PLATO Complementary Science

website: https://fys.kuleuven.be/ster/research-projects/plato-cs/home

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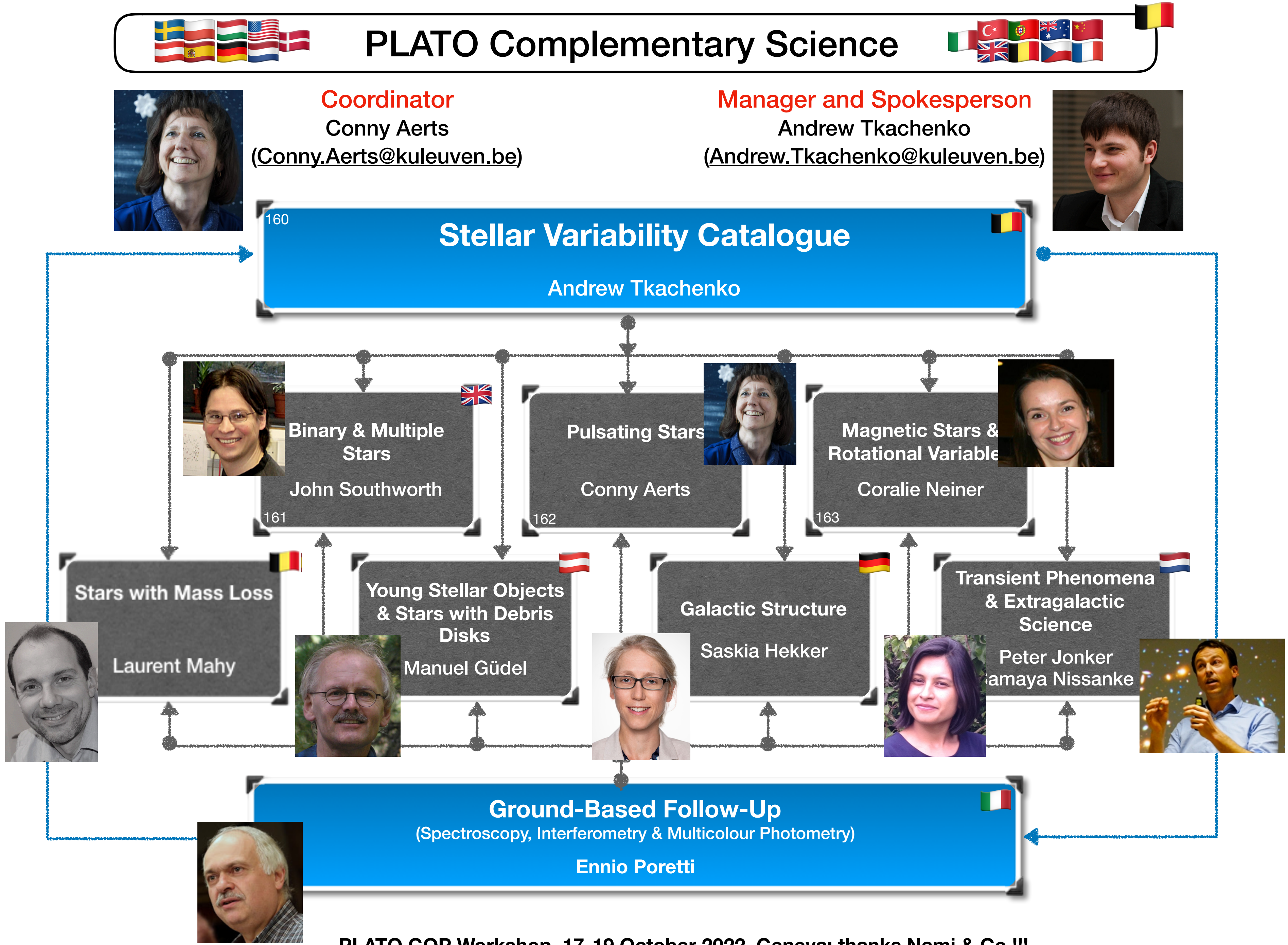
More than 250 registered scientists

On behalf of the PLATO-CS team

Andrew Tkachenko

Institute of Astronomy, KU Leuven (BE)

PLATO-CS: who is who



PLATO GOP Workshop, 17-19 October 2022, Geneva: thanks Nami & Co !!!

PLATO-CS: brief summary*

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Objectives

- Scientific programmes distinct from the Core Science
- Unique database of variable phenomena

How

- **Guest Observer** (GO) programme (call and selection by ESA)
- GO is assigned **8% of the science data** (10th of thousands objects)

Task

Make sure community is ready for optimal GO proposal submission

PLATO - COMPLEMENTARY SCIENCE (PLATO-CS)

