

Simulating the pulsation of long-period variables for LSST

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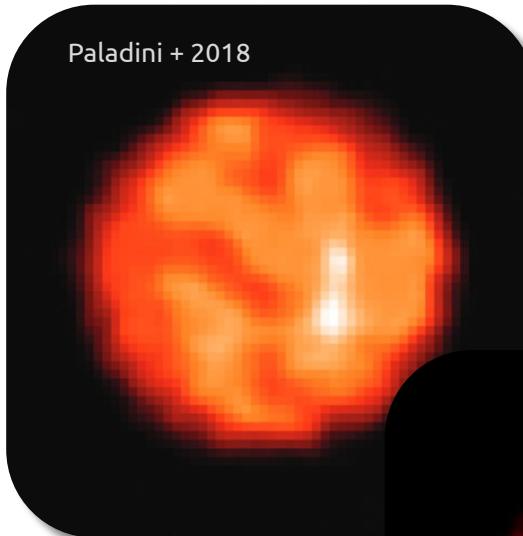
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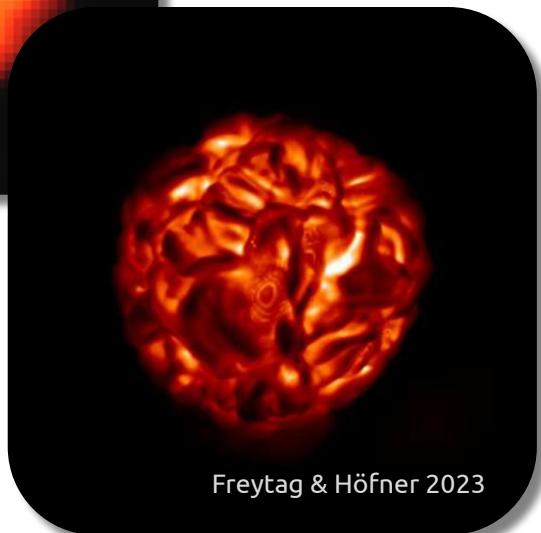
Long-Period Variables

- Evolved stars: AGB, RSG
- Radial pulsation (and more)
- Possibly multiperiodic
- Period: days to months
- Amplitude: $0.001 \leq \Delta V / \text{mag} \leq 10$

