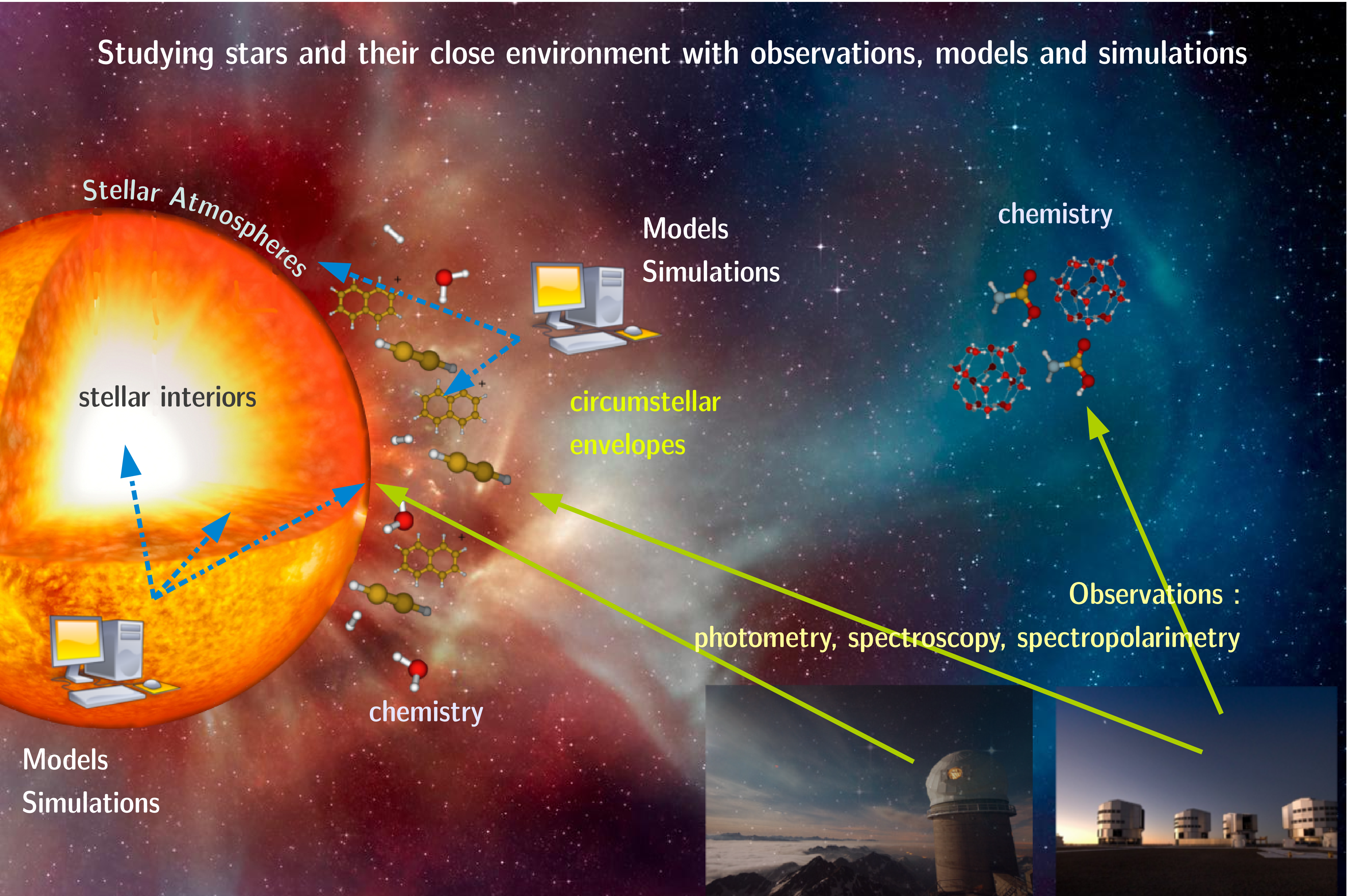
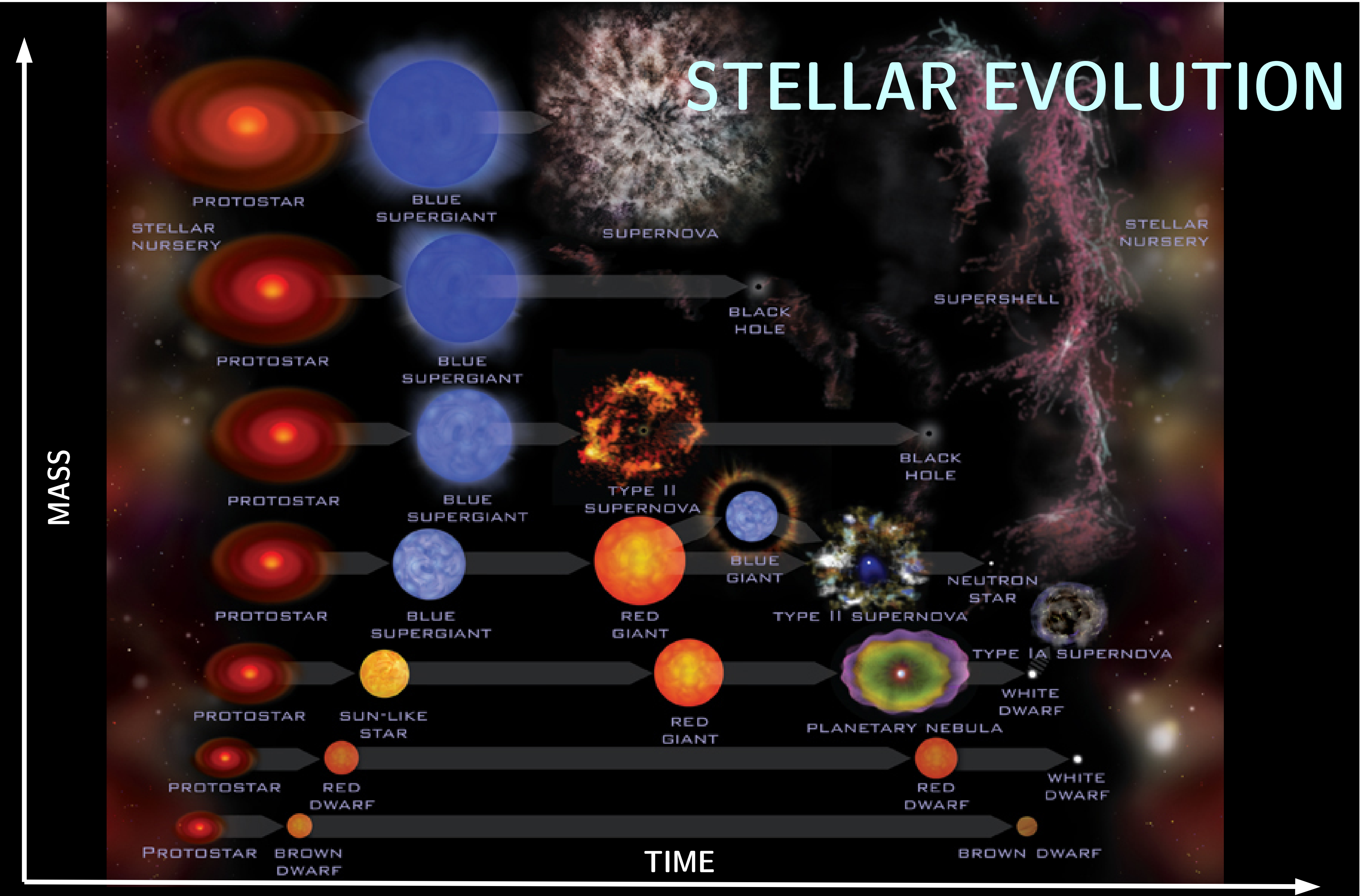
Version du 17 janvier 2014