Call for Participation

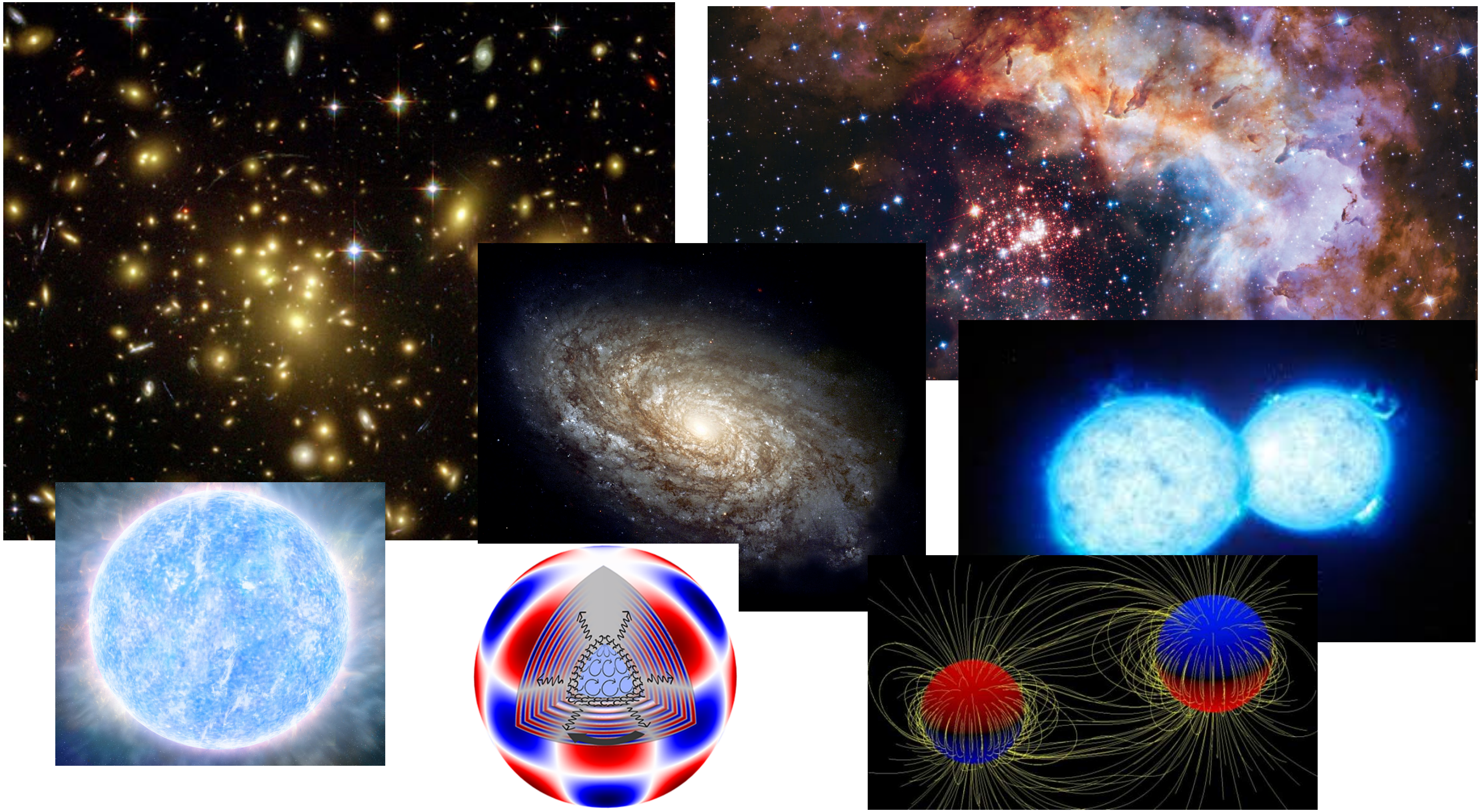
The PLATO Complemenary Science program is open to any interested scientist who would like to participate and contribute. It covers all aspects of astrophysics not covered by the core science of the mission. The core science covers exoplanet science as well as stellar science for stars of spectral type F5 or later.

REGISTER HERE

website: https://fys.kuleuven.be/ster/research-projects/plato-cs/home

*I promise this is the last slide about PLATO-CS organisation/management

PLATO-CS: scientific component



Not a joke: though we do not aim to solve the Universe, we do cover a broad range of science questions, from extragalactic research to inner workings of individual stars

PLATO-CS: Disclaimer

The list of science questions presented in this talk is not inclusive but rather representative. Moreover, there is a high level of subjectivity in the selection of scientific topics that are presented

PLATO-CS: “far, far away”

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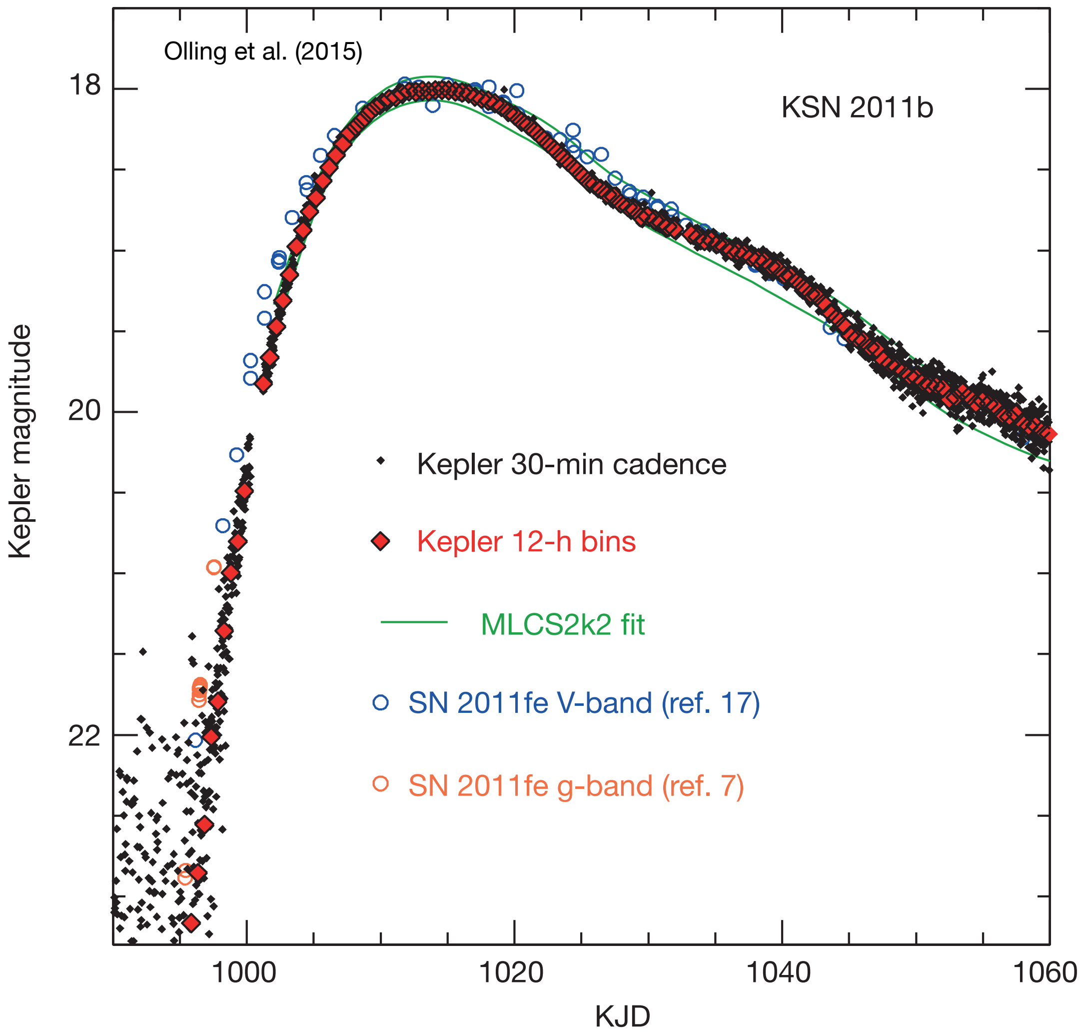
Transient Phenomena & Extragalactic Science
Peter Jonker
167 Samaya Nissanke