Paladini + 2018



Freytag & Höfner 2023



Motivation

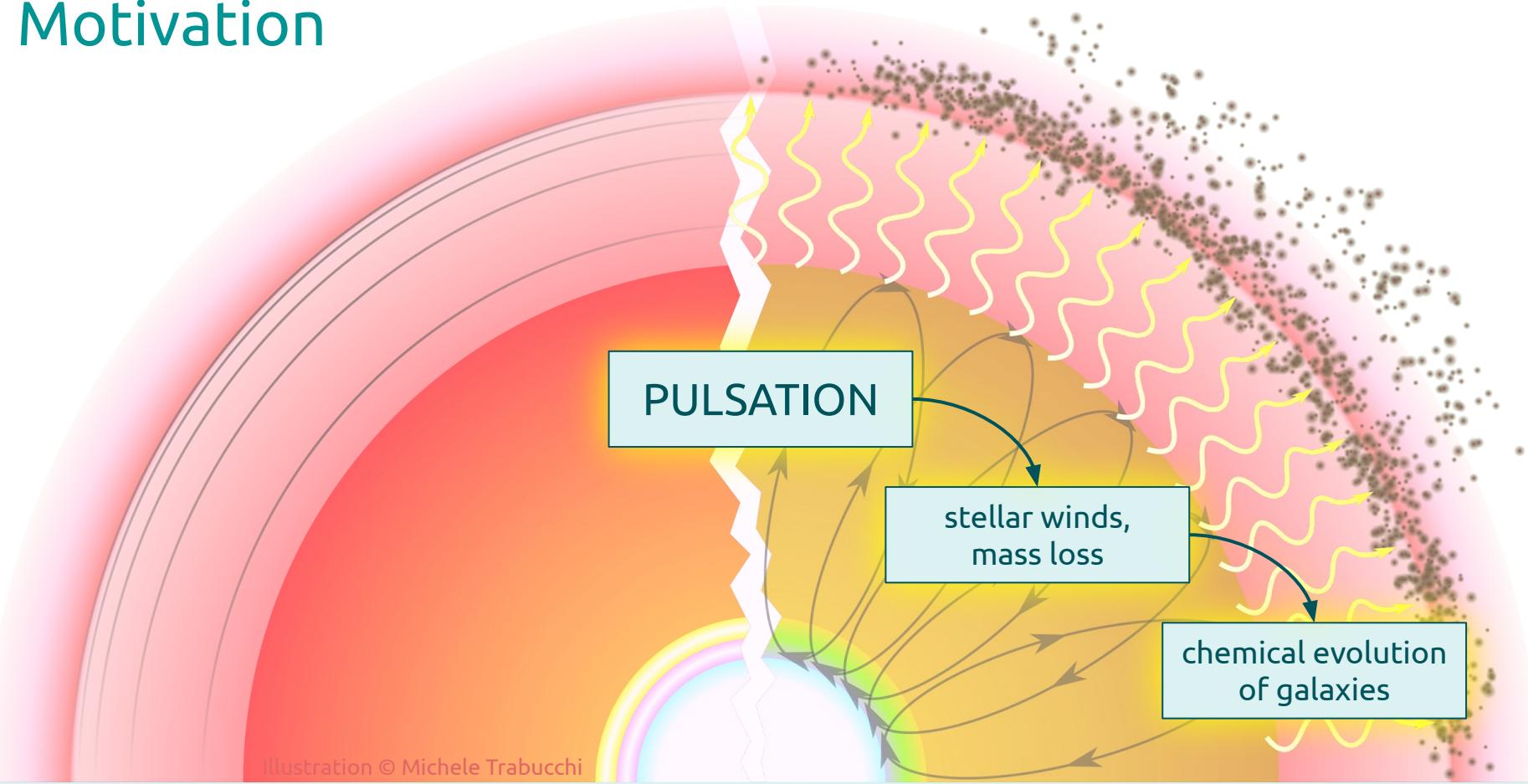
