

Eliot Ayache



Kilonova afterglows

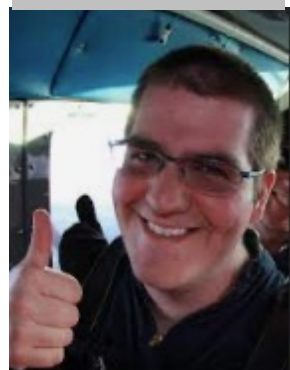
High-energy electron transport and degradation

Sofie Liljegren



Molecule formation in stripped-envelope SNe

Conor Omand



Pulsar wind-powered SNe

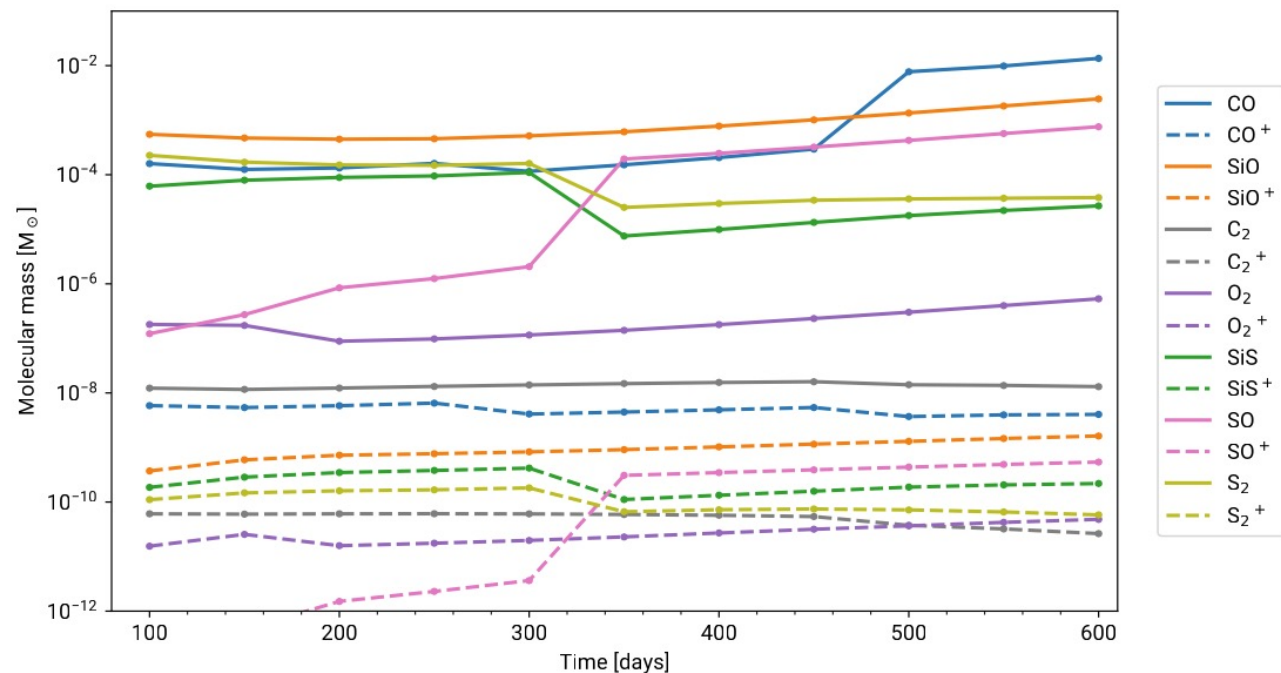
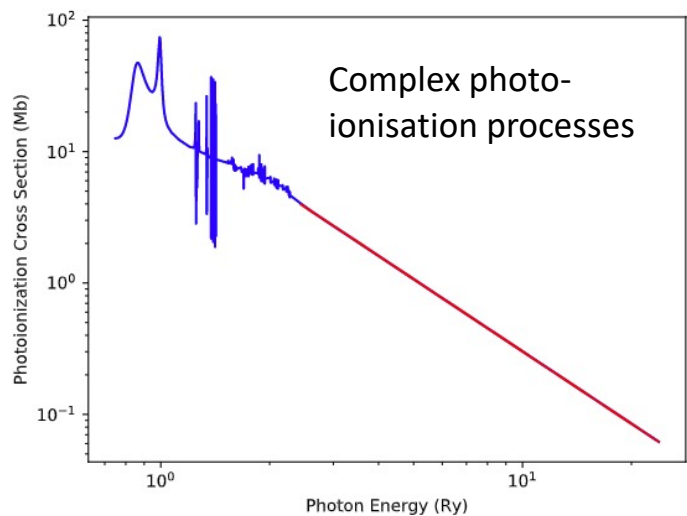


