Summer Projects and Internships

PhysSoc Exec

What opportunities are there in the summer?

Jobs and Industry Experience

- Internships
- Part time work

Research and Academia

- URSS

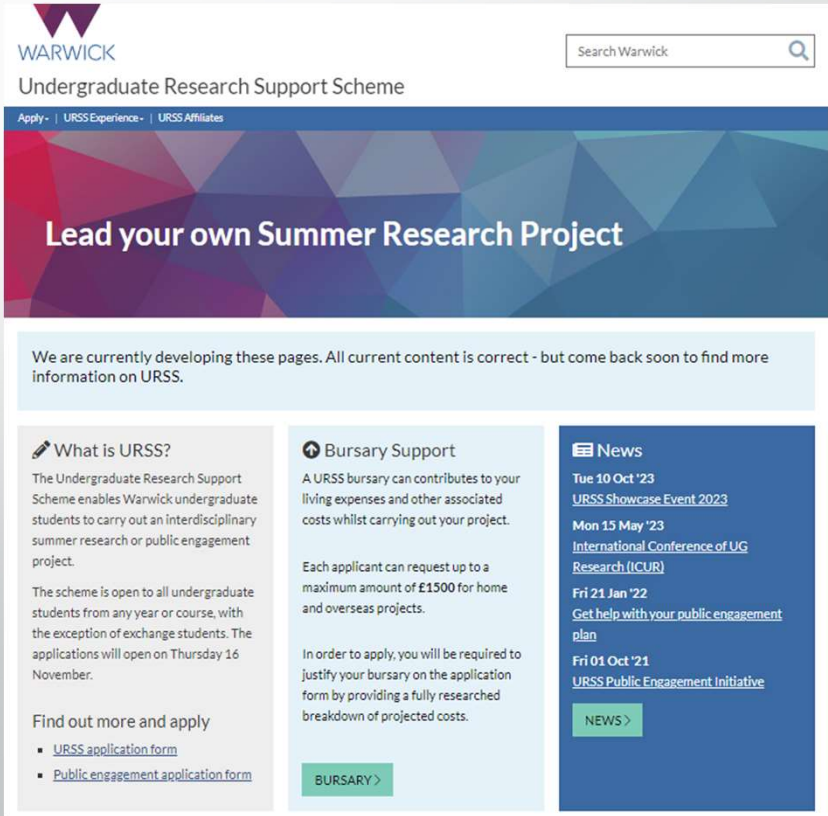
BRIGHT NETWORK

GRADCRACKER
Where the STEM jobs are

URSS
UNDERGRADUATE RESEARCH SUPPORT SCHEME

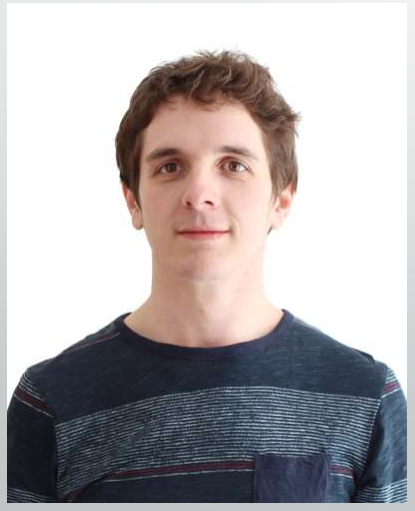
What is URSS?

- A chance to take on a summer research project
  - Over the course of 6-10 weeks
  - Public engagement activity
  - Poster showcase in November

