

Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *Cheap Astronomy: Live in Cape Canaveral*.

So, first some geography. Most of what you might think of as Cape Canaveral – that is, Kennedy Space Center – is really Merritt Island. Most of the early NASA missions, like Mercury and Gemini, did actually launch from Cape Canaveral Air Force Station, but Kennedy Space Center was built as a civilian space center, adjacent to, but well beyond the perimeter of the air force station. So, NASA central is more in the general vicinity of Cape Canaveral than actually on it.

While there's a whole bunch of stuff to do at Kennedy Space Center Visitor Complex, most people advise you should get on the queue for the bus tour early in the day. If you only go to Kennedy for 1 day, I did 3, then you should just do the standard bus tour, which is included in the Visitors Complex admission cost. Just the standard bus tour is still pretty good and covers all the main attractions. For an extra \$25, I also did the Launch Control Centre tour – which gets you inside the launch control room, something that may no longer be possible once they recommence launching humans from the Cape, which might happen as early as 2018. For now though, Launch Control is mostly standing idle – and has been since the last shuttle launch, STS 135 in 2011.

I also did the Kennedy Space Center Explore tour, which is largely an enhancement of the standard and free bus tour – where you even closer to the main attractions and you're also allowed to get out of the bus to take some photos. The main attractions of any bus tour include the VAB – the Vehicle Assembly Building and pads 39 A and 39B, which is where all the Apollo and Space Shuttle missions launched from.

The VAB was, for a time, the biggest volume-holding building in the world and it still remains the biggest single-storey building in the world. It's just a bit taller than a Saturn V rocket – which is what it was built for, although 135 space shuttle stacks were subsequently assembled in it too. Since the last shuttle launch in 2011, it's mostly been sitting idle, although work is underway now to refit it for construction of the next generation Space Launch System, or SLS, rockets.

Leading out of the side doors of the VAB is the crawl-way. This is a roadway for the crawlers, huge machines straight out of the Thunderbirds which carry rockets and their payloads from the VAB to pads 39 A or B. We were also shown the mobile launch platform that is waiting for the yet-to-built SLS rocket to be built on. When that happens, the platform will be taken into the VAB atop a crawler and the SLS rocket will be built onto the platform. Then the whole thing – the rocket, its payload, the launch platform and the crawler – will crawl out of the VAB along 2 kilometres of crawl-way to pad 39B, before being prepared for launch – all of which might happen as early as 2018 for an unpiloted test launch of the SLS, with an Orion capsule on top.

The reason why these pads are numbered 39 is all about the history of US spaceflight. As we covered earlier, Kennedy Space Centre lies adjacent to Cape Canaveral Air Force Station – which is where most of the lower-numbered pads are – and there's also launch pads 40 and above at the air force station. So, launch pads 39 A and B were the just the next ones in line after pad 38 was established. Pads 39 A and B are special because both can be reached by crawl-ways from the VAB and both are in line-of-sight of Kennedy Space Centre Launch Control – which was established to oversee the Apollo launches and subsequently oversaw all the Shuttle program launches.

The first ever Saturn V launch – the uncrewed Apollo 4 launched from 39A and was followed by all the crewed Apollo missions, apart from Apollo 10 which launched from 39B – and the final Apollo launch, the Apollo-Soyuz Test Project in 1975, also launched from pad 39B. The first shuttle flight STS1 launched from 39 A, although subsequent shuttle flights were then shared between pads A and B. The only-ever Constellation program rocket, the Ares 1-X, also launched from pad 39B in 2009.

With the end of the Shuttle era, NASA leased pad 39A to Space X for 20 years, starting from 2014. Space X are yet to use pad 39A to launch anything – for now the lease seems mostly a statement of intent that they are getting into the crewed space mission business and Space X remains hopeful of a first launch of their Dragon V2 capsule, atop a Falcon heavy rocket in 2018. Space X has no immediate plans to use the VAB – they have their own *horizontal* assembly building on site, right next to pad 39A.

