3D effects of rotation on spectroscopic observables

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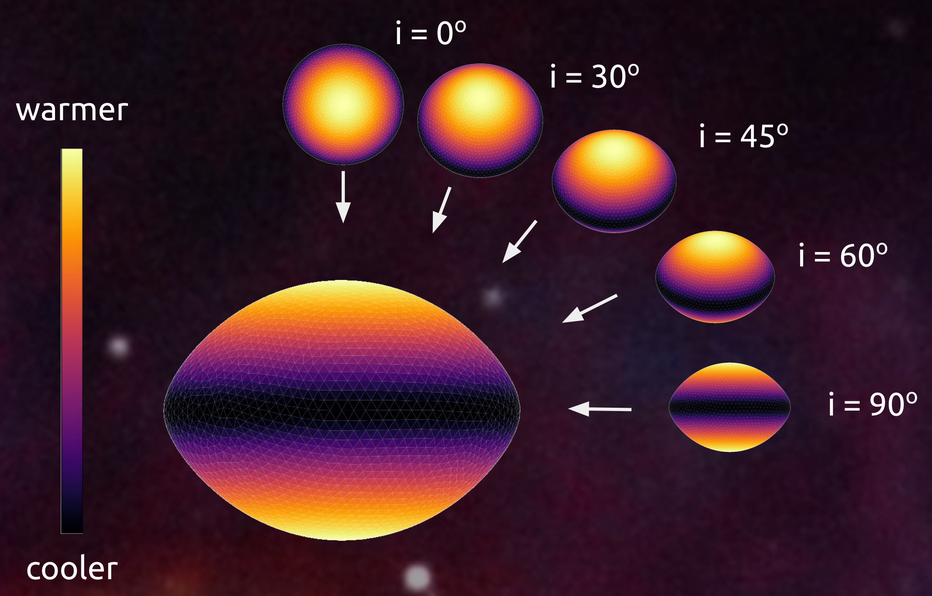
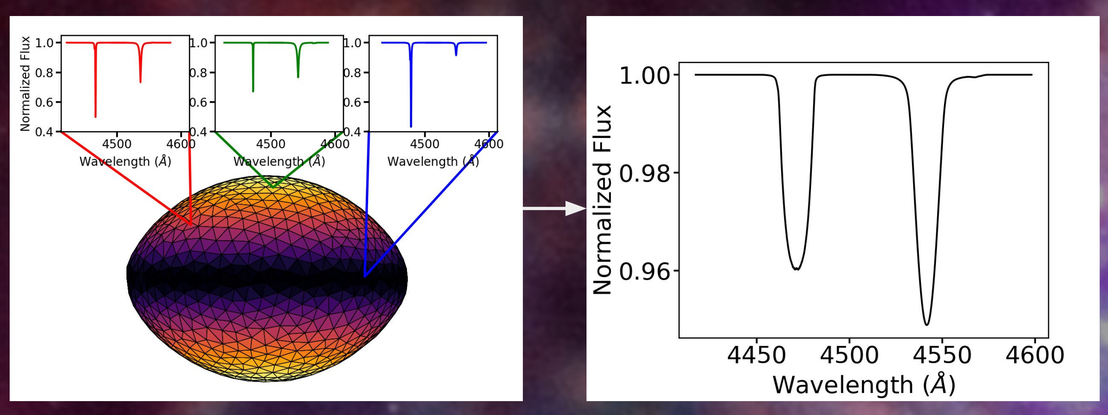
Rapid rotation can play a crucial role in massive star evolution

A key aspect of rapid rotation is a deviation from spherical symmetry, which in turn leads to non-uniform surface gravity and surface temperature distributions across the surface of rapidly rotating stars. Unfortunately however, **these 3D effects are often neglected in spectroscopic analyses of massive rotating systems**. This is problematic as these 3D effects can lead to vastly different observed parameters depending on the inclination of the object in question.