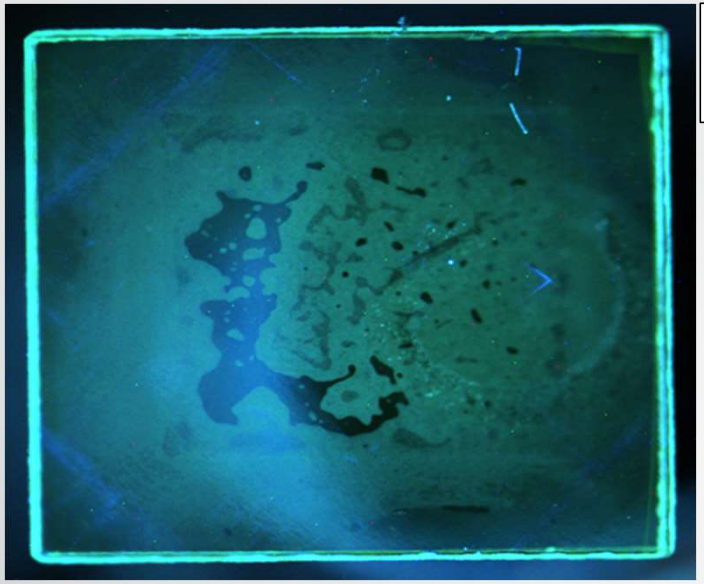


Ethan

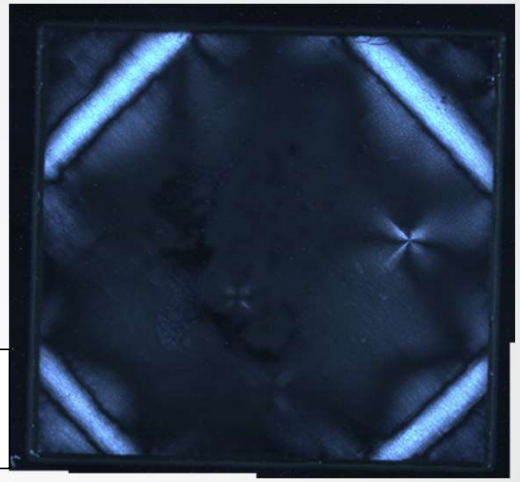
- Title: Mapping Strain in CVD-Grown Diamond
- Supervisor(s): Ben Green



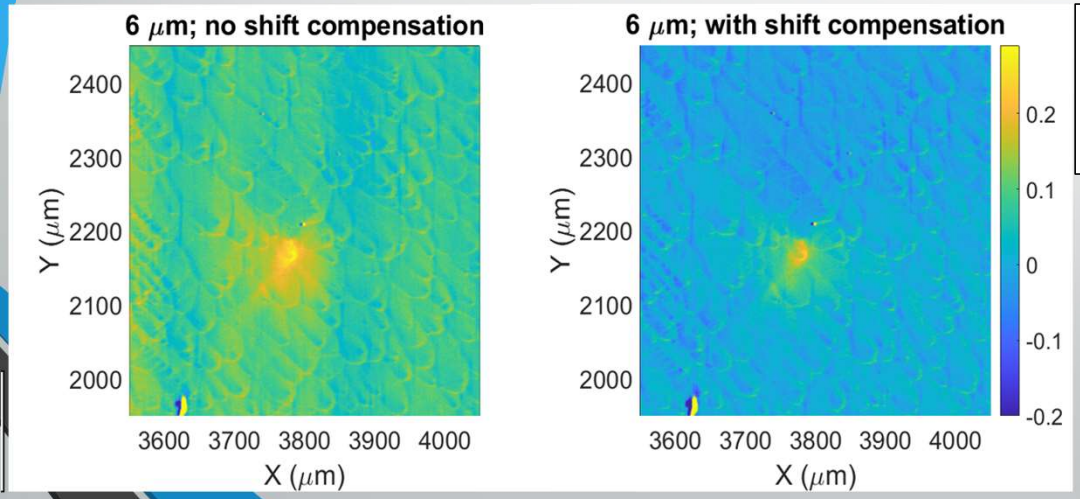
DST
Diamond Science Technology Centre



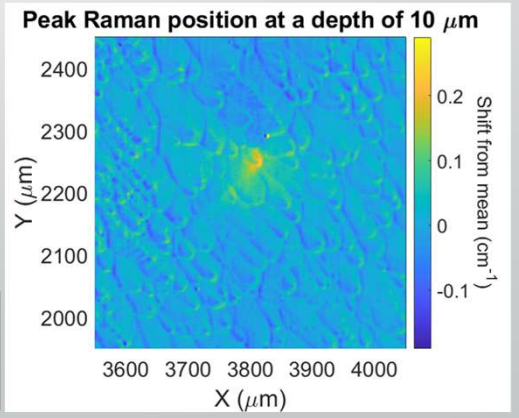
Diamondview of sample



Birefringence of sample



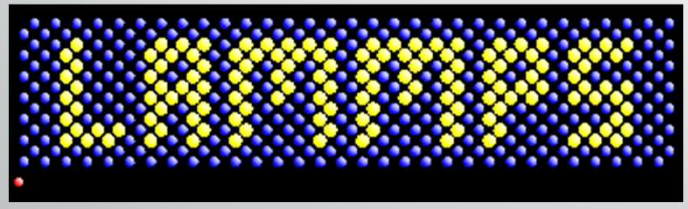
Comparison of shift compensation



Raman map of defect

Chung

- Title: Moiré Phonons in Twisted Bilayers of Transition Metal Dichalcogenides
- Supervisor(s): Nick Hine, in collaboration with Dr Samuel Magorrian and Anas Siddiqui



