IN DECEMBER this year, a Russian Soyuz TMA-19M space capsule will dock at the International Space Station. When the hatches between the spacecraft and the orbital outpost open, three crew members of the Expedition 46/47 will float in. Among them will be 43-year old former military pilot Tim Peake.

The first Briton to fly to space under the flag of the European Space Agency (Esa), Peake, who has more than 3,000 flight hours on various types of aircraft under his belt, will find himself in an unusual position, learning his ‘first steps’ in the weightless environment.

He will be a complete novice among much more experienced spacefarers. With him will be 52-year old American Tim Kopra, who spent 58 days at the ISS in 2009, and Russian cosmonaut Yuri Malenchenko (54), already on his sixth space mission and, with almost 642 life-time days in space, one of the most experienced active astronauts in the world (so at home is Malenchenko in space that he even got married there in 2003).

Already aboard will be upcoming record setters: Nasa astronaut Scott Kelly and Russian cosmonaut Mikhail Korniyenko. By the time of Tim Peake’s arrival, they will be more than halfway through their groundbreaking one-year stay. Also, 42-year-old Sergey Alexandrovich Volkov, a son of a 1960s cosmonaut, will already have more than 500 days in space by then.

“These experienced guys can spot a rookie astronaut straight away,” Peake admits as we talk over Skype during a short break in his incredibly busy schedule. “It’s a bit like learning to ski. Initially, your legs are flailing, your arms are flailing, you are kicking things off the walls, knocking things all over the place, but after about two weeks you really get the hang of it and after about a month you are doing the black moguls with no problem at all.”

With boyish charisma and infectious enthusiasm for the mission ahead, the Chichester-born astronaut is clearly undeterred by any minor setbacks and hopes to get a chance to participate in one of the spacewalks planned for the time of his mission.

Peake’s journey to space

At the time of our interview, Peake’s training was in its final stages. He had just returned from Russia’s Star City, where he practised with his crewmates in a life-sized mock-up of the Soyuz space capsule and was about to head to Houston for a month and a half for spacewalk and robotics training.

“The final six months of our training is mostly about maintaining the essential skills,” he explains. “During this period we will also learn more about the exact scientific experiments that we will be doing. I am expected to take part in 25 medical experiments that will continue for up to a year post-flight, focusing on cardiovascular health, bone density and muscle wastage and even things like asthma and cancer.”

Peake will not be the first Briton to go to space – this spot is firmly occupied by Helen Sharman, who spent a week on Russian space station Mir in 1991 as part of a project financed by British companies. Neither would he become the first UK citizen to set foot on the ISS. However, he will be the first to achieve that without being in possession of a US passport, and the first to have the bill for his space trip footed by the UK government through membership in Esa.

Peake’s mission, named Principia after the cornerstone work of legendary English physicist Isaac Newton, is breaking new ground for aspiring British space cadets. However, the opportunity presented itself >
Without a doubt, my army career played a huge part,” he concedes. “Esa is looking for a number of different things in astronauts, but there are two major routes in how one can become an astronaut. It’s either the practical operational experience or the scientific and academic experience. My background was clearly very firmly in the operational experience.”

As Esa considers its astronauts to be spokespeople for the European space industry, it is clear that Peake’s cheerful demeanour made him an excellent candidate for the job.

**Training for an asteroid mission**

After joining the European Astronaut Corps in 2009, Peake and his family relocated to Cologne, Germany, where Esa’s astronaut training centre is based. If the selection process put the candidates through their paces, the training tested the successful applicants even further.

They had to become perfectly familiar with virtually every nut and bolt of the International Space Station, one of the most complex engineering structures ever assembled, and learn how to manoeuvre the Soyuz space capsule. The training also involved diving in a special pool – the so-called neutral buoyancy facility – simulating spacewalks, learning how to control the station’s robotic arm, and studying the science behind the experiments. There was also the tricky task of mastering the Russian language.

In the past five years, Peake has been around the world and back several times, not only to Russia’s Star City and NASA’s Johnson Space Centre in Houston Texas, but also to some rather unusual places such as a large cave complex in Sardinia and an underwater habitat off the coast of Key Largo, Florida. It’s the latter he considers the greatest highlight of his training.