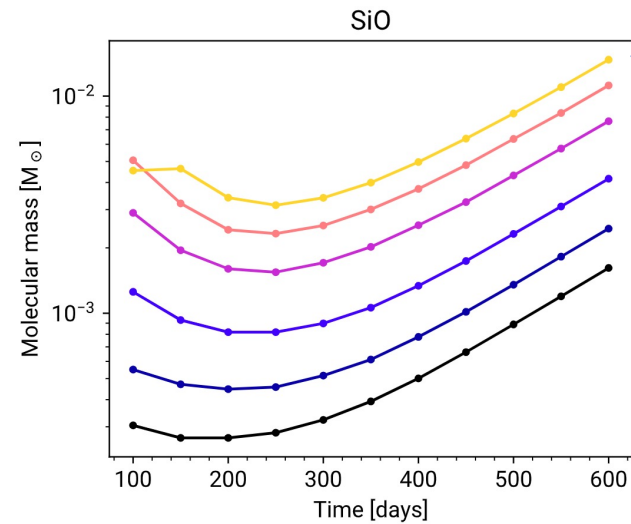
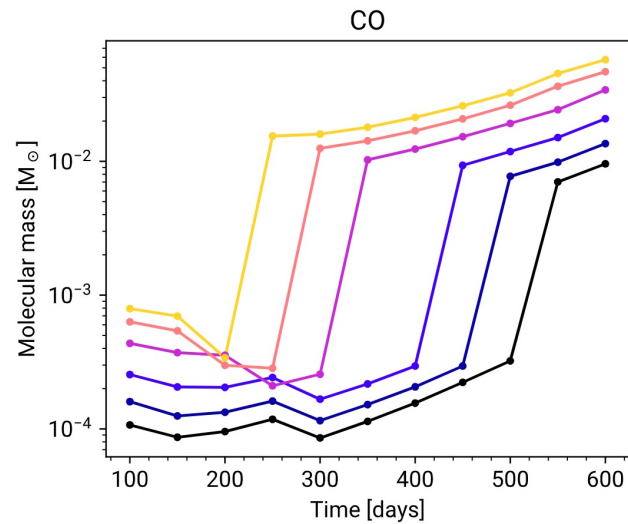
Fig. 1. The total mass formed for different molecule species, over the synthesised epochs.

