

Hi, this is Steve Nerlich from Cheap Astronomy [www.cheapastro.com](http://www.cheapastro.com) and this is *Fobos-Grunt*.

Cheap Astronomy originally did a podcast on the *Fobos-Grunt mission in 2009*, it didn't make the launch window – so now it's scheduled for a late 2011, early 2012 launch window.

Launch windows to Mars come around once every 26 months. If *Fobos-Grunt* doesn't launch this time there will be another 26 months wait until early 2014. This is all because Mars has a 687 day solar orbit, which is close to, though not quite twice the time that of Earth's solar orbit. This means there's only one opportunity, when the two planets are in just the right spots to launch a spacecraft, give it a bit of a push up the Sun's gravity well to Mars' orbit, just at the right time that Mars is passing by that particular point.

The recent history of launches to Mars reads like this: in 2007, the highly successful though now ice-entombed *Phoenix* mission launched; in 2005 the fabulous *Mars Reconnaissance Orbiter* launched; in 2003, there was Europe's *Mars Express* and its lander *Beagle 2*, which kind of crashed, and of course *Spirit* and *Opportunity*, the Mars rovers; in 2001 *Mars Odyssey* was launched, a trusty workhorse still in operation today, that amongst other things can relay signals from a Mars rover.

If you use the Mars launch window, the travel time to Mars is around 7 to 10 months. Alternatively, you could launch at a different time and perhaps try to pursue Mars around its orbit, in which it moves at 24 kilometres a second. But that means you expend more time and more fuel. You could also try flying in the opposite direction to its orbit around the Sun to meet it head on, but that means you lose all the 30 kilometres a second momentum you should otherwise gain from the Earth's orbital velocity.

So it really is best just to use the launch window.

So there's a window opening in November 2011 - and both NASA's new Mars rover *Opportunity*, as well as the *Fobos-Grunt* mission are scheduled for launch. If you are wondering, *Grunt* is Russian for ground or soil, because that's what the mission is all about – bring back some soil – well regolith really, back from Mars' moon Phobos. It's what rocket scientists call a sample-return mission.

*Fobos-Grunt* was developed by NPO Lavochkin – which is a bit like NASA's JPL – and the mission will be managed by Russia's equivalent of NASA, the Russian Federal Space Agency - also known as Roscosmos.

The Russians first attempt at a Mars mission dates way back to October 1960 – which was the start of the Marsnik program, although unfortunately most of these missions failed on launch. Nonetheless, the Russians were the first to get probes to the surface of Mars, in 1971, although both of them crashed on the surface, hence leaving the Americans to make the first successful landing of a functioning probe, *Viking 1*, on the 20th of July 1976.

Now flying to Mars is really difficult, but the Russian's have had particularly poor luck with 18 out of 18 missions so far failing in one way or another –and this includes two previous missions to Phobos. *Phobos 2* actually managed to enter Mars orbit in January 1989 – it returned nearly 40 photos, then... nah. The Russians last attempt was Mars 96, a spacecraft launched in 1996, but

its launch rocket failed and – like so many of its predecessors - Mars 96 crashed into the Pacific Ocean. But the Russians are nothing if not persistent and if *Fobos-Grunt* does succeed in achieving a sample return from Phobos – that will be quite something.

The first ever sample return mission was actually Apollo 11, although the first robotic one was the Russian's *Luna 16*. The first sample return from outside Earth's gravity well was NASA's *Genesis*, which collected particles from the solar wind – although these were somewhat contaminated when it crashed back to Earth in 2004 due to a parachute failure. Then there was *Stardust* which collected particles from the tail of Comet Wild 2 in chunks of Aerogel and returned, without crashing, in 2006. Then there's Japan's *Hyabusa*, which may or may not have landed on 25143 Itokawa and managed to collect a few dust grains that were swept up in the attempt.

And that's about it. So a sample return from Phobos? That would be quite something.

After launch, *Fobos-Grunt* will take about 10 months before getting into orbit around Mars, staying there for a few months to study the planet and its moons - and then attempting the Phobos landing.

Assuming that works, it's planned that the spacecraft will use a robotic arm to collect samples and undertake experiments, including heating a soil sample to check for the release of water vapour. And then finally, after staying for approximately 14 months in the Martian system, a launch window back to Earth will come around and a small rocket-propelled canister will be launched from the top of *Phobos-Grunt* and returned to Earth carrying soil samples and one other very interesting package.

Well, when I say launched – Phobos' gravity is not very strong, with an escape velocity of about 40 kilometres an hour, so the sample return canister will simply be spring-vaulted into space, its rocket only firing when it's well above the surface.

The other very interesting package to be returned to Earth is the Planetary Society's *Living Interplanetary Flight Experiment*, or LIFE Life. The LIFE package will contain ten types of organisms to be launched with *Fobos-Grunt* and then returned to Earth with the Phobos soil sample, that is the Grunt – allowing us to see just how well these organisms coped with the extreme environment of space over a total of 34 months - that is a 10 month journey each way and a 14 month stay. The LIFE package includes an animal (the little segmented tardigrade, or water-bear), a plant (cress weed), a fungus (would you believe brewer's yeast), three prokaryotic organisms from the Archaea domain – known for their extremophilic tendencies – and three other hardy prokaryotes from the Bacteria domain - including Conan the bacterium, also known as *Deinococcus radiodurans*.

The *Fobos-Grunt* spacecraft will also transport a companion spacecraft to Mars, the Chinese *Yinghuo-1* probe. Yinghuo apparently means firefly, but rather than being a tribute to the TV series, it is a transliteration of the traditional Chinese word for Mars. *Yinghuo 1* will separate from *Fobos-Grunt* after the ten month journey to Mars and will go into a different orbit to the Russian spacecraft. Then, as well as fulfilling its own research agenda, *Yinghuo 1* will conduct occultation measures of Mars' ionosphere in collaboration with *Fobos-Grunt*. The idea is that

one spacecraft will ping the other just as it is about disappear around the edge of the planet. Any changes in that signal should reveal valuable information about Mars' upper atmosphere.

So, what's actually a joint *Fobus-Grunt* / *Yinghuo 1* launch will take place from the historic Baikonur Cosmodrome in Kazakhstan – site of Sputnik's launch in 1957, Yuri Gagarin's launch in 1961 and Valentina Tereshkova's launch in 1963. Hopefully *Fobus-Grunt*'s launch, hopefully in the 2011-2012 launch window, which achieve a similarly firm place in history.

Many thanks for listening. This is Steve Nerlich from Cheap Astronomy, [www.cheapastro.com](http://www.cheapastro.com). Cheap Astronomy offers an educational website where currency depends on your frame of reference. No ads, no profit, just good science. Bye.