Engineering and Physical Sciences Research Council

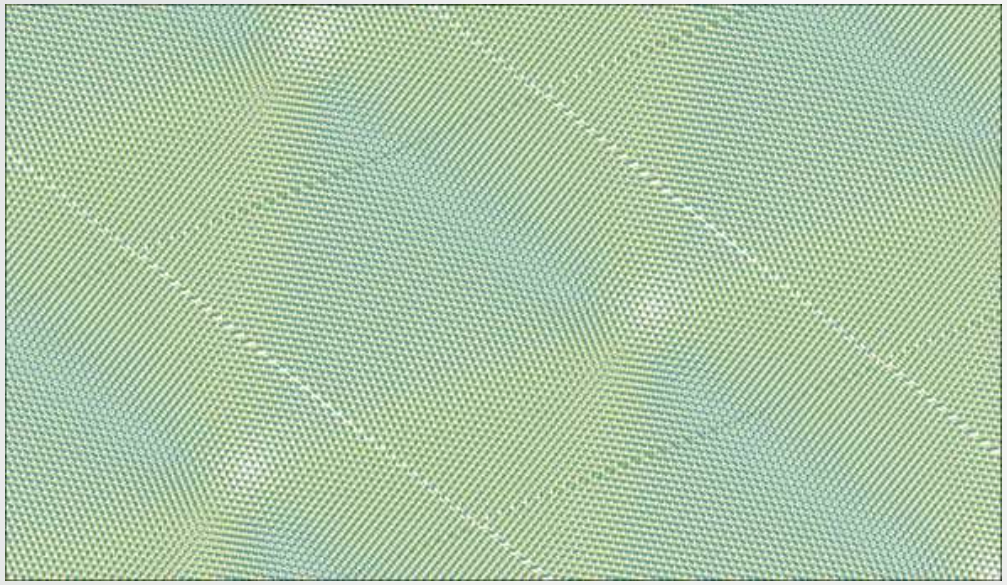
EPSRC CDT in Modelling of Heterogeneous Systems - HetSys

