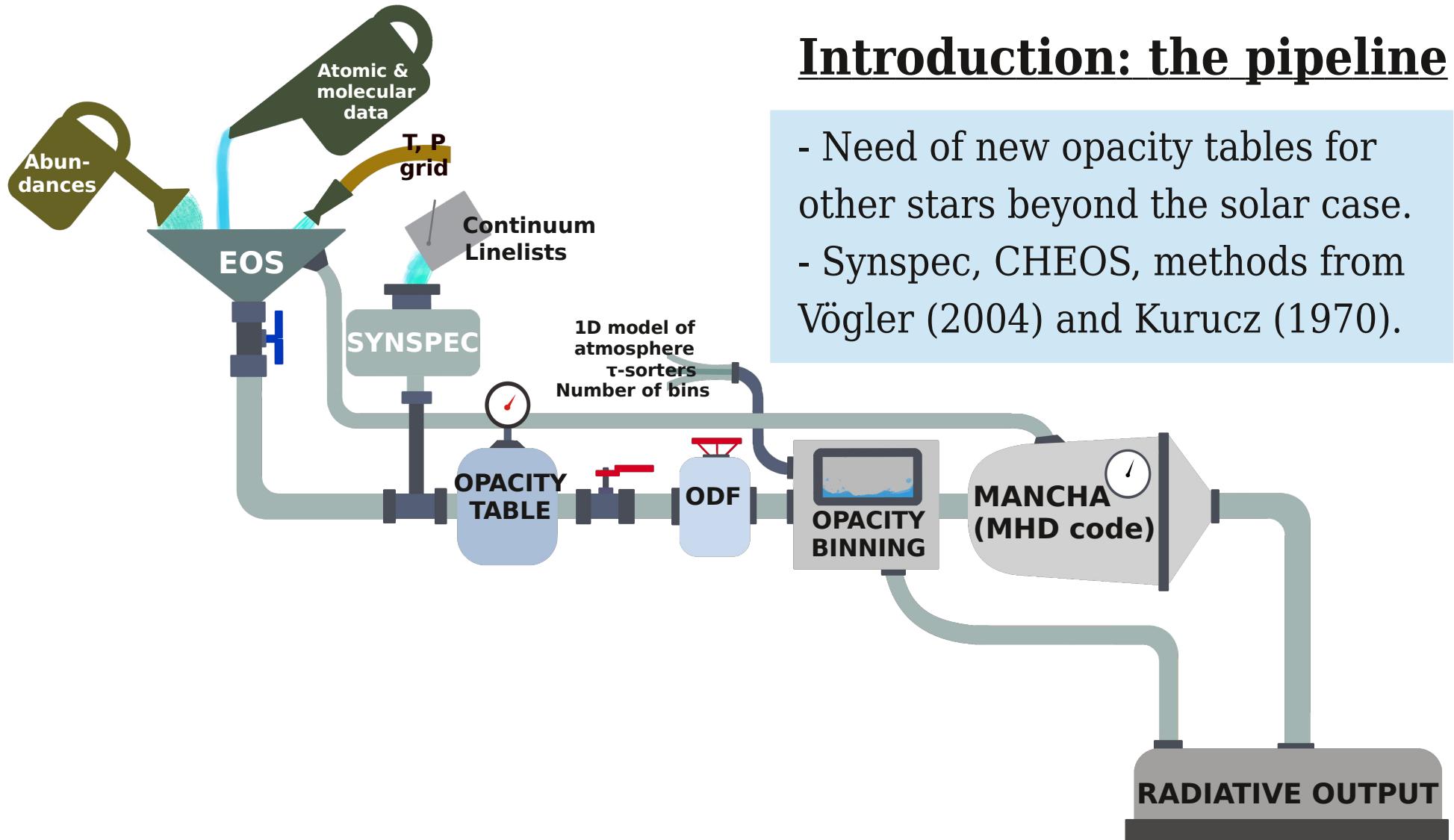# The opacity pipeline: from atomic data to realistic RMHD simulations

