

TARDIS



TARDIS

Exploring supernovae made easy

SN

a radiative transfer code, an open source
community, and an interdisciplinary collaboration

W. E. Kerzendorf
ESO Fellow
European Southern Observatory
on behalf of the collaboration



Ulrich Noebauer

Stefan Lietzau

Stuart Sim

Vytautas Jančiauskas

Fotis Tsamis

Aoife Boyle

Frederik Beaujean

Hans Eggers

Talytha Barbosa

Christian Vogl

Adam Suban-Loewen

Gaurav Gautam

Sourav Singh

Maryam Patel

Vaibhav

Ujjwal Wahi

Kevin Yap

The TARDIStas

Contributors



OpenHub has analysed our code and says:

In a Nutshell, tardis-sn...

...has had [2,685 commits](#) made by [38 contributors](#)
representing [11,938 lines of code](#)

...is [mostly written in Python](#)

with [an average number of source code comments](#)

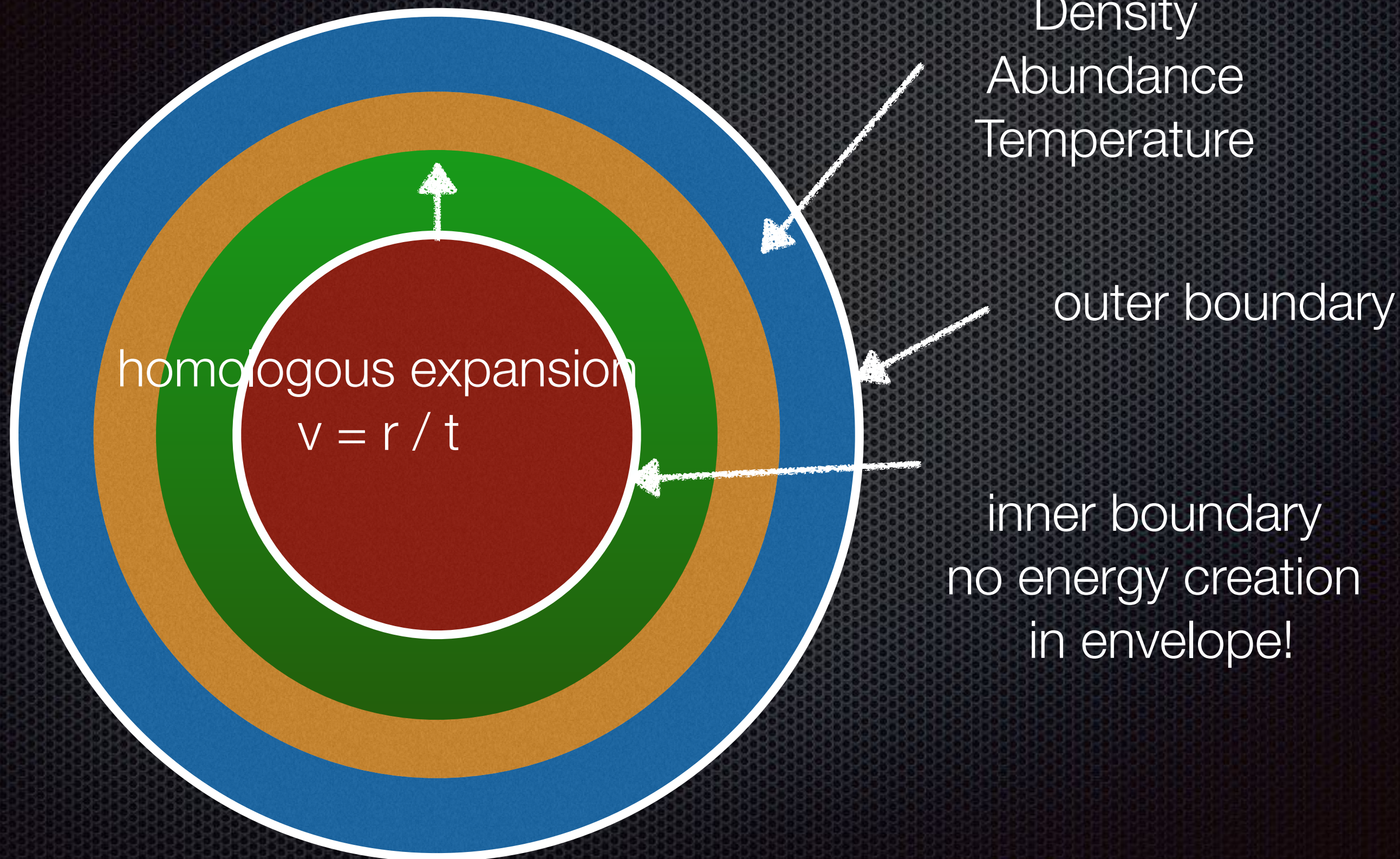
...has [a well established, mature codebase](#)
maintained by [a large development team](#)
with [decreasing Y-O-Y commits](#)

...took an estimated [3 years of effort](#)(COCOMO model)

starting with its [first commit in December, 2011](#)
ending with its [most recent commit 4 days](#) ago

How does it work?