SNe explosions in distant galaxies



Type Ia supernova: triggered by accretion or a merger of white dwarfs?

- Important to observe right after the explosion
- Cadence decides: ground-based observations can’t compete
- Amplitude is often quite large (some 5mag in this example)

PLATO will provide cadence, quality, and fast reaction (ToO)

GOP: optical spectra to probe physics and/or formation scenarios

PLATO-CS: “far, far away”

Transient Phenomena & Extragalactic Science

Peter Jonker
Samaya Nissanke

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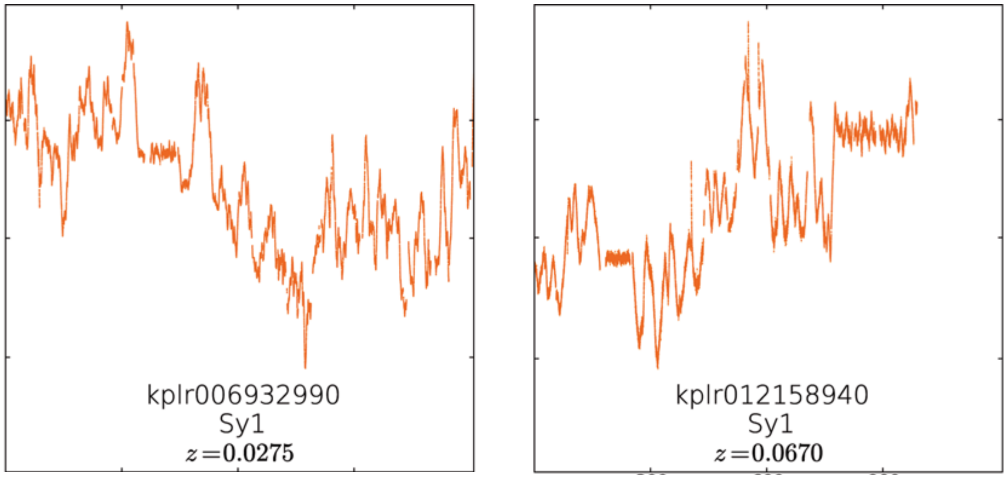
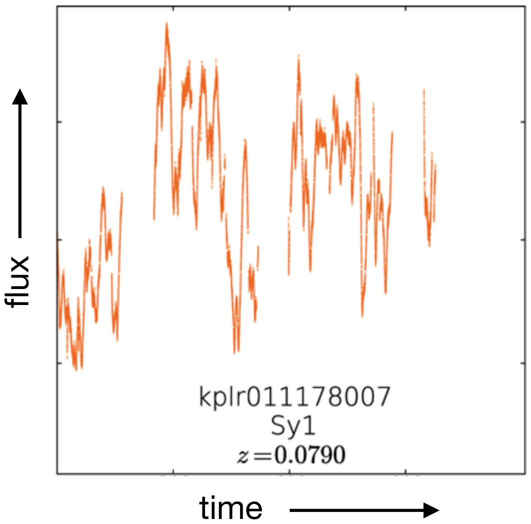
Physics of SMBH accretion & variability

Kasliwal et al. (2015, 2017)





Time-scales of hours to years; amplitudes of few tens to hundreds of mmag

Also observed by TESS: Treiber et al. (2022; arXiv:2209.15019)

AGN variability: what is the underlying physical cause?

- Viscosity fluctuations in the accretion disc by episodic mass deposition at the outer disc edge?
- “hotspots” in the accretion disc due to shock heating?
- Thermal viscous instabilities and/or variable mass transfer rate?
- Magnetic flares in the corona of the accretion disc?