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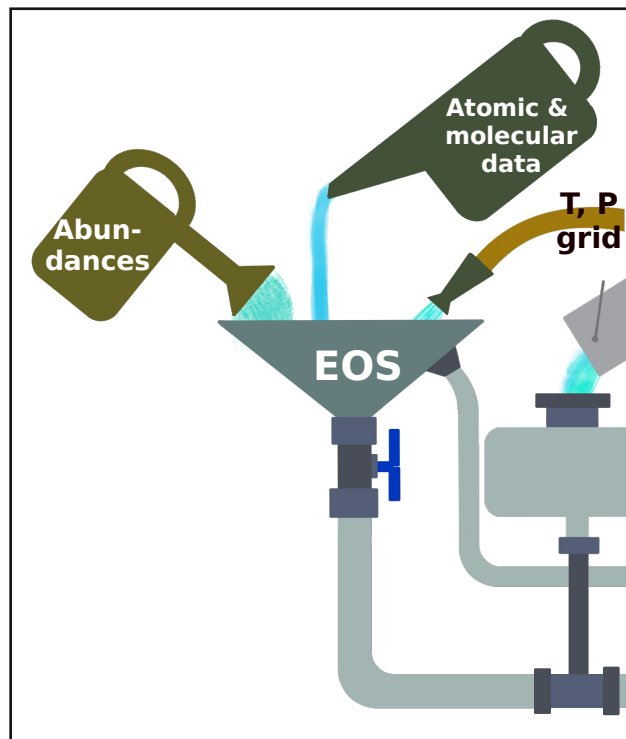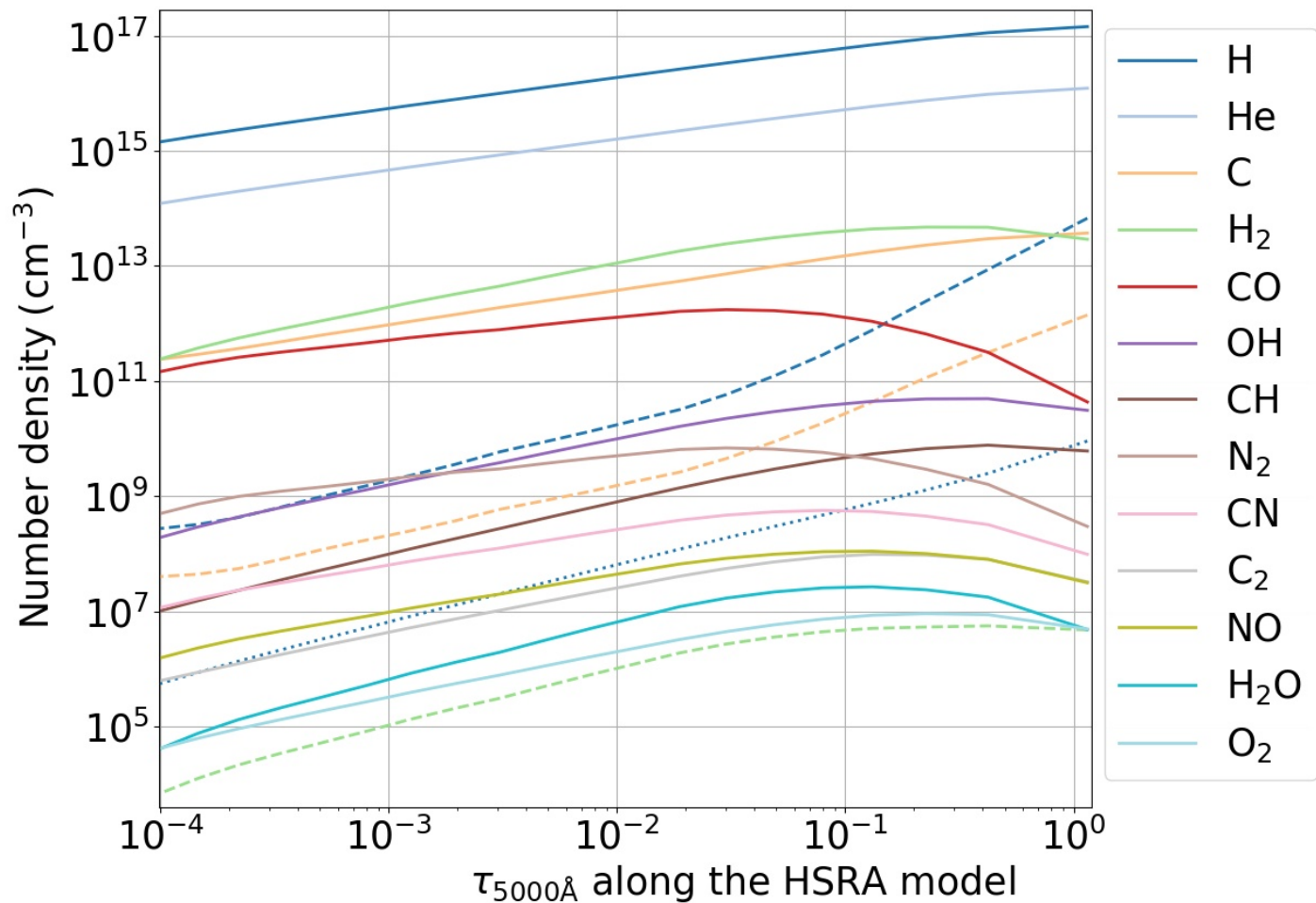
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Introduction: the pipeline

