DARK

20mins

Fulldome Format 4k

Script by:

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Dark Script Final (transcript)

Shot	Video	Audio
	SCENE 1: INTRO - Alan on Beach	
1.1		Dr Alan Duffy, (Title: Research Associate International Centre for Radio Astronomy Research (ICRAR) Perth Western Australia)) ALAN VO I'm an Astronomer, and I'm looking for something that is very hard to find. Imagine trying to search for something that you can't see. You don't know what it looks like, what it's made of, or where it is. But you do know that nearly 80% of the mass of the universe is made of it. Now that's a real problem. At least we've been able to name it - it's called 'Dark Matter' One way scientists investigate the natural world is to look for patterns. Now we can discern patterns across a range of scales. From the foam on this beach, to the stars above us. From something very small, local and intimate - to something across the very distant cosmos.

	SCENE 2: MILKY WAY	
2.1		ALAN VO One way we might understand Dark Matter is by the effects it has upon the patterns of normal matter around us. - the stuff that we, our planet, the stars and galaxies are made of. We can't observe it directly, but we can infer its existence - by looking for subtle hints of its presence. If we are to learn about Dark Matter, firstly we need to understand galaxies.
2:1		ALAN VO The long pale strip of light across the sky is our galaxy, the Milky Way. The Milky Way is like a giant disk, made out of stars. Our sun lies at the edge of the disk, which is why we see a thin band of light completely surrounding us. Dotted along the arms are red points of light - these are the birthplaces of millions of stars, shrouded in a thick layer of dust - which to us appears red. The blue regions show young stars which have since blown away the gas clouds that surrounded them by the strength of their stellar-winds. The dark material lying along the arms are other regions of dust and gas - which have not yet formed stars. So what triggers star formation in the galaxy? The answer is gravity. But often these processes are hidden from us by the gas and dust itself. So how’re we going to to see them?

	SCENE 3: HOLODECK	
3:1		ALAN VO Have you ever been lost in the fog? The fog blocks visible light, which makes it very difficult for you to see through it. Astronomers have the same challenge when they try and look at galaxies. They try and look through the gas the galaxies are made of, to try and determine the inner structure of the galaxy, as well as all the other hidden processes, such as the formation of our Sun and the formation of the stars. When you're in the car in the fog - you can still hear the car-radio play, even when you can't see through the windscreen. This means that radio waves can be detected even when visible light cannot. So astronomers use radio telescopes to peer through this thick gas and make unique observations that visible telescopes can't. We can look at the skies above in all of these different wavelengths - we can reveal all of these different structures in our universe.

	SCENE 4: Parkes	
4:1		ALAN VO This is the Parkes radio telescope in Australia, nearly 400 kilometres West of Sydney. Radio waves have a longer wavelength than visible light - which means that to get the same level of detail, radio telescopes have to be larger than optical instruments. For instance, the Parkes dish is 64 metres across - but your eye can still see details 10 times finer! We need something bigger.

	SCENE 5: ASKAP: Australian SKA Pathfinder	
5:1		ALAN VO In Western Australia, a new telescope called the Australian Square Kilometer Array Pathfinder - is under construction. With 36 dishes spread over 6 kilometres, this instrument will see details 100 times finer than the Parkes telescope. Yet what really sets ASKAP apart are the Australian-built phased array feeds sitting at the focus of the dish. These are the eyes of the telescope, able to view 30 times more of the sky in a single snapshot than a standard receiver. Similar to your digital camera - they can take in light (in this case radio waves) and create digital images. This happens across all the dishes and we can later add them together using a supercomputer, to form a giant virtual telescope. Because of this ground-breaking technology, ASKAP will be able to survey the sky 10 times faster than Parkes - making it amongst the most powerful radio telescopes ever built, capable of viewing more of the Universe, - faster, than ever before - creating an unprecedented wealth of data. To help make sense of all this information, as well as guide the design of such a groundbreaking telescope, astronomers create simulations of the Universe inside supercomputers.