TARDIS 1D Supernova Model



TARDIS Simulation

TARDIS 1D Model

pick a time
pick output luminosity



TARDIS solves
plasma states



Montecarlo starts



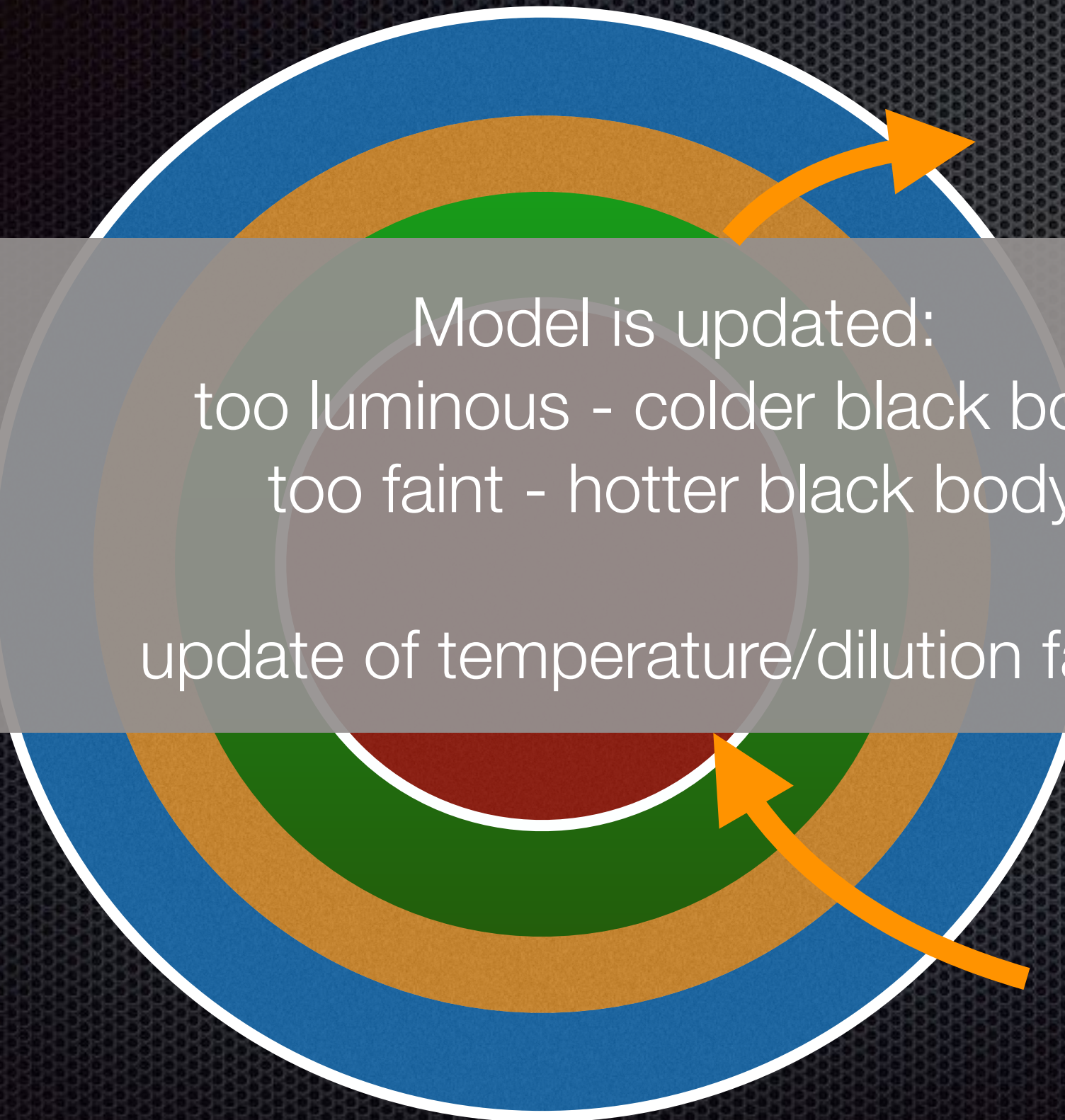
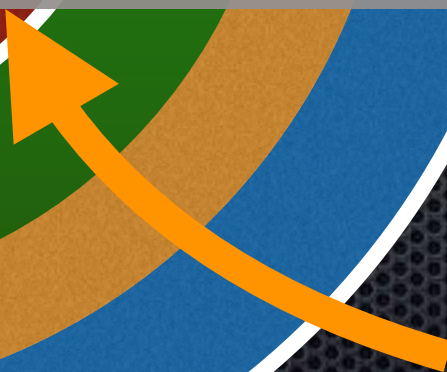
Spectrum
estimators:

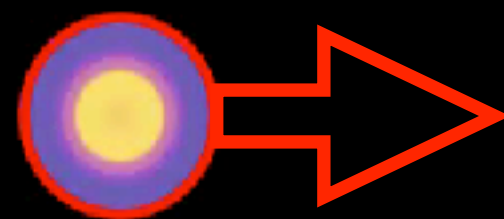
e.g.

rad. Temperature

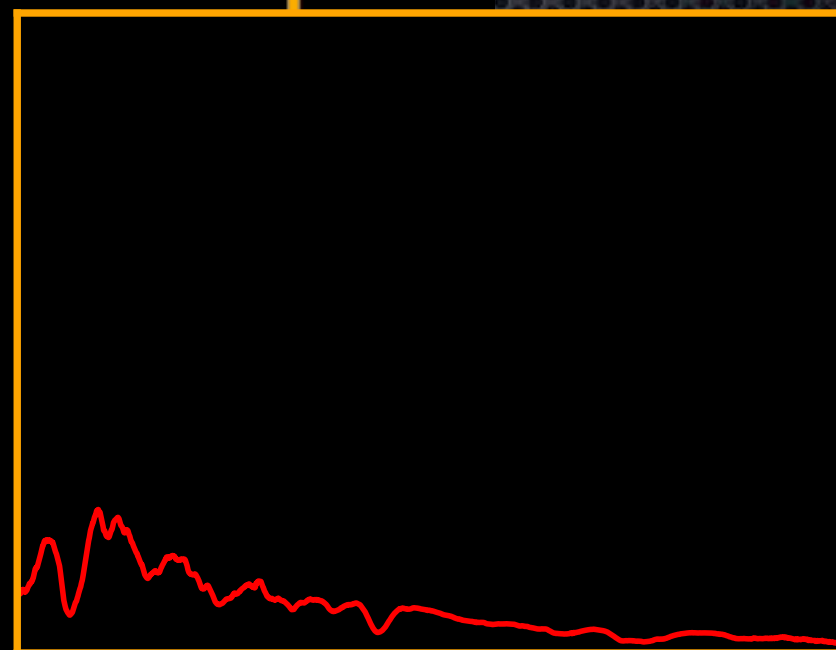
Model is updated:
too luminous - colder black body
too faint - hotter black body