# The chemistry of Ibc SNe

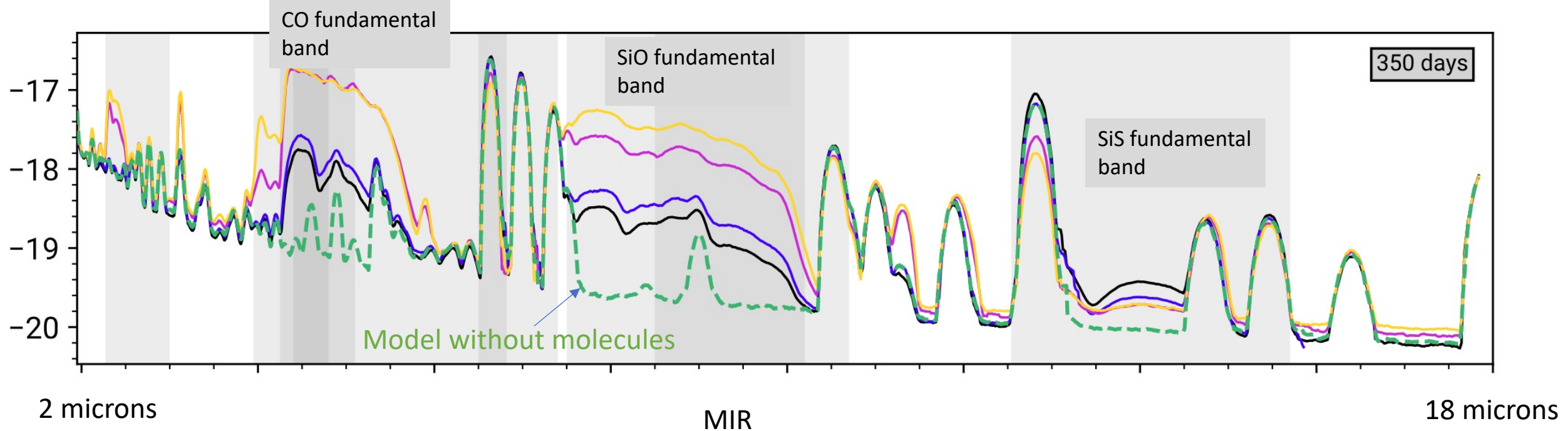


Strong density-sensitivity.

JWST should give very useful constraints.

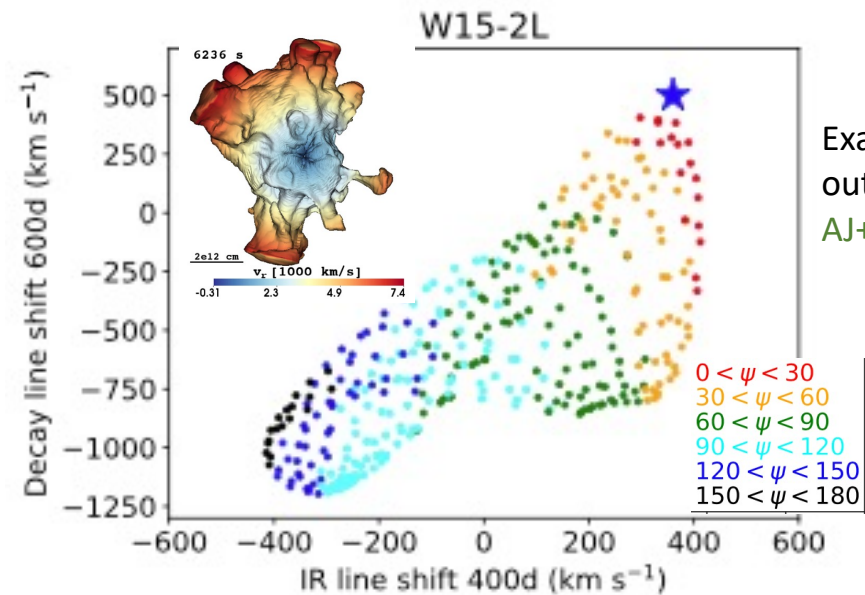
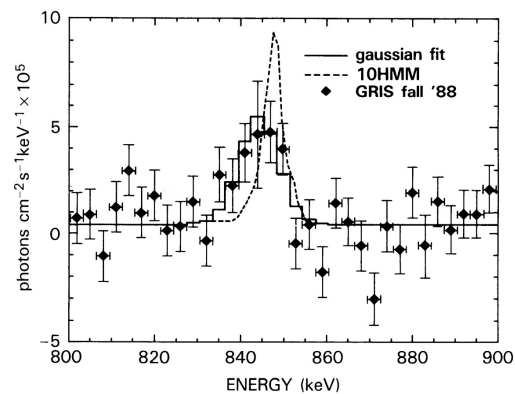
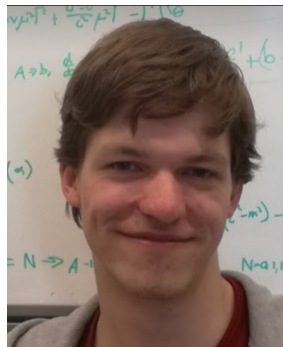