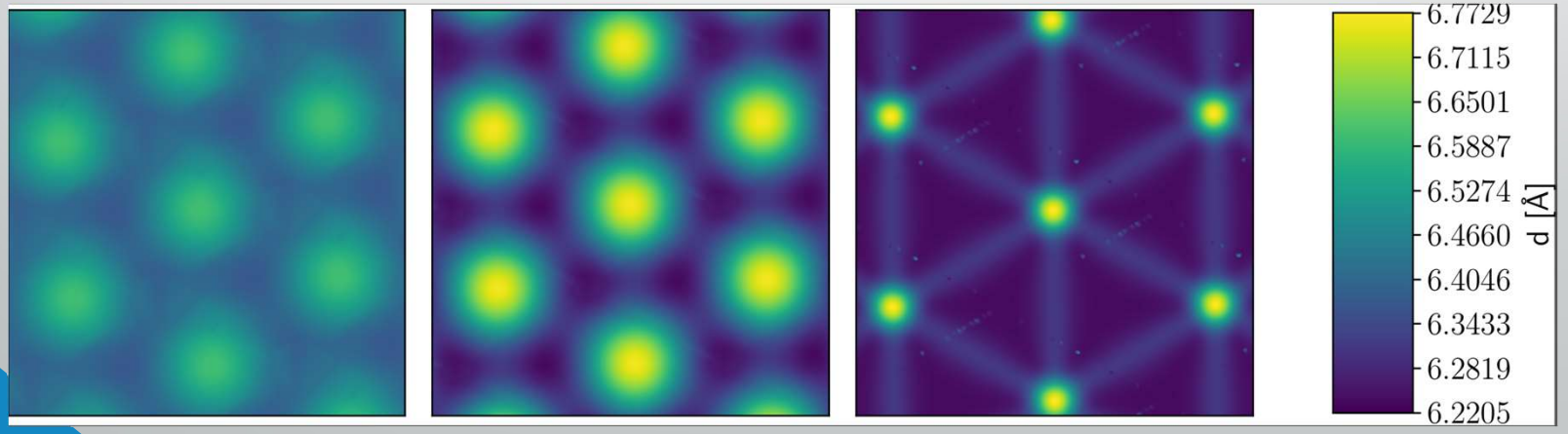
What is a TMD and what is a phonon

- Transition Metal, M commonly Molybdenum (Mo) or Tungsten (W)
- Chalcogen, X: commonly selenium, sulfur
- Transition Metal Dichalcogenide (TMD): MX_2
- Phonons are quantised particles of vibration (like how emitted photons from atoms are quantised)
- Any different mode of oscillation represents a phonon mode at a specific phonon frequency

Outline of the project:

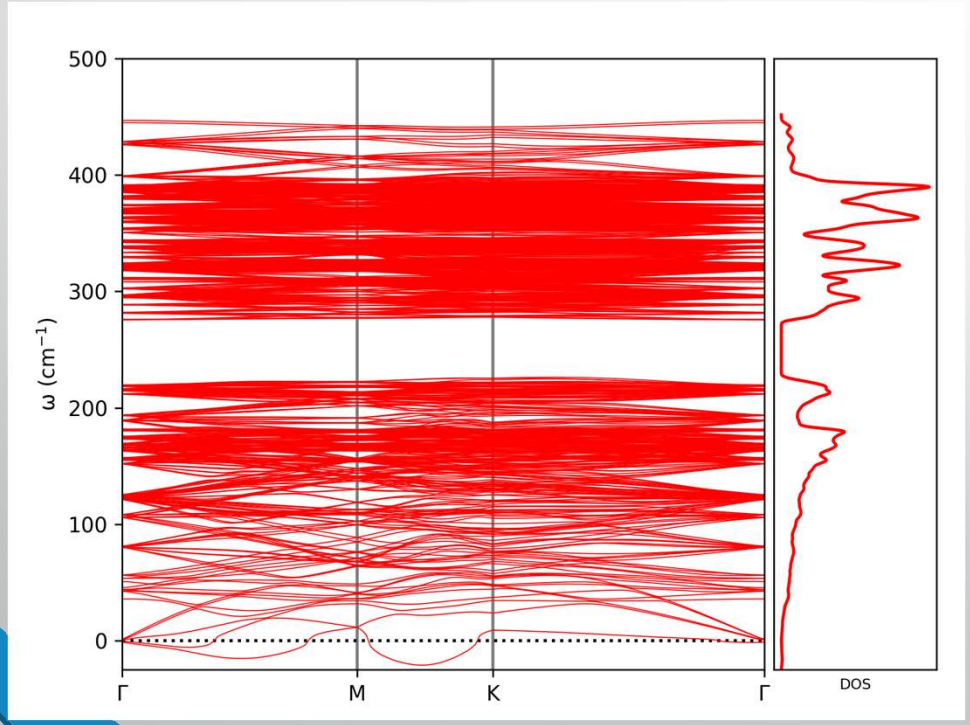
- Traditionally, calculation of minimisation energies and phonon modes are traditionally done with a computationally expensive set of calculations called density functional theory
- This solves the Schrödinger equation (and a bunch of other stuff) using the electron density functional as part of the wavefunction
- Newer methods use Machine-Learned Interatomic Potentials
- Implement this Machine-Learned Interatomic Potential into LAMMPS to relax the material. Relaxed material will have varying interlayer distance due to atoms settling in different potential wells




6.7729
6.7115
6.6501
6.5887
6.5274
6.4660
6.4046
6.3433
6.2819
6.2205
d [Å]

Outline of the Project

- Then perform Phonon /vibration mode analysis by calculating the second order force constant tensor. This is done under the hood
- We get phonon bandstructures



$$\Phi_{ij}^{\alpha\beta} = \frac{\partial^2 U}{\partial x_{i,\alpha} \partial x_{j,\beta}}$$

Conclusion

- Very fast, performed 17862 atom in 48 hours, DFT would take weeks.
- Predictions can be easily made