update of temperature/dilution factor





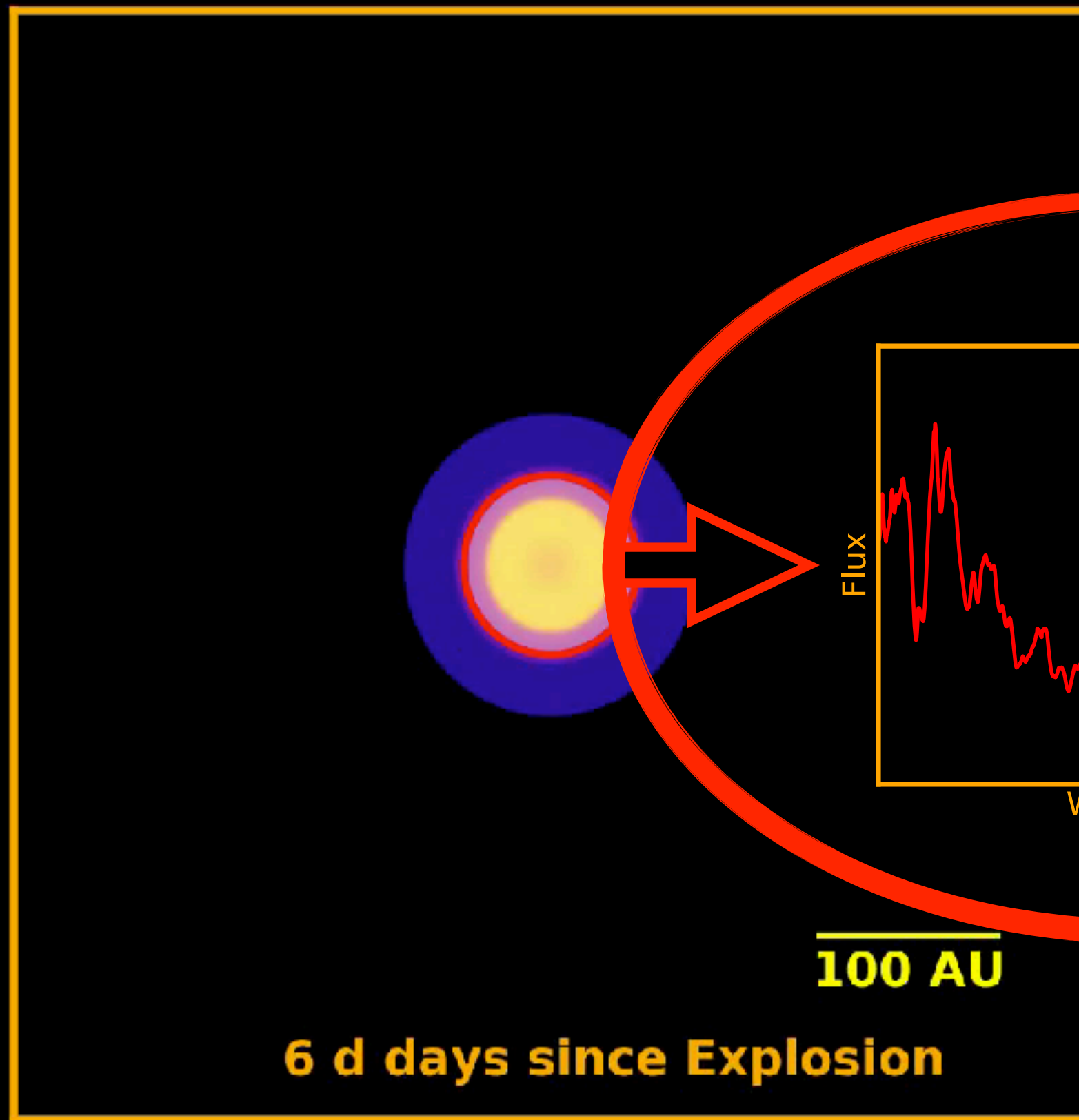
Flux



Wavelength

100 AU

3 d days since Explosion



Best practices

for a scientific code (IMHO)

which I unfortunately sometimes ignored

Best Practices - quickest way from idea to product

- ✦ hack things together
- ✦ don't use anything that will slow you down (can be version control, unit tests, etc.)
- ✦ don't worry you will likely rewrite
- ✦ specifically speed is not an issue (in most cases)

“ We should forget about small efficiencies, say about 97% of the time: **premature optimization is the root of all evil** ”

— Donald Knuth

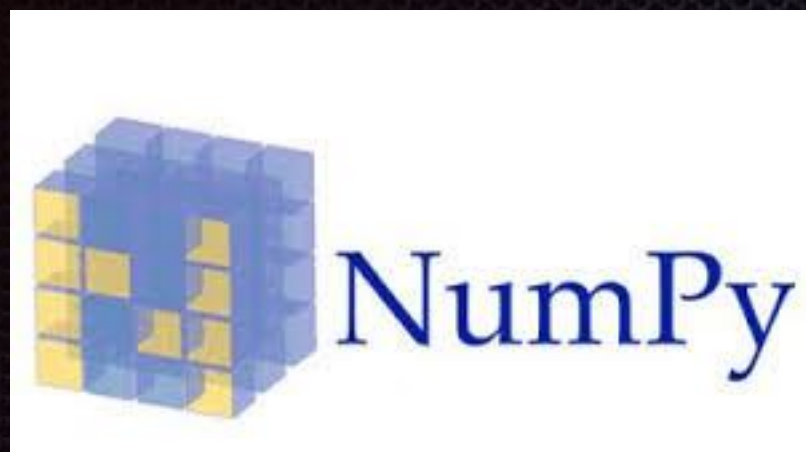


Don't Reinvent

Reuse!