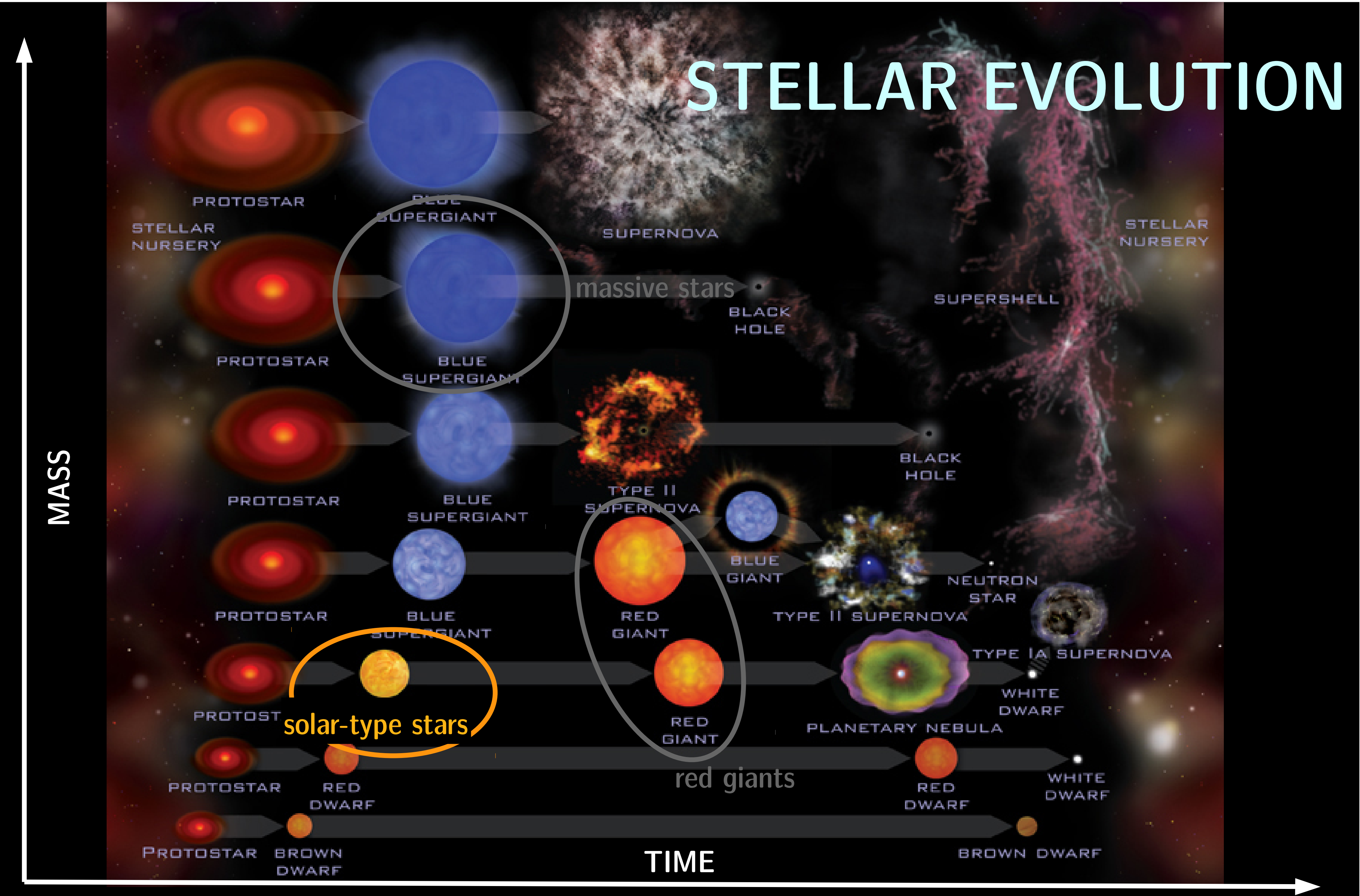
Specificities of the team Stellar Astrophysics (AS)