- Need of new opacity tables for other stars beyond the solar case.
- Synspec, CHEOS, methods from Vögler (2004) and Kurucz (1970).

Atomic & molecular data

Abun-dances

T, P grid

EOS

Continuum Linelists

SYNSPEC

1D model of atmosphere
τ-sorters
Number of bins

OPACITY TABLE

ODF

OPACITY BINNING
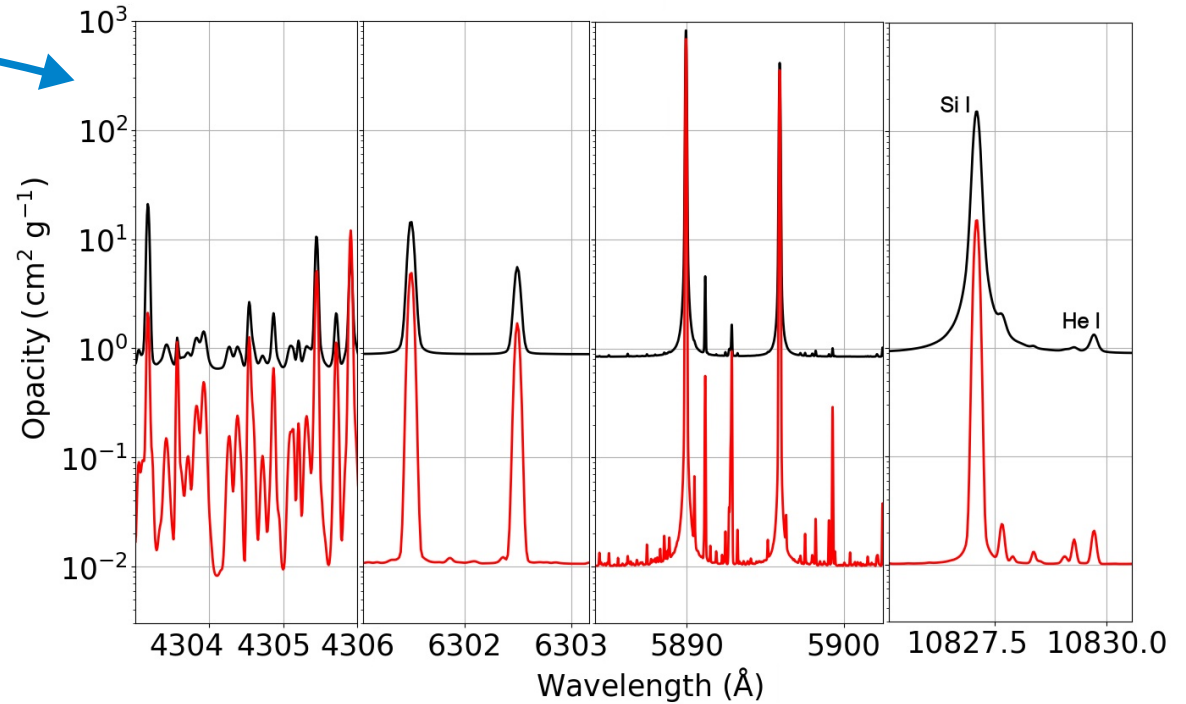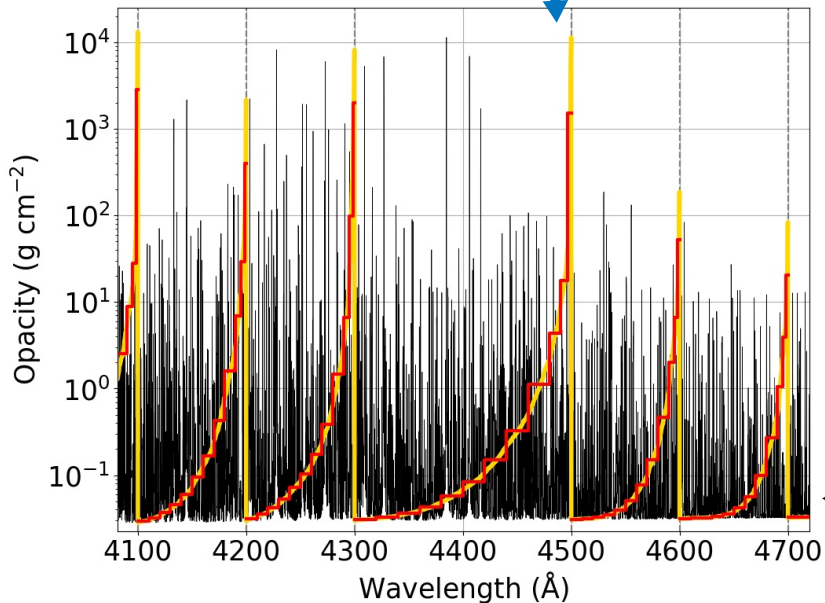
MANCHA (MHD code)

RADIATIVE OUTPUT

Equation of state (EOS)

CHEOS, Synspec

Opacity and opacity distribution function (ODF)