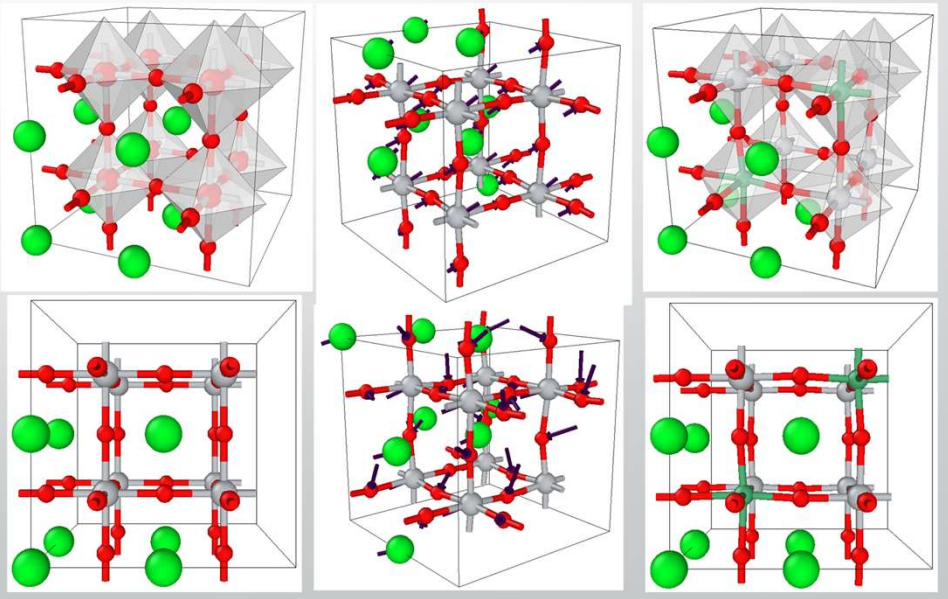
WCPM Mathys

OVITO

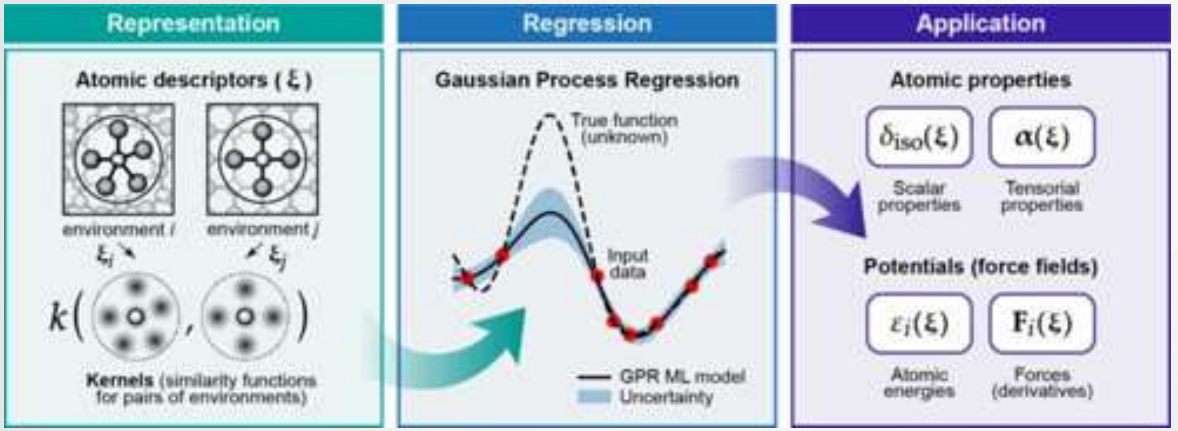
- Title: Computational Study of Niobium-Doped Strontium Titanate Perovskites
- Supervisor: Albert Bartók-Pártay

CASTEP

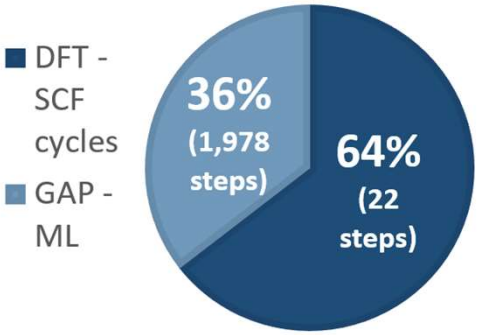
1. Condensed Matter --> (Maths/Phys/Chem/Eng)
2. Computational Research (**WCPM** + **HetSys** + **Conferences…**)
3. Thermoelectrics
4. DFT modelling $SrTiO_3$ --> **CASTEP** (octahedral tilting, defect migration…)