Research topics of the team Stellar Astrophysics (AS)



Research topics of the team Stellar Astrophysics (AS)



Modelling Stellar Evolution

Stars = nuclear factories → stellar evolution necessary to understand the chemical evolution of the Universe

The modelling of stellar evolution is crucial

Drivers of stellar evolution:

Initial Mass and Chemical Composition

Dynamical physical processes :

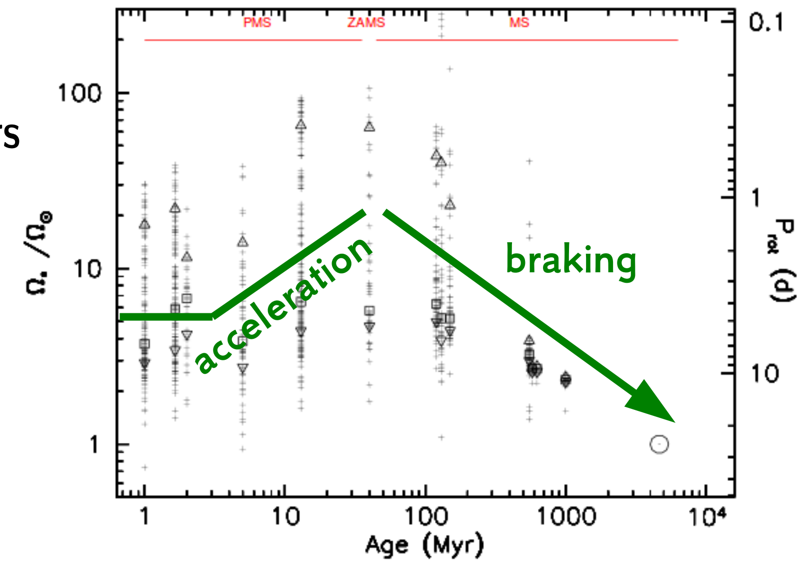
- rotation
- magnetic fields
- diffusion
- (magneto-) hydrodynamical instabilities
- mass loss

Several of the researchers of the LUPM AS team develop state-of-the-art codes (STAREVOL, Montpellier-Montréal code) to model the evolution of stars.

Angular Momentum Evolution of Solar-Type Stars

Context

Understand the early angular momentum evolution of Sun-like stars based on rotation periods derived in young open clusters and associations



