



Reaching for Space: Skyrora, the journey to orbit

Written by **Katie Miller**
Project Manager, Skyrora Ltd

The space industry is rapidly evolving, with the UK aiming to capture 10% of the global space market by 2030. Three vertical spaceports are in development in the North of Scotland, with the aim of launching satellites into orbit. The space industry will boost the economy and play a crucial role in Earth Observation.

Many people don't realise that the UK has been involved with space technology from the very start of the space age. We are the first nation after the US and USSR to operate a satellite. We built spacecraft which have been sent to Mars, Venus, Titan, and various comets. What we have been missing out on, is our own rockets!

On October 28th, 1971, we proved our capability with the successful deployment of the UK satellite, Prospero, from a Black Arrow vehicle launched from Woomera, South Australia. Sadly, the last and only launch programme in the UK closed that year. Built on the Isle of Wight, the fourth Black Arrow vehicle was never launched and now resides at the London Science Museum. Since then, the government and space industry have been seeking to bring back launch capability to the UK.

Which is where Skyrora comes in! Founded in 2017, with a team of 130 people across the UK and Europe, we are building a new environmentally conscious launch system. We aim to launch our polar orbital vehicle by the start of 2022, here's our journey so far.

May 2020 saw us conduct a full static fire test of our 11-metre sub-orbital launch vehicle, Skylark L. This is a complete testing of all systems on the rocket. We built an entire mobile launch complex in five days in the Scottish Highlands. The complex was comprised of several modules including a command centre, oxidiser and fuel handling containers, and a compressed gas container. The full static fire test allowed a complete inspection of the design and in-house manufacturing and validation tests of the feed system, ensuring that the rocket is launch ready. During the test, the Bells and Two Tones Fire and Rescue team were onsite, just in case!



^ Image of Skyrora

August saw the launch from Langanes Peninsula, Iceland, of Skylark Micro, a 3.3m 2 stage vehicle, which ascended 26km before parachuting back to sea. We then completed in-vacuum chamber engine tests and the successful third stage static fire test, which will be used on our polar-orbital vehicle, Skyrora XL. 2021 will be another successful year for us with even bigger launches!

Skyrora depends on the passion, dedication and skill sets of many people to ensure success. Here, members of our engineering team give you a glimpse of what it takes to reach beyond planet Earth.



^ Image of test launch



**Name: Dr Jack-James Marlow
CEng MRAeS**

**Title: Head of
Engineering
Department**

Tell us about yourself and what you do at Skyrora:

I work for Skyrora, which is a Commercial Launch Vehicle Company. Which basically means we create and launch rockets into space. People pay for their satellites to be deployed in orbit around the Earth. I manage the department of Engineering. This means I plan and coordinate all the staff to achieve our mission goals. This can be from the mundane of creating new policies for a new workshop, to overseeing a very large rocket testing operation – mostly I make sure everyone has the skills and tools to do their job and lower the potential risks to the company via correct project planning.

Leading up to working at Skyrora, I was always interested in propulsion and combustion / chemistry and followed the GCSE, A Level to Engineering Degree route. I focused on Maths, Physics and Chemistry, which form a great foundation for an Engineer. I then continued research at University and taught whilst completing my PhD in Advanced Rocket Engines. I used to test up to 50 Rocket Engines in a day. It was a very cool job!

What did you want to be when you were younger?

I always wanted to be a scientist or designer as I really liked and excelled at STEM subjects. I have always had a passion for research and pushing the boundaries of what we can achieve. I remember when I was about 13 or 14 and doing an experiment in my back garden to make Thermite (metallic aluminium and iron oxide) with my friend David. Thermite under combustion has a very high exothermic reaction. We had lab coats on and was recording it on a very old Nokia phone (pre-iPhone so the quality was very poor). The experiment was a success and I nearly set fire to my back garden, much to the dismay of my parents. I knew from then on, I wanted to pursue research into combustion / propulsions studies.

Can you share with us the next exciting thing you and the company will be involved in?

The next 12 months is going to be very exciting for us. We have a new test site coming online and we will start the testing of our new larger engine to power our biggest rocket: Skyrora XL. We will also be moving to a new factory which will allow us to generate many more jobs.

What would your dream job be if you could be or do anything in the world and why?