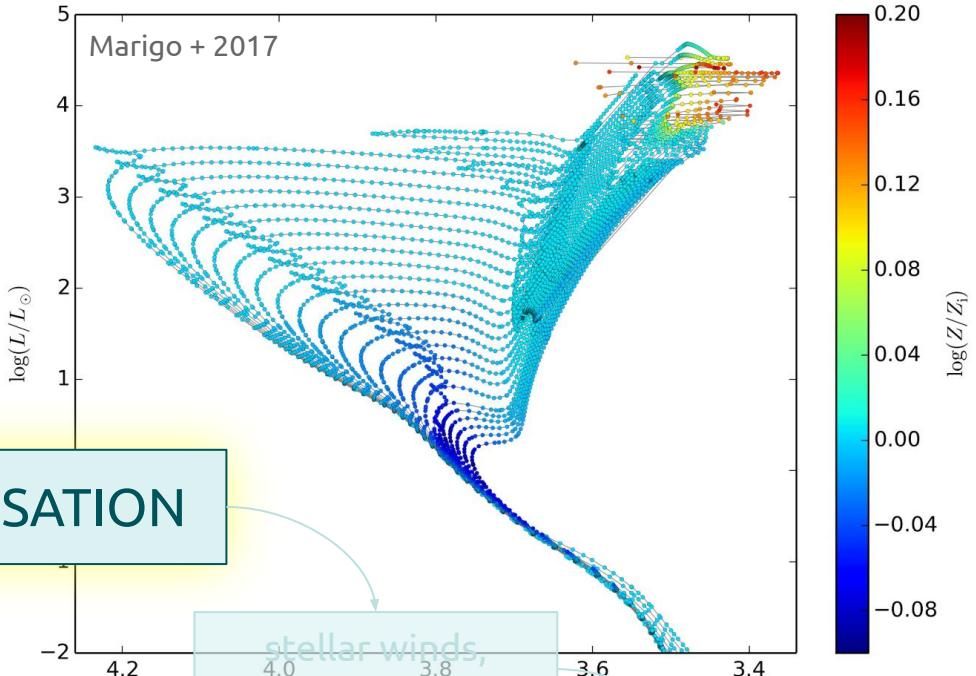
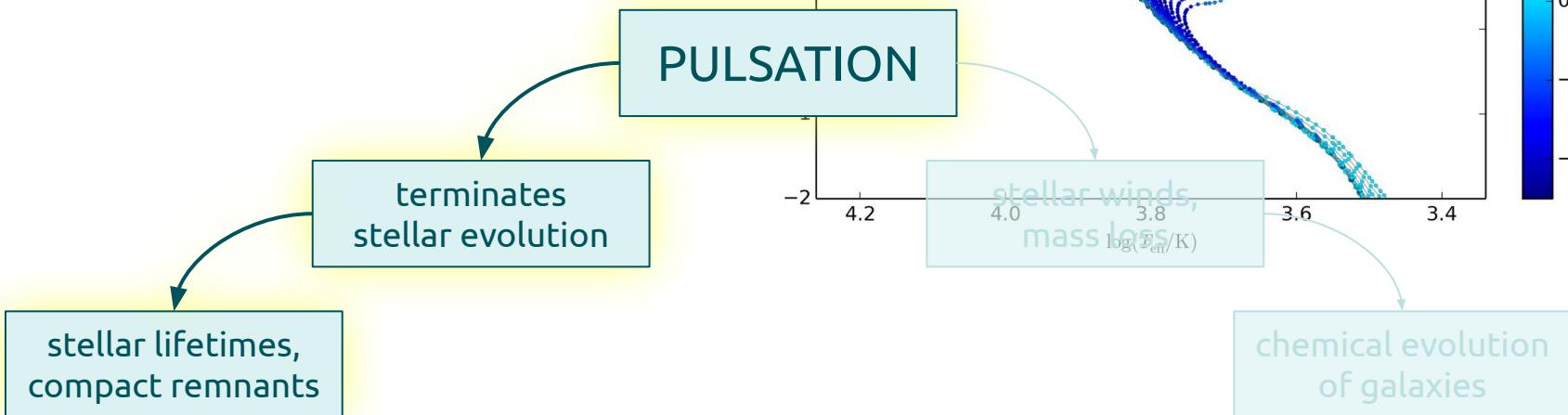
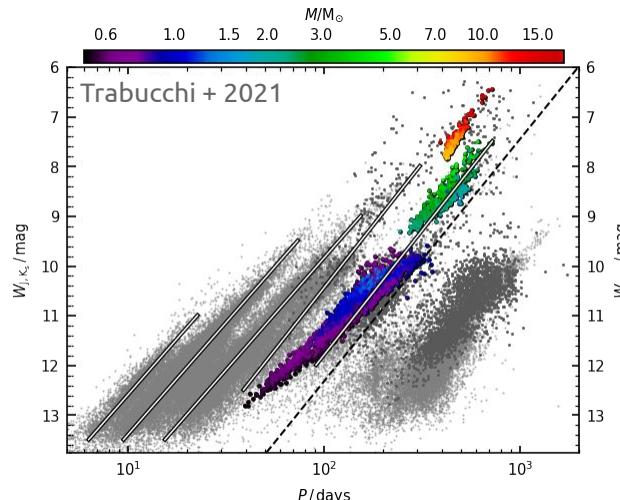


