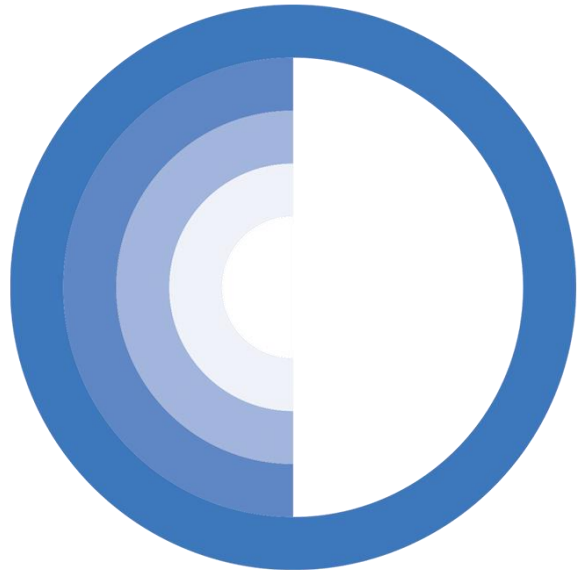




first light

Data science in a Deep tech Start up

James Allison & Thomas Edwards

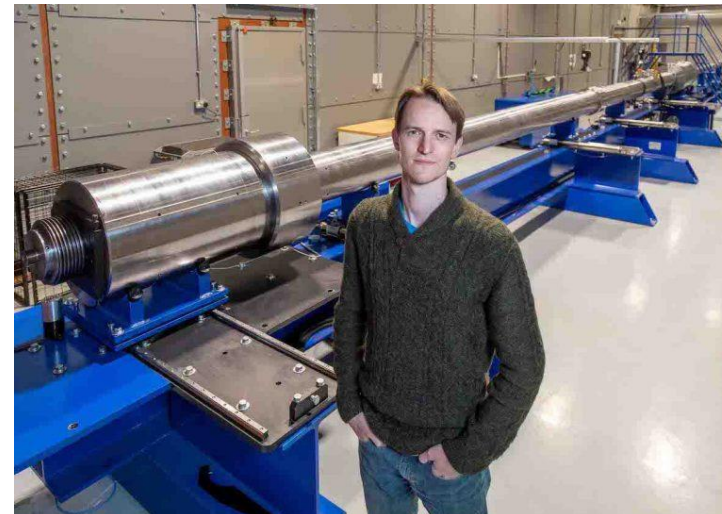
Senior Data Scientists

First Light Fusion Ltd

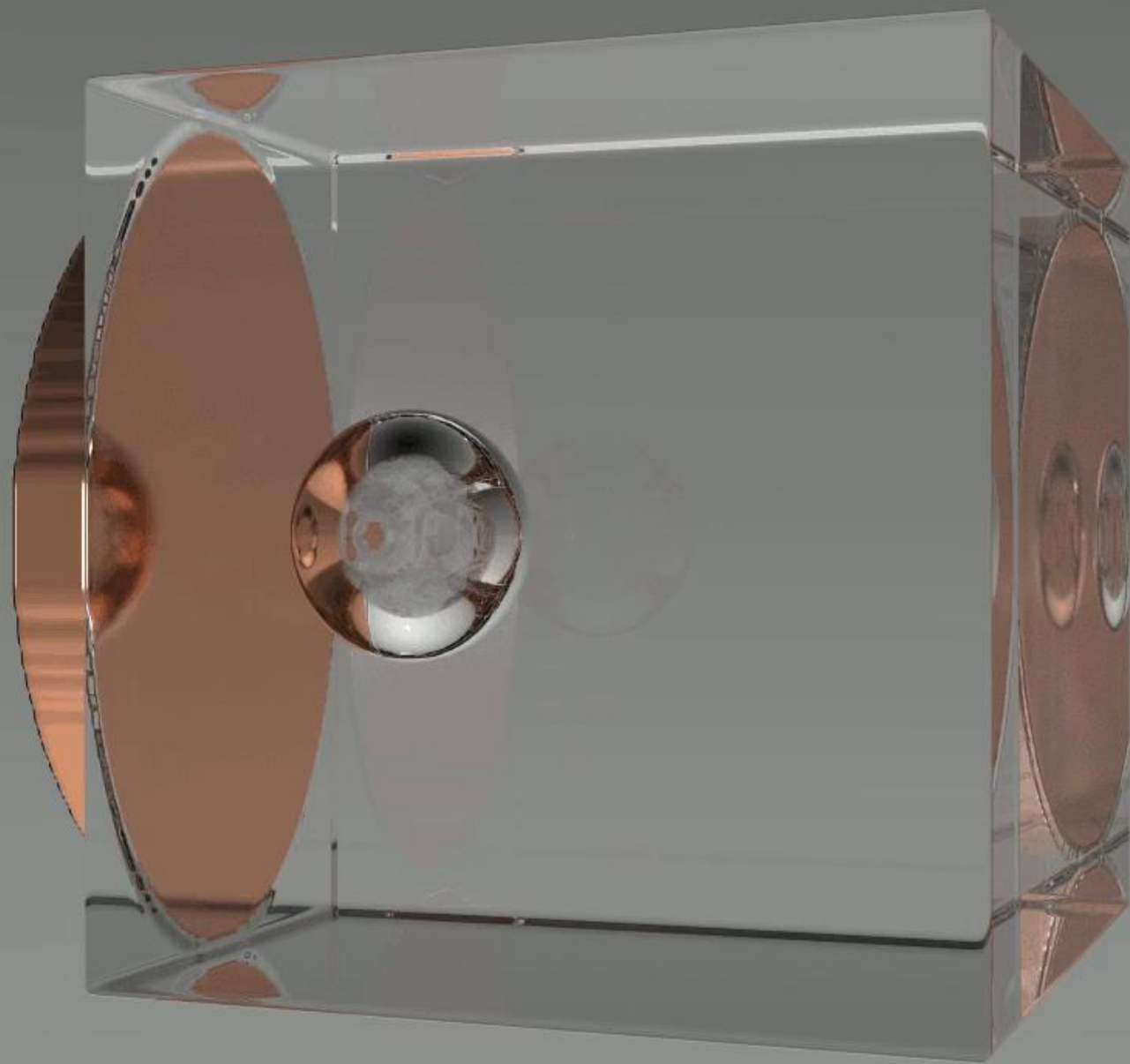
- First Light Fusion (FLF) is a **nuclear fusion energy start-up** company, spun out of Oxford University in 2011
- Currently **68 employees**
- Inertial confinement fusion (ICF) driven by hyper-velocity projectiles
- **Novel** shock-driven **target designs**
- Four experimental platforms, led by
 - M3 pulsed power
 - Large Light Gas Gun



M3
Pulsed
Power
Facility



Large
Light Gas
Gun (&
CTO Nick
Hawker)



Numerical Physics Team

- The team
 - 14 People (Physicists, engineers, mathematicians)
- Development of two core simulation capabilities
 - **Hytrac**: 2D, front-tracking, AMR, hydrocode
 - **Code-B**: 3D resistive MHD code
 - EoS and microphysics models
- Target & driver simulation and design optimisation
 - Simplified (surrogate) system models for rapid large parametric studies
 - Data science applications



Data Science @ First Light Fusion Ltd

- Established March 2021
- Broad Data Science responsibility in FLF with a focus on supporting simulation studies
 - Efficient **uncertainty quantification** and propagation
 - Numerical **optimisation** tools
 - Accelerating workflows and codes through **surrogates & emulation**
 - Model calibration with **Bayesian Inference**
 - General **statistics** and **software development** support for Experimental & Pulse Power teams
- Diverse technical background (Applied Maths, Computer Science, Plasma Physics, Astrophysics, Software Engineering)



