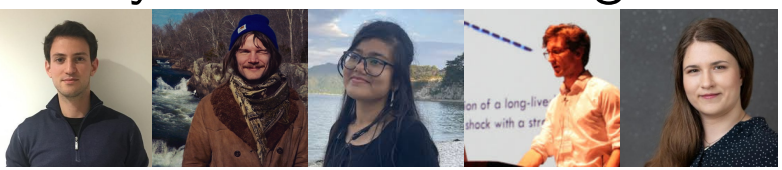
New models for kilonova IR emission - guidance for observation planning

Anders Jerkstrand, with Quentin Pognan, Jon Grumer, Smaranika Banerjee, Eliot Ayache, Blanka Vilagos + many others



Stockholm University

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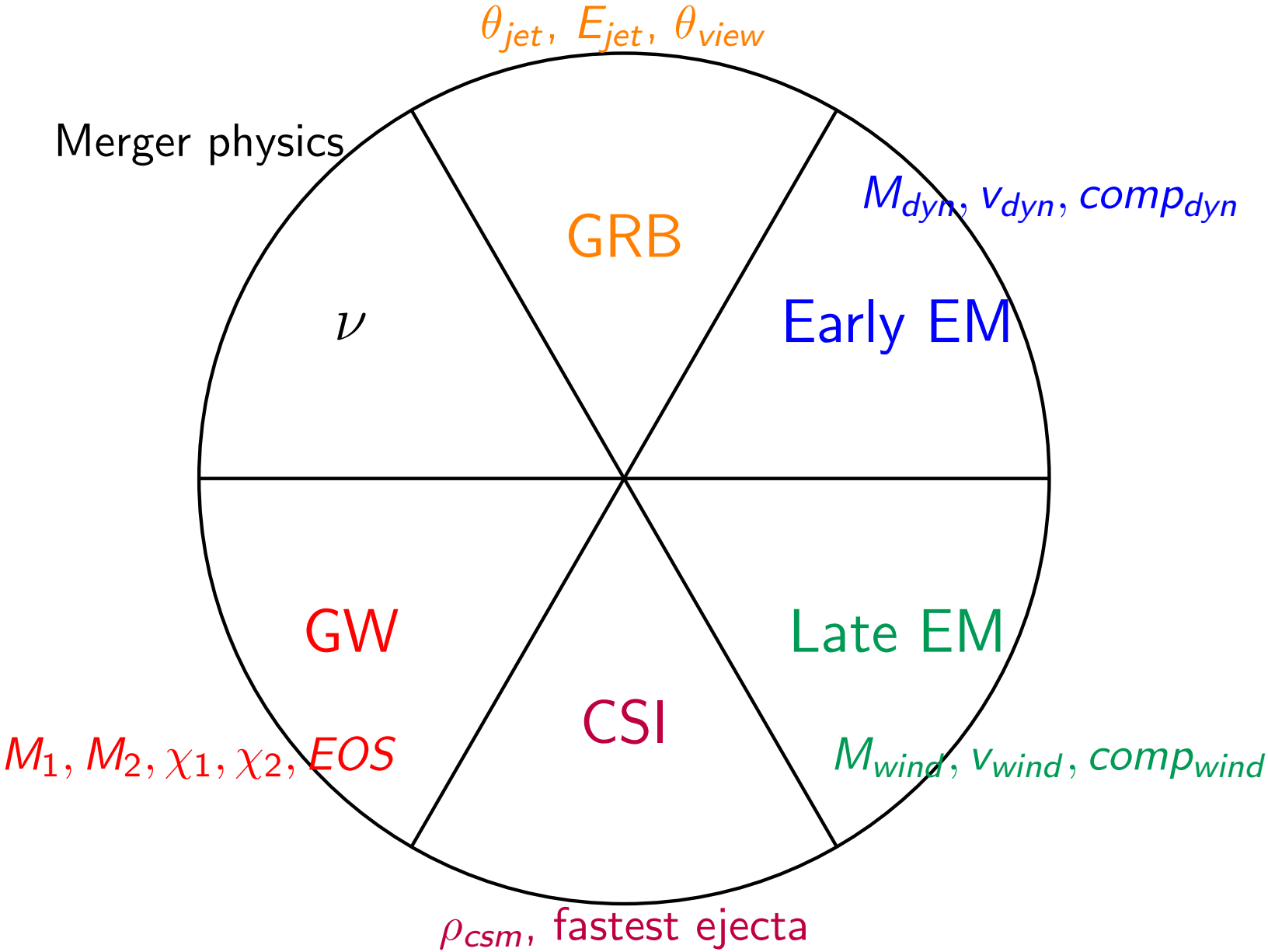
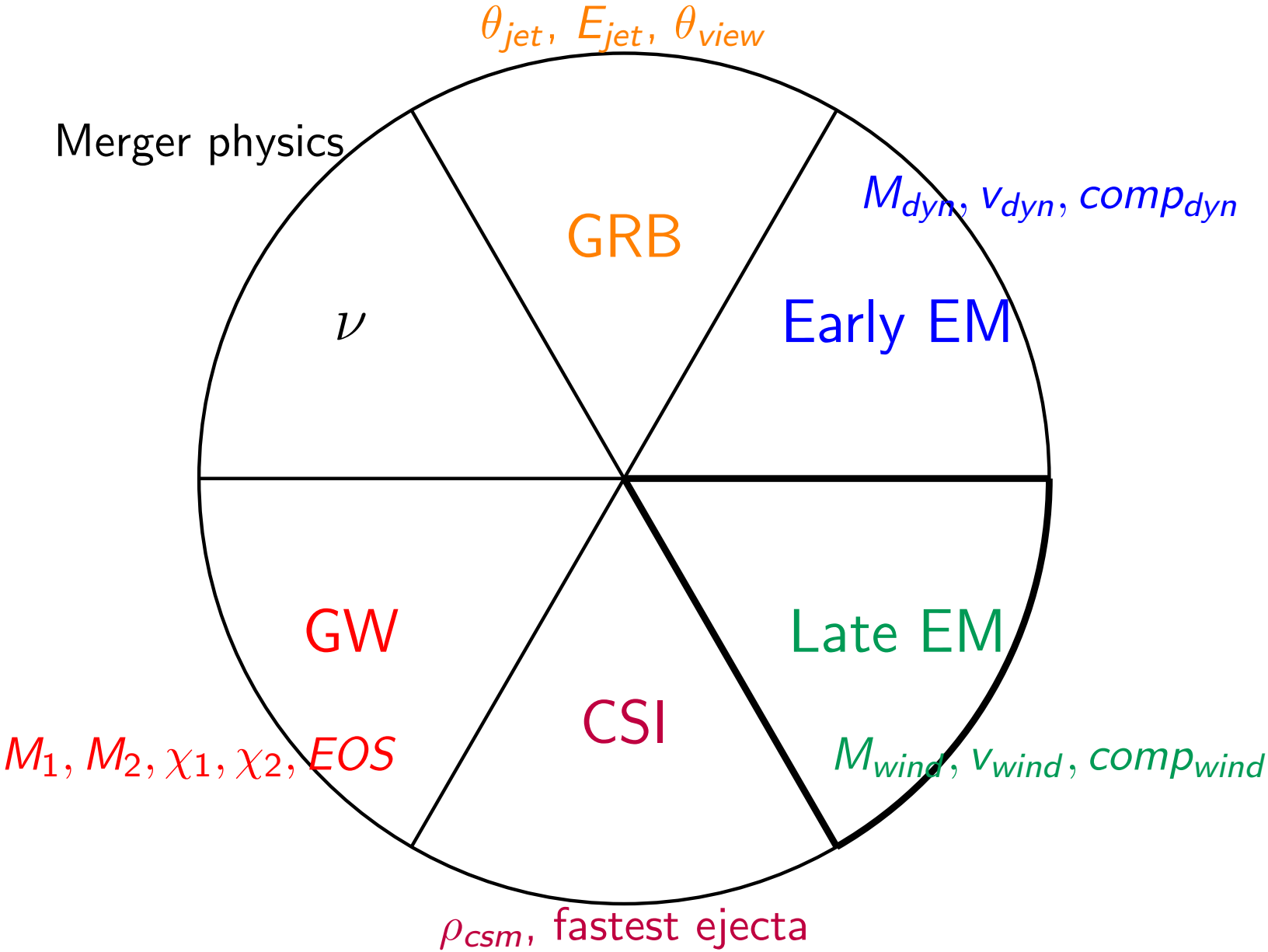
Swedish Research Council