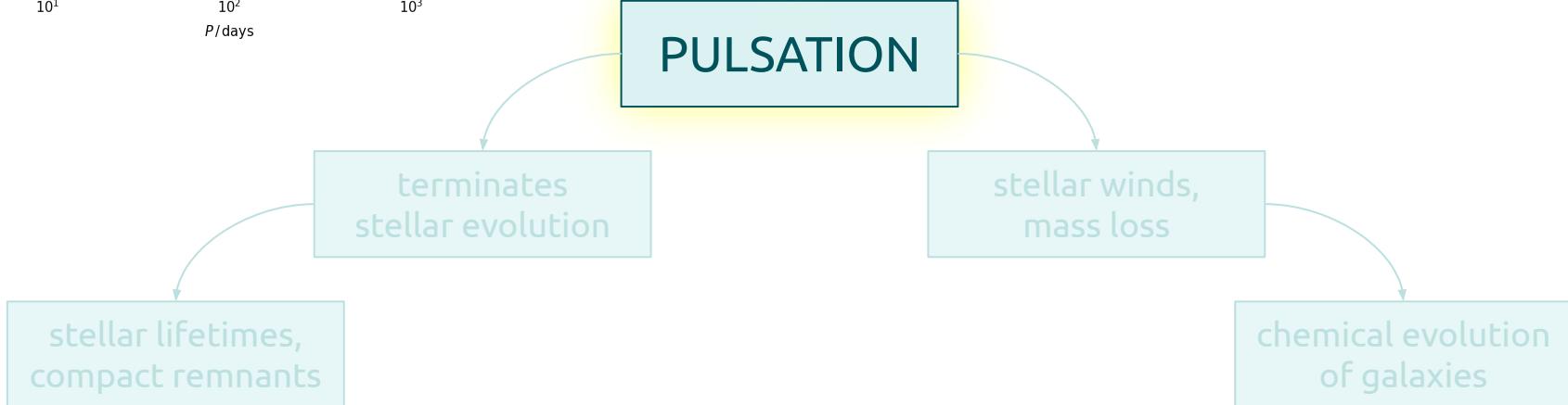
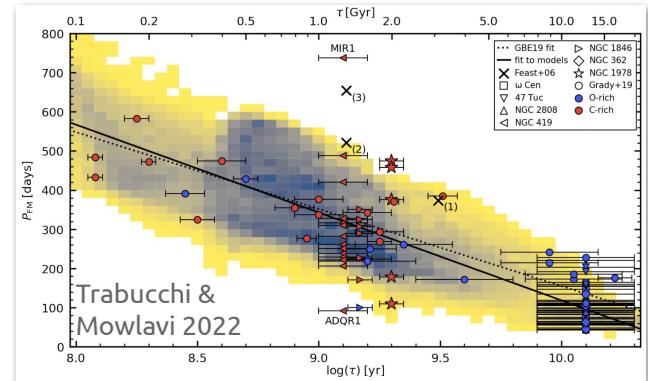
Illustration © Michele Trabucchi