PLATO will provide cadence, quality, and time base

PLATO-CS: “home, sweat home”

Galactic Structure

Saskia Hekker

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WIKIPEDIA
The Free Encyclopedia

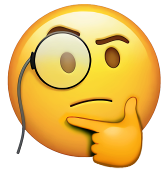
Article Talk

Structure of the Milky Way Galaxy

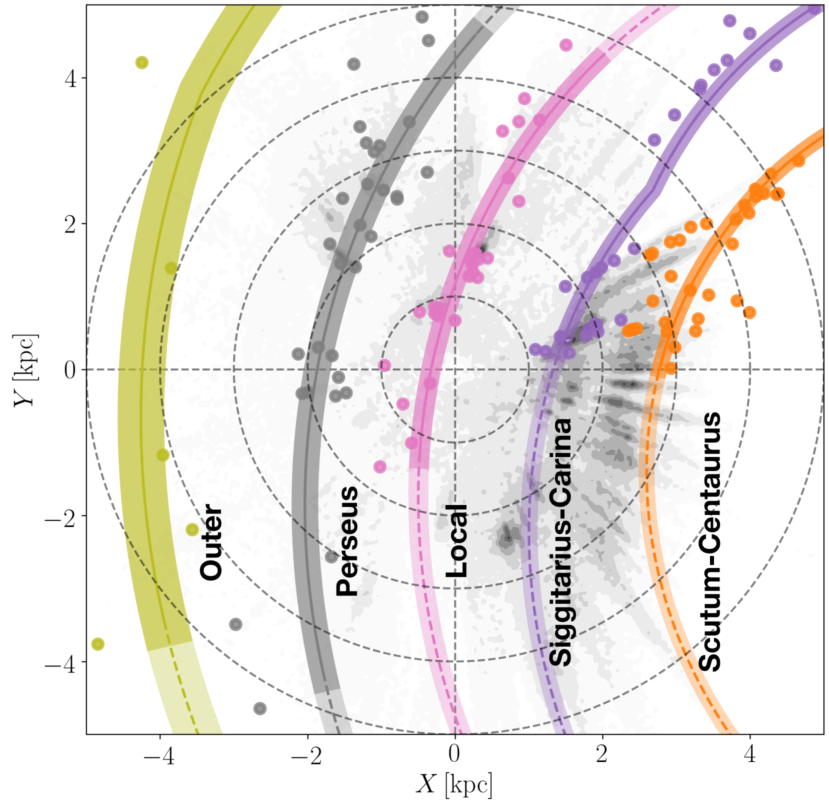
Milky Way

From Wikipedia, the free encyclopedia

The Milky Way is a barred spiral galaxy with an estimated visible diameter of 100,000–200,000 light-years.



Zari et al. (2021)



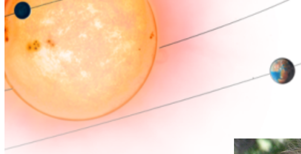
Is Milky Way a grand-design spiral galaxy?

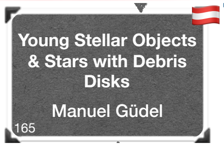
- Do different tracers agree on the number of arms?
- Perseus arm, as traced by young massive stars, dispersing in the field?
- What do older stars and dust tell us about the spiral arms structure?
- Does the MW galaxy have different structure at different wavelengths and when traced by different astrophysical objects?

PLATO will provide cadence, quality, time base, and large range of stellar ages

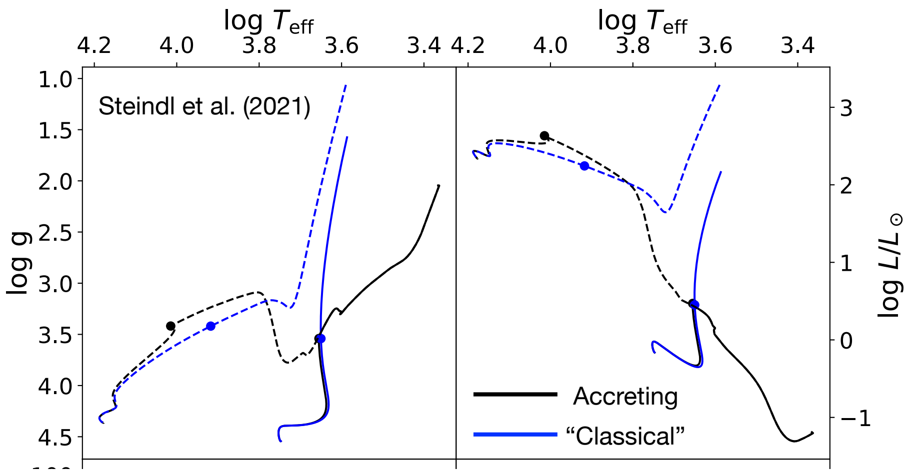
GOP: RVs, chemical composition, atmospheric parameters