GAP-Machine Learning



Evaluating speedup time: 2000 iteration example from above	
Time for GAP+DFT	15h 29m
Time for DFT only	37d 10h 10m

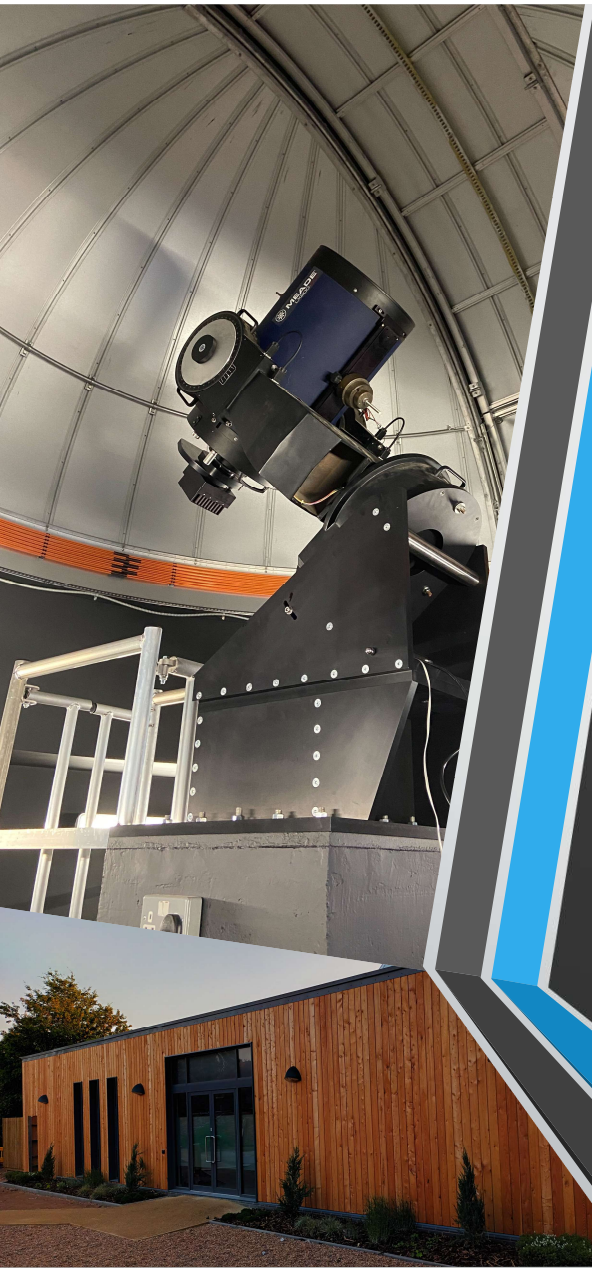


Time in SCF cycles	64.5%
Time in GAP	35.5%
Total Iterations	2000
AIMD iterations in same time	≈34
Speedup using ML	≈58×

Sam

- Title: Exploring Excited B Mesons at the LHCb Experiment
- Supervisor(s): Fernando Abudinén and Tim Gershon

$$B_c^+ \to B_{(s)}^{*0}\pi^+$$
$$\hookrightarrow \mu^+\mu^-$$



Davina

- Title: The Birth of Windmill Hill Observatory
- Supervisor(s): Daniel Bayliss (special thanks to James McCormac and Paul Chote)