Raf
(Lead DS)



Tom
(Senior DS)

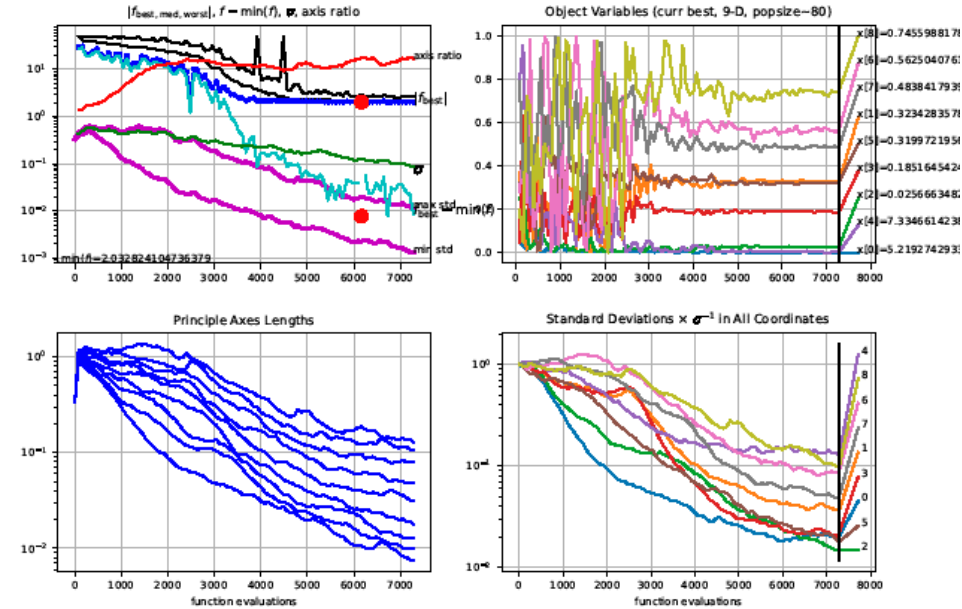


James
(Senior DS)

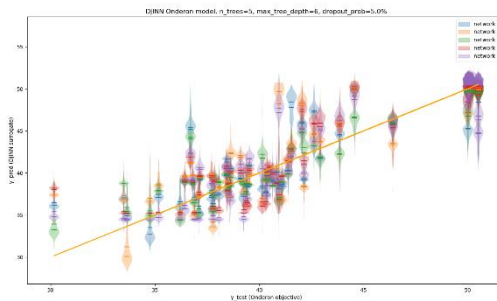
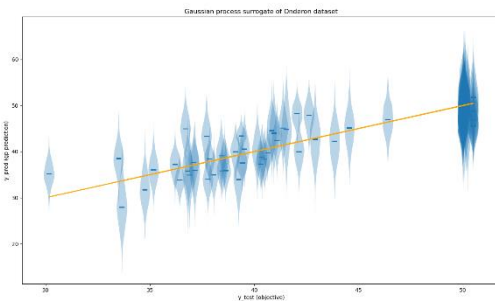
Data Science @ First Light Fusion Ltd

Numerical optimisation is key to our fusion target system design approach

- CMA-ES through Machine Discovery's software
- Initial success with Bayesian Optimisation methods



CMA-ES
Optimisation
Diagnostic



ARD Gaussian Process emulator vs simulator (left)
DJINN NN emulator vs simulator (right)

Investigating acceleration through the use of **statistical emulators**

- Benchmarked a number of Gaussian Process and Neural Network emulators with our target models