“We spent 12 days living under water in a habitat called Aquarius, trying to figure out how future astronauts could work on an asteroid,” Peake explains. “When people go to an asteroid, it will be very difficult to collect scientific samples there as the asteroid has a very low gravity. We tested different techniques for how to move around the asteroid, like whether to use a system of cables, virtually lassoing the asteroid, or whether to use jetpacks to move around.”

“The habitat is about 25 metres below the water surface and the ocean is about 30 metres deep there. Every day, once or twice, we would dive as a team of two, just like if we were going on a spacewalk. We would be using the ocean floor to simulate the asteroid. We would make ourselves neutrally buoyant and we would be wearing similar tools that we would expect to have on a spacewalk.”

**Exciting times ahead**

After our interview, the six-month wait for Peake’s launch was marred by several critical mishaps that disrupted life on the space stations. In April, Russia lost its space cargo vehicle Progress due to a failure during separation from the rocket. Even worse, in June, the Falcon 9 rocket of US private space transporter SpaceX exploded two minutes after lift-off with its Dragon space capsule aboard. The lost Dragon was packed with costly equipment, including one of the two International Docking Adaptors – new
moving, but it is hard to stop them, especially in space. In space, it is very easy to get things easy to stop. That's exactly opposite in viscosity of water means that it is very different in water and in weightlessness. The whole sequence in a pool several times.

Before that, the astronauts would have to move the station's storage module to another location and remove one of the permanent mating adaptors. They perform these tasks with one astronaut inside the station controlling the robotic arm and two others outside in the open space, hurrying through the vacuum at 27,000 kilometres an hour, tethered to the orbital outpost just by a thin umbilical cable.

"Every spacewalk is carefully planned and rehearsed," says Peake. "We learn about every aspect of the task first in a classroom, we learn to use the tools and get to see the real hardware. After that we practise the whole sequence in a pool several times.

"The spacewalk training is really good, but there are many things that are very different in water and in weightlessness. The viscosity of water means that it is very difficult to get things moving and it's very easy to stop them. That's exactly opposite in space. In space, it is very easy to get things moving, but it is hard to stop them, especially if they have a large mass."

Spacewalking is a serious business. Although there have been no fatalities in the five decades of space walks, there were a couple of close calls, the most recent being the incident of Tim Peake's predecessor, Italian astronaut Luca Parmitano, who nearly drowned in 2013 after his helmet filled with water.

"We train for critical scenarios. All the things that can go wrong with the spacesuit, whether it's depressurisation or CO₂ not scrubbing correctly, all sorts of fan failures, cooling failures, we practice for these so that by the time we go for a spacewalk, we know exactly what to do," Peake explains.

"However, what happened to Luca was something that was completely unheard of before. There was no procedure for it. Since then, there was a change in procedures and adjustments in the helmet design. Our helmets now have a sort of a diaper installed in the back to remove water and there is also a snorkel now that would enable us to breathe by taking air from the centre of the space suit."

Another major change will take place at the space station during Peake's stay—installation of the Bigelow inflatable habitat, a four-metre-long expandable unit made not of titanium and high-grade steel, but of soft extremely resilient textile.

**Space dad**

For Major Tim Peake, with his extensive military experience, six months away from home is not a big deal. His two young sons, six and three years old, are only slowly realising that their father's job is somewhat out of this world.

"We are trying to include them as much as possible into what's happening so that they understand it," Peake says. "They will both come to the launch event, and the communication from the space station is really good. We have six Voice over IP lines so I can call any phone any time, day and night. Once a week, on a Sunday, we will be able to have a private family conference, something like Skype, which is wonderful."

As excited for the mission as he clearly is, Peake admits that in addition to his family, there will be many other things he is going to miss.

"I really love the outdoors," he says. "All my life I really enjoyed camping and hiking, and even now with two small children, I get them outdoors as much as possible. I think I am going to miss that kind of experience, the fresh air, whether it's mountain climbing or kayaking, or sailing or whatever. So I think that when the hatch opens on the steppes of Kazakhstan after the six months away, the first breath of fresh air will be a relief."