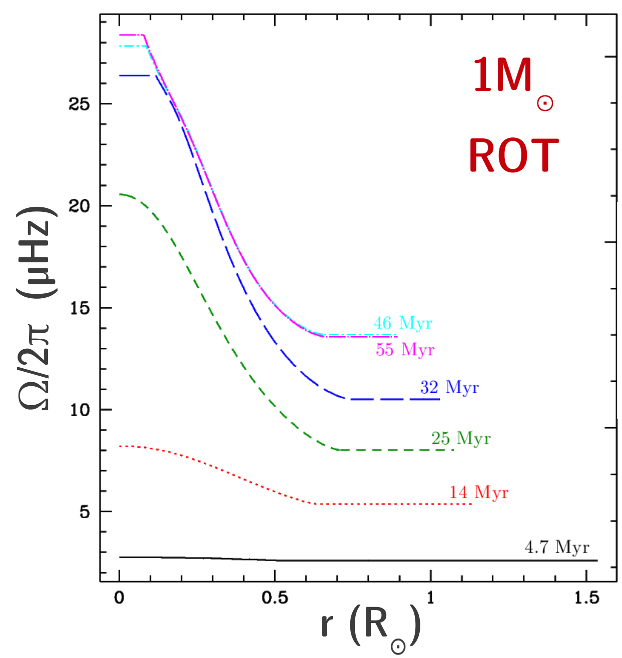
Methodology

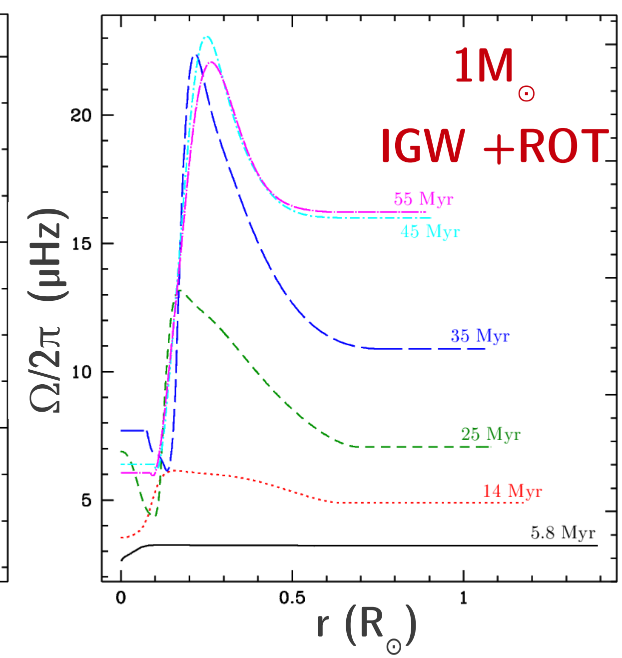
First pre-main sequence self-consistent stellar evolution models including rotational mixing, centrifugal forces, magnetized winds and internal gravity waves using locally developed STAREVOL code

Result

Internal gravity waves efficiently transport angular momentum and modify the angular velocity profiles as the stars evolve

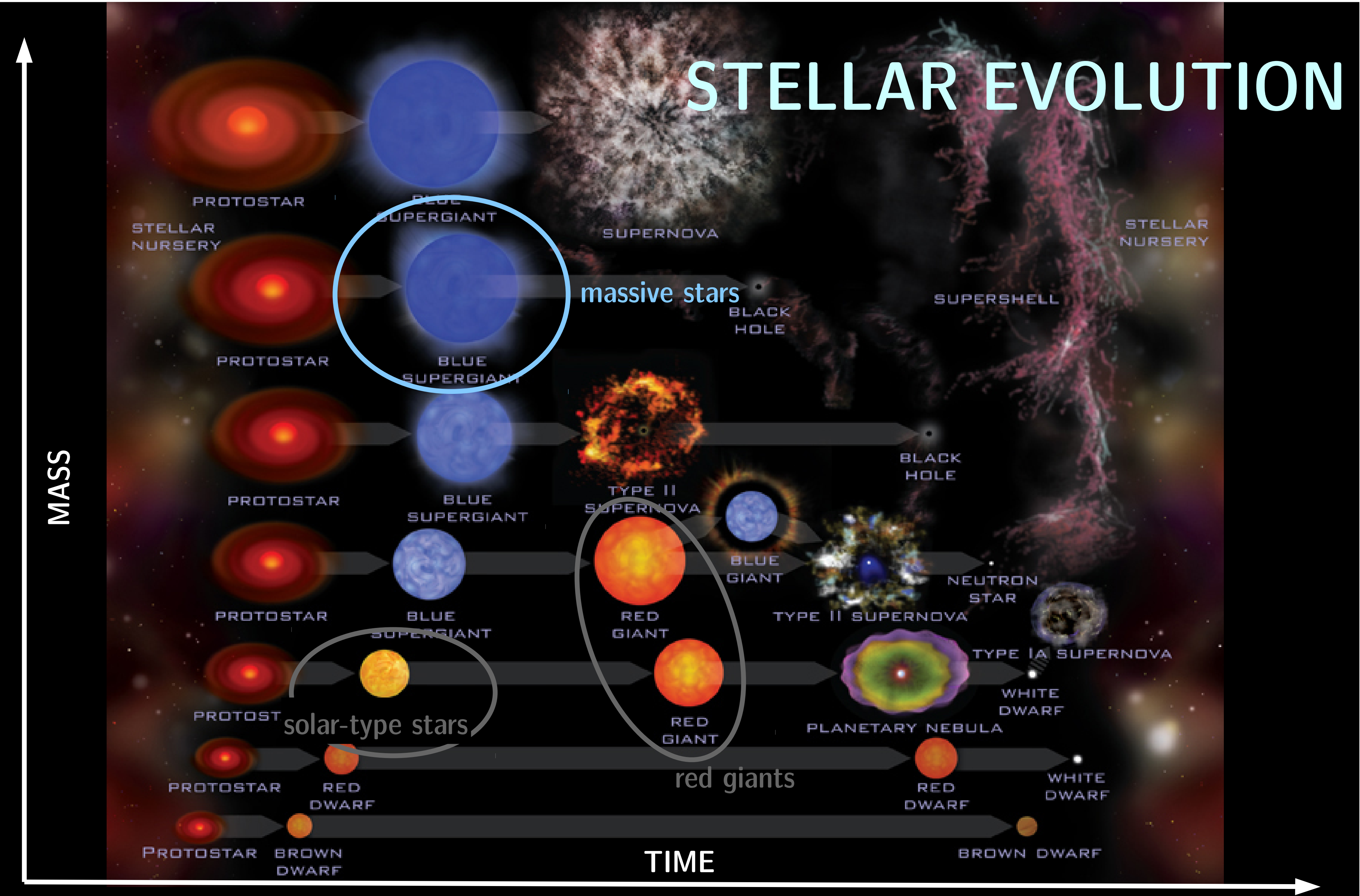
→ Impact on the evolution during later evolutionary phases