Highest density model  
Lowest density model



Barteld van Baal

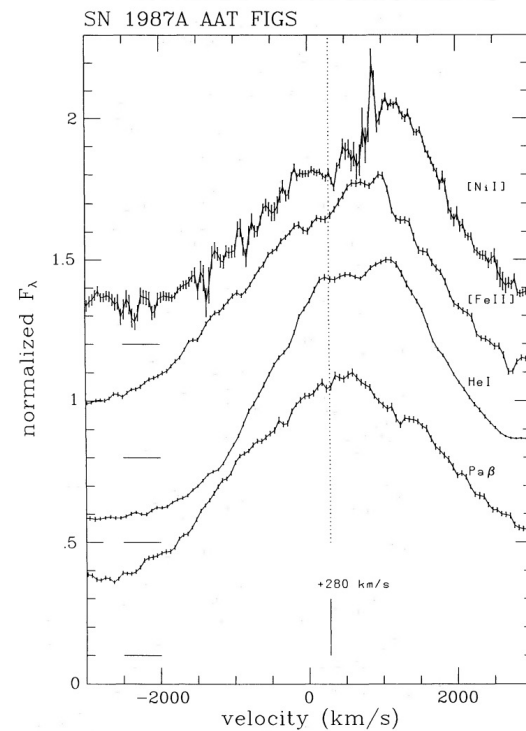
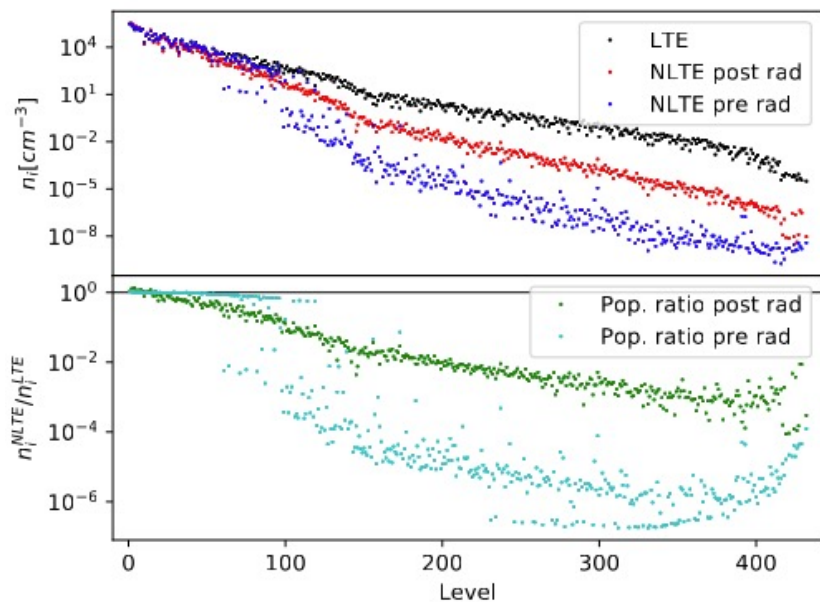
### 3D spectra of supernovae