Motivation





ACCURATE MODELS!



Purpose

1. **Present:** provide results of pulsation models to the LSST community
(TRILEGAL LSST simulation in-kind contribution P.I. Léo Girardi, see talks by G. Pastorelli, A. Mazzi)
 - a. Period(s)
 - b. Excitation state (dominant / secondary / stable)
 - c. Coverage of stellar parameters
 - d. Amplitudes
 - e. Light (+) curves templates
2. **Future:** calibrate pulsation models with LSST observations

Methods (a): pulsation models

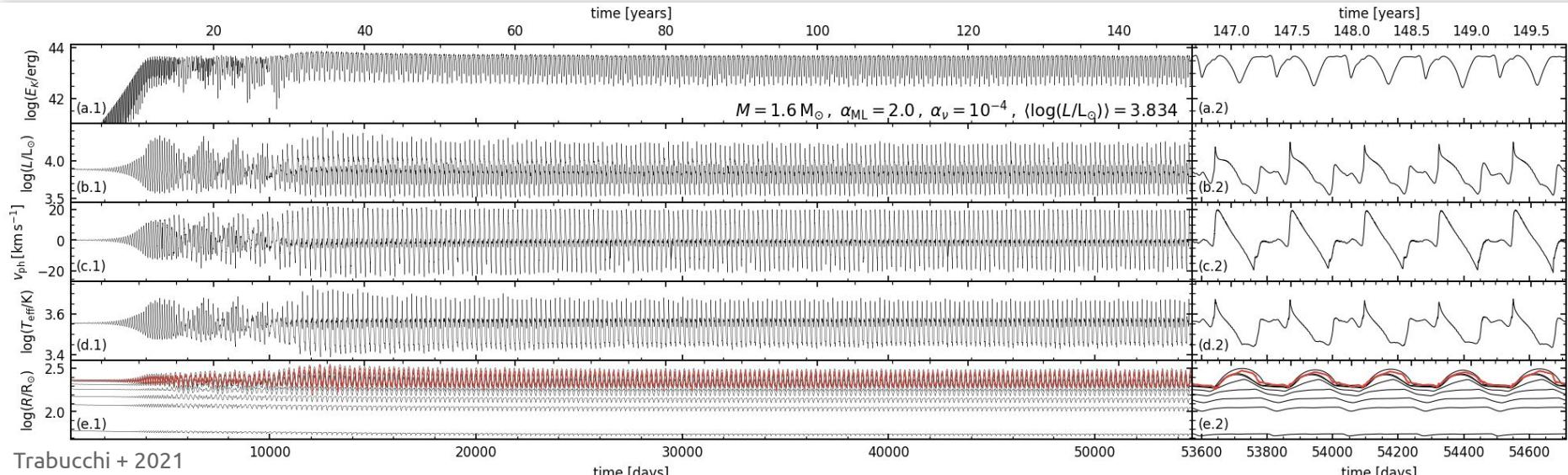
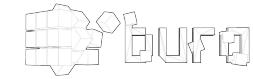
1D hydrodynamic pulsation code

(Keller & Wood 2006, Trabucchi+ 2021)

Envelope evolution on several dynamical time scales

Calculations: HPC Bura @ Rijeka

(Croatian in-kind contribution & LSST data center)