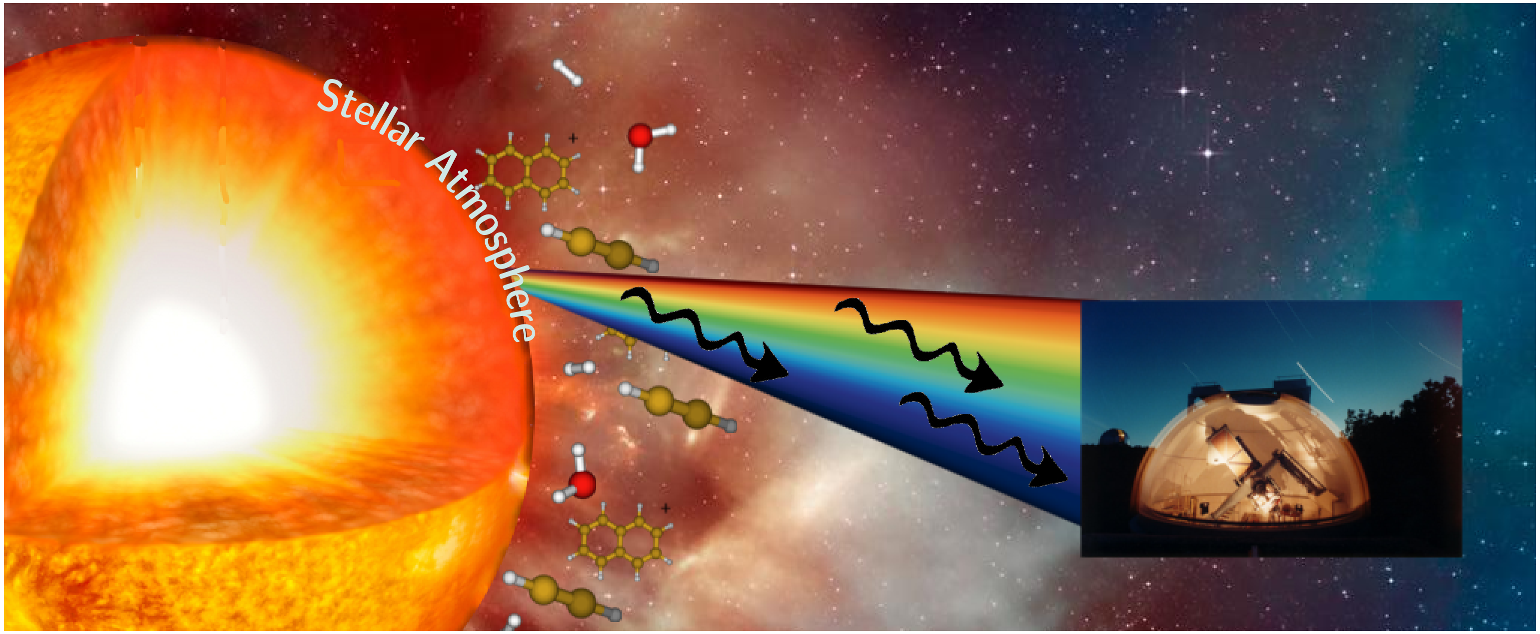


Charbonnel, Decressin, Amard, Palacios, Talon, Astronomy and Astrophysics 554, A40, 2013

Research topics of the team Stellar Astrophysics (AS)



Stellar Atmospheres



Our knowledge of stars comes from the analysis of the light escaping their photospheres.

The model atmospheres are used to build synthetic spectra that can be directly used to interpret spectroscopic data :

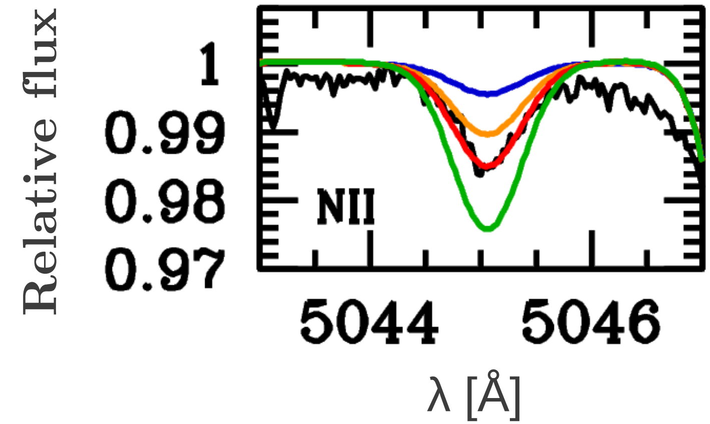
→ crucial link between observations and models (stellar evolution and chemical) predictions

→ atomic/molecular physics and chemistry data needed as input

Several astrophysicists within the LUPM AS team are involved in the development and expert use of model atmosphere (MARCS, CMFGEN) and radiative transfer codes (Turbospectrum, MORAD) for a large variety of stellar types.