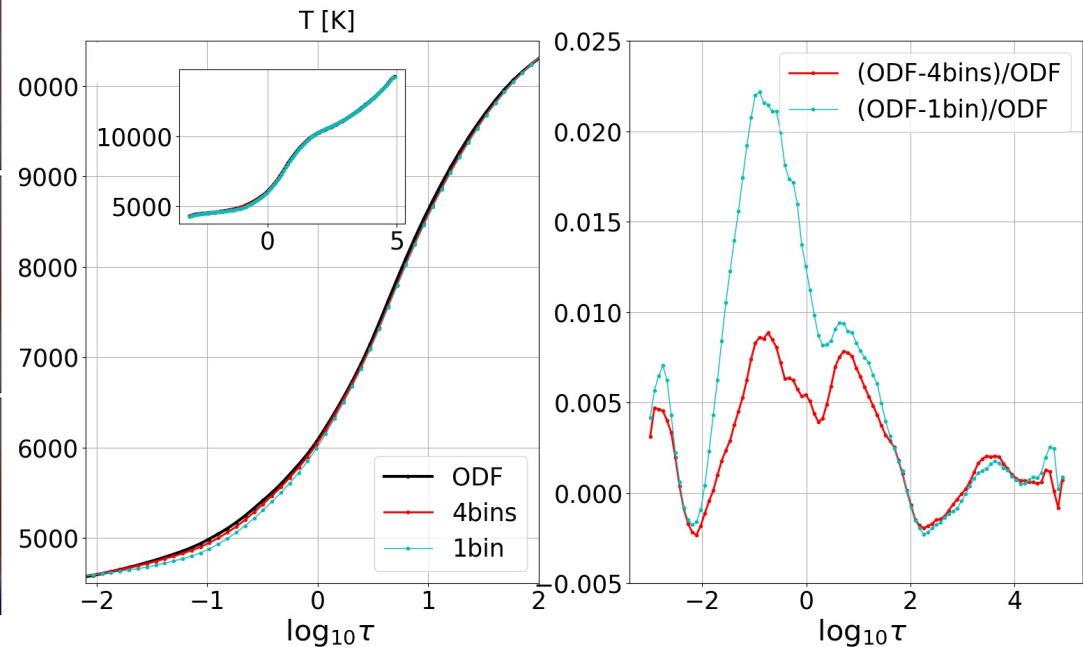

Continuum Linelists
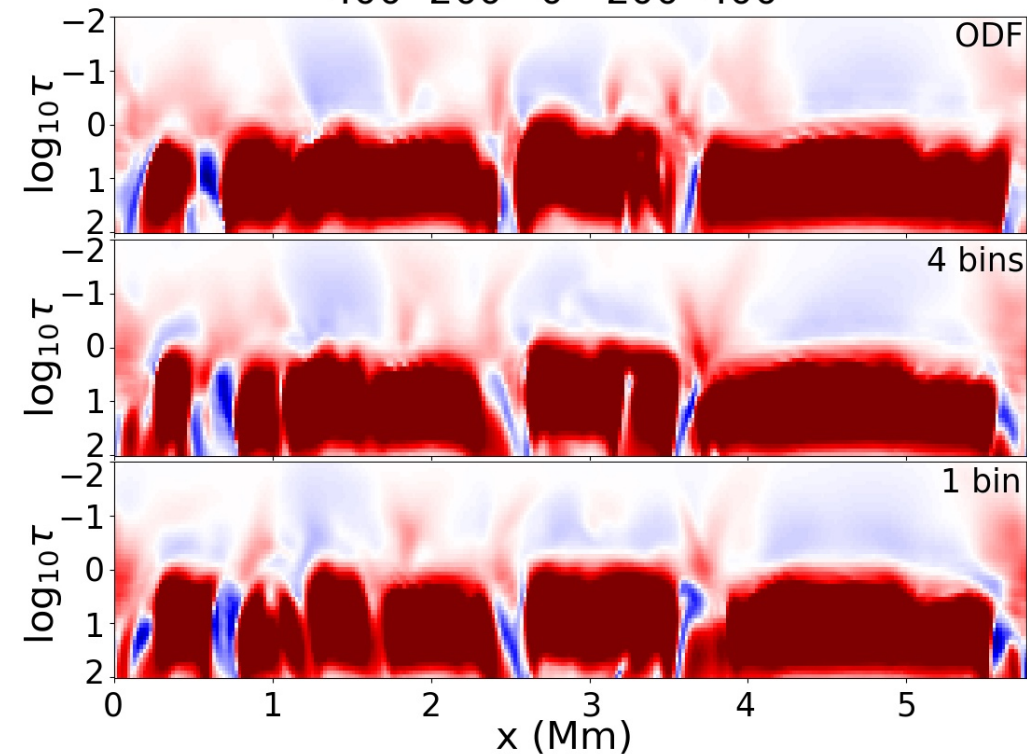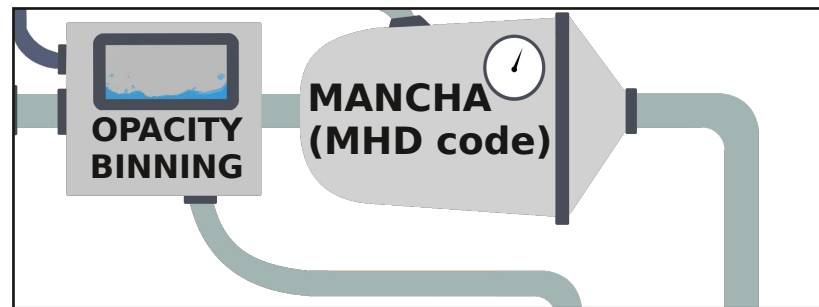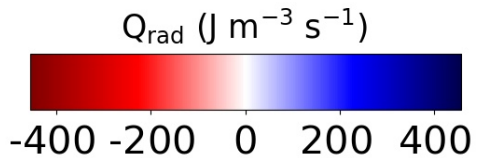
SYNSPEC

