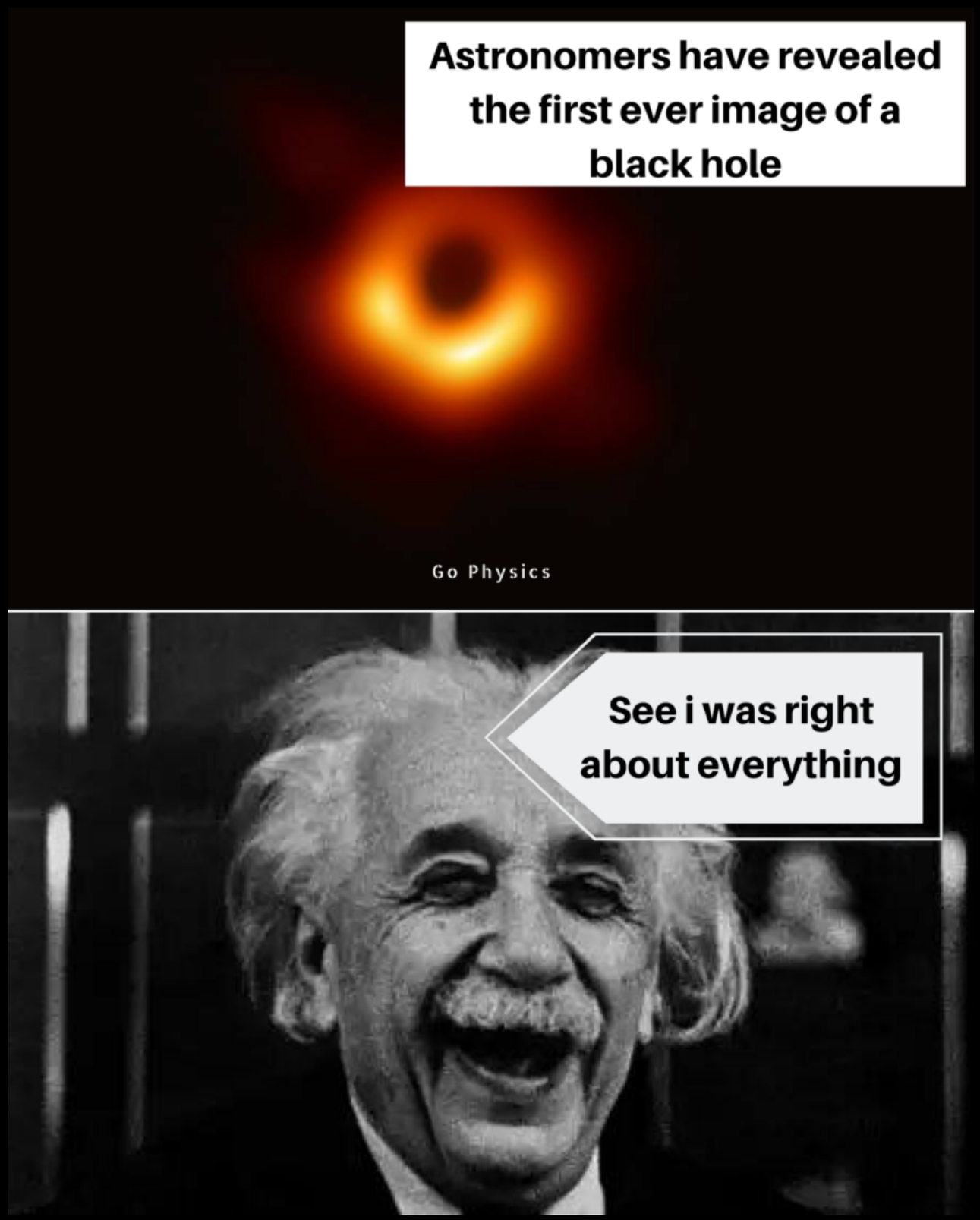
A crash course on Systems Biology for Plant sciences

Uriel Urquiza
Edinburgh


Astronomers have revealed the first ever image of a black hole
Go Physics
See i was right about everything

Ready for a new way of doing biology

What is systems biology?