I'm doing it as I always wanted to work for a UK Launch Vehicle Company. Contrary to popular belief, not all Rocket Scientists want to be Astronauts – I have zero desire to go to space. In a parallel universe, I would like to have my own coffee shop (maybe because the coffee at Skyrora is not the best). Maybe in this universe, I can set one up at Skyrora too.... SkyCafe?



**Name: Joseph Laynton
AMIMechE**

**Title:
Mechanical Engineer**

Tell us about yourself and what you do at Skyrora:

I am one of the lead mechanical engineers in Skyrora's Technical Department. My background is as a mechanical engineer specialising in documentation, design, and mechanical structures. I have worked across multiple industries spending 4 years in the nuclear and power sector before joining Skyrora in the space industry. I studied Mechanical Engineering at the University of Nottingham, specialising in Dynamical Analysis, Structures, and Control.

I have always been fascinated by problem solving, where it is as simple as perfecting the technique for the best cup of tea, or developing blast protection for accidental detonation, the challenge of overcoming and gratification once solved has always motivated me. With all the challenges, variables and unanswered questions originating from any STEM subject drove me to study in these areas. Space was always a fascination of mine, leading me to pursue a career in the rocket industry.

Tell us about the most exciting thing you have done at Skyrora:

My year at Skyrora has been action-packed and exciting with many firsts for me, the Skyrora team and UK Space. For example, the 3rd stage static fire test and Skylark L static fire test, it has been nearly 50 years since anyone has done this in the UK. The 3rd stage static fire is our most recent test which is the top stage of the Skyrora XL orbital rocket. I oversaw the development of the blast protection for this project and ensured we had sufficient protection for the public and operators. Modelling blast and explosion is technically a challenge and cool at the same time, especially when determining the plausible scenarios and determining how fragments penetrate protection, it is like calculating bullet penetration.

What would your dream job be if you could be or do anything in the world and why?

Professional TT Rider, my second passion is motorbikes and if my riding skills were good enough (or I was crazy enough) I would have always wanted to ride the TT professionally. Racing motorbikes is one of the most thrilling and exciting experiences with the ability to go fast with very little between you and the tarmac.

Who is the most inspiring person you have met or would like to meet?

Capt. James Lovell, who was the commander on the Apollo 13 mission. The Apollo 13 mission was one of the most iconic space missions for making the impossible happen. James was stuck in the spacecraft with his crew, when disaster struck and one of the oxygen tanks on the craft exploded, leaving them in a critical situation. Their ingenuity, calmness and resourcefulness allowed them to convert some of the systems to allow them to return to the Earth safely and alive. Meeting James to understand how he managed to keep calm, implement this last-minute engineering, and bring his team back would be inspiring.



Name: Katie Miller

Title: Project Manager

Tell us about yourself and what you do at Skyrora:

I'm a Project Manager and I am involved in delivering small to medium sized business-related projects and I also manage the PR and Communications department. My background is more general compared to my engineering colleagues. I grew up travelling around the world, experiencing different cultures, landscapes, environments, and meeting people. From this, I developed an interest in the relationships between people and their environments which led me to complete a degree in Geography at the University of Edinburgh.

As a result of my degree, the opportunity arose to take a "Remote Sensing and Global Climate Change" course, and this is where I learned about the importance of satellites and their relationship with Earth observation and Climate Change. This led me to research the UK space sector only to find that it was very up and coming with what is called 'New Space'. I came across Skyrora and felt compelled to apply, basing my cover letter on the Remote Sensing and Global Climate Change course I took at university. Three interviews later and much persistence, I landed a job as a Business Development Executive. I have learned so much since joining Skyrora, having become immensely knowledgeable in the future of the UK space sector, about our rockets and how environmentally friendly they are and of course, the important part Skyrora plays in the UK space sector and in Earth observation.

What did you want to be when you were younger?

To be completely honest, I wanted to be a doctor. I always ask myself why I wanted to be a doctor and I have realised that it was because I wanted to make a difference and to have a positive impact on people's lives. I soon realised that I could achieve this without the need for becoming a doctor. The role I have at

At various points in my life at a much younger age I aspired to be a doctor or the next David Attenborough. I wanted to make a difference and have a positive impact on people's lives. However, when I was in high school and I needed to start seriously considering my career path, I had no idea in which direction to look. But I soon realised that I was not alone in this

feeling and that it was okay for me not to know what I wanted to do or in which direction in life I was headed. I pursued what I enjoyed doing the most which was striving to make a positive impact on our planet. The role I have at Skyrora might not appear as though it has a positive impact on the lives of others, but I believe it does.

