But we never got to see the explosions themselves, because they were shrouded by dust at the time. And so the fact remains that no supernova inside the Milky Way has been directly observed since the invention of the telescope. Instead of just sitting around and waiting for one, astronomers have decided to increase their odds by widening the search far beyond our own galaxy. And since we're talking about a very small and distant phenomenon, we need a telescope that can deliver extremely precise images — a telescope like Hubble.		
03:51 [Narrator] 7. The most famous supernova that Hubble has directly observed came with the death of a giant star in the Large Magellanic Cloud. The light from the initial blast first reached Earth in 1987, a few years before Hubble's launch. But Hubble's images of the evolving supernova over the quarter of a century since then have become the gold standard for understanding this event. Astronomers have been able to study the complex explosion in great detail, showing how the shock from the exploding star is interacting with the gas that surrounds the star, making it light up.		
04:37 [Dr J] 8. More distant supernovae can't be observed in the same kind of detail as 1987A, but Hubble is still a great help. For example, because Hubble has been in orbit for more than 20 years now, astronomers have been able to make before-and-after images of galaxies which allows them to search for the progenitors of supernovae. Now these kinds of observations potentially tell us a lot about the conditions of the progenitors just prior to the explosion.		
05:09 [Narrator] 9. As well as telling us about the star that has just died, supernovae are powerful tools for probing the cosmos. The supernovae that come from exploding white dwarfs have a peculiar property: they all have the same intrinsic brightness. This means that how bright they appear to a telescope is a measure of how distant they are, much like a street light looks bright when you are near it, and dim when you are far away.		

05:54 [Dr J] 10. Supernovae are extremely bright. In fact, they are so bright that they usually outshine their entire host galaxies. And that is why it's relatively easy to detect them, even out to large cosmological distances. In 2011, the Nobel Prize in Physics was awarded to two teams that measured the brightness of many supernovae to map out their distances. And what they found was that the faraway supernovae were surprisingly faint, which could only mean that they were even more distant than expected. Now we already knew that the Universe was expanding, but what this research proved was that the expansion is in fact accelerating — and that came as a complete surprise.		
06:42 [Dr J] 11. Now this is really cutting-edge science, and astronomers continue to study distant supernovae to better understand the expansion of the cosmos. And Hubble plays a big part in this game. It just recently hit another milestone when it spotted the most distant supernova yet discovered of this type. It is so far away that its light has taken more than 9 billion years to reach us — that's about two thirds the age of the Universe.		
07:15 [Narrator] 12. Closer to home, Hubble has played a big role in imaging the wreckage left behind by supernovae. Even though a supernova is only bright for a short period of time, and its shockwaves only propagate visibly for a few years, the dusty clouds left over can last for millennia. Their effect on the surrounding interstellar gas lasts even longer. And that means that although no supernovae in our galaxy have ever been observed with any telescope, plenty of supernova remnants have been. Hubble's sharp images of their complex structures help to chart the processes involved in their violent formation.		 
08:07 [Dr J] 13. What's more, the clouds of debris are an important reminder of the huge role that supernovae play in shaping everything around us. Nuclear reactions inside stars and in these explosions are the source of most of the elements found in nature, including the carbon in our bodies, the oxygen we breathe, and the iron and silicon in the planet we live on. And so although they tell us a lot about the past and future expansion of the Universe, supernovae also teach us something even more profound: they literally tell us where we come from. This is Dr J signing off for the Hubblecast. Once again, nature has surprised us beyond our wildest imagination.		 

End
[08:55]