- A systems thinking approach to biology
  - Life emerges from complex non-linear interactions
    - general systems theory, K. Ludwig von Bertalanffy
- Tackle complexity with formal languages
  - Mathematics
  - Computational sciences

Aim

- Treat biology formally (mathematical and computationally)
    - A tradition in physics and chemistry
- More adopted in biology now though
    - Figure 1 theory Meets Figure 2 experiments
        - (Rob Philips et al. 2018)

Disciplines

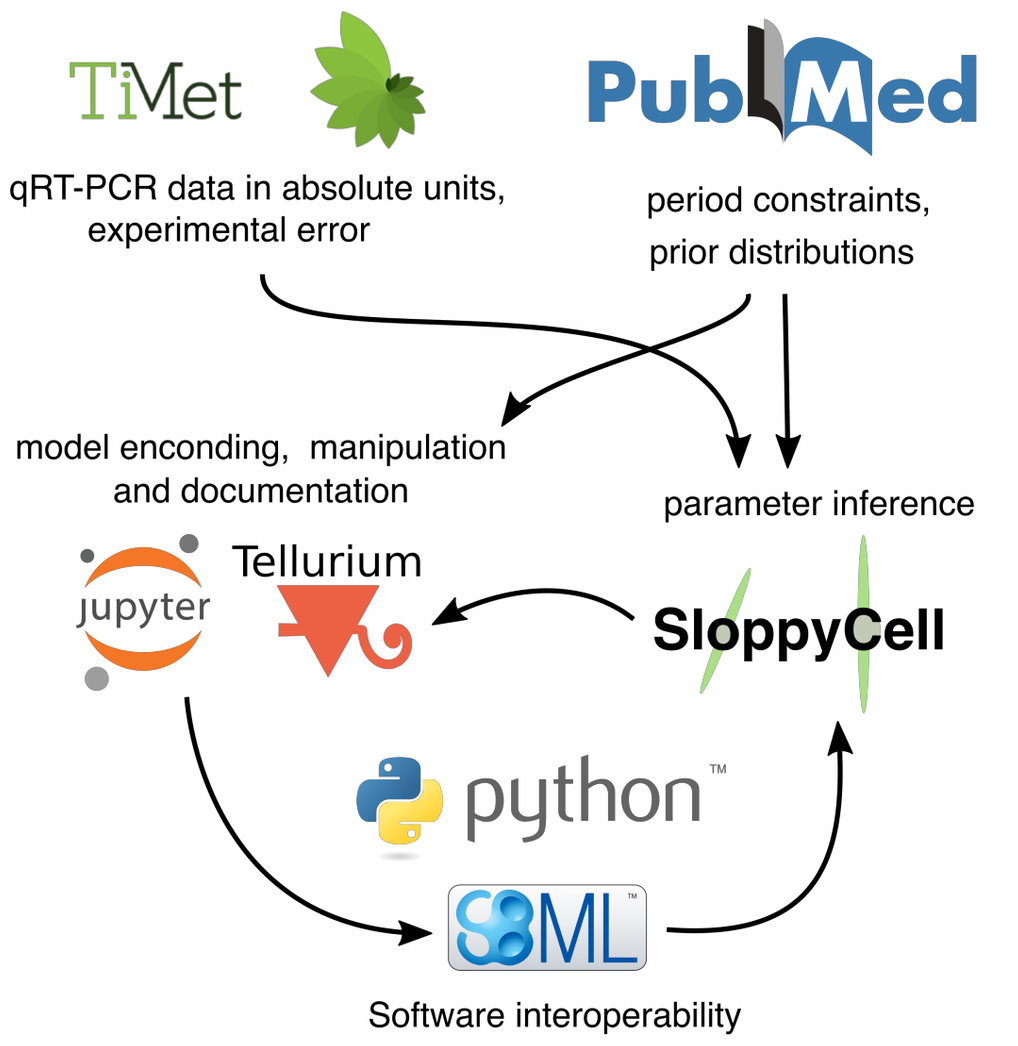
- Biology
- Chemistry (chemical kinetics, allosteric regulation)
- Physics (thermodynamics, statistical mechanics)
- Computer sciences (information theory)
- Engineering (control theory) -> synthetic biology

Why using computational tools?

- Theoretical hypothesis can be tested faster
  - many proposed equations are not analytically tractable
    - even if solvable difficult analytic tools and slow
  - numerical solvers to the rescue for simulating dynamics
  - Parameter inference of non-linear systems requires numerical methods, Maximum Likelihood, Bayesian methods.