Tell us about the most exciting thing you have done at Skyrora?

That is the Skylark Micro Mission project where we successfully launched a 3.3 metre, two-stage rocket from the Langanes Peninsula in Iceland last year. It was by far one of our biggest missions to date and I was responsible for the PR and external communications. I acted as the media contact, creating press releases, releasing media and photos to the press, and ensuring Skyrora representatives were available for interviews. I really enjoyed working on our social media channels to get our wider audience excited about the launch. We did several campaign posts leading up to the launch and I loved interviewing the technical team. It was a privilege to meet the Icelandic stakeholders that were involved in the regulation's aspect of the mission. The most exciting meeting was with the Icelandic President, Guðni Th. Jóhannesson. He was so welcoming and interested in our work and it was wonderful to share Skyrora's vision and details of the Skylark Micro Mission with him.

What's next for you and Skyrora?

Skyrora are currently working towards the test launch of Skyrora XL, scheduled for Q4 of 2022. My role within this project is helping to promote Skyrora externally, through PR & media and working on our social media campaigns that build up to our big milestones. In the next 12 months, we are planning to launch Skylark L, our largest suborbital launch vehicle. This will be like the Skylark Micro Mission but on a much larger scale! I am very excited for this and cannot wait for the mission results!

Climate change is a mainstream topic and global concern, and Skyrora is heavily focused on ensuring that our methodologies and processes are environmentally focused as a priority. Within each aspect of the company, environmental conscious is the number one objective. For example, the third stage of the Skyrora XL launch vehicle can not only place satellites into orbit (which will have the ability to carry out Earth observation applications such as monitoring potential flooding and volcanic eruptions) but is also able to remove space debris to clean up low Earth orbit, a topic of increasing concern within the space industry.



Name: Robin Hague

Title: Head of Launch

Tell us about yourself and what you do at Skyrora:

I have always been interested in science and engineering, and in particular spaceflight; drawing rockets and aeroplanes and trying to work out how to get something into space! After my GCSEs I took a less common route as my local college offered BTEC aeronautical engineering, though mostly I was sold on the kitplane they were building. I had not considered university as my direct family had not been to university and I didn't really know about them; then at college I found Physics with Space Technology was available at the University of Salford; so, I enrolled in Space Technology and the Physics just happened to come along too. Project work was the most interesting part of university and I was able to conduct a final project on hybrid rockets, which I was able to turn into an MSc, which led to me working in rocket propulsion and then on to Skyrora.

What did you want to be when you were younger?

At various points I was resolved to build propeller driven aircrafts and make them the dominant means of air transport again; to launch supplies to the ISS with an electromagnetic railgun; to direct movies or to revolutionise access to space by starting a launch company that would bring launch to the UK. The trouble is Elon Musk proved one of those ambitions was possible, I just missed out on making loads of money on the internet!

How did you get your job at Skyrora?

Though I may not have started Skyrora I was lucky enough to become involved very early on, joining in spring 2018. Though I had worked on space propulsion out of university the opportunities to work on rockets in the UK were somewhat limited then, so I had been involved in designing nuclear safety robots, including for the ITER fusion reactor. When I discovered Skyrora had been founded nearby I made a speculative approach and was welcomed in.

How does your work impact the world around us?

We want to provide the most sustainable access to space possible, because Earth observation and science satellites are critical to understanding our world and fighting climate change. We want to be able to support those launches without significantly adding to the problem, and to make it cheaper and easier for more scientists to be able to get those payloads into space.



Name: Cameron Miller

Title: Structural Engineer

Tell us about yourself and what you do at Skyrora:

From a young age I was fascinated by how things worked and was excited by speed. This inevitably led to an interest in engineering, particularly aerospace since it involves the fastest and most powerful machines ever created. Being ambitious I decided it was what I wanted to be involved with as a career. This ambition and interest were further encouraged by my parents, my Dad is an electrical engineer, and my Mum is a civil engineer. After completing school, doing as many things skewed towards engineering as possible, I completed my undergraduate degree in Aerospace Engineering at Georgia Tech in Atlanta, then studied a postgraduate Masters in Mechanical Engineering with Aerospace at Strathclyde and subsequently began my career at Skyrora.