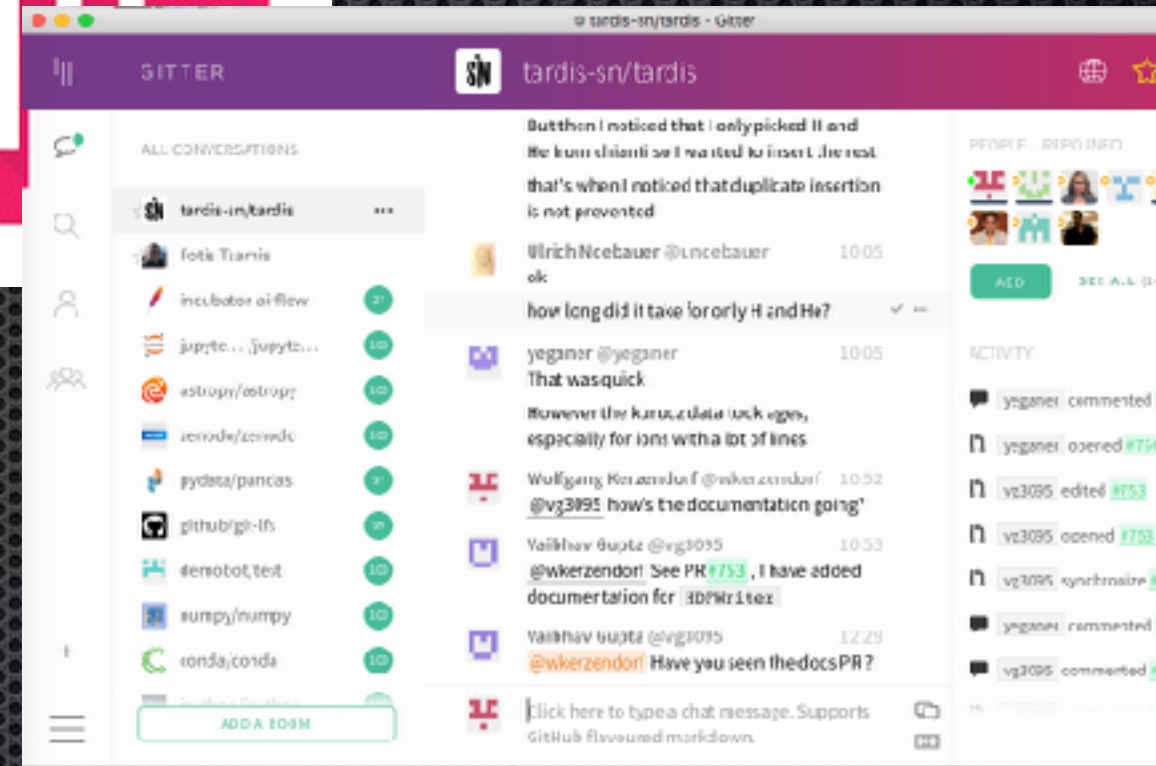
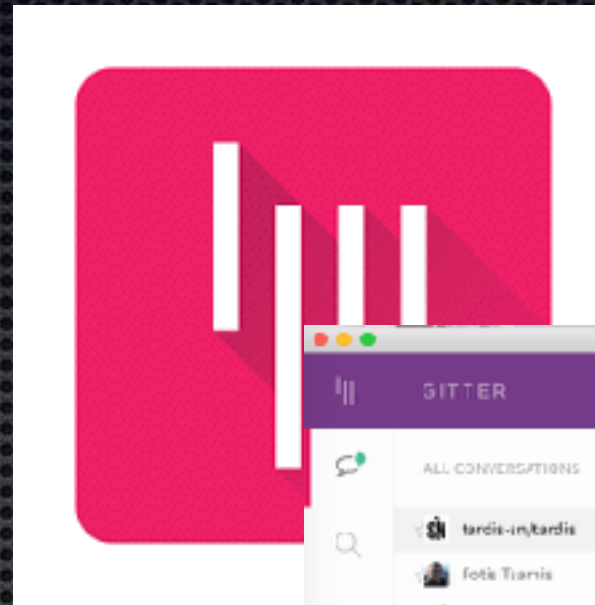
**Best use for old wedding dress: snow
hunting camo**