The problem, in practice how do we implement all this theory for our benefit

Open tools for systems biology



git
version control

docker
reproducible
OS environment

Reproducibility in systems biology

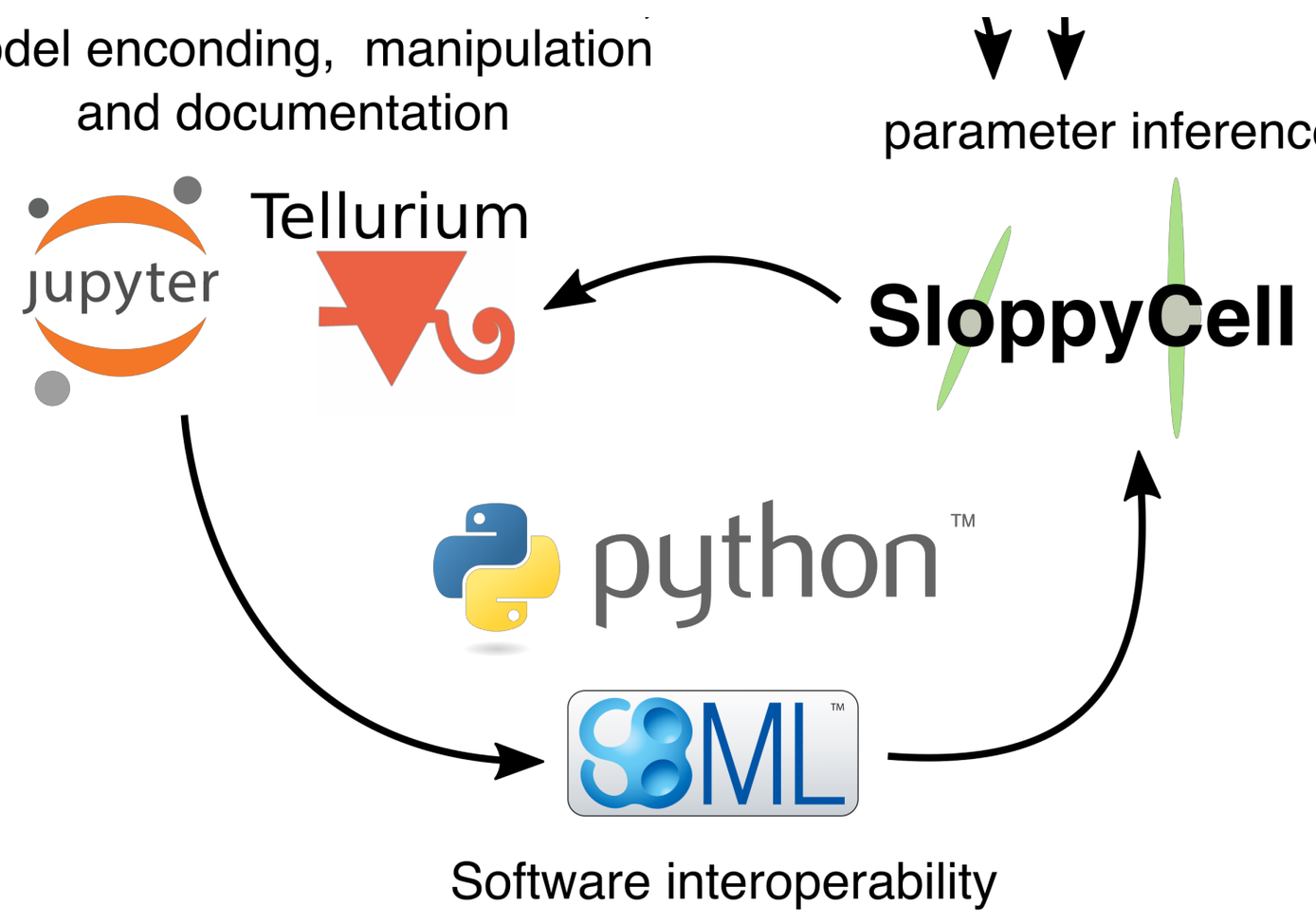
- Computational tools are not treated with the same standards as experimental results why?
- Lack of understanding for reviews. How to asses reproducibility?
- How to solve this?

Tools for reproducible computational research

version control

reproducible
OS environment

Documenting your progress



Lets do some Physical chemistry