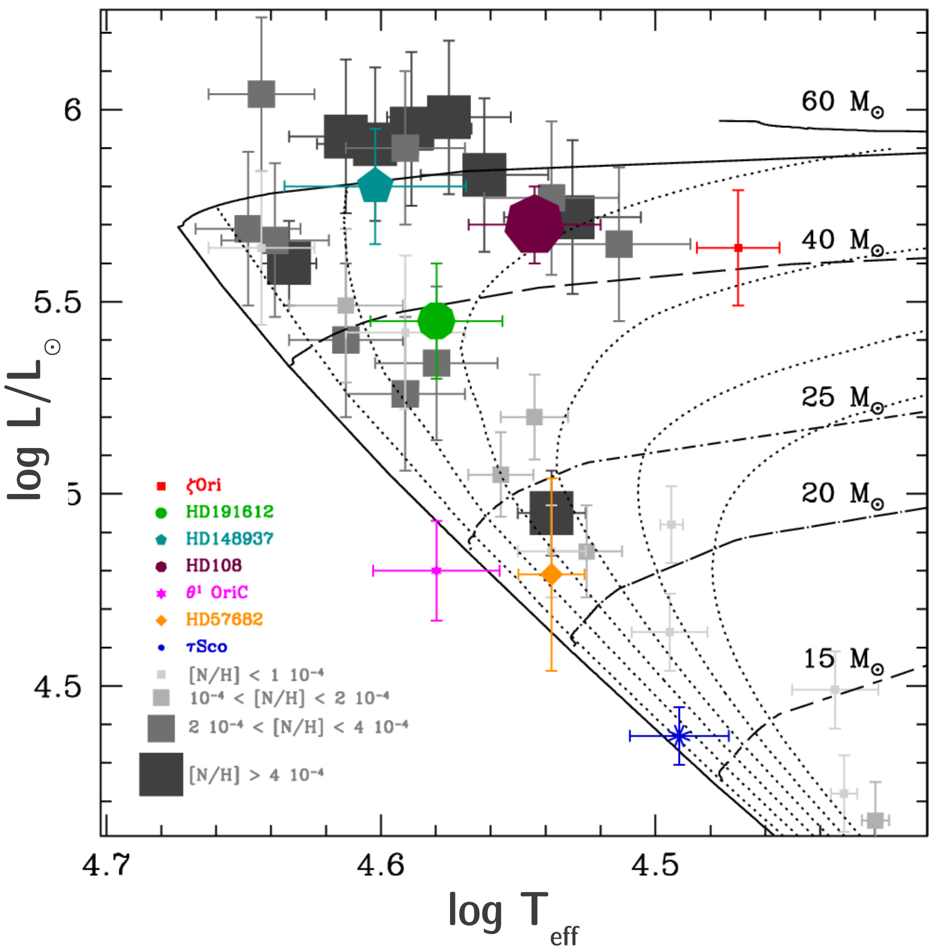
Observations – Models - Simulations

Chemical Abundances of Magnetic Massive Stars



Context

Observationally probe the possible impact of magnetic fields on internal transport processes from surface abundance patterns of massive stars



Methodology

High-resolution spectroscopy of 6 O-type stars.

Data analysis using spectral synthesis → Nitrogen surface abundances and rotation velocities

