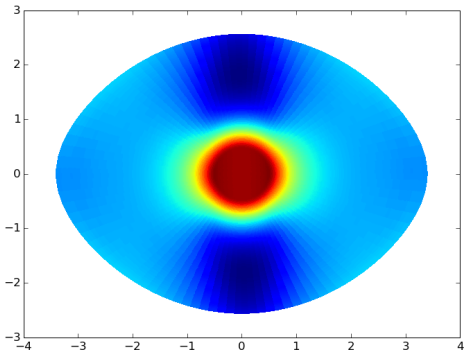
The ESTER project : Modelling rotating stars in two dimensions

MR with

K. Bouchaud, A. Domiciano de Souza, F. Espinosa Lara, D. Gagnier, B. Putigny, D. Reese ...

- Designed for modelling *the structure and evolution* of an isolated rotating star.
- Include *self-consistently :* differential rotation and meridional circulation
- Presently, only the main sequence...
- Available freely on GitHub



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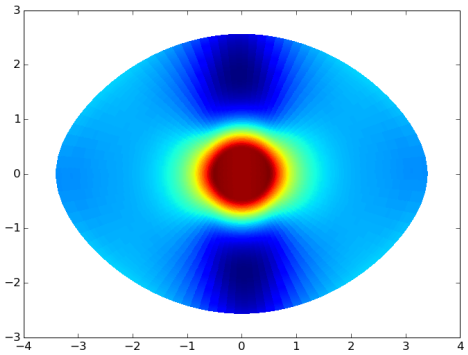
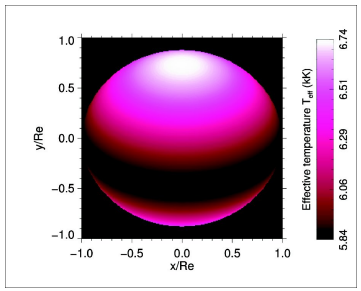
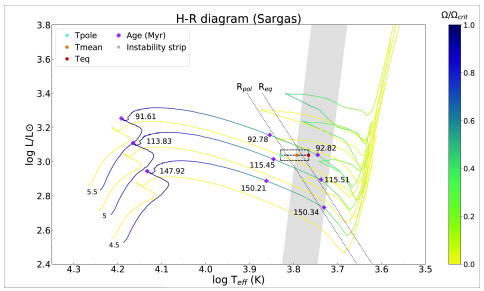


Usage in interferometry
This is the PhD of Kévin Bouchaud

But :

- ESTER has validated the ω-model : a simple 2D description of rotating radiative envelope, much better than $Flux \propto g_{\rm eff}^{\beta}$ (i.e. the generalized von Zeipel law).
- inversion of interferometric data of Sargas (θ Sco) cf Domiciano de Souza et al. 2018,
- SPICA could constrain the surface differential rotation ?





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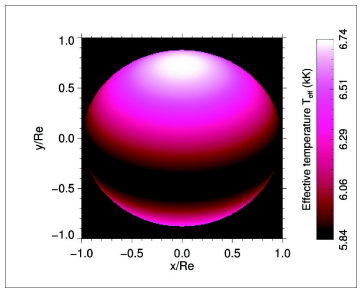
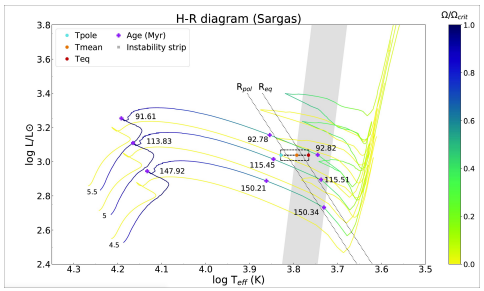




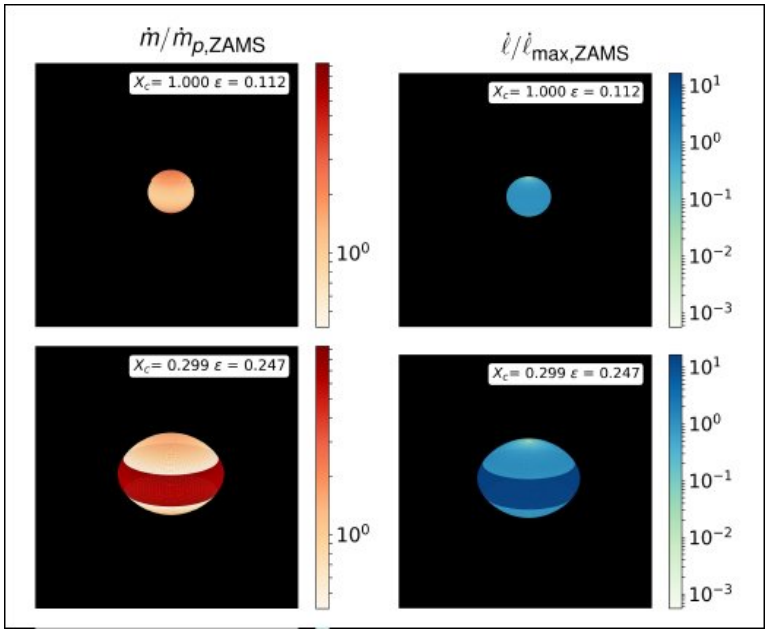
Evolution with mass-loss and angular momentum loss

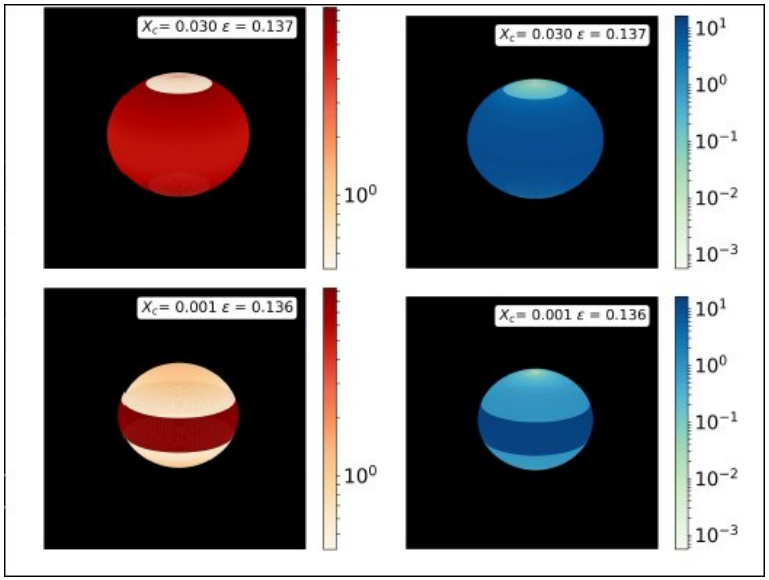
- Can we test the bi-stability dilemna ? Below some T° $\sim 20k$K Fe IV recombines into Fe III, changing the mass-loss rate, but is it effective ?

Interferometry can help solve the puzzle if it determines i.

Use for massive stars

Bistability jump in rotating stars





Preferred targets

- Make the best image of a star at different wavelengths
- Include a high resolution spectrum of the star (Vsin$i$ needs strong constraints)
- Seismological data are most welcome ($\langle\rho\rangle$, core size,...)

Some references

- Gagnier et al. (2019), submitted to A&A
- Rieutord, Espinosa Lara & Putigny (2016), J. Comput. Phys. 318, 277
- Espinosa Lara & Rieutord (2013), A&A,**552**, A35
- ESTER website : http ://ester-project.github.io/ester/