Tom Edwards – Senior Data Scientist

My background

- **Undergraduate degree (2006 – 2010)** – MSci Mathematical Physics
 - Established **foundational knowledge and skills** in physical sciences and mathematics/numerics
 - Learned basic **scientific computing** - MATLAB and C++
- **Doctoral degree (2011 – 2016)** – PhD Physics
 - CDT for Theory and Simulation of Materials
 - Developed **research and soft skills**
 - Further developed **programming skills** and **software carpentry** – Python, Unix, version control, bash scripting, etc.
 - Got involved in extra curricular activities such as **Hackathons** – Improved **software engineering, data retrieval, data wrangling**, learned other programming languages and **worked in teams**





My Career Path



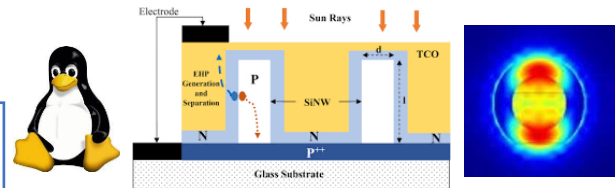
Education

Imperial College
London

MSci Mathematical Physics @ Uni of Nottingham (2006 – 2010)

$$i\hbar \frac{\partial \psi}{\partial t} + \frac{\hbar^2}{2m} \nabla^2 \psi - V\psi = 0$$


PhD Physics – CDT for Theory and Simulation of Materials @ Imperial College (2011 – 2016)



Reroo train tickets app (The Hacktrain Hackathon) – (2014 – 2018)



“Startup Experience”

Software Engineer (2016 – 2021) @ First Light Fusion



Senior Data Scientist (2021+) @ First Light Fusion

Machine Learning Interests (~2015 +)



Career

first light





James Allison – Senior Data Scientist

My background

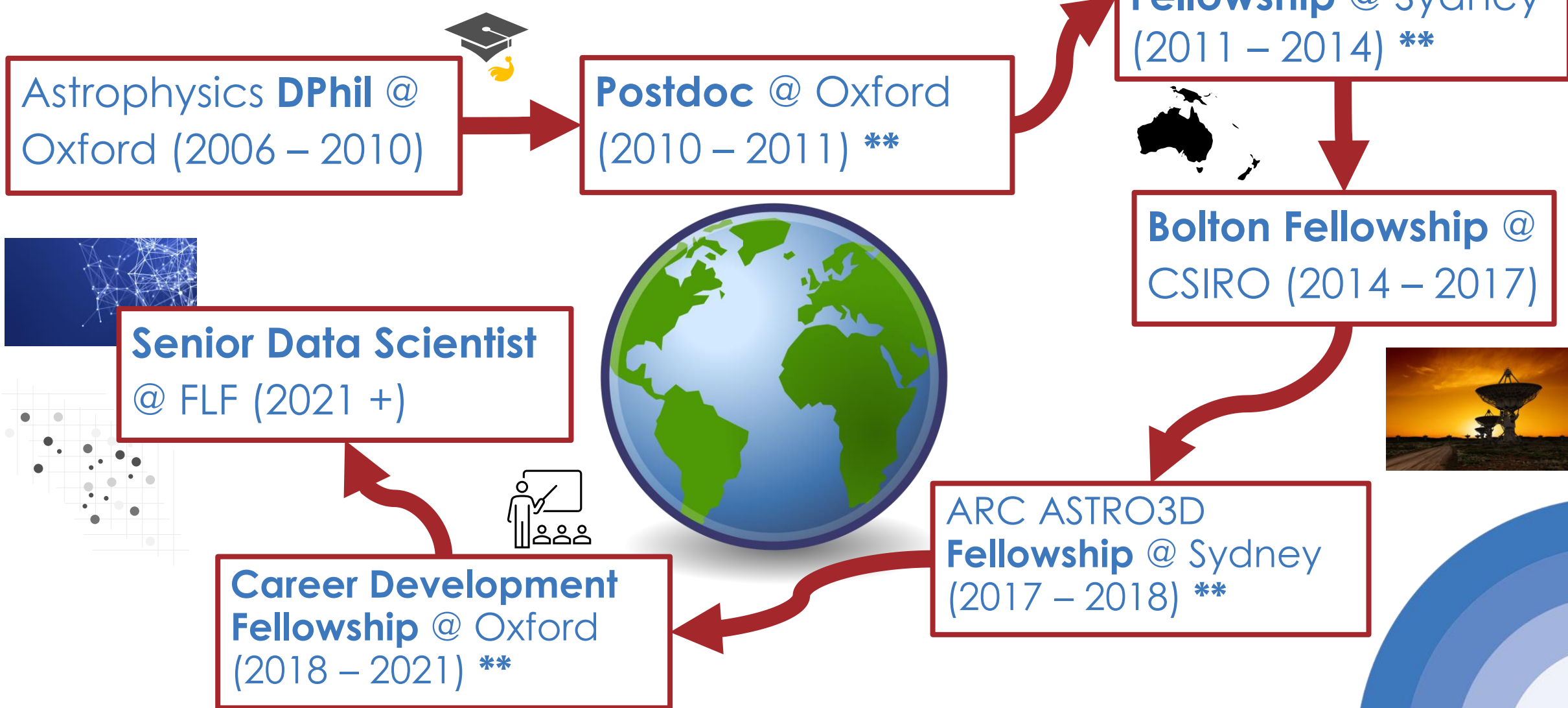
- **Undergraduate degree (2002 – 2006)** – Physics
 - Established solid **knowledge base** in the domain
 - Built **confidence** to question assumptions
- **Doctoral degree (2006 – 2010)** – Astrophysics
 - Developed independent **problem-solving skills**
 - Worked with **real** experimental **data**
 - Learnt to **code** for data processing and analysis
 - Gained important skills in **statistics**, data **visualization** and **reporting** (both verbal and written)