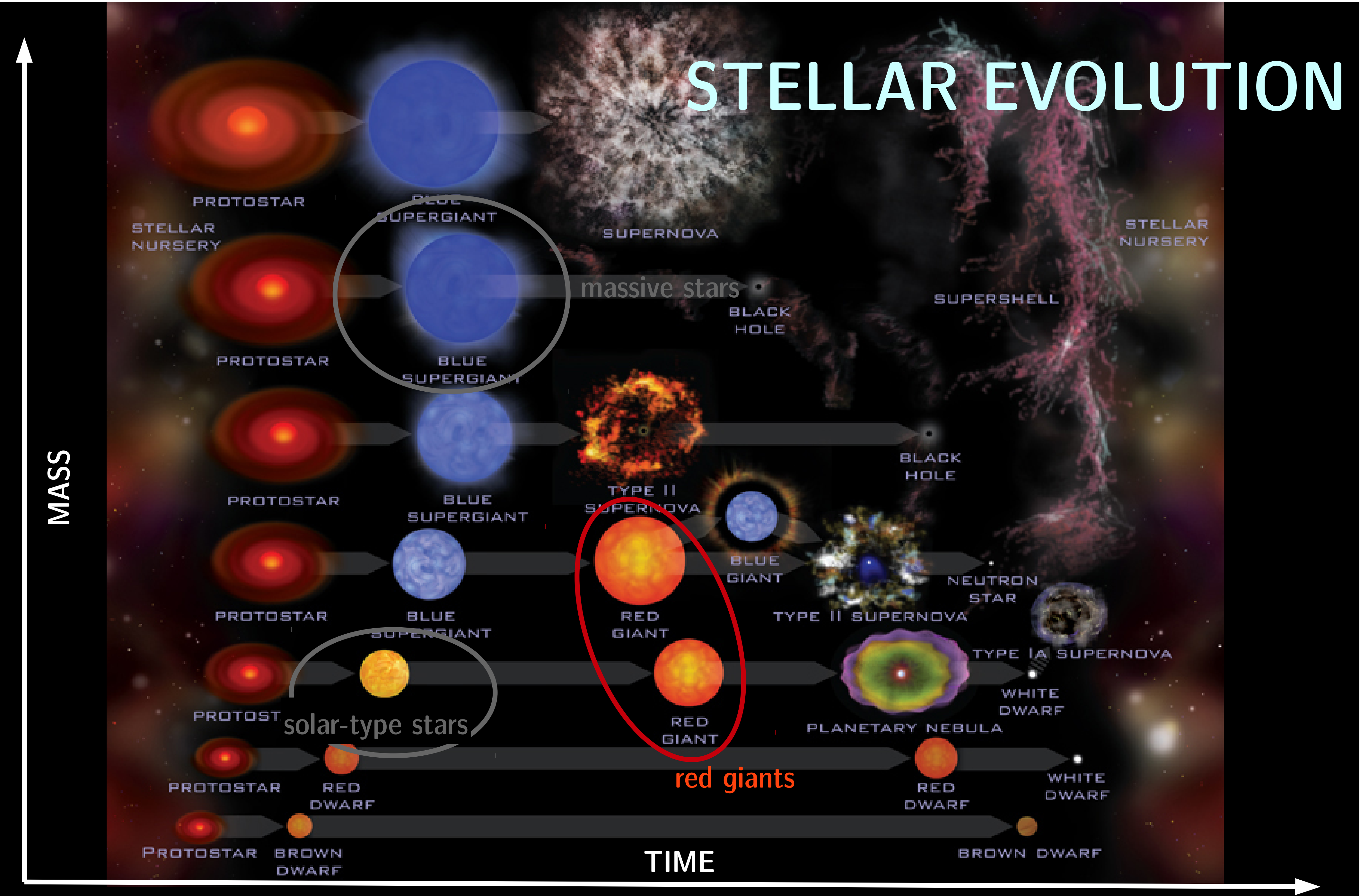
Result

kG magnetic fields induce Nitrogen enrichment in slowly rotating stars of similar importance as that found in non-magnetic rapidly rotating stars.

→ observational sound evidence of the important impact of magnetic fields on internal mixing and surface abundance patterns

Martins, Escolano et al., Astronomy and Astrophysics 538, A29, 2012

Research topics of the team Stellar Astrophysics (AS)



Stellar Magnetism

Spectropolarimetry

=

High resolution spectroscopy

+

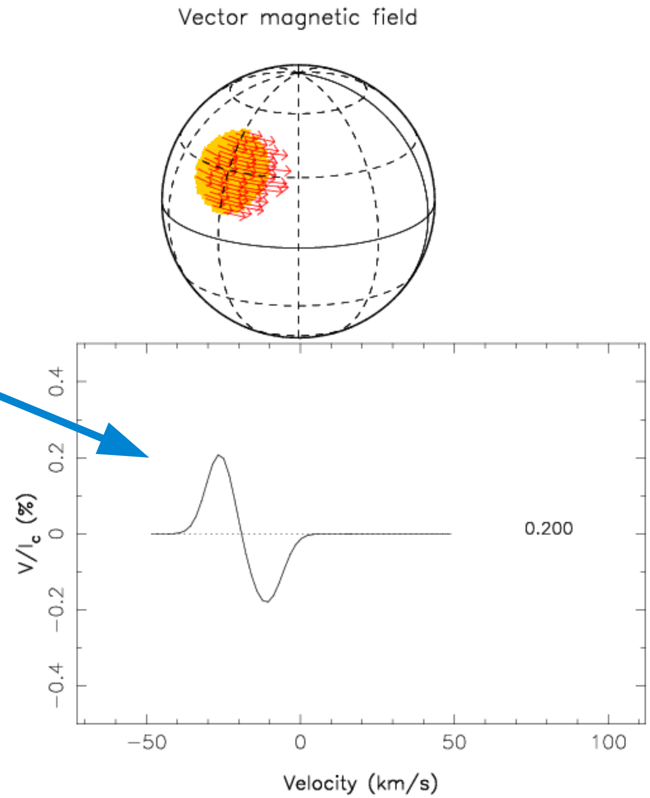
linear and circular polarization spectra

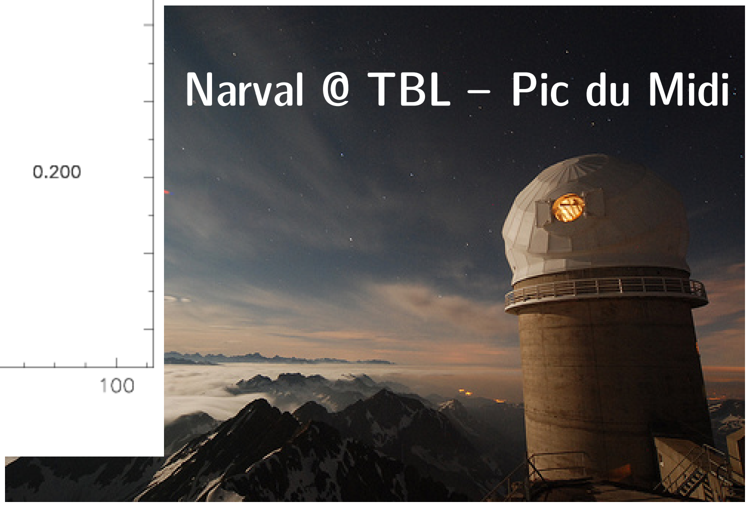
↓

Signature of Zeeman effect

↓

Probe of stellar surface magnetic fields





Several astrophysicists of the LUPM AS team are experts in spectropolarimetry data acquisition and analysis, and have made major contributions in the field of stellar magnetism detection and characterization.