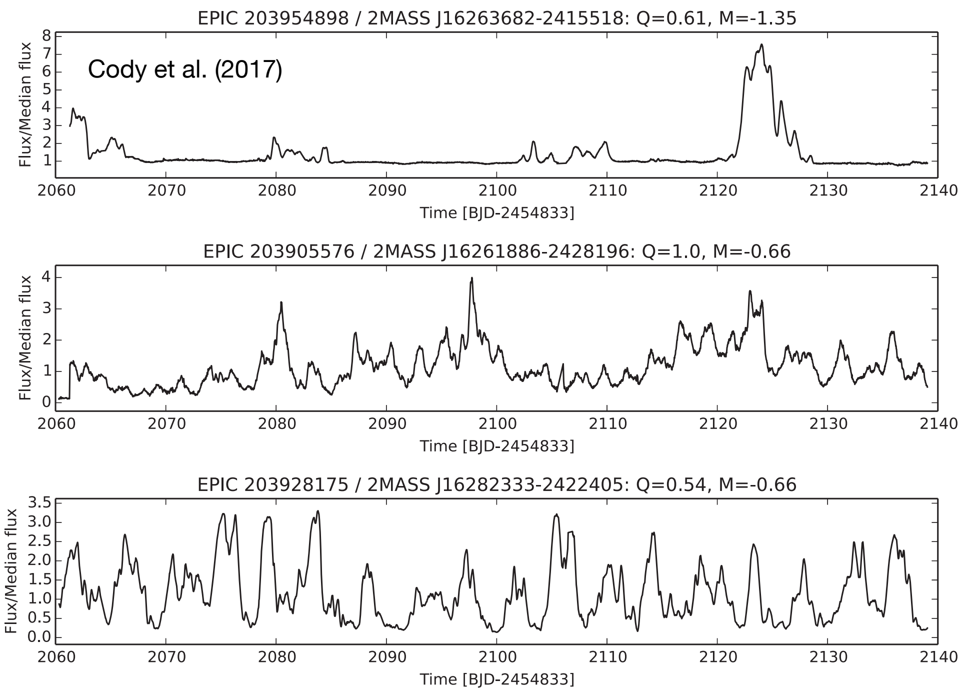
PLATO-CS: youth of stars





Star and planet formation, binarity, magnetism, and pulsations





YSO accretion: evolution and stellar mass accumulation

- "Classical" contraction vs. accreting models
- Continuous stochastic accretion: its role in stellar mass accumulation and inner disc evolution
- (Some of the) time-scales and amplitudes are not properly sampled/appreciated in ground-based observations

PLATO will provide cadence/sampling, quality, and time base

GOP: atmospheric parameters, chemical composition, polarimetry(?)

PLATO-CS: stellar magnetism

Magnetic Stars & Rotational Variables

Coralie Neiner

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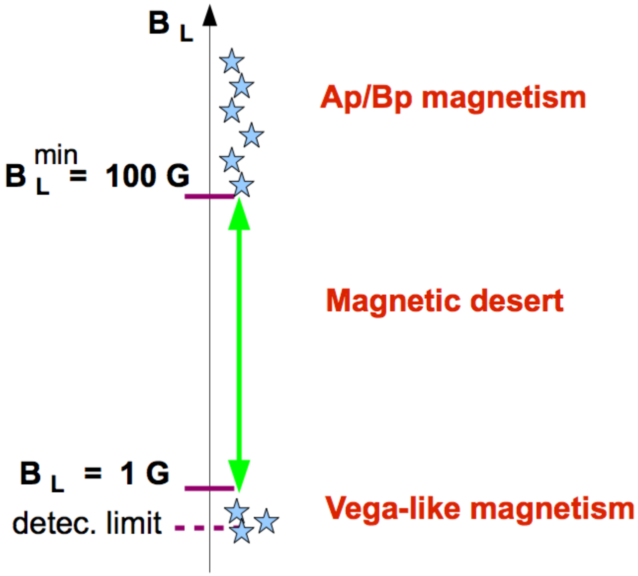
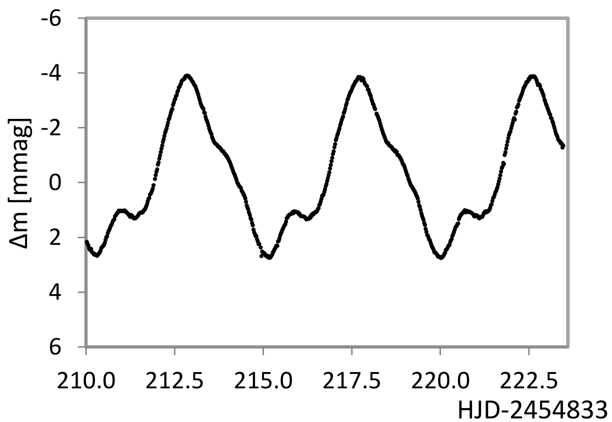
Nature and origin of magnetic fields in early-type stars

Lignières et al. (2014)





Hümmerich et al. (2018)

- Observations: flux redistribution in the abundance spots vs wind blanketing; magnetic field strength dichotomy
- Theory: fossil fields vs dynamo-generated fields vs binary mergers (e.g., Jermyn & Cantiello 2020)
- Evolution: pre-MS vs MS stars; time-scales for the field evolution (e.g., Jermyn & Cantiello 2021)

PLATO will provide cadence/sampling, high quality, and numbers

GOP: atmospheric parameters, chemical composition, polarimetry(?)

PLATO-CS: Pulsating stars

Pulsating Stars

Conny Aerts

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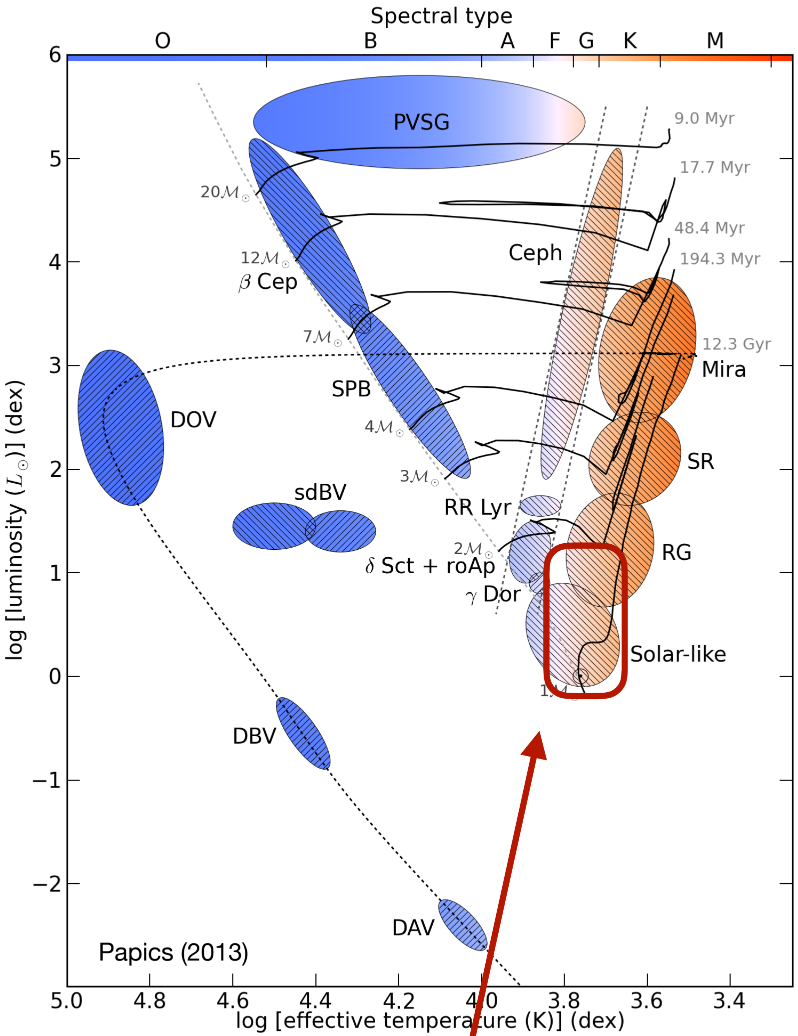
Internal properties of stars with asteroseismology