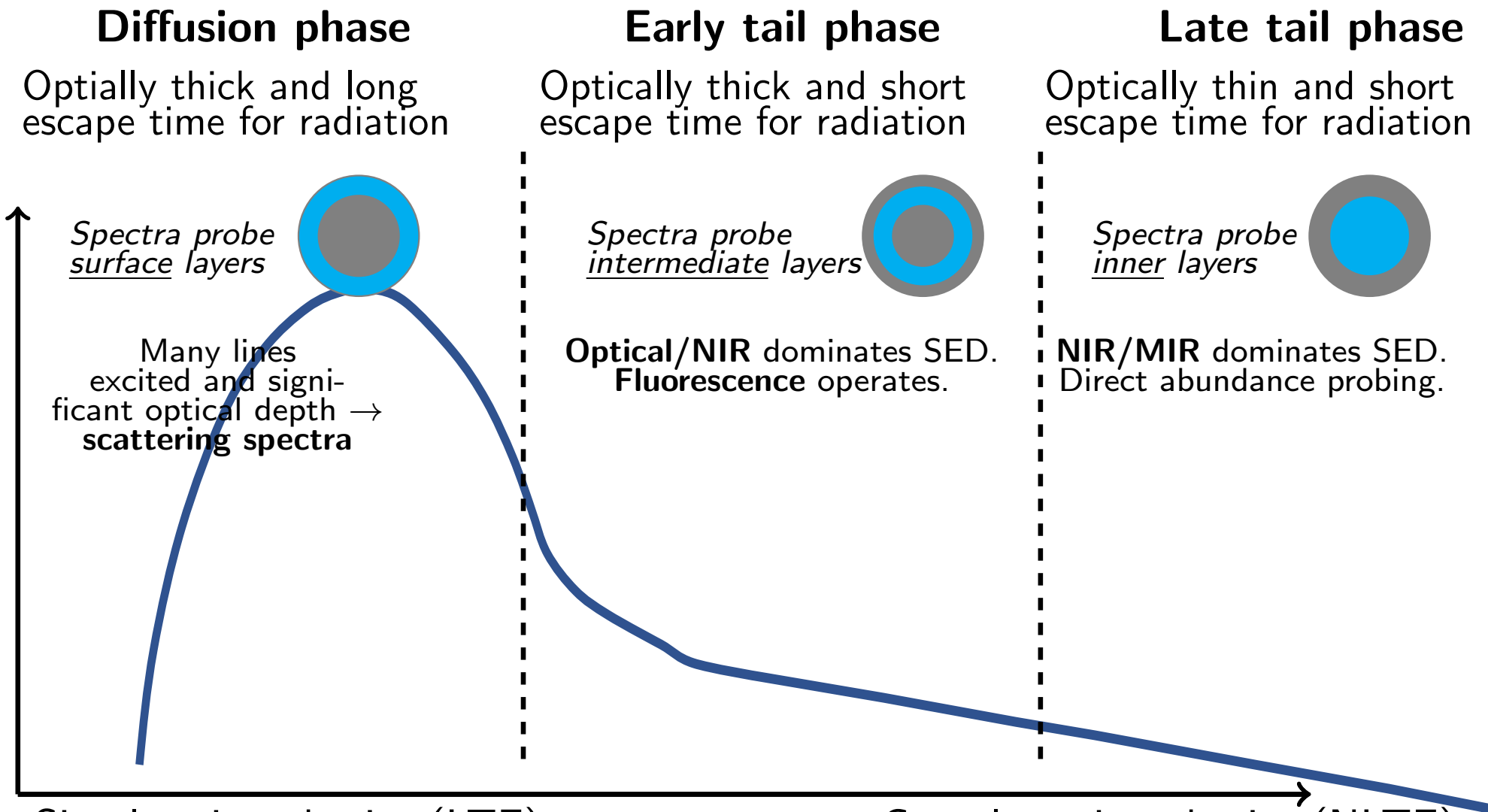
The r-process transient Multi-Messenger Cake



The r-process transient Multi-Messenger Cake



Kilonova evolution

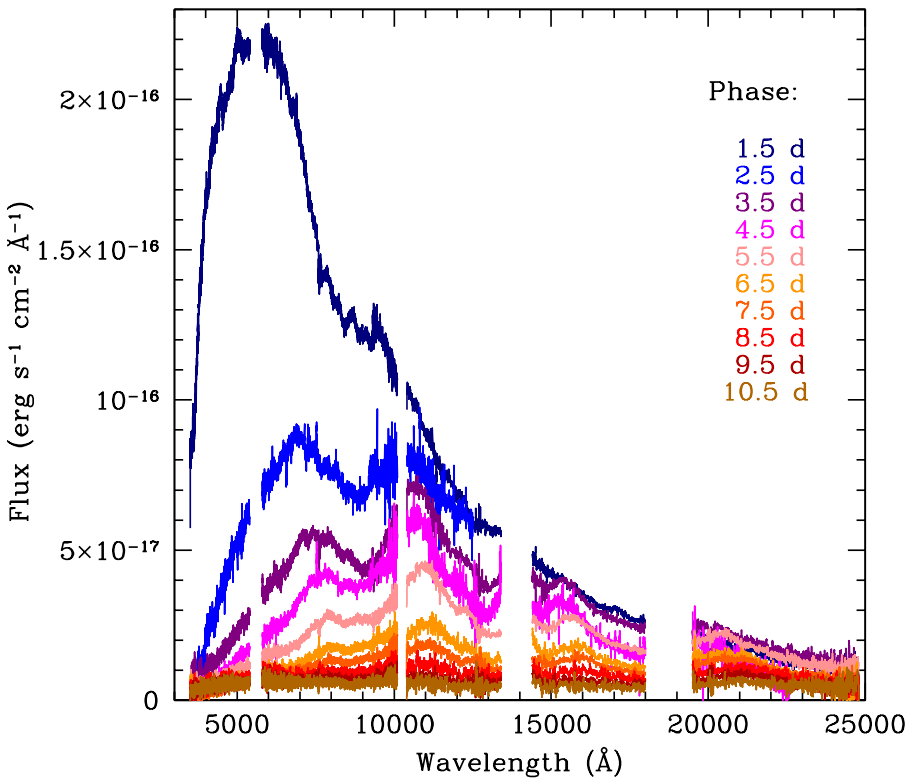


Reviews: Sim 2017, Handbook of SNe Jerkstrand 2017, Handbook of SNe

Higher Doppler broadening and many active elements and lines → transition phases less clear in KNe than in SNe

