

PUSHING THE (CONVECTIVE) ENVELOPE: LEVERAGING P-MODE OSCILLATIONS IN SUBGIANTS TO IMPROVE RV PRECISION

JACOB LUHN¹, PAUL ROBERTSON¹, HOWARD ISAACSON², AND BRAD HOLDEN³

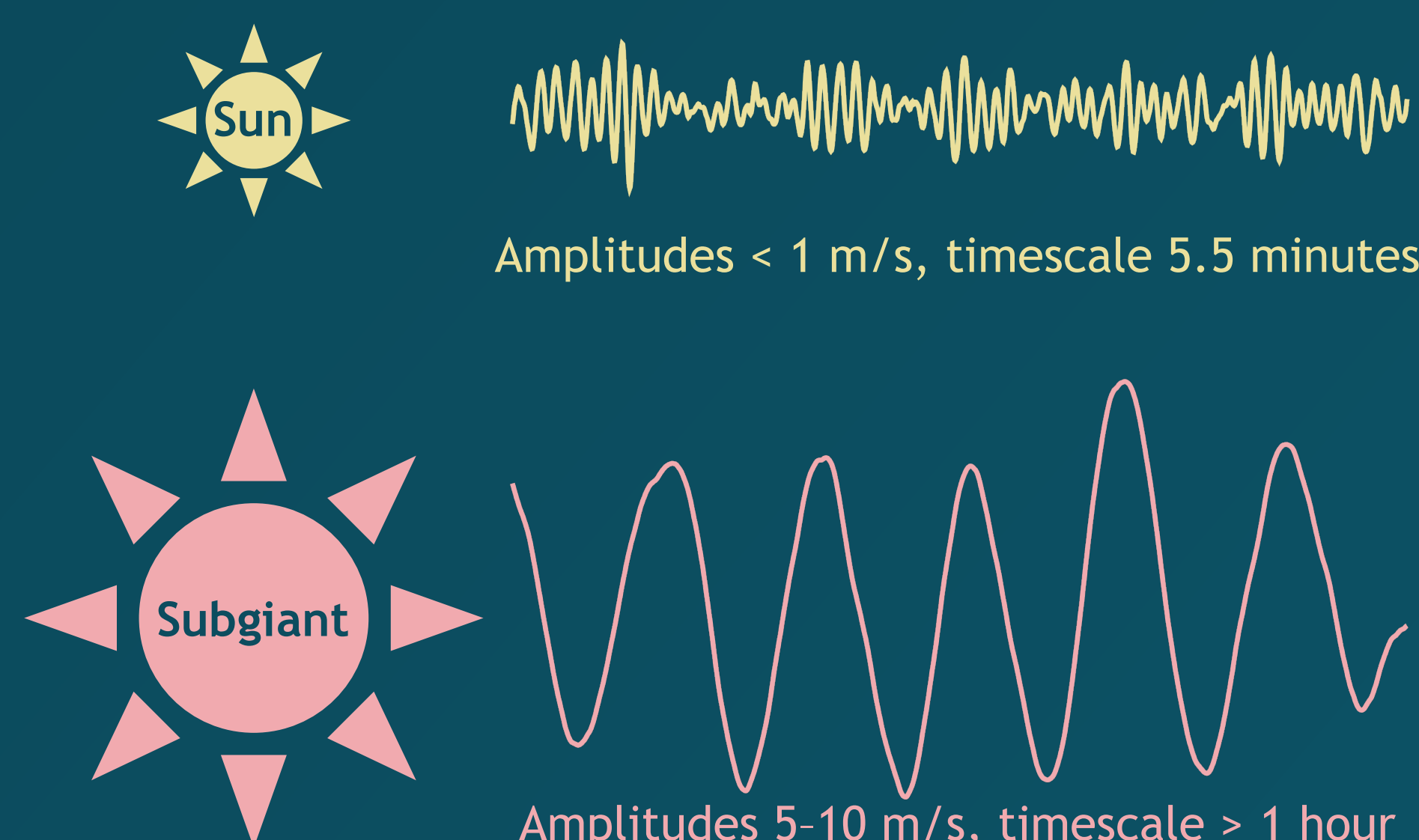
1. UC Irvine; 2. UC Berkeley; 3. UCO/Lick Observatories

MOTIVATION

Mitigating p-mode oscillations for Sun-like stars involves exposing over an integer number of p-mode cycles (Chaplin et al. 2019)

This approach is *not feasible* for evolved stars with larger timescales and amplitudes!

