arXiv – Cornell University

Tue, 4 Oct 2022

- **NGTS-21b: An Inflated Super-Jupiter Orbiting a Metal-poor K dwarf** by *Douglas R. Alves et al.*
  Subjects: astro-ph.EP

- **On the evolution of pebble-accreting planets in evolving protoplanetary discs** by *Arnaud Pierens*
  Subjects: astro-ph.EP

- **Collisional growth efficiency of dust aggregates and its independence of the strength of interparticle rolling friction** by *Sota Arakawa et al.*
  Subjects: astro-ph.EP, astro-ph.GA, astrp-ph.SR

- **Orbital Stability of Proposed NY Virginis Exoplanets** by *Xinyu Mai et al.*
  Subjets: astro-ph.EP, astro-ph.SR

- **CO_2 ocean bistability on terrestrial exoplantes** by *R. J. Graham et al.*
  Subject: astro-ph.EP

- **A revised energy formalism for common-envelope evolution: repercussions for planetary engulfment and the formation of neutron star binaries** by *Ricardo Yarza et al.*
  Subjects: astro-ph.SR, astro-ph.EP, astro-ph.HE

- **Large Interferometer For Exoplantes (LIFE): VIII. Detecting rocky exoplanets in the habitable zones of Sun-like stars** by *Jens Kammerer et al.*
  Subjects: astro-ph.EP, astro-ph.IM

- **Evaluating the Plausible Range of N2O Biosignatures on Exo-Earths: An Integrated Biogeochemical, Photochemical and Spectral Modeling Approach** by *Edward Schwieterman et al.*
  Subjects: astro-ph.EP

- **No evidence for radius inflation in hot Jupiter from vertial advection of heat** by *Aaron Schneider et al.*
  Subjects: astro-ph.EP

- **Survival of Terrestrial N2-O2 Atmospheres in Violent XUV Environments through Efficient Atomic Line Radiative Cooling** by *Akifumi Nakayama et al.*
  Subjets: astro-ph.EP, astro-ph.SR

- **Directly tracing the vertical stratification of molecules in protoplanetary disks** by *T. Paneque-Carreno et al.*
  Subject: astro-ph.EP, astro-ph.SR

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Thu, 6 Oct 2022

- **MAO-2020-BLG-208: Cool Sub-Saturn Planet Within Predicted Desert** by *Greg Olmschenk et al.*
  Subjects: astro-ph.EP, astro-ph.GA

- **Particle clustering in turbulence: Prediction of spatial and statistical properties with deep learning** by *Yan-Mong Chan et al.*
  Subjects: astro-ph.EP, cs.LG, physics.fludyn

- **Searching for Hα emitting sources in the gaps of five transitional disks. SPHERE/ZIMPOL high-contrast imaging** by *N. Huelamo et al.*
  Subjects: astro-ph.EP, astro-ph.SR

- **Nonlinear Outcome of Coagulation Instability in Protoplanetary Disks II: Dust Ring Formation Mediated by Backreaction and Fragmentation** by *Ryosuke Tominaga et al.*
  Subjets: astro-ph.EP, astro-ph.SR

ORBITAL STABILITY OF PROPOSED NY VIRGINIS EXOPLANETS

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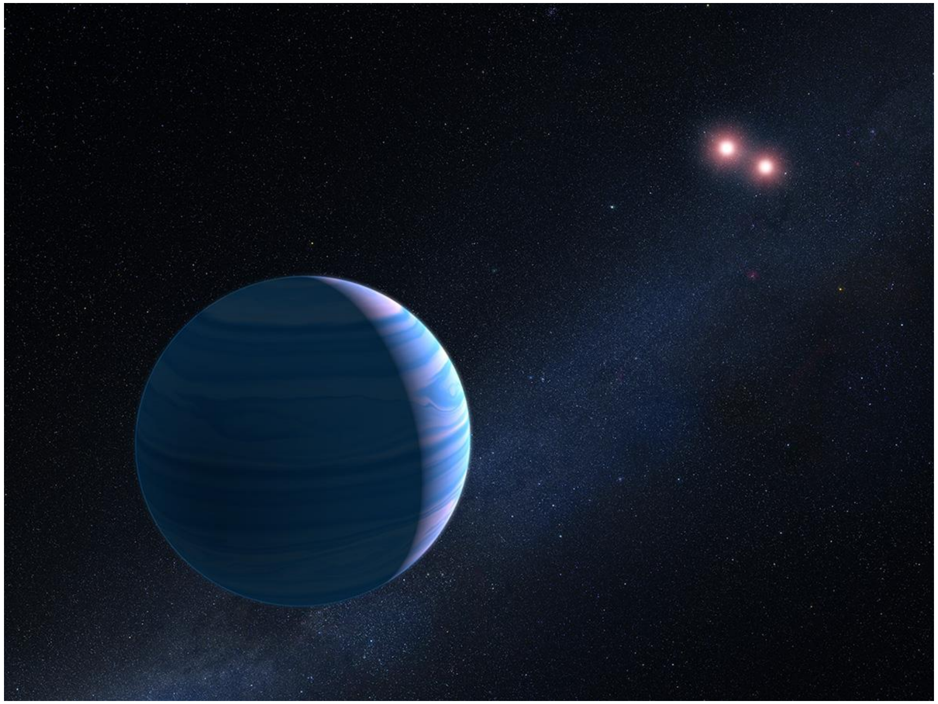
Eclipse timing variations (ETVs): irregularities on eclipse timing measurements of a binary star system due to the presence of planets