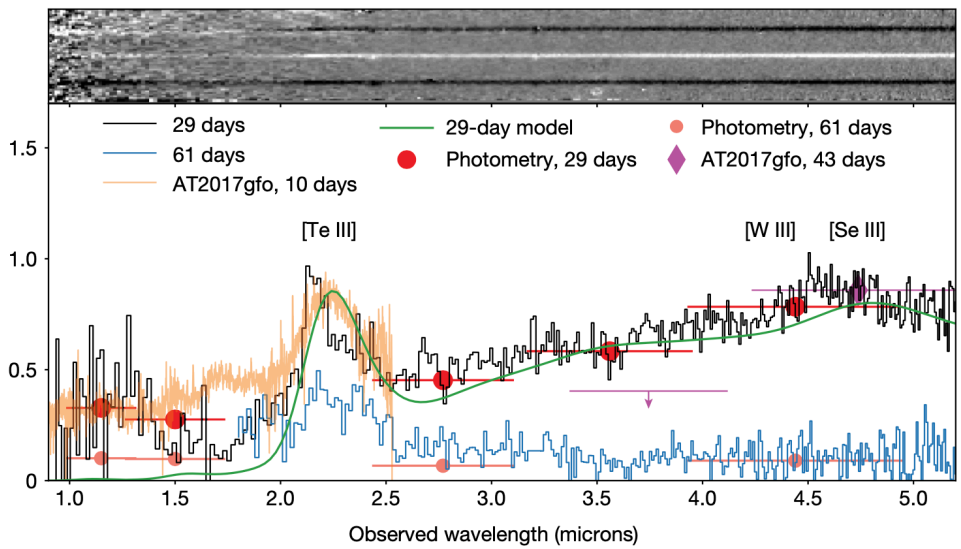
AT2017gfo

Pian+2017



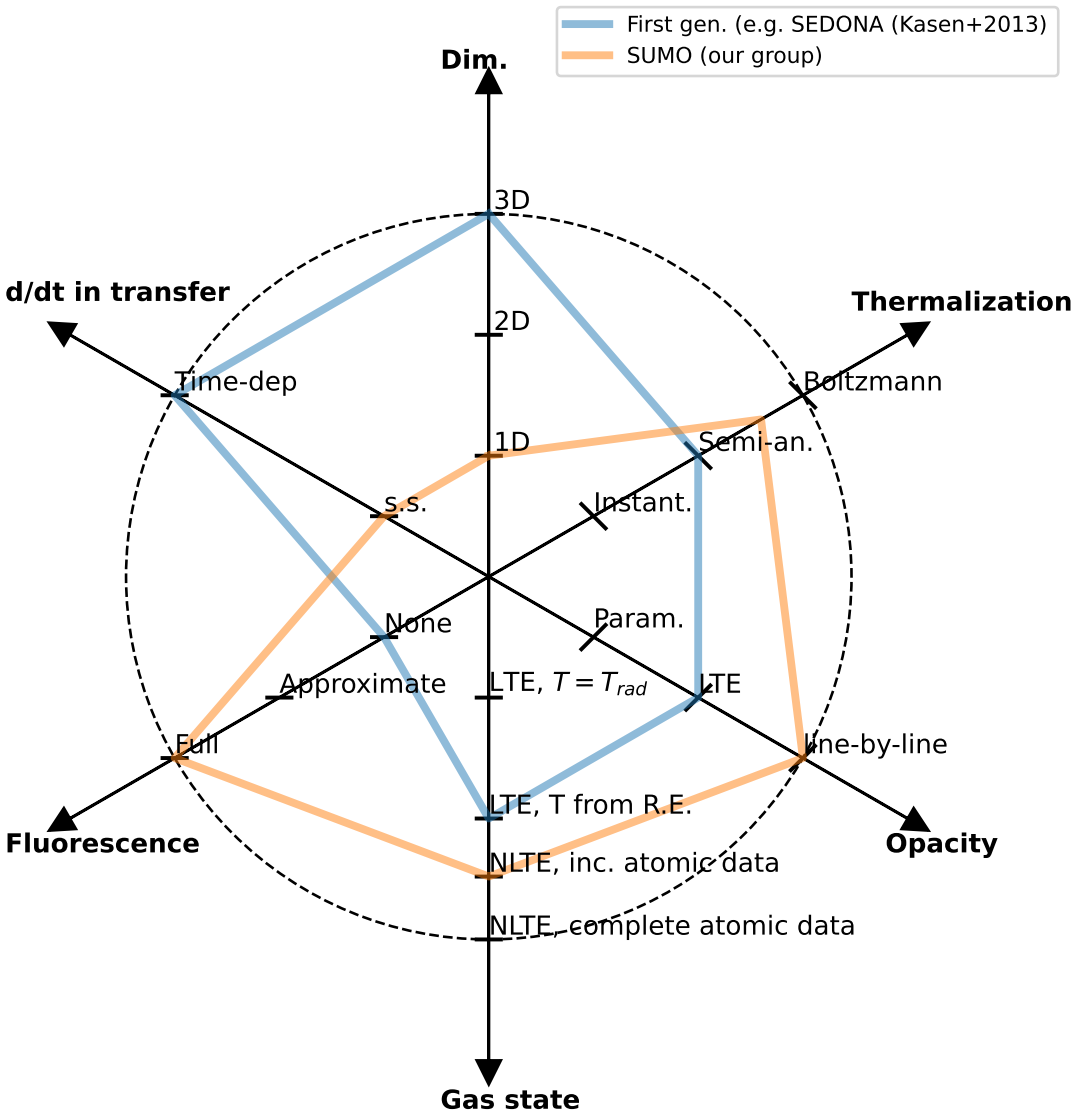
AT2023vfi

Levan+2023

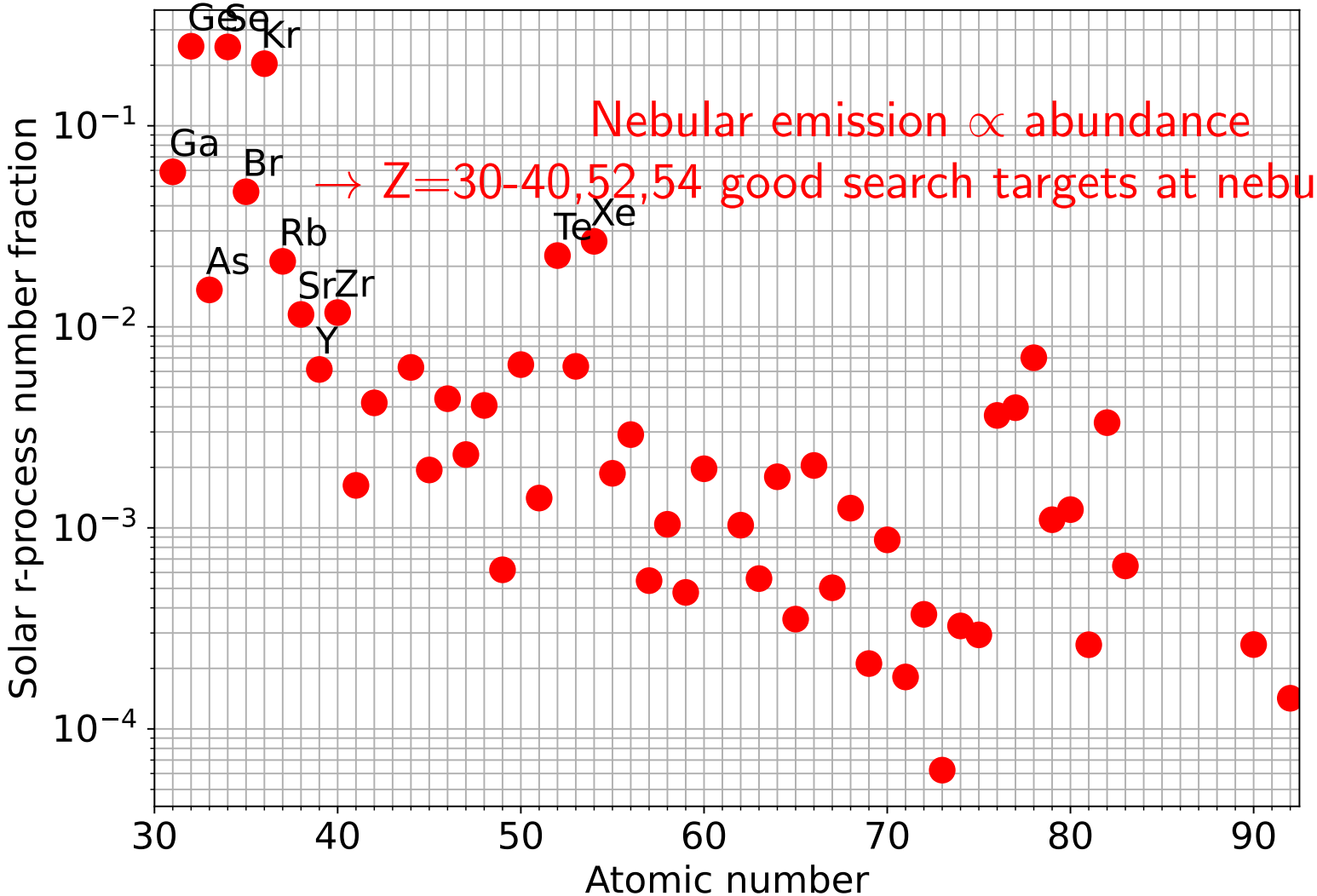


Complex spectral formation → interpretation needs guidance from **spectral models**.