OPACITY TABLE

ODF
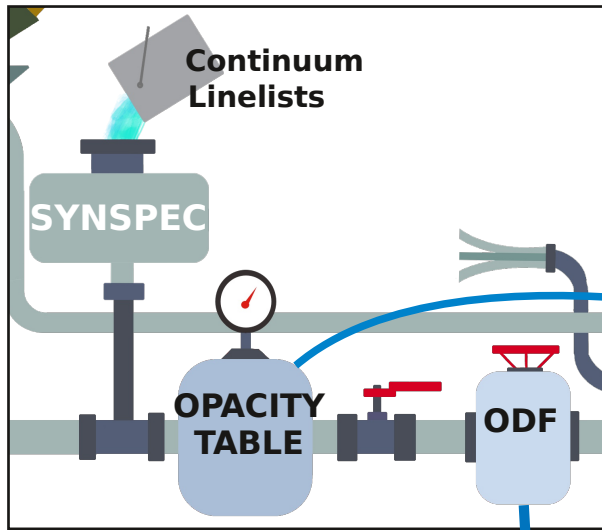
G-band, Fe I lines, Na doublet, Si and He lines around 10830 Å

Divide (steps); sort; discretize (sub-steps); weights.

MANCHA (MHD code)

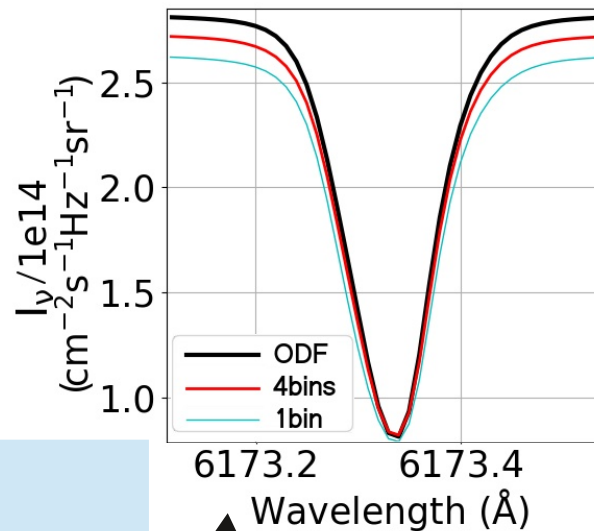Q_{rad} (J m^{-3} s^{-1})

MANCHA (MHD code)