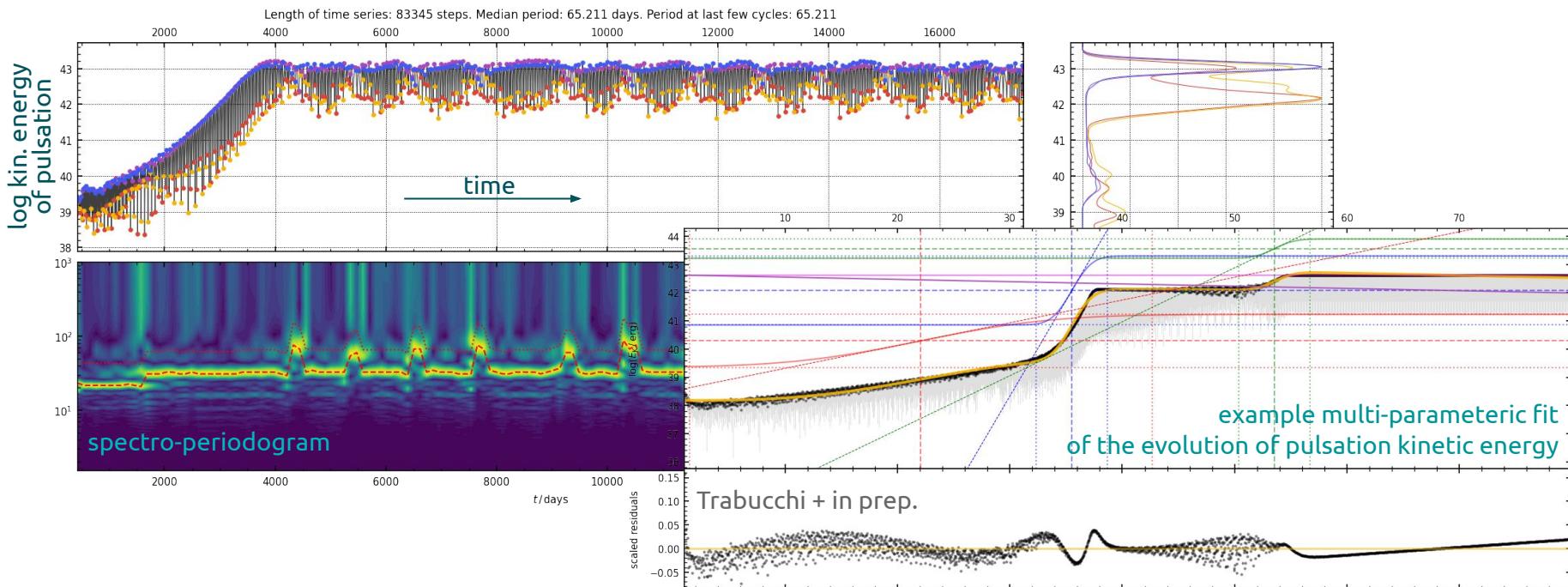


Trabucchi + 2021

Methods (b): time series post-processing

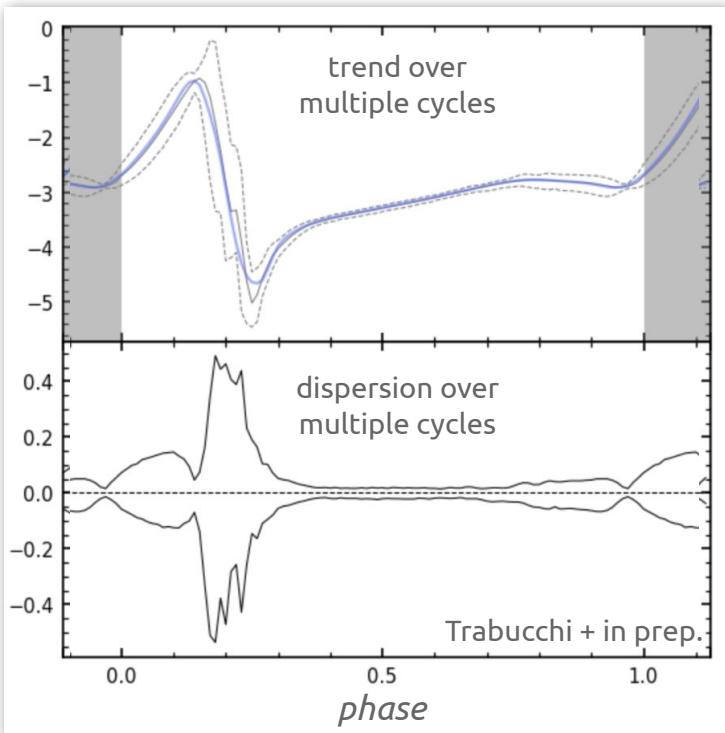
Parametric description
of pulsation growth:

1. **Scientific** purposes: link pulsation/evolution physics
2. **Practical** purposes: flexible/compact models delivery

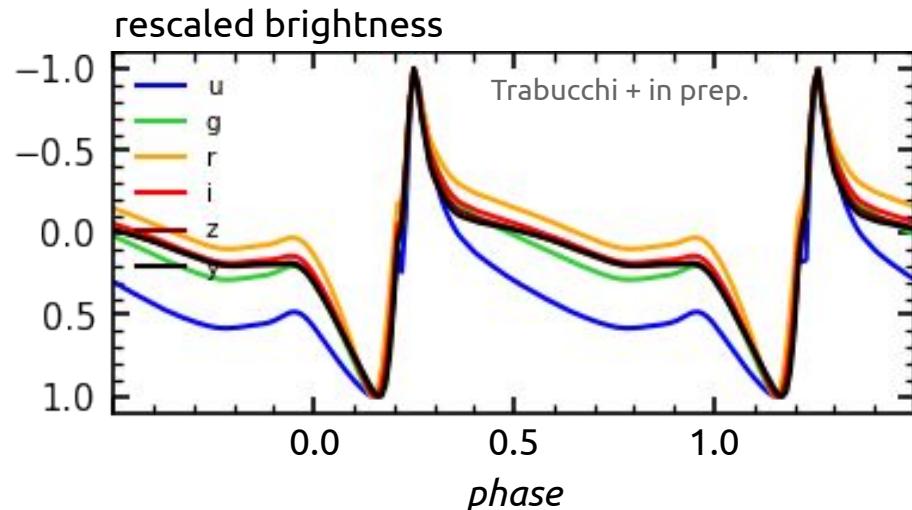


Methods (c): curves templating

Example template curve
(mag, velocity, radius, temperature, ...)