KN spectral synthesis modelling



Solar r-process abundances



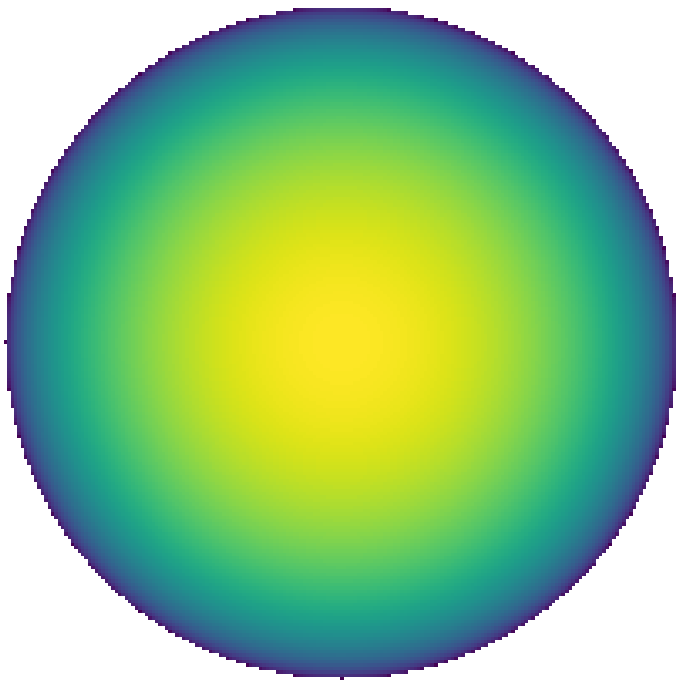
Data from Prantzos+2020

Models exploring the MIR signatures *AJ+ in prep., QP+ in prep.*

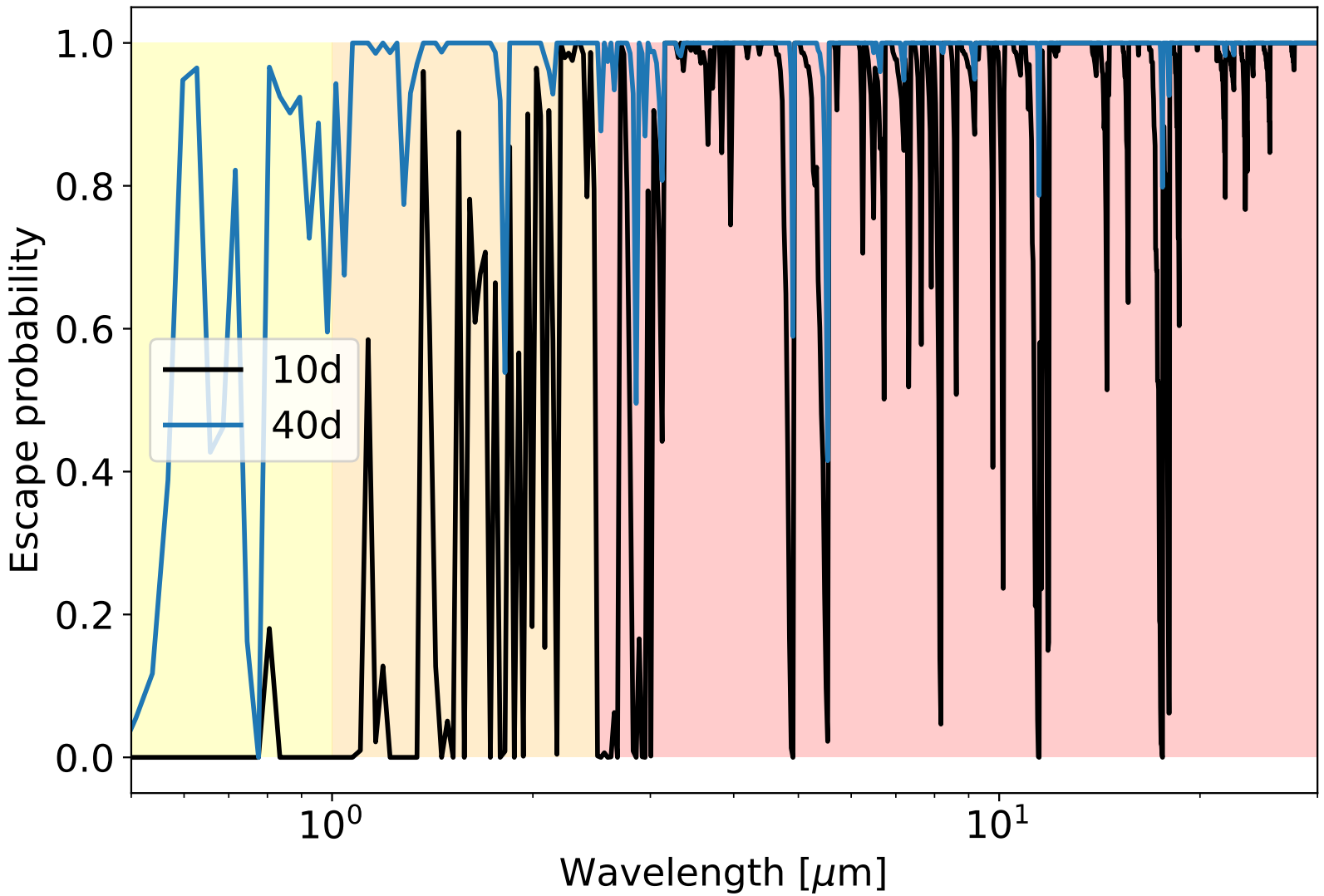
$M_{ejecta} = 0.05\ M_{\odot}$

$\rho(v) \propto v^{-3}$

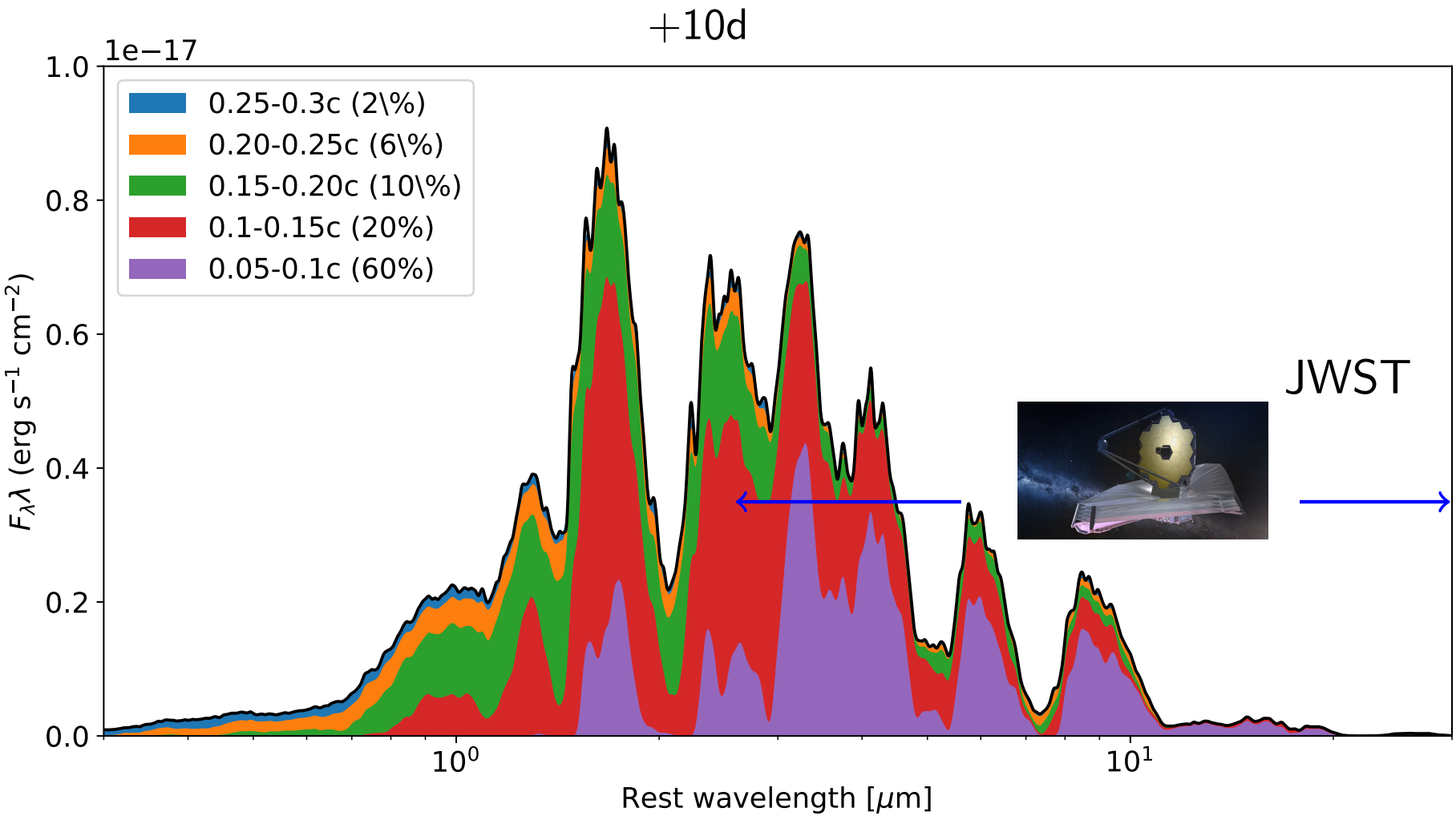
Z=30-40, 52, 54, solar composition.