OPACITY BINNING
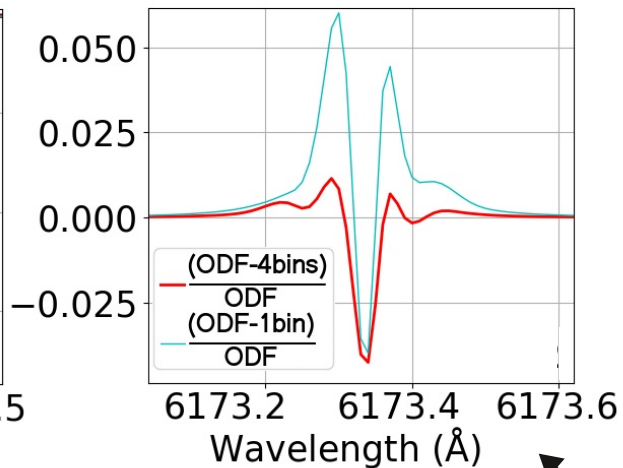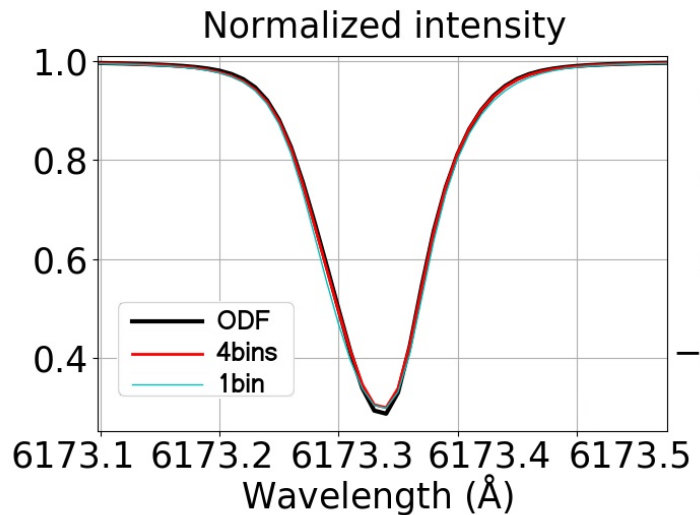
Notice the definition of the structures over $\tau=1$.

Temperature gradient steeper for 1 bin in the line formation region.

Radiative output

Normalized intensity

RADIATIVE OUTPUT
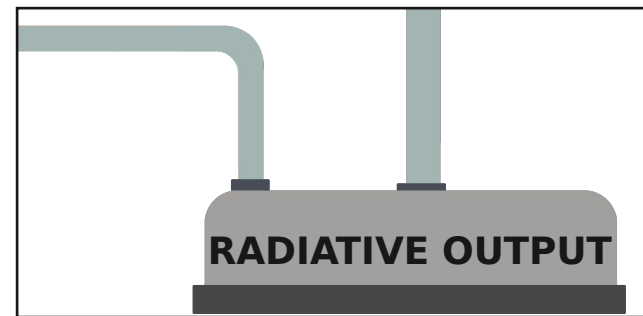
Line **wings** better reproduced with 4 bins than 1 bin, but not that much difference in the **core**.

Shifted **continuum** level → Phase shift of plasma oscillations due to opacity change?

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MANCHA (MHD code)