Existing RV surveys of subgiants (critical for probing planets around stars $> 1 M_{\odot}$) are therefore *dominated* by 5–10 m/s RV residuals



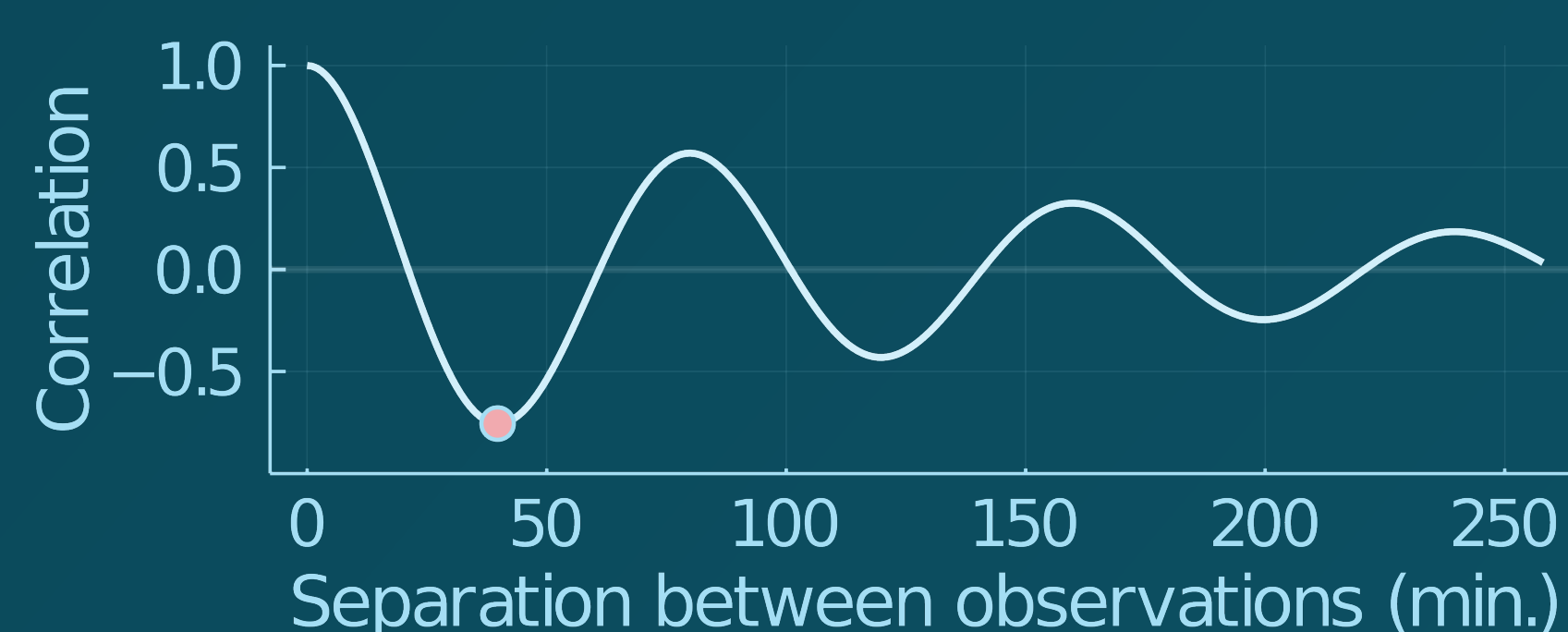
THE CHALLENGE

HOW CAN WE
MITIGATE P-MODE
OSCILLATIONS IN
SUBGIANTS



A SOLUTION

Two observations separated by *exactly half* the oscillation timescale will be *anticorrelated*!



Such observations taken within a night will bin down faster than pure white noise (similar to approach described in Medina et al. 2018)

This precise timing is ideal for capabilities of the Automated Planet Finder (APF) telescope

PUTTING IT TO THE TEST

THE APF A-STAR RETIREMENT PROGRAM

A new survey with APF
to extend the Retired
A-star legacy using a
novel approach to
mitigate stellar p-
mode oscillations



Program Goals

STRETCH OUT

Extend the baseline on 35 planet-hosting subgiants

REVIVE

Re-establish high-cadence observations now with APF

RELAX

Reduce jitter with tailored strategy to bin down stellar oscillations

AARP CADENCE PERFORMANCE

Observations began in 2022B

136 total observation pairs

13 unpaired observations
(weather, guiding errors)