Best practices

Building a community

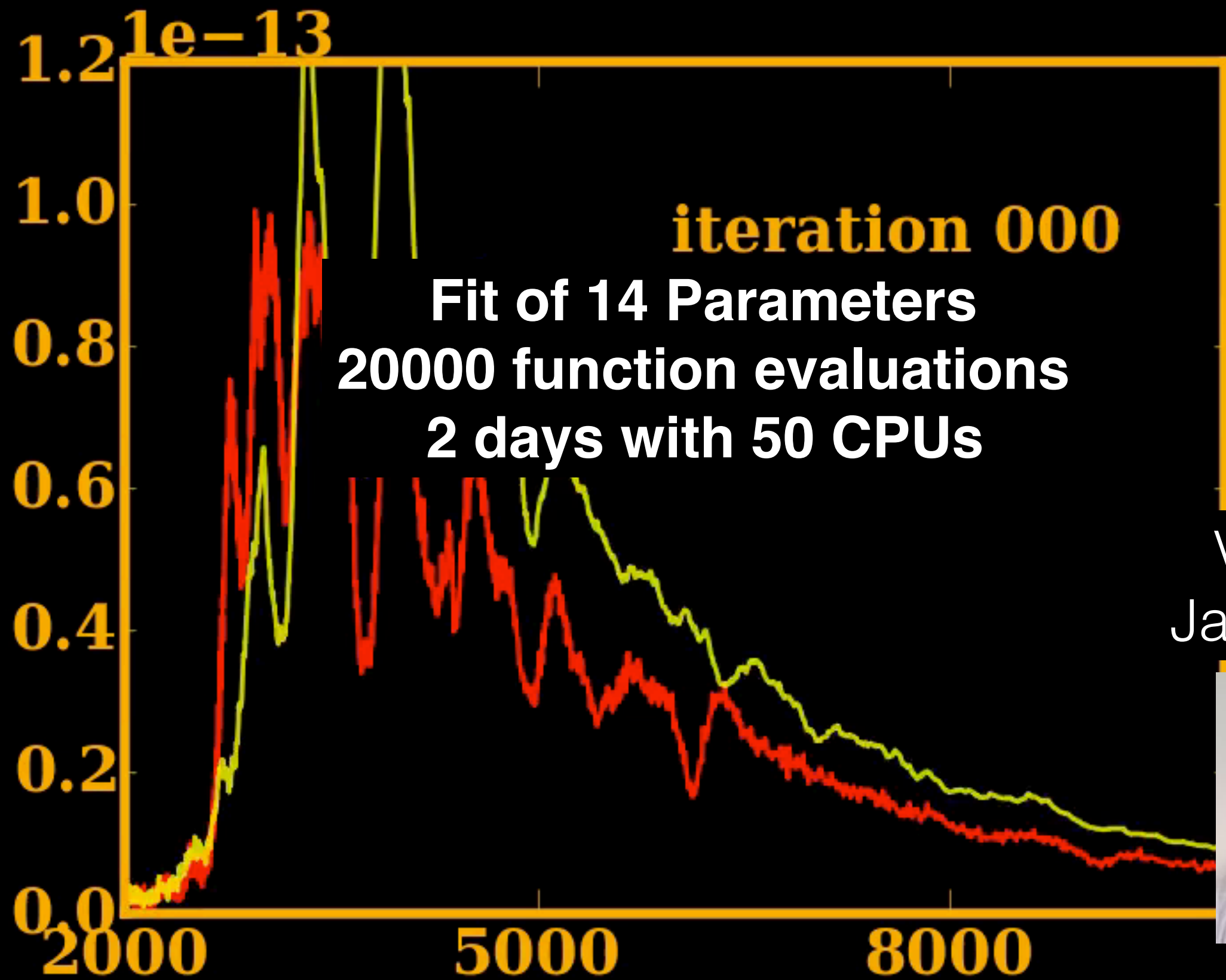


Best practices

Building an interdisciplinary community

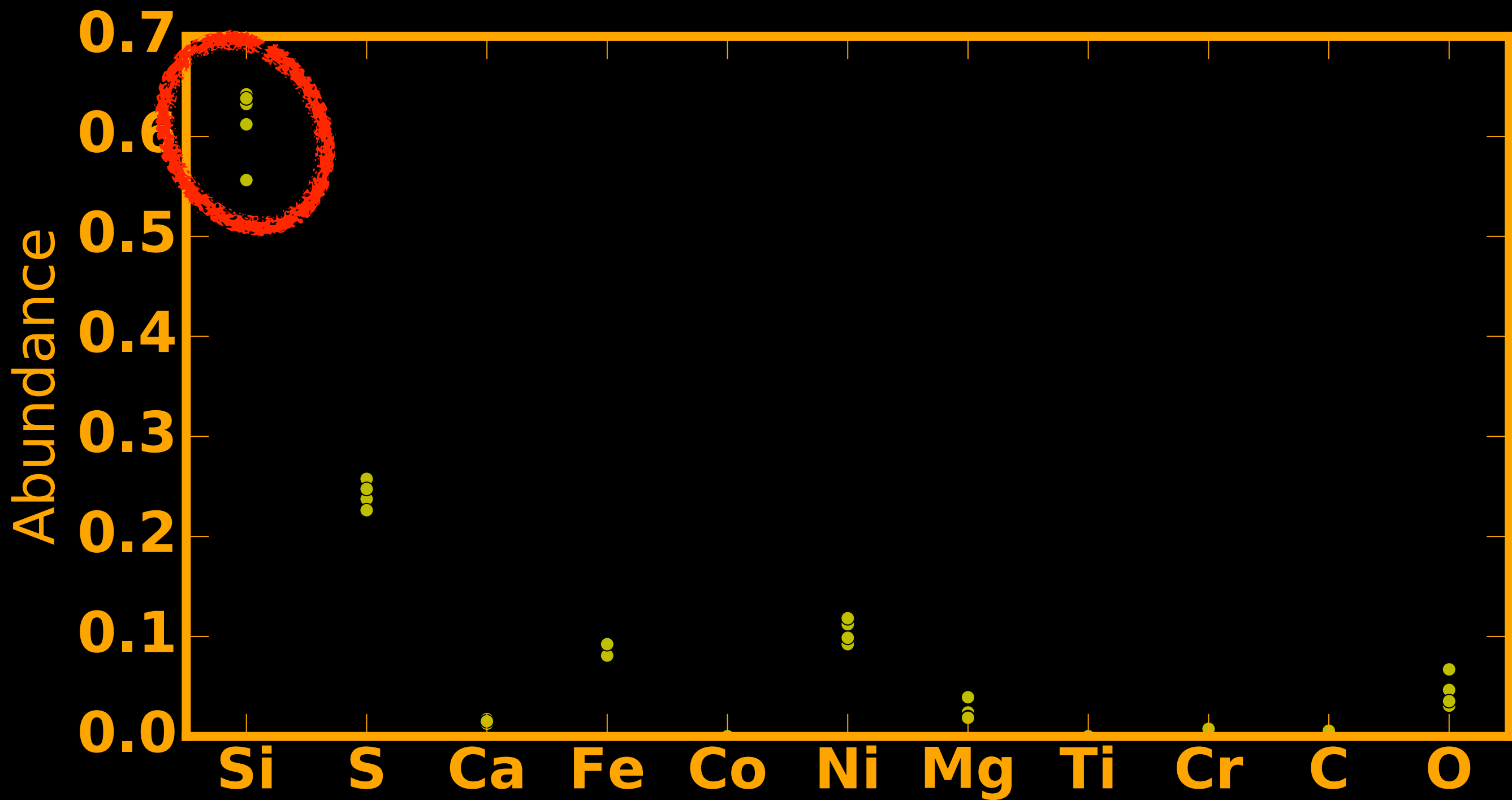
Computer scientists

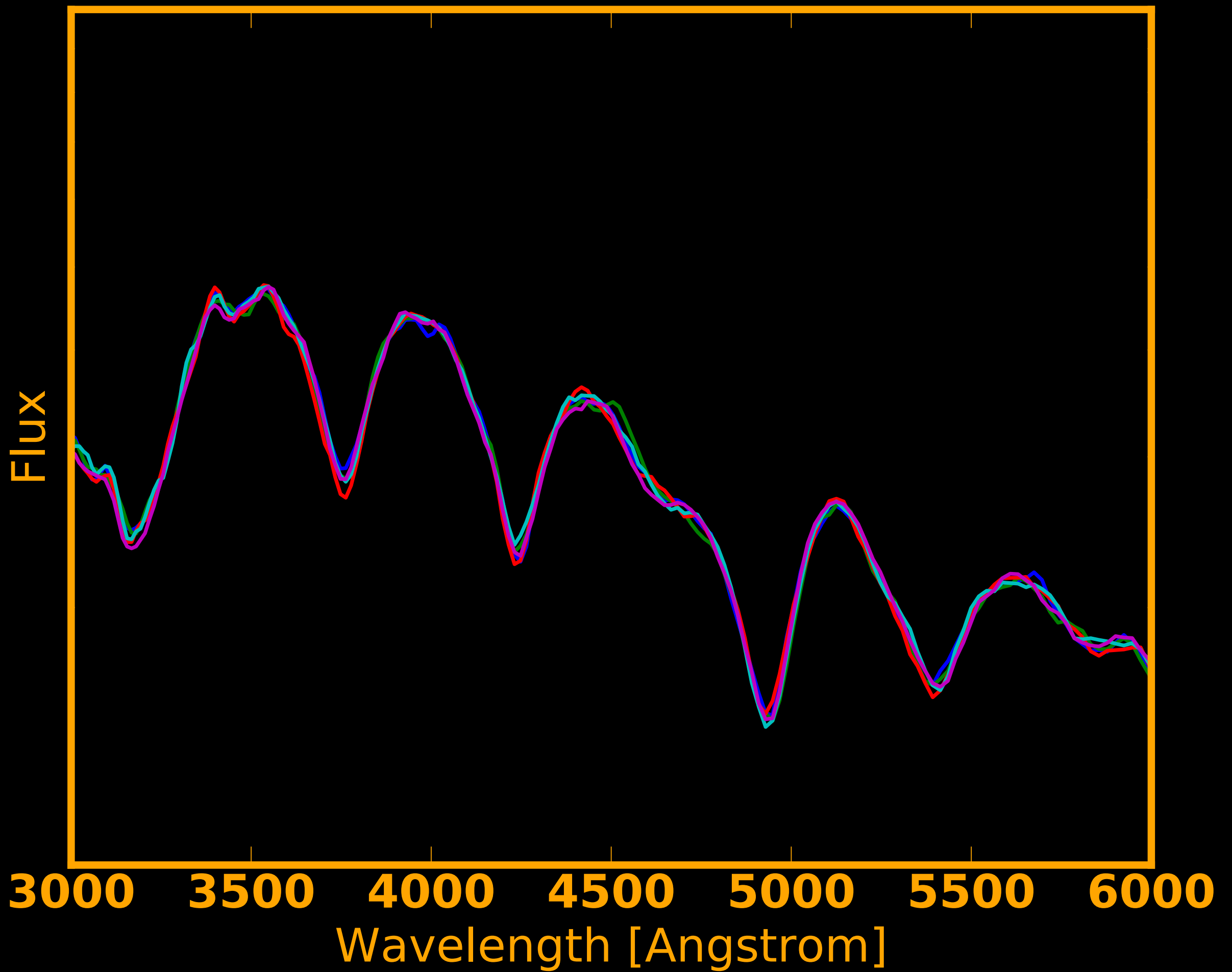
Optimizer - Differential Evolution



Vytautas
Jančiauskas



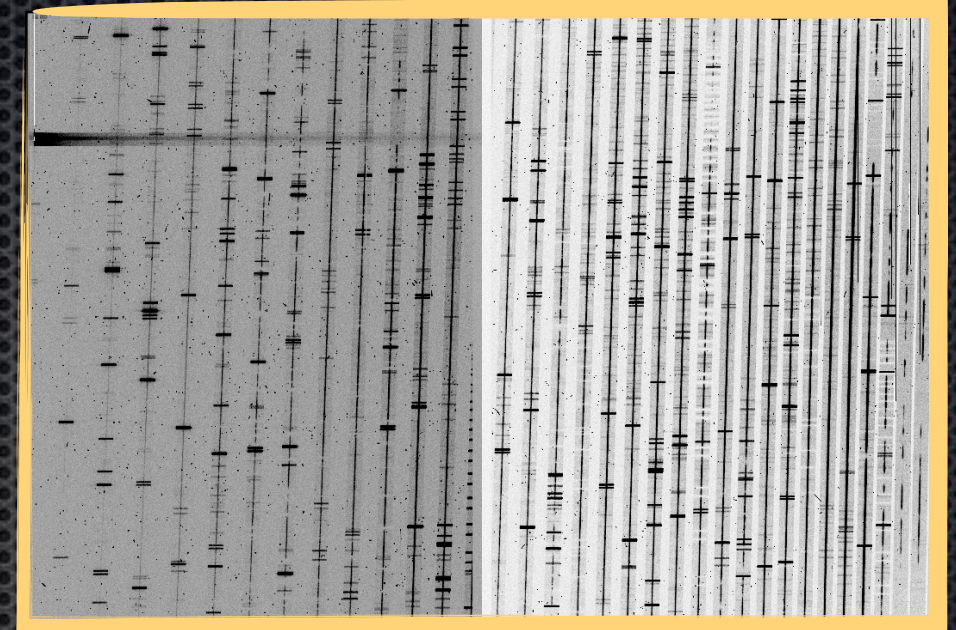




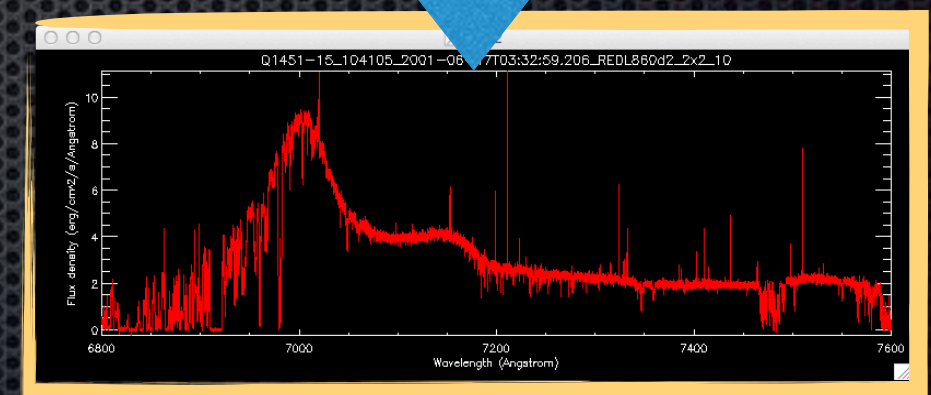
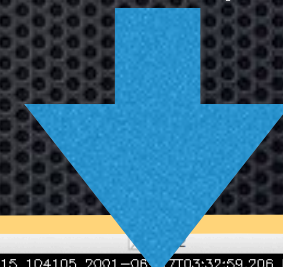
Statisticians

Know your limits!

- ✧ What carries the biggest uncertainty?
- ✧ What precision do you need to distinguish between models?
- ✧ A statistician will be disgusted at first!



Raw frame from the UVES high-resolution spectrograph



Processed data: it's an accreting black hole in the infant Universe!

Best practices

Credit - an unsolved problem

Value of you/your code

- ✧ Peer reviewed Journal Article!
- ✧ ASCL
- ✧ Software is difficult - many contributors - constantly changing



zenodo

Developing simulation codes

- ✦ Science discovery needs to be the key driver (everything else is secondary)
- ✦ Only write code that doesn't exist anywhere else
- ✦ Many of the software engineering techniques are geared towards team development - not always applicable

Thank you