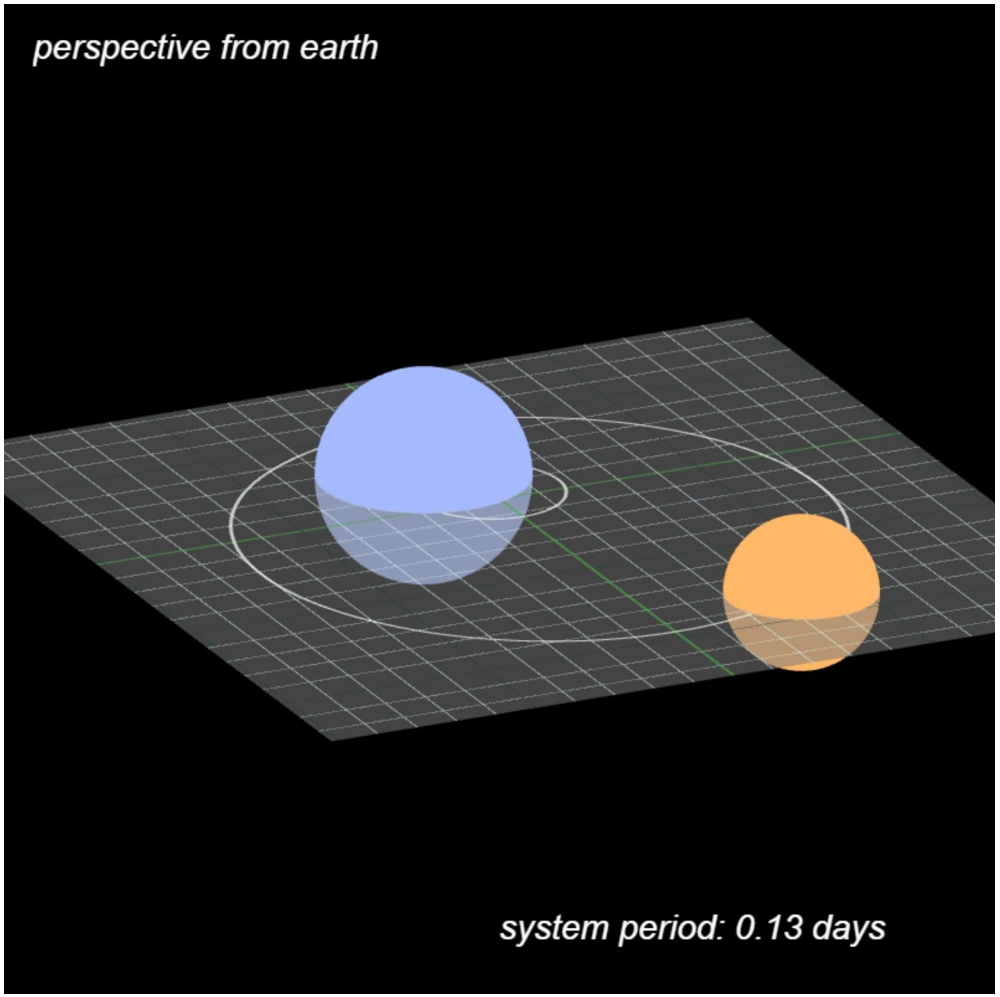
Now known as The Marsh Observatory

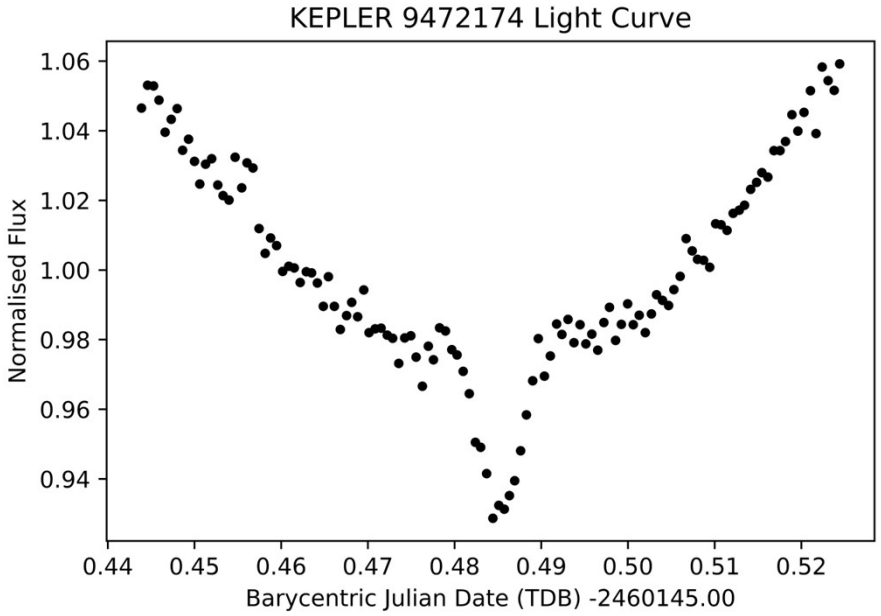
- Image processing
- Eclipsing Binaries/transits
- Zero-point calibration
- Outreach