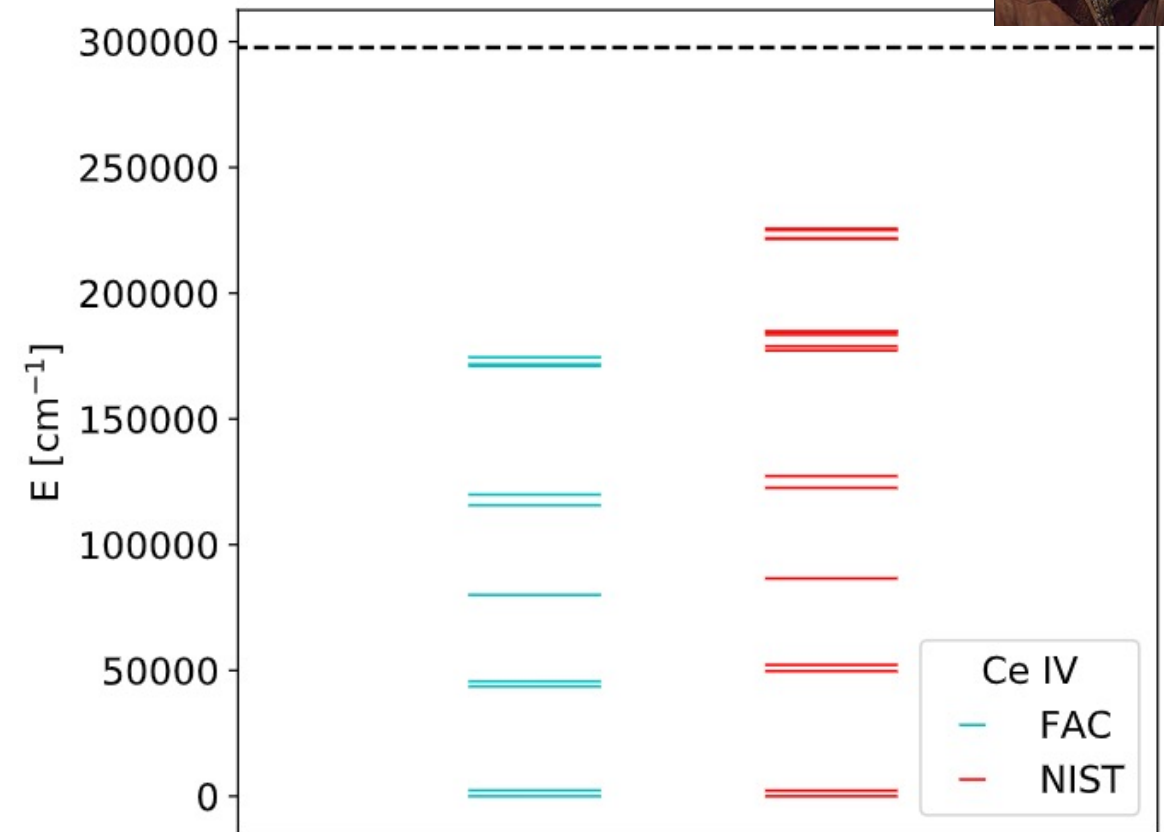
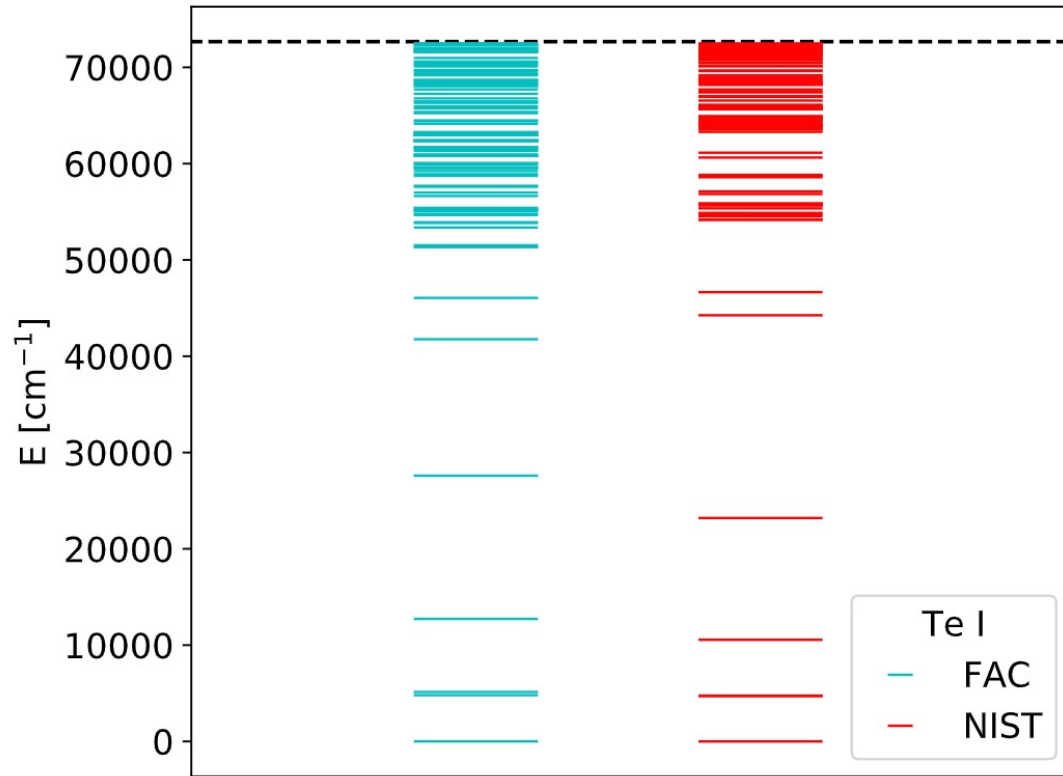
Example 3D output, from AJ+2020.