How does your work impact the world around us?

As a company, Skyrora has been achieving several UK firsts and things not seen since the previous UK space programme, Black Arrow, some 50 years ago. This is progressing the UK space launch capability at an unprecedented rate towards domestic orbital launch capability. The orbits which would be accessible by a UK launch are critical for Earth observation so would launch missions able to provide data to improve the world around us in a variety of different ways. Additionally, it would make the UK an end-to-end space mission capable country and reduce reliance and compromise using the launch vehicles of other nations.

What has been the biggest challenge and greatest achievement of your career to date?

The biggest challenge was the initial learning curve to become familiar with the engineering systems and standards used since university can only prepare you some of the way for full practical industry experience. The greatest achievement has been doing the design and overseeing the manufacture of structures for our various testing platforms.

Who is the most inspiring person you have met or would like to meet?

The person I would like to have met (although they died before I was even born) is Wernher Von Braun, since he headed the Mercury and Apollo programmes including the Saturn V development. This led to the most intense period of technology development humanity has ever seen in going from almost nothing to the Moon in a decade.

We asked the team to provide their top tips for anyone seeking a STEM related career:

Jack-James:

Focus on what you like. Do not pursue something you are not motivated in. When I was a lecturer, I would see the unmotivated students and they would drop out when the studies and University pressure would increase. You must have a passion in the field to really push and strive to make a change. If you know what you like to study, then start to look at the future and what careers that path could lead to. Try to visualise the goals and create a vague 5-year plan on a bit of paper to help you visualise the path. You must take calculated risks in life. I advise everyone to follow their own path, but you must know it first, so take the time to invest in it.

Robin:

From an engineering point of view, I would strongly recommend gaining practical experience in making, building, crafting. Anything related to your area of interest that gives you experience of creating real things; university engineering still commonly lacks a connection between theory and practice. From my own subject area of space technology there has never been a better time to be involved in the UK. From the construction of satellites and space probes, the development of rockets to get them up there, and the renewed interest in human spaceflight.

Katie:

My advice and what I love to promote is that you don't need to take a STEM subject to work in the space sector and I hope that sharing with

you my background has shown this. My high school subjects were higher Geography, Theatre Arts, and English and I am proud to say that I work in the space sector. What got me into my position at Skyrora was persistence and passion. I was well prepped for my interviews and ensured I came across as confident and eager to work for the company. Don't let other people tell you otherwise. If you have a dream, a passion, there is no one stopping you from pursuing that!

Joseph:

Work hard and provide some time out of your day to think about what you want to do in the future, create an action plan, then most importantly, action it. Most people can do the first, but then stumble at actioning the plan.

Cameron:

Pursue your natural curiosity and it should lead to discovering which STEM career you want to take further. Obviously, mathematics is the foundation for everything so even if it is not the most exciting to you, try to work hard and as early as possible on maths. Try to get as much practical hands-on experience, as there is no substitute for this. By following natural curiosity and with some encouragement, help, and hard work along the way it is possible to get to your realistic dream career. It is important to find something which you are naturally interested in, then your enthusiasm will pull you through the challenges and setbacks and eventually you can find a career where you are excited to go to work everyday, which I think is the most important thing!

Additional information

The sub-orbital launch vehicle, Skylark L is a part of an incremental approach which will eventually build up to launch of the polar orbital vehicle, Skyrora XL. Skylark L is a bi-liquid propellant launch vehicle and it is Skyrora's first suborbital flight vehicle. The rocket will be able to reach a height of approximately 100km, just on the Karman line, while carrying a payload of up to 60kg. Skylark L uses a propellant which combines Hydrogen Peroxide and Kerosene, which are pressure fed into a Skyrora 30kN engine. Building up to the static fire test, the rocket engine itself has gone through three hot fire tests before it was integrated into the vehicle. When commercial, Skyrora plan to use Ecosene, a Kerosene equivalent fuel made from unrecyclable plastic waste.