“Data cleaning” in my PhD - sweeping the antennas on a telescope in Chile

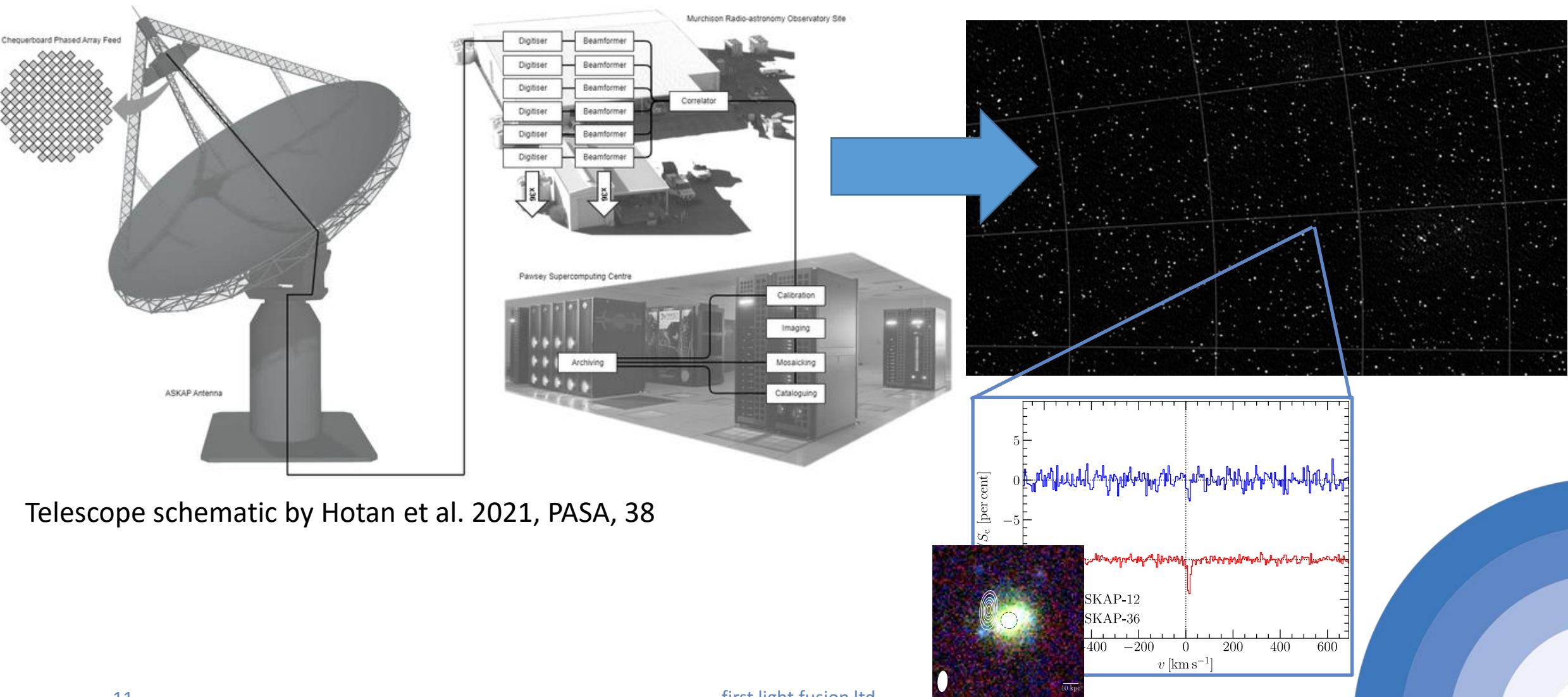


My career path to current role





How did I use big data in my previous roles?



Telescope schematic by Hotan et al. 2021, PASA, 38



What relevant DS skills did I learn in PhD & academia?

- Technical
 - Worked with **+100TB** astronomical data sets in a world-class **HPC environment**
 - Developed python code for **signal processing, modelling** and **visualisation**
 - Used bleeding-edge tools in **Bayesian Inference** (MCMC & Nested sampling)
- Reporting
 - Journal **papers** & conference **talks**
- Project leadership
 - Successful **research proposals**
 - **Project** leadership **roles** (PI on astronomical survey)
 - **Supervised** and taught students, both formally and **informally**



How does FLF recruit for new DS roles?

- We are **agile** and so recruit on a **role by role** basis defined by need – hence the diversity of technical experience in our team
- Roles are advertised on our **website** and via **LinkedIn**®
- We use preferred recruiting agents who are specialists in our sector
- We expect to grow to 100 employees by the end of the year
- We recently recruited for a new graduate data scientist and expect that **PhD-entry-level DS roles** will be advertised soon

<https://firstlightfusion.com/careers>



What key skills are we looking for?

- We look for **specific skills** in each role so be careful to **tailor your application** to the job specifications
- In general, we are looking for people with:
 - A solid background in **physical sciences, maths** or **computer science**
 - **Enthusiasm** for nuclear fusion energy and our mission
 - Strong **programming** and **scientific computing** skills
 - **Passion for data science** techniques – the company relies on the expertise of our team for data science and statistical support
 - **Demonstrated self-motivation** to lead projects within the company
 - **Effective communication** and **people skills** to work with a diverse range of technical backgrounds across the company



Increasing your awareness of the (Deep)tech sector

- Large universities will **spin out** multiple **technology start ups**
- **Find out** which companies span out of your department / faculty / division, and which are **growing their data science** capability
 - Pay attention to word of mouth or talks by senior department management
 - Talk to your PhD supervisor about opportunities outside the department
 - Look at **job boards** and build an **online presence** by uploading your **CV**, making yourself available to **recruiters**, uploading examples of your code to **Github**
- Start up companies in Deep tech tend to maintain a good **relationship with academia** and are often sympathetic to **recruiting PhDs**
- Working for such a company can be a **rewarding balance** between academic research and the benefits of industry

Thanks for listening! Any questions for us?