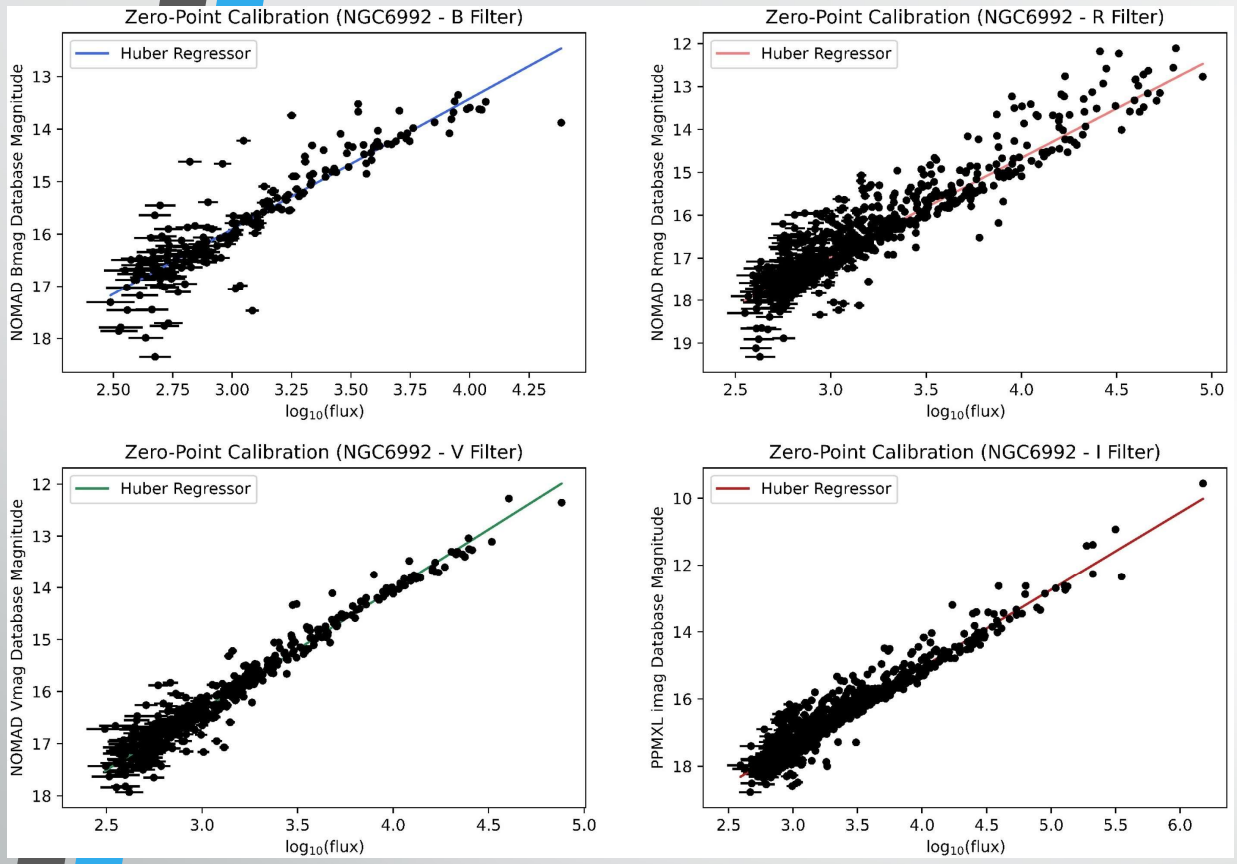

NGC6992


M13


M27


perspective from earth
system period: 0.13 days


KEPLER 9472174 Light Curve
Normalised Flux
1.06
1.04
1.02
1.00
0.98
0.96
0.94
0.44
0.45
0.46
0.47
0.48
0.49
0.50
0.51
0.52
Barycentric Julian Date (TDB) -2460145.00



$$m = -2.5\,log_{10}\left(\int_0^{\infty} F(\lambda)\,S\,d\lambda\right) + C$$

m is the apparent magnitude

$F(\lambda)$ flux as a function of wavelength

S is the sensitivity function $\left(S = \begin{cases} 1, & inside\ colour\ band \\ 0, & outside\ colour\ band \end{cases}\right)$

C is an unknown constant (the ZERO POINT)

FILTER	ZERO POINT	GRADIENT	STARS FOUND	OUTLIERS
B	23.36 ± 0.29	-2.48 ± 0.21	230	25
V	23.30 ± 0.17	-2.32 ± 0.06	473	12
R	23.87 ± 0.35	-2.30 ± 0.23	662	43
I	24.31 ± 0.24	-2.31 ± 0.12	899	30