Quentin Pognan

### NLTE spectra of kilonovae



# r-process atomic data



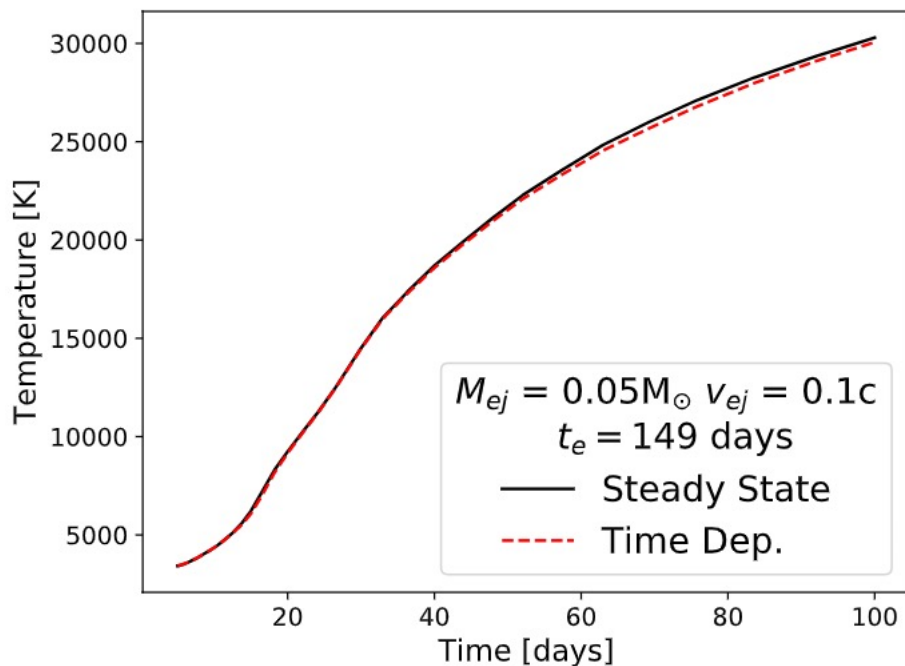
**Figure 1.** Theoretical energy levels of Te I from this work compared to those compiled in the NIST atomic spectra database ([Kramida et al. 2020](#)). The dashed line indicates the ionisation energy as given by NIST. The same kind of plots for the other ions can be found in [Appendix B](#).

**Flexible Atomic Code** : Accuracy is decent enough to get rough transfer effects correct, and right SED shape, but not good enough (mostly) for spectral line IDs.



# Kilonova temperature evolution

AT2017gfo-like ejecta + standard physics →  
Steady state good for  $t > \sim 100d$ .