- Light curve templates in the LSST filters
- Templates of physical quantities in the pulsating layers as a function of time



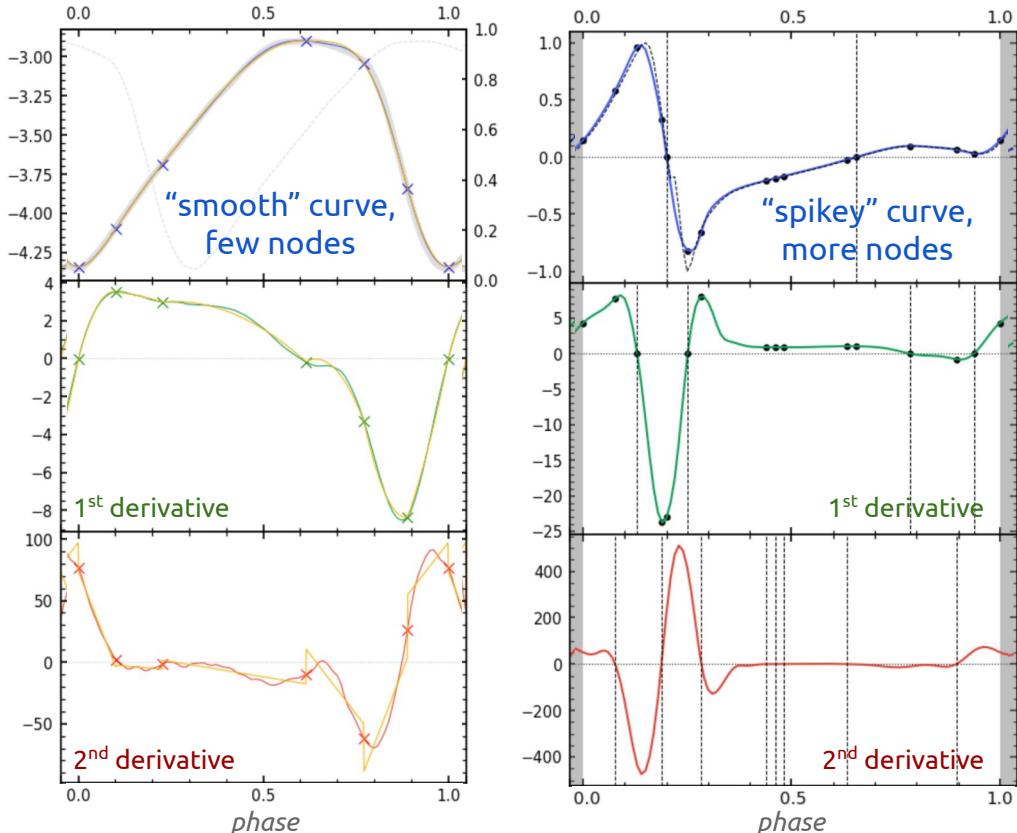
Methods (d): templates optimization

Full templates not suited
for large simulations.

Optimization:

- spline-like interpolating nodes
- normalized / rescaled curves
- preserve derivatives
at “critical” points
- 2D extension: boundary
conditions for hydrodynamic
atmosphere models, etc.

Trabucchi + in prep.



Community input

Delivery

Periods, amplitudes, templates (optimized) included in the simulation.

How do the SMWLV (& TVS, ...) communities would like to access these data?

Extension

Delivery / optimization methods applicable to any variability data:
variability parameters and curve templates both from models and observations.

If you are interested, please contact us!