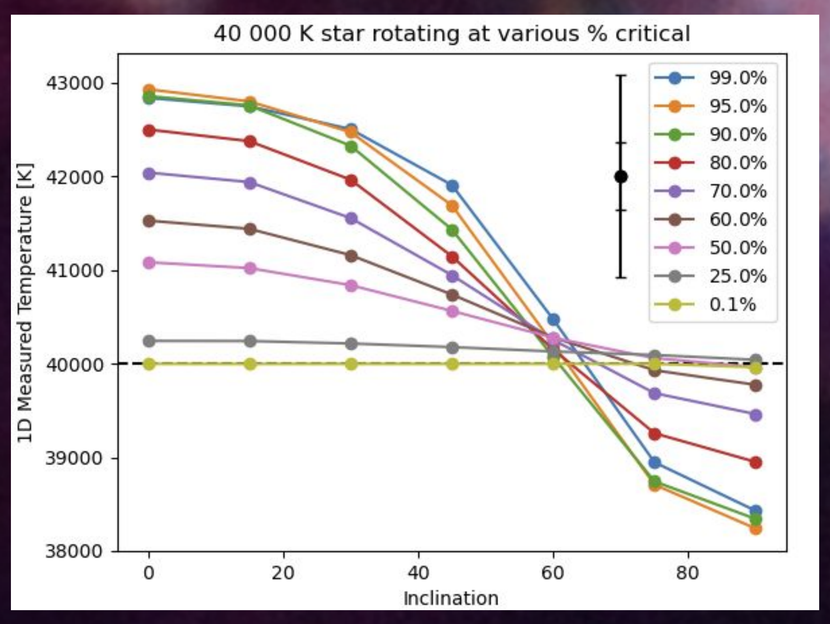


SPAMMS* allows us to model these 3D effects

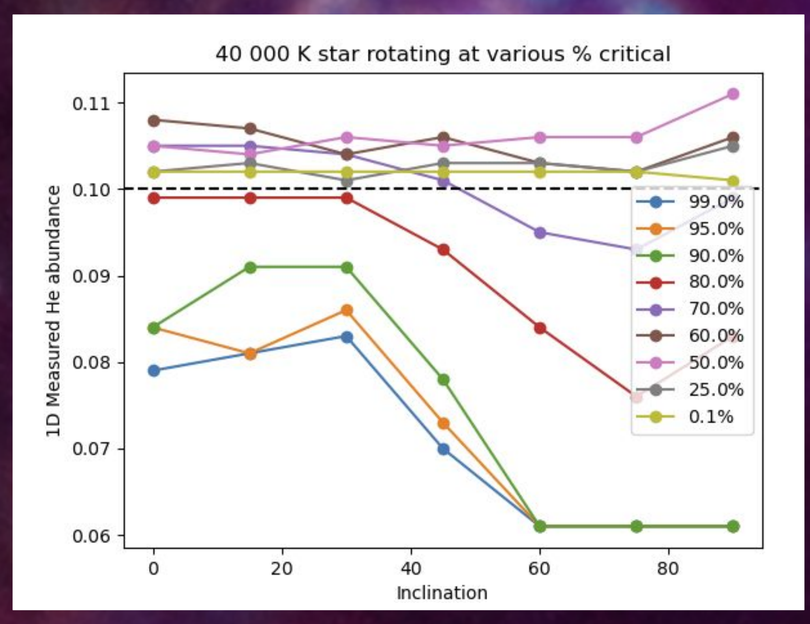
From the stellar and rotational parameters, we construct a 3D mesh of the system. Based on the local conditions (T_{eff}, log(g), r, RV) we assign FASTWIND line profiles to each patch and integrate over the visible surface

* Abdul-Masih et al. 2020 A&A, 636, 59
https://github.com/MichaelAbdul-Masih/SPAMMS

We can quantify these effects by fitting synthetic SPAMMS (3D) spectra with 1D models



Since we know the input stellar and rotational parameters for the 3D models, we can fit them with 1D models to see what parameters the 1D models predict.



Failing to account for the 3D geometry can lead to incorrect measurements of T_{eff}, abundances, log(g), and more!

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Image credit: NASA/CXC/Penn State Univ./L. Townsley et al.