Transparancy vs wavelength

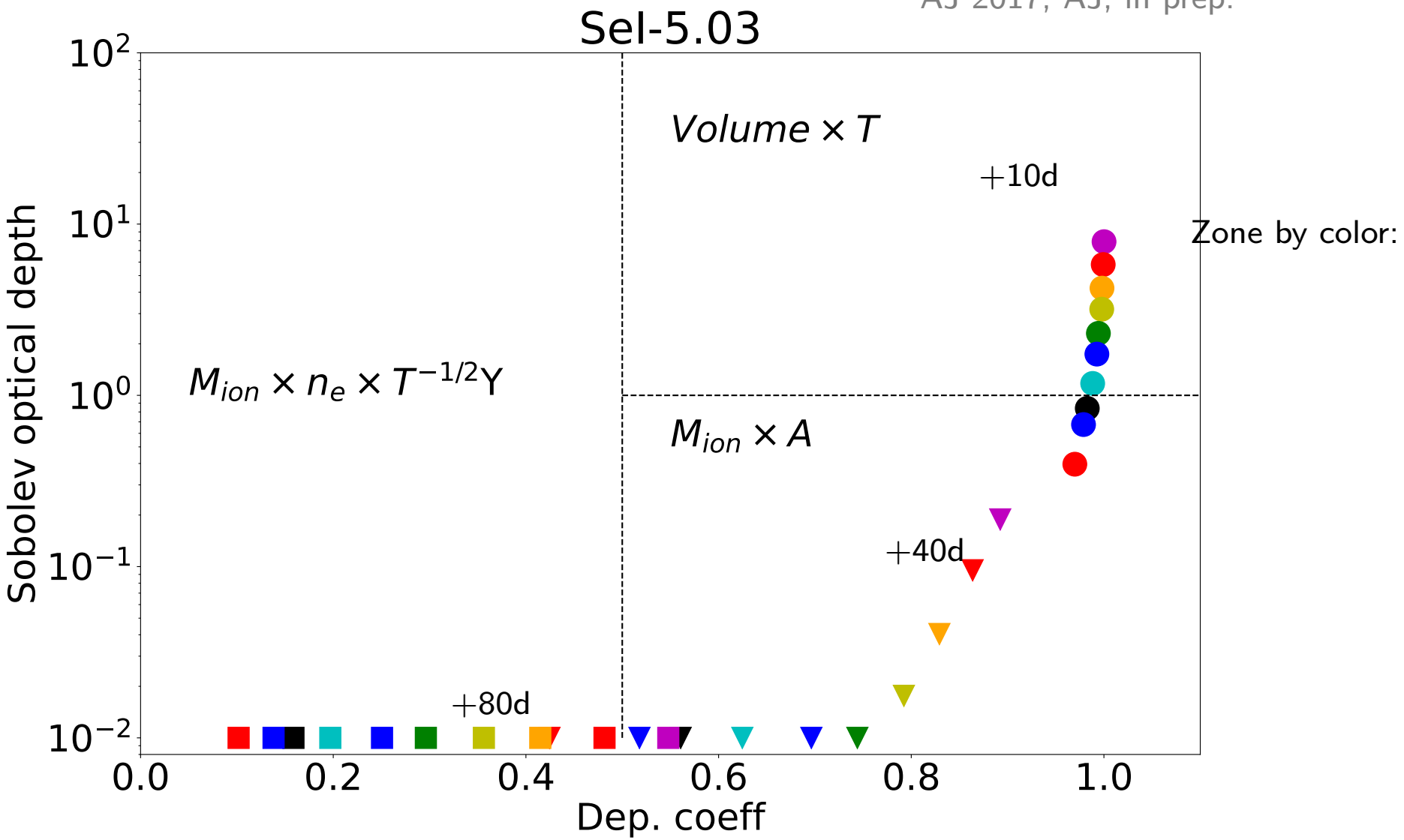


Only long wavelengths probe the main composition

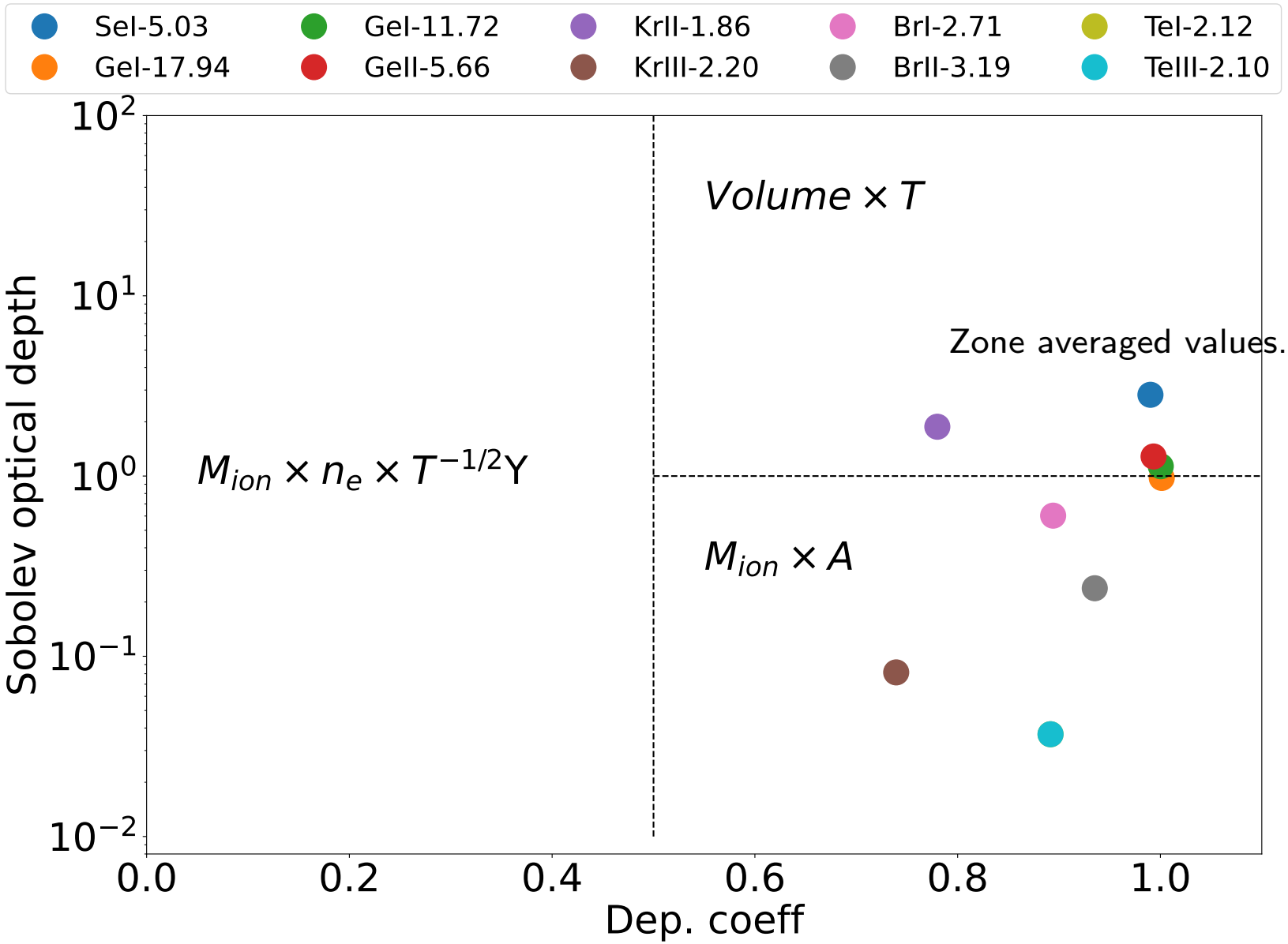


IR emission line domains