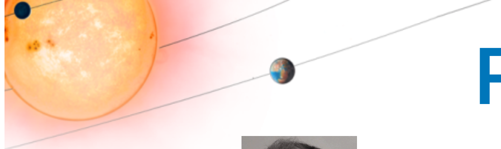


Core Science

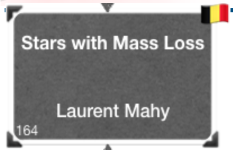
- Classical pulsators and long-period variables
- Upper main-sequence: interaction between stellar pulsations and winds; dynamic boundary conditions
- Internal rotation, mixing, and magnetic fields with asteroseismology
- Tidally affected and induced pulsations
- Rapid pulsators and pulsation mode identification with F-Cams

PLATO will provide high quality, larger numbers compared to Kepler, and reasonably long time base

GOP: binaries vs single, atmospheric parameters, chemical composition, LPV

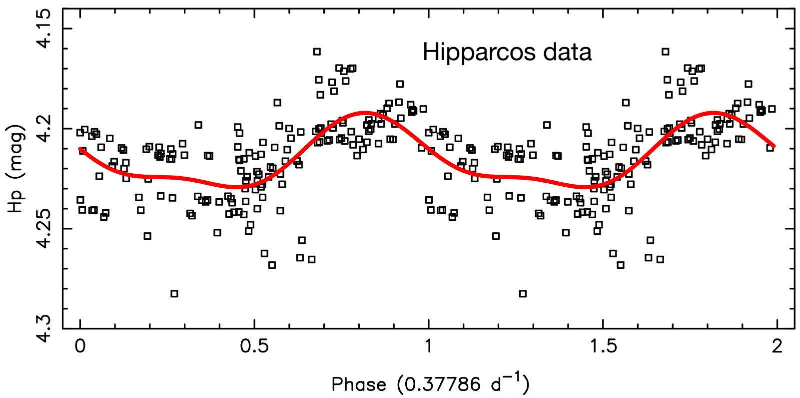


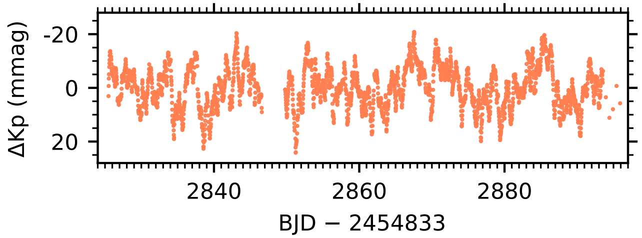
PLATO-CS: Stars with mass loss

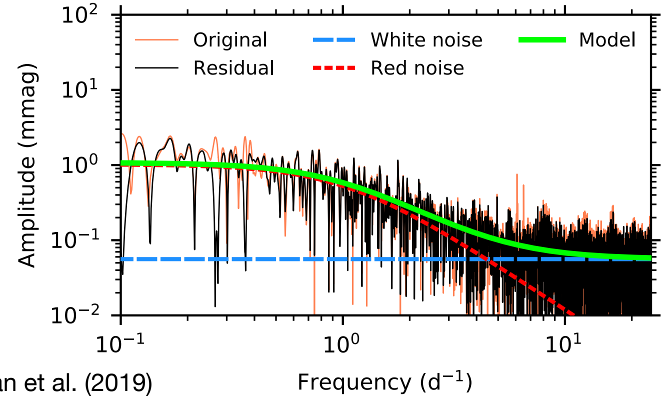


Physics of massive stars with (strong) winds

Simon-Diaz et al. (2018)







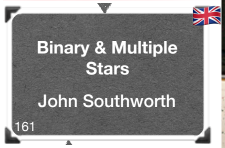
Bowman et al. (2019)

- Distinguishing wind variability from photospheric variability
- Micro- and macro-turbulent broadening: what's their physical origin
- Line broadening and low-frequency stochastic variability: sub-surface convection or waves?
- Uninterrupted, high-cadence photometry combined with spectroscopy