RADIATIVE OUTPUT
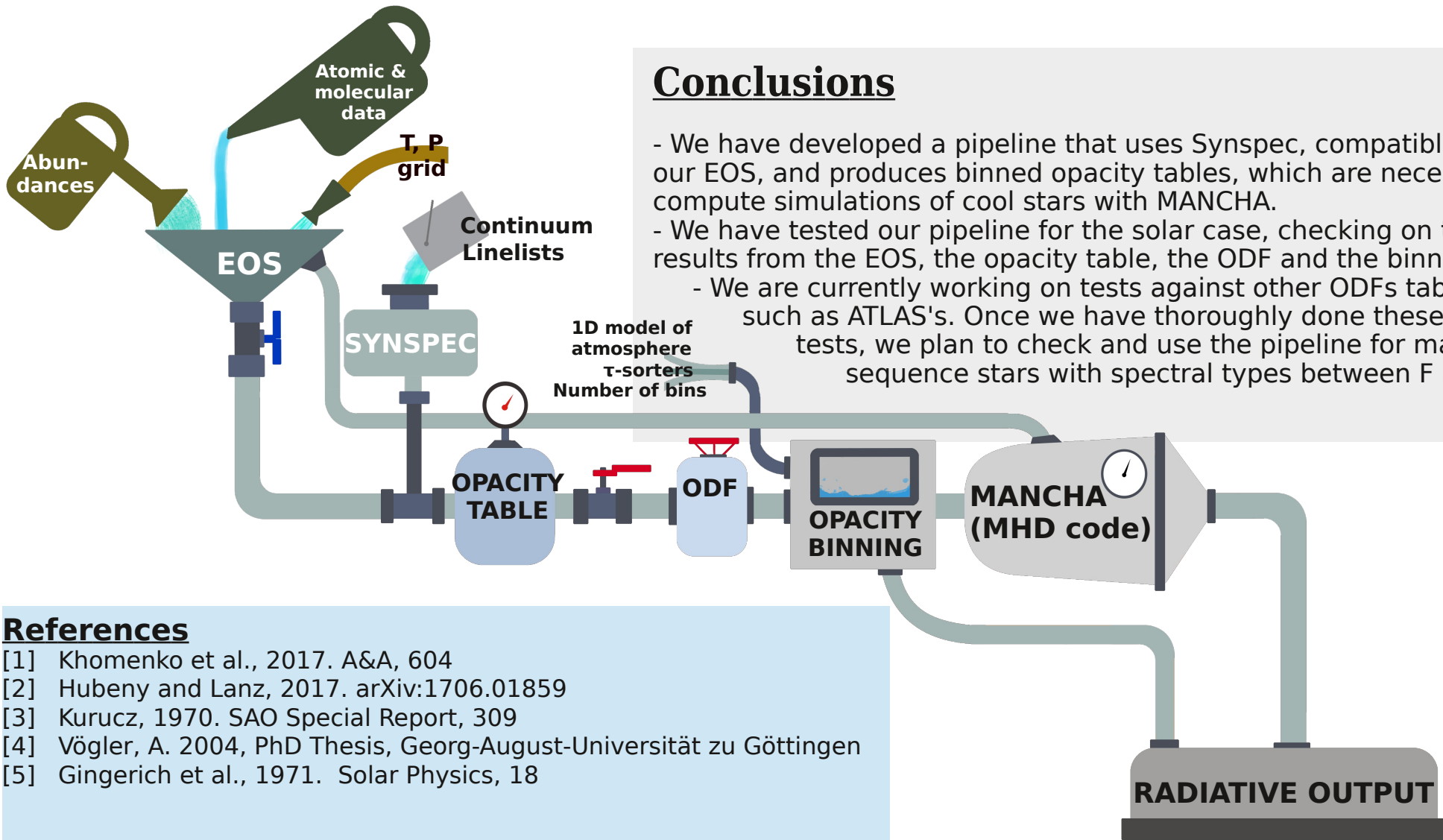
Conclusions

- We have developed a pipeline that uses Synspec, compatible with our EOS, and produces binned opacity tables, which are necessary to compute simulations of cool stars with MANCHA.
- We have tested our pipeline for the solar case, checking on the results from the EOS, the opacity table, the ODF and the binning.
- We are currently working on tests against other ODFs tables, such as ATLAS's. Once we have thoroughly done these latter tests, we plan to check and use the pipeline for main sequence stars with spectral types between F and M.

References
[1]   Khomenko et al., 2017. A&A, 604
[2]   Hubeny and Lanz, 2017. arXiv:1706.01859
[3]   Kurucz, 1970. SAO Special Report, 309
[4]   Vögler, A. 2004, PhD Thesis, Georg-August-Universität zu Göttingen
[5]   Gingerich et al., 1971. Solar Physics, 18