AJ 2017, AJ, in prep.

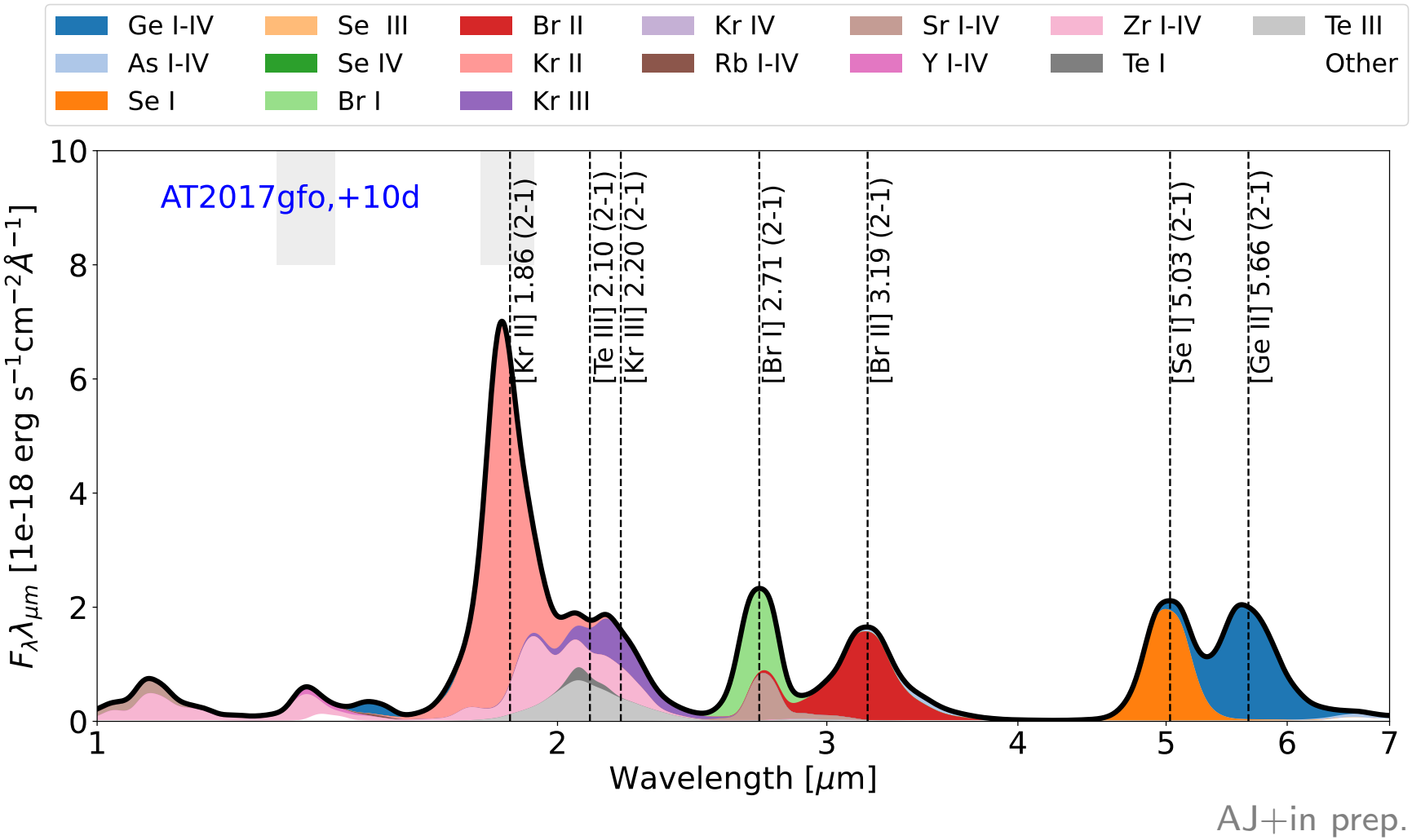


IR emission line domains



MIR signatures from light r-process elements

An example model at +10d



AJ+in prep.