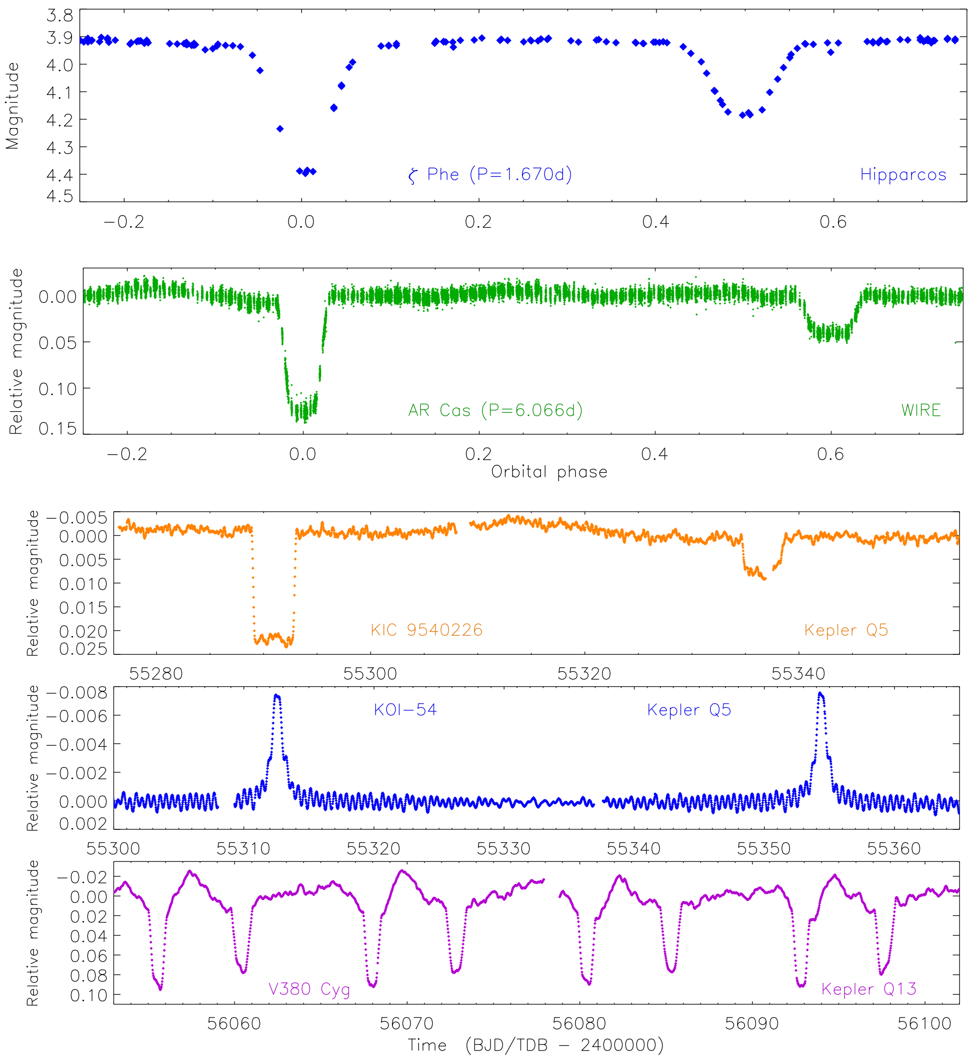
PLATO will provide high quality/cadence, larger numbers compared to Kepler, and long time base

GOP: atmospheric parameters, chemical composition, time-resolved LPVs

PLATO-CS: binary and multiple systems



Southworth (2021)



Eclipsing binaries as a test of (single star) SSE theory

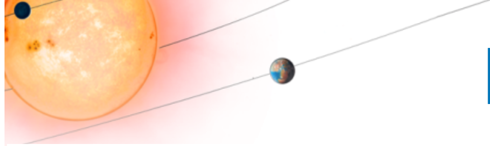
- Masses and radii, 1-3% accuracy (Torres 2010, Serenelli et al. 2021)
- Internal mixing from apsidal motion and/or isochrone fitting (Guinan et al. 2000, Tkachenko et al. 2020)

Binary interactions and accretion physics

- mass-transfer, formation and evolution of accretion discs, cataclysmic variables
- Binary mergers, colliding winds, interacting magnetospheres

PLATO will provide high quality, numbers, and time base

GOP: orbital phase-resolved spectra, RVs, atmospheric parameters, chemical composition