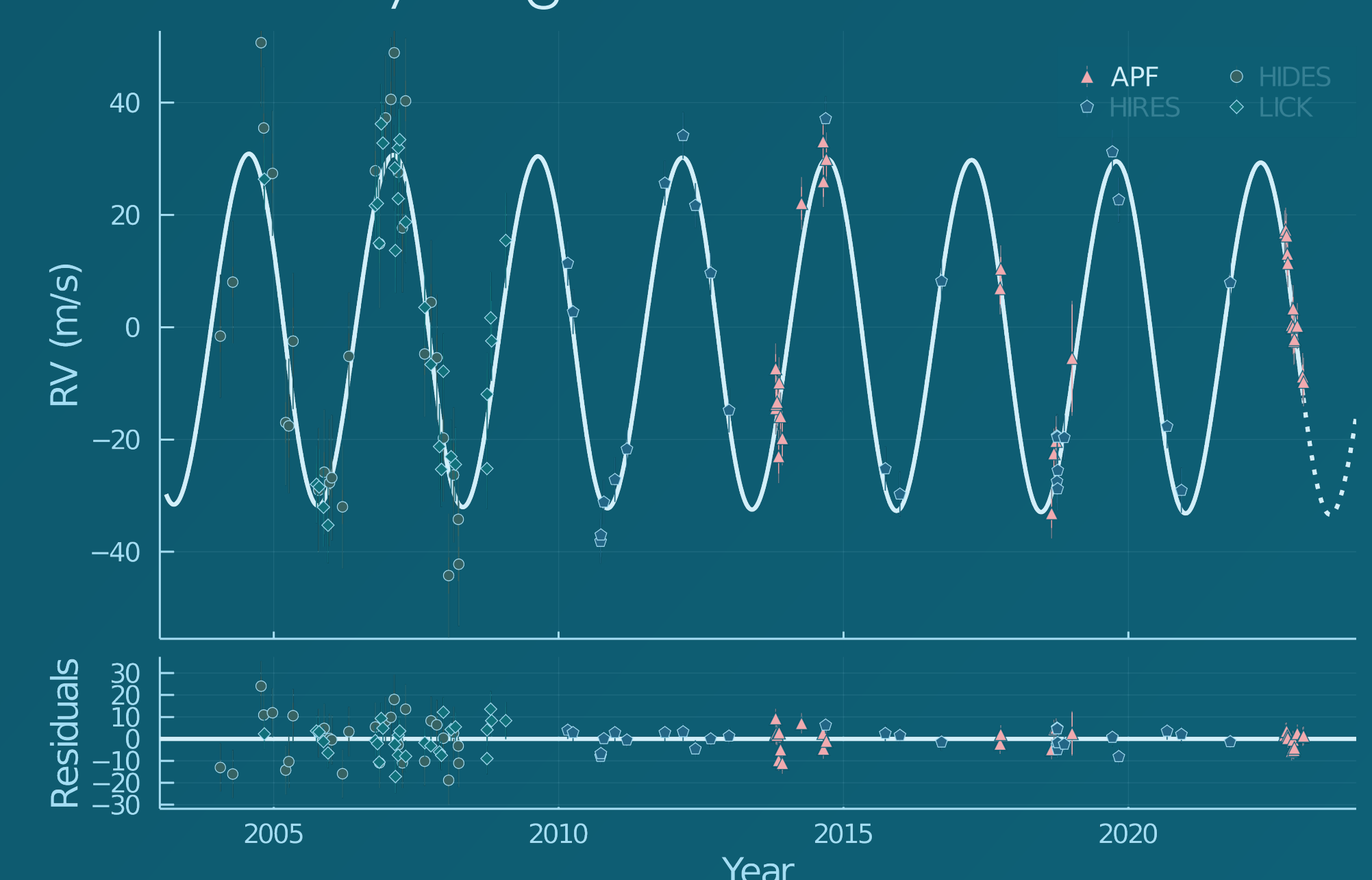
96% of observation pairs
are within 10 minutes
of nominal cadence

All binned observation pairs are shown at right; the vertical lines mark the intra-night separation



AARP RV IMPROVEMENT

RV case study: target with most observations



APF RV RMS reduction:

5.9 m/s → **3.3 m/s**
(pre-AARP) (AARP)

(APF reported uncertainties are 3.1 m/s for this target)

KEY TAKEAWAYS

Implementation of APF intra-night cadence has been extremely successful

Initial RV performance shows promise for reducing impact of p-mode oscillations

Continued observations will increase sensitivity to long & short period companions

LET'S CONNECT!

✉ jluhn@uci.edu

🐦 @jacobkluhn