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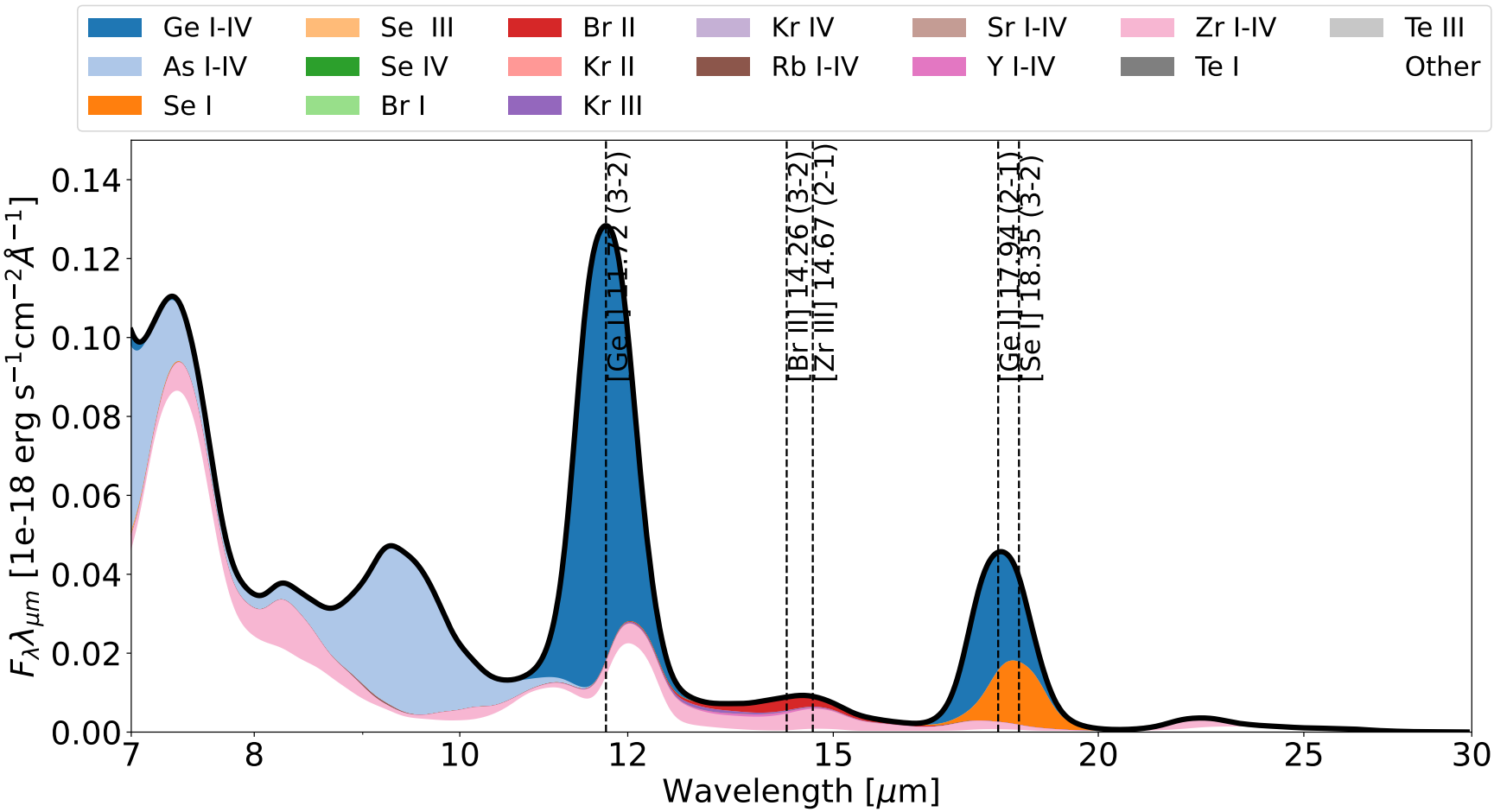

AJ+in prep.

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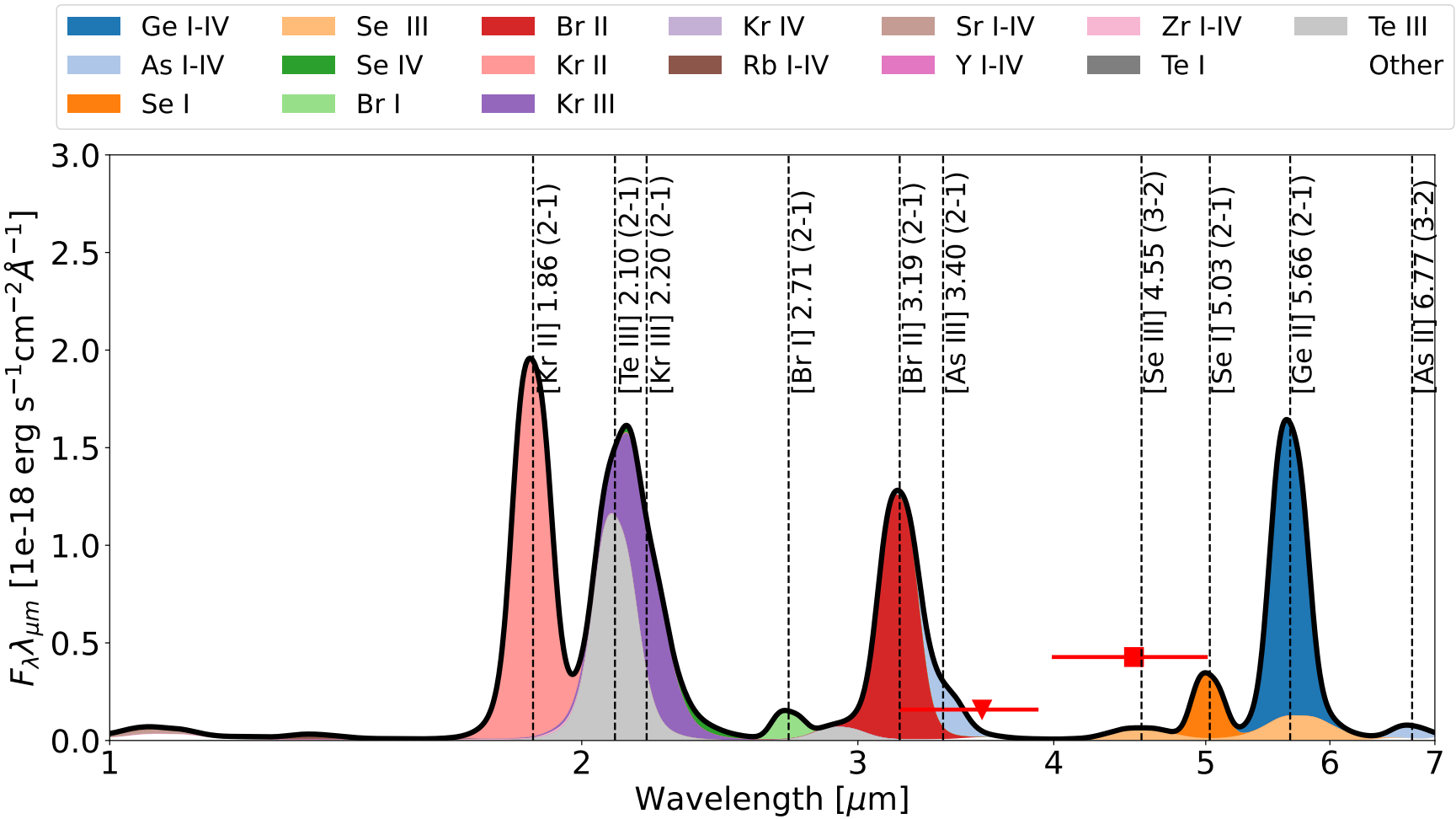