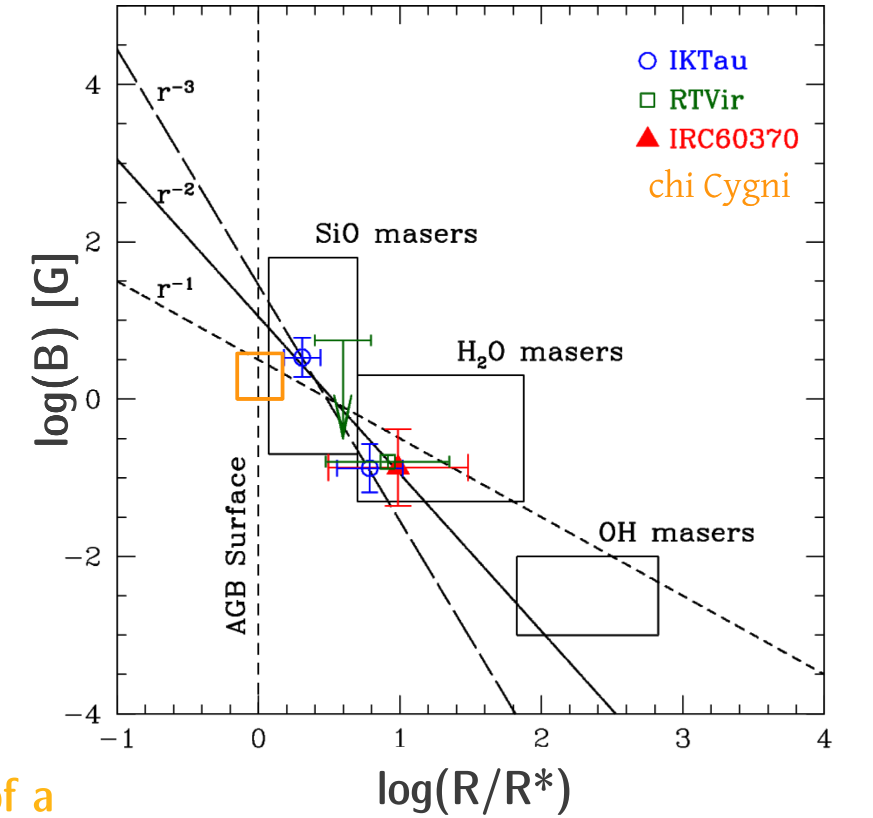
Magnetism and Atmospheric Dynamics of Red Giant Stars

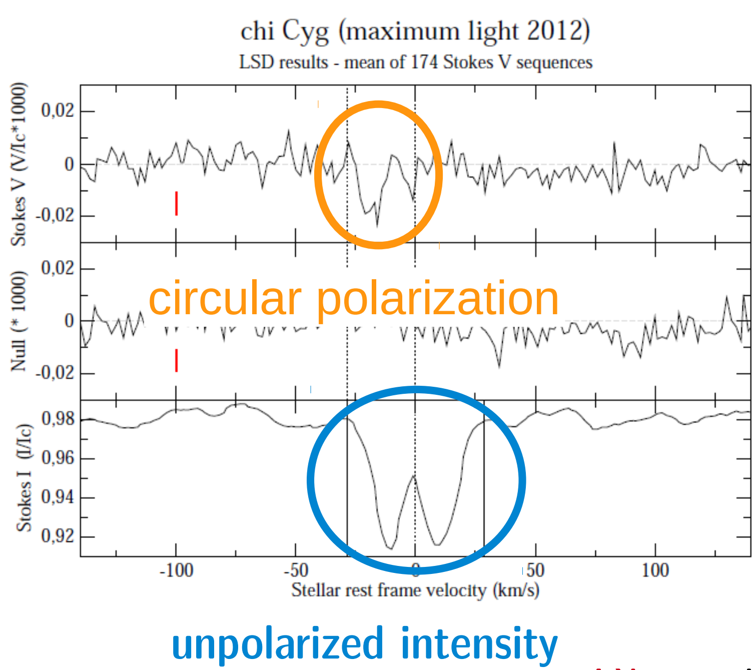
Context

Understand magnetic fields evolution and generation processes in late evolutionary stages

Methodology

Spectropolarimetric follow-up of a Mira type pulsating red giant using Narval@TBL and analysis of circular polarization spectra

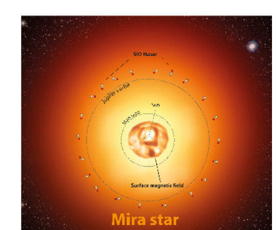




Result

Very first detection of a photospheric weak magnetic field (sub-gauss level) at the surface of χ Cygni when the shock waves reaches its maximum intensity.

→ Relation convection/magnetism/atmospheric dynamics



Lèbre et al. Astronomy and Astrophysics 561, A85, 2014