	SCENE 6: ALAN and the supercomputer	
6:1		ALAN VO As astronomers we are in a different position to other scientists. We can't perform repeatable experiments on distant galaxies - we couldn't have them collide in a different way. What we do have is a series of stunning images, these snapshots in time, of - stars forming and galaxies colliding and we can use those to try and infer what's going on underneath. to do that, we use powerful supercomputers just like this one to simulate the stars and even entire galaxies This gives astronomers a kind of laboratory in which they can test their physical theories and observe galaxies colliding in as many different ways as they want, over and over again.
	SCENE 7: GIMIC	
7:1	GIMIC rotate	ALAN VO In the real world we can only see a snapshot of any galaxy at a single point in a lifecycle lasting billions of years. But computer simulations can make a movie of how galaxies evolve over time. This helps us to link together observations and theory - to form a bigger picture of galaxy formation.

7:2	GIMIC Evolve	This is an example of a simulated galaxy, which is forming from gas that cooled after the Big Bang, the point at which the Universe began.
	SCENE 8: GALACTIC SPIN	
8:1		ALAN VO Giant galaxies take hundreds of millions of years to rotate. If we calculate the gravity of all the visible material in a galaxy - they shouldn’t rotate as fast as they do. In fact, they spin so fast - all the stars in the galaxy should be flung into space - the galaxy should disintegrate. This can only mean that there's a huge unseen amount of material providing the extra gravitational force, keeping it all together. This unseen material is Dark Matter.

	SCENE 9: KINETIC	
9:1		ALAN VO But, we can only indirectly detect Dark Matter through its gravitational effects on the gas and stars. In computer simulations, however, we know exactly where the Dark Matter, gas and stars are, because we put them there! This can aid astronomers in understanding how Dark Matter causes galaxies to form and stay together.
	SCENE 10: Dark Matter Filaments	
10:1	Cosmic Web/ Spiderweb	The Dark Matter extends beyond just the galaxies. We think it is connected into long strings, or filaments, that stretch across the Universe. Just like morning dew is found on a spider web in the back garden, our simulations show the galaxies dotted along the Cosmic Web, the Dark Matter Cosmic Web. Except this web is many millions of light years across... It’s enormous.

	SCENE 11: COSMOS	
11:1	COSMOS	ALAN VO This simulation represents a small region of the Universe, 600 million light years across. The simulation begins just after the Big Bang. Everything starts off smooth, but tiny quantum mechanical fluctuations cause some regions to be slightly denser than others - regions that will collapse under their own gravity, forming the seeds of modern day galaxies. So, we can see, Dark Matter forms into enormous filaments along which the galaxies are strung.

11:2	COSMOS	ALAN VO The Australian Square Kilometer Array Pathfinder telescope will not only see the fine details of individual galaxies, but also reveal their place along the Cosmic Web. The telescope surveys a much larger volume than this simulation alone. - but remember that the galaxies are what we see, not the Dark matter. Observers use these simulations to help them play a 'cosmic game' of 'join the dots', linking galaxies together to learn about the underlying Dark Matter filaments.

	SCENE 12: ASKAP finale -	
12:1		ALAN VO We've used some of the largest supercomputers in Australia to follow the formation of a galaxy from the Big Bang until now. But this is only a model. To see what's actually happening we need the futuristic ASKAP Telescope. The first 24 of the dishes are already onsite in the Murchison Radio-Astronomy Observatory, in Western Australia. It's already taking data. And we're already analysing it - at the International Centre for Radio Astronomy Research in Perth. ASKAP will help us to answer some fundamental questions - what are the hidden processes by which stars form? - are there organic molecules in the atmospheres of exoplanets - Why are galaxies distributed across the Cosmic Web? and the greatest puzzle of all - what is the nature of Dark Matter? this mysterious substance that makes up 80% of all the mass in the universe
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