Anyhow, having taken all this in, on either the standard free bus tour or the extra paid bus tours, you get dropped off at the Saturn V center – which houses a Saturn V rocket that was never launched. Now housed in its own building, this Saturn V somehow doesn't seem quite as impressive as when I last saw it about twenty five years ago – when it was outside in the weather and the bus had to drive *around* it. Nonetheless, at the new center, you get to gaze up at the horizontally-positioned rocket, which is raised off the floor – and then proceed through the inevitable gift shop to catch a return bus back to the visitor complex.

Of course, there is a whole bunch of stuff to do at the visitor complex – that – along with the bus tour easily fills out a whole day. The only thing I skipped was *Lunch with an Astronaut* – which hardly mattered since there's free astronaut talks at the visitor complex anyway – which were delivered by the same astronaut (Tom Jones), just without the lunch.

Also included in the visitor complex admission cost are two IMAX movies – I saw *Journey to Space 3D* and *A Beautiful Planet 3D* – the second featuring Samantha Cristoforetti, excuse me a moment... These 3D IMAX shows really do give you great views from space and of course there's the science – ah, the science.

The Journey to Space movie wasn't bad though. It provides a bit of shuttle history followed by the latest plans for going to Mars. Indeed, going to Mars was the focus of pretty much everything that was happening at the visitor complex – the IMAX movies, Tom Jones the astronaut, even the bus drivers went on about it. The standard spiel is that the SLS rocket is under construction and Orion capsule for the crew is close to completion – notwithstanding first the Boeing CST-100 Starliner and then the Space X V2 will commence crewed launches to low earth orbit and the ISS from 2018 – with SLS crewed launches commencing in the early 2020s. Either a return to the Moon or an asteroid mission is on the cards – but whatever it is, it will be the first crewed mission out of low Earth orbit in about fifty years – so, woo hoo. And then, apparently, it's off to Mars in the 2030s. The Journey to Space movie did acknowledge that no-one is now seriously thinking that we can cram four astronauts into an Orion capsule and send them off on a two or three year mission to another planet. They might take some kind of transit habitat module – maybe a huge Bigelow-type inflatable rumpus room – but from there it all started getting a bit speculative since none of this stuff has been built yet. Incidentally, Buzz Aldrin did a speaking tour of Australia not long after I got home and he was saying the 2040s was a more likely timeframe.

Of course, this all leads us to *Destination Mars*, mentioned in a recent Science on the ISS podcast. *Destination Mars* is also a free part of the visitor complex attractions. First, you get a personally-fitted HoloLens headset and then you get taken into a room where it all happens. When the show starts, a virtual Buzz Aldrin is your MC and you enjoy a sequence of three room-filling views of Mars, which are built from Curiosity rover imagery – and hence all include the 5.5 kilometre high Mount Sharp in the background. The different locations show you some different Mars geologies and the third location has an animated Mars base with imaginary habitat modules, astronauts and rovers.

And of course, a trip to the Kennedy Space Center Visitor Complex would not be complete without seeing Atlantis, the space shuttle orbiter – indeed it would be pretty hard not to see it. Atlantis has its own building which is really a whole museum dedicated to the space shuttle era. Atlantis is positioned as though doing a banked turn right in the middle of the museum, with its cargo bay doors open and a Canadarm extending outwards. It's an impressive display, so if you only have one chance to see a space shuttle orbiter in your life, try and make it Atlantis.

Keen listeners may recall I also booked a chopper flight over the Cape Canaveral area – which included flying down the length of the Shuttle Landing Facility – which some people might have just called a runway – but, hey it's NASA and runway just sounds too ordinary. The flight was, for the record, awesome – although, one must admit, not exactly cheap. And that was my trip to Kennedy Space Center.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy www.cheapastro.com. Cheap Astronomy offers an educational website that keeps you on the launch pad. No ads, no profit, just good science. Bye.