Temperature *rises* with time:

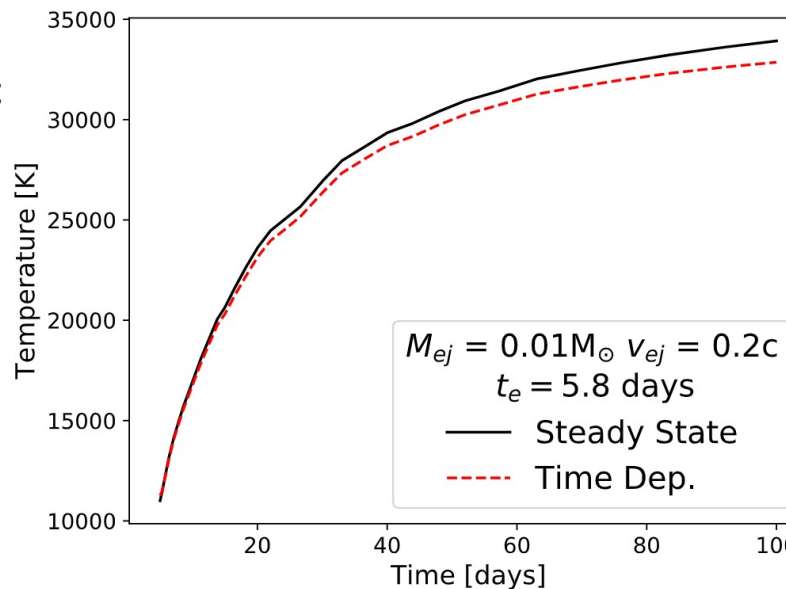
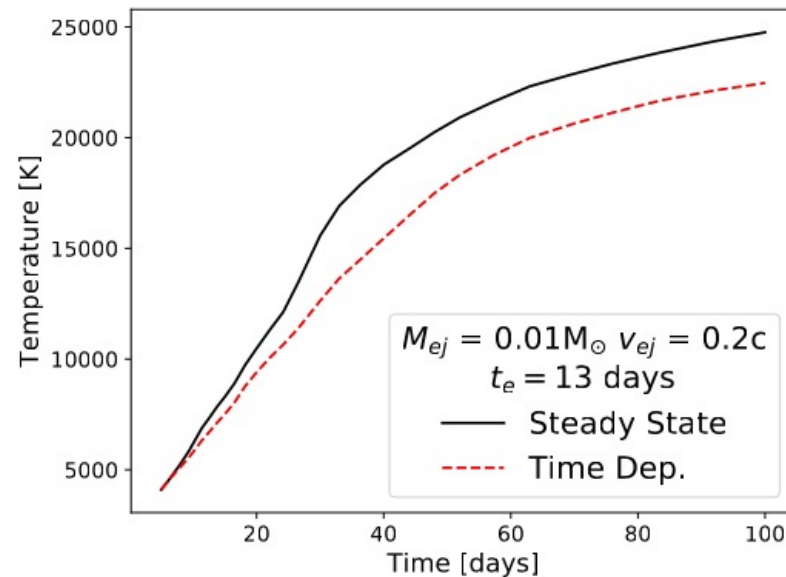
$$h(t) \sim t^{-1/3} * t^{-3} * t^{-1.5} \sim t^{-5.8}$$

$$c(t) \sim \Lambda(T) * t^{-6}$$

..low decay power  
( $1E9$  erg/s/g  
at 1d).

..no magnetic  
trapping of  
electrons.

Low density plus..



# Directions and questions

r-process atomic physics

Improved H-Fe atomic physics

3D

chemistry

Non-thermal electron physics

Unusual power sources

- Modular development – make interfaces as generic as possible.
- Accommodate for future extension needs, but what horizon?
- Separation of physics/code and data.
- Public access
  - Immediate?
  - With a delay?
  - Light versions?

Time-dependent terms

Revisiting assumptions and standard approximations

Technology changes and open-source pressures push astrophysics towards “superstar economies”. How do we adapt advanced modelling degrees and projects? Building a broad environment with rich connections between adjacent fields probably important.