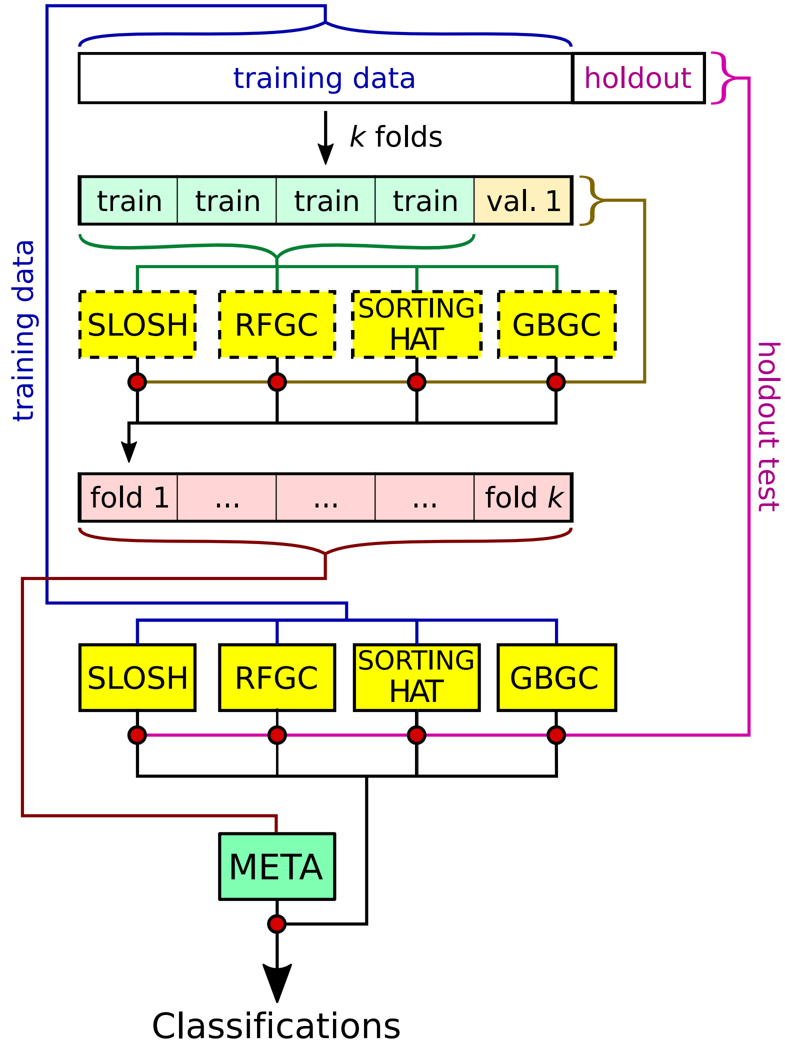
PLATO-CS: Variability catalogue

Stellar Variability Catalogue

Andrew Tkachenko

Diversity of photometric variability

Audenaert et al. (2021)

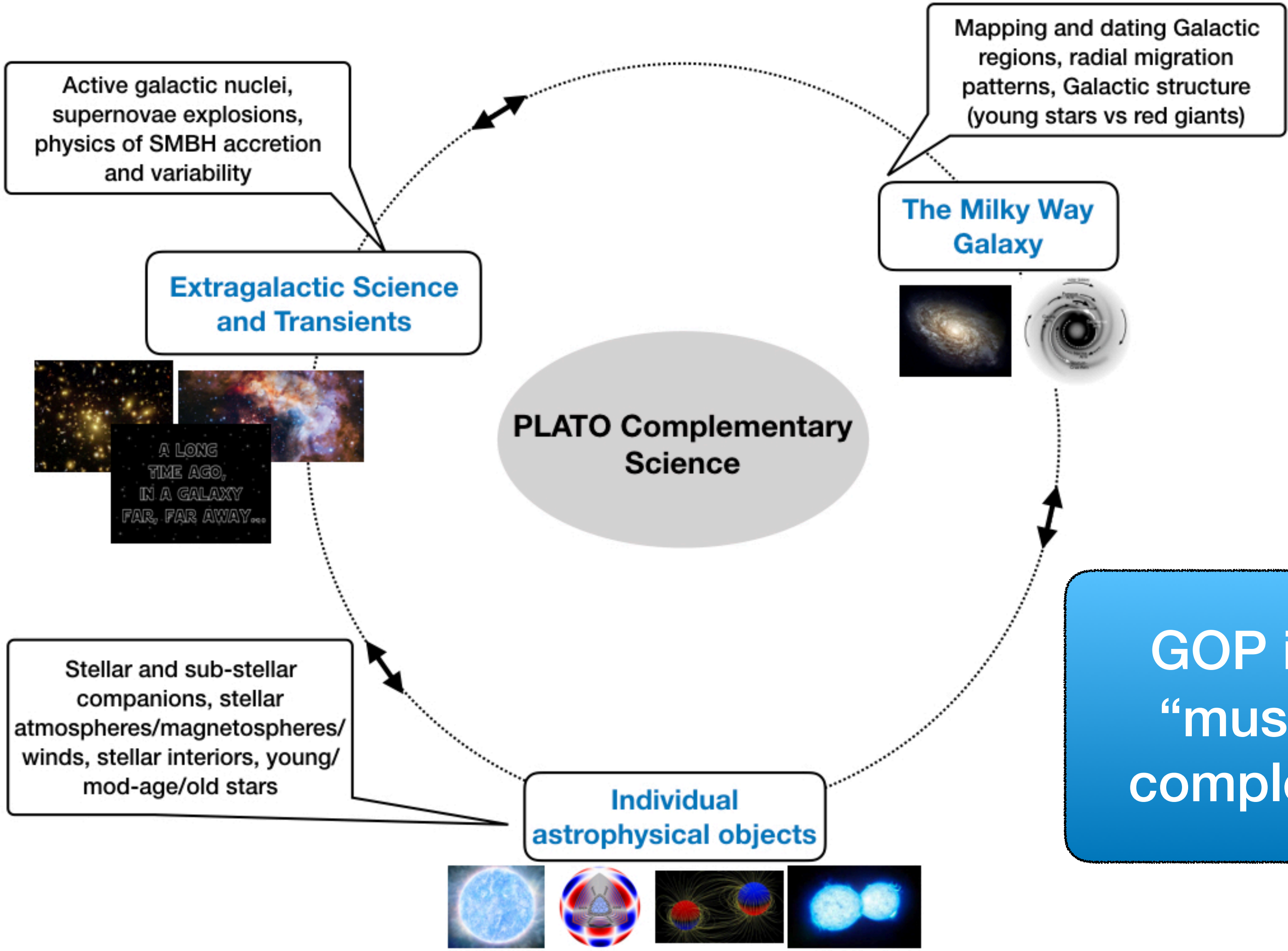


- MetaClassier: combining strengths of several ML-based classification methods
- (Re-)training: domain adaptation or stars in common
- Unsupervised learning: identifying variability(sub-)classes and finding new classes
- Extra components: flaring stars, AGNs, transients, pre-MS stars, etc.

PLATO will deliver a rich data set of light curves that will be subject to automated variability classification

GOP: atmospheric parameters as extra (very useful) features

PLATO-CS: scientific component



GOP is the "must be" complement

Not a joke: though we do not aim to solve the Universe, we do cover a broad range of science questions, from extragalactic research to inner workings of individual stars

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Work Pac...

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...gistered scientists

Advertise within your institution and join us!!!

...alf of the PLATO-CS team

Andrew Tkachenko

...nstitute of Astronomy, KU Leuven (BE)