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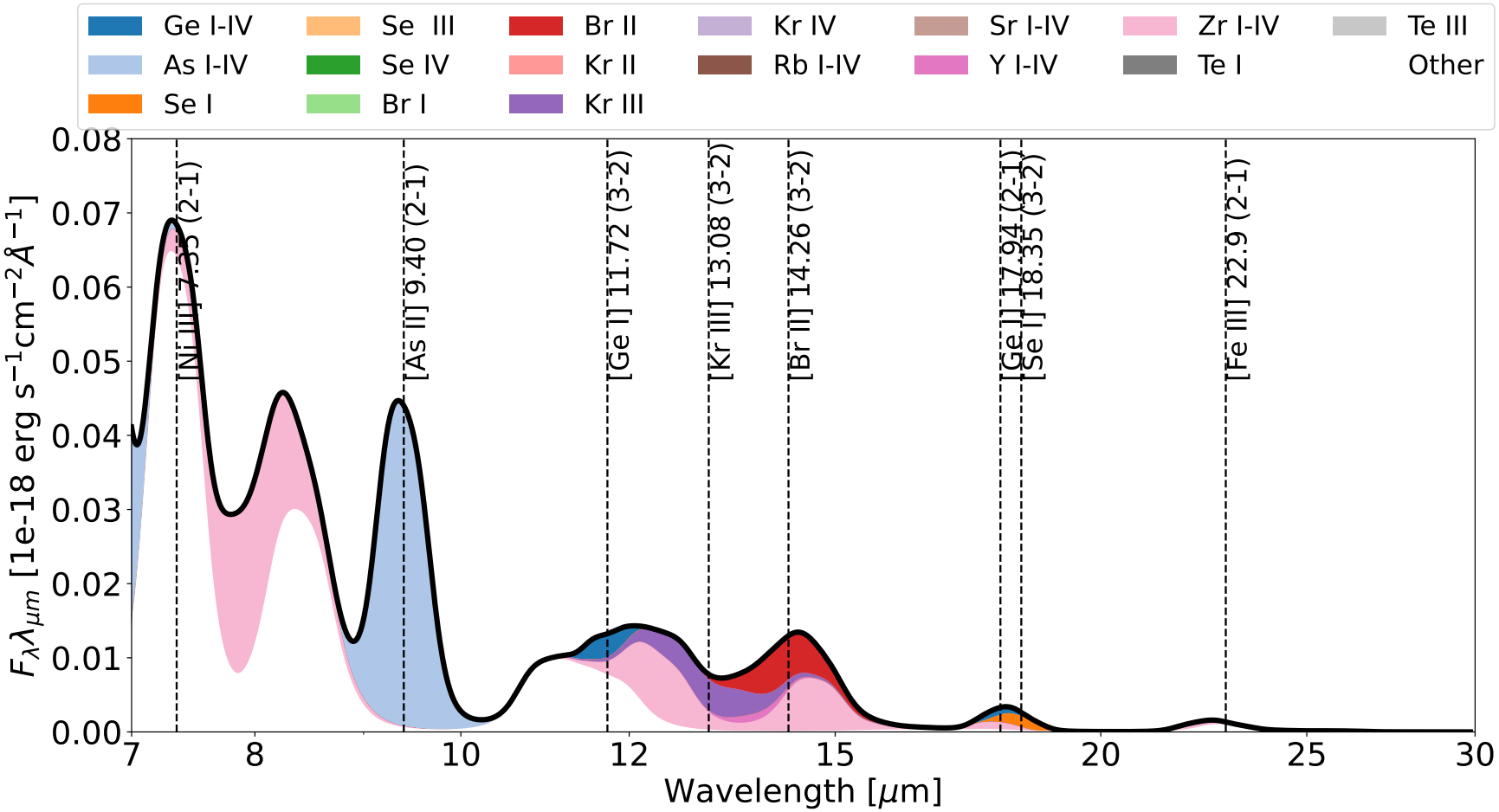

AJ+in prep.

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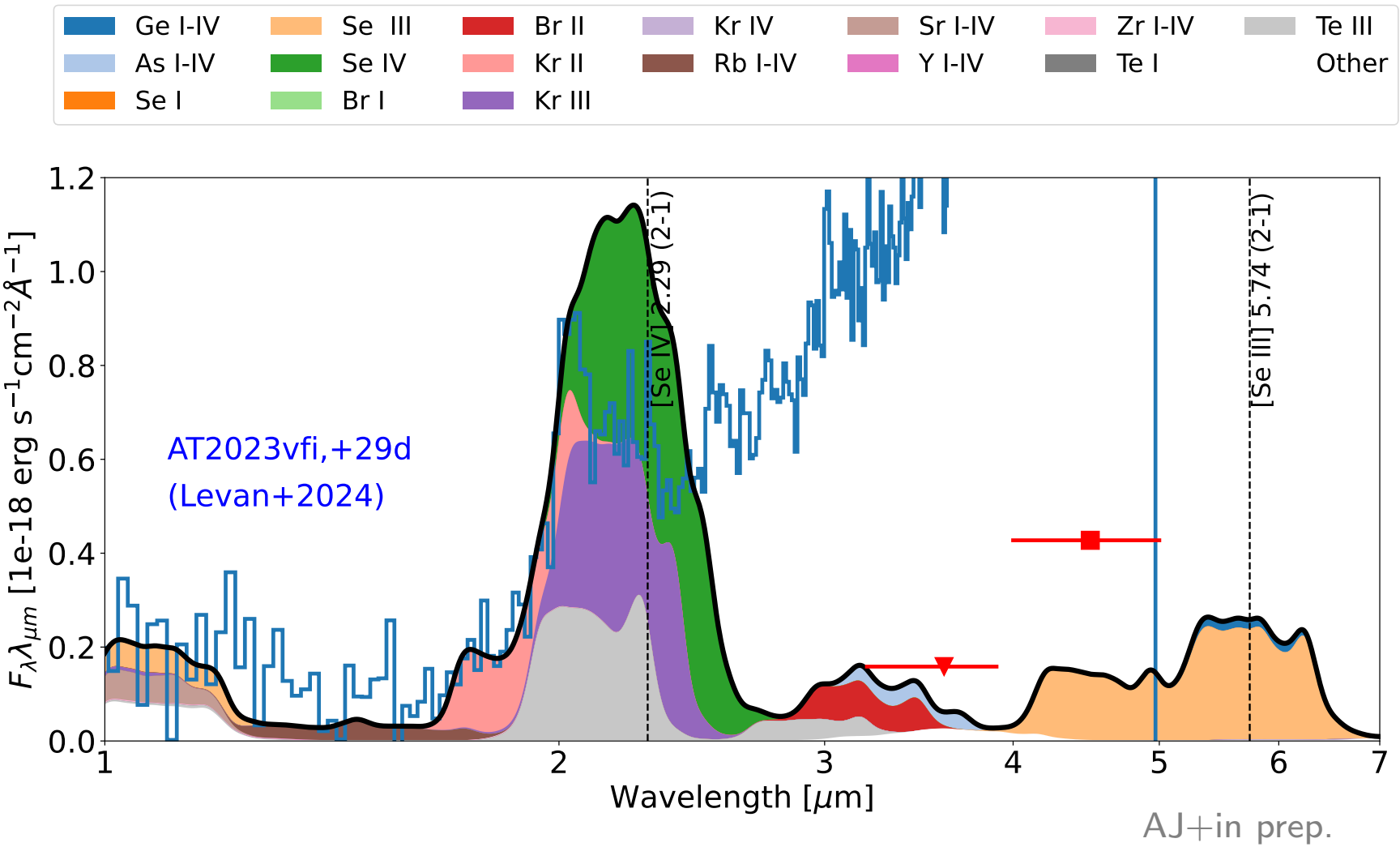

Summary

- **Second generation of KN spectral models** coming into place considering **NLTE** and **fluorescence**. These effects qualitatively change KN spectra from a few days already and are useful for EM follow-up planning and data analysis.
- Tail-phase EM, particular in IR, gives information on **slow/inner material** constituting the **bulk of KN ejecta**.
- **Z=30-40,52,54** are good primary search targets for nebular NIR and MIR lines (AJ+in prep.).