ADVANTAGES

- Binary star systems are extremely common
- It is possible to measure the mass of the planet, even it is not directly observable

DISADVANTAGES

- Only big mass planets are detectable
- Usually in these systems the planets are far from the star



Introduction
ETVs Technique

Since the orbiting planets perturb the centre of mass of the binary system, it is possible to infer **mass** and **orbital elements**.

But there can be some **problems/limitations**!

1. Typical timing offsets caused by a Jovian size planet are **relatively small**, of order one percent of the orbital period
2. Several **other physical mechanisms** can contribute to timing variations in these binaries
3. Several published multi-component models have been subsequently shown to be highly **unstable** on timescales that are short compared with the expected lifetimes of the **post-common envelope phase**

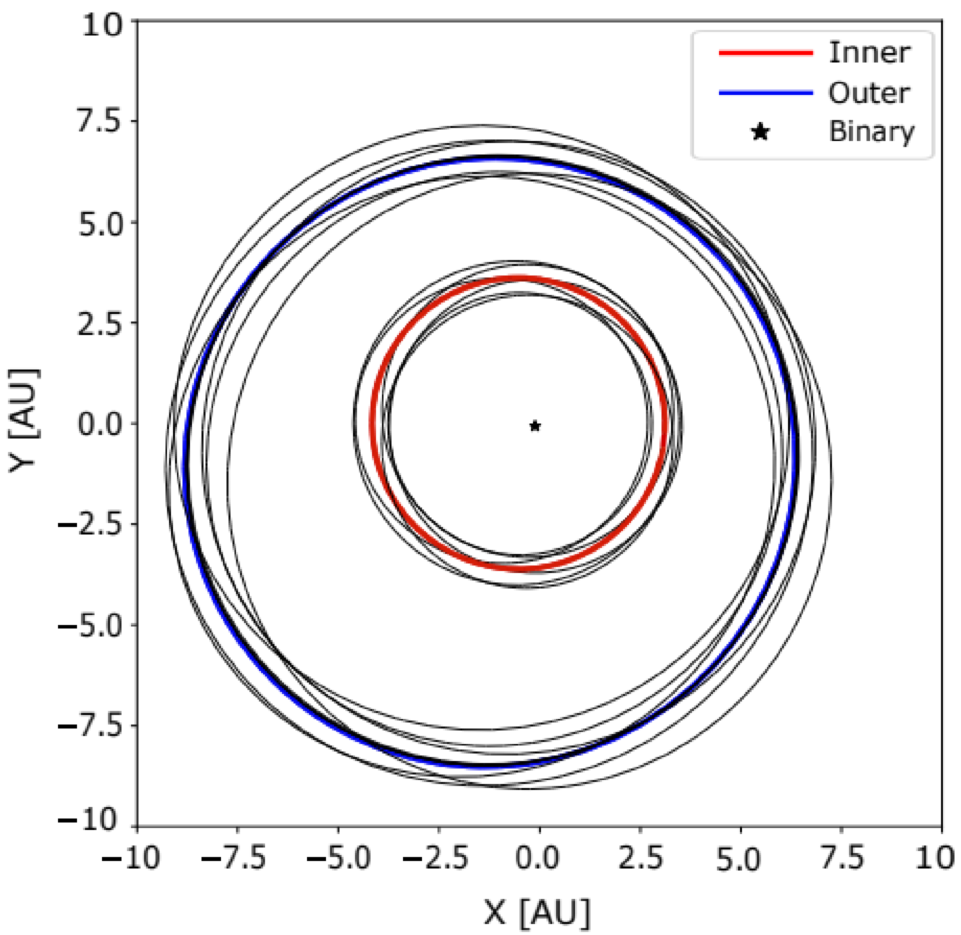
Phase in which the binary system is contained in the same gas envelope

Determination of orbit stability of the two-component model recently reported by Er et al. (2021) for the sdB binary NY Virginis

Er et al. (2021) created a model that comprises **two planets** orbiting the binary system star with the following parameters:

	Planet 1	Planet 2	Unit
$\boldsymbol{P}$	$8.97^{+0.36}_{-0.24}$	$27.2^{+1.3}_{-1.2}$	yr
$\boldsymbol{e}$	$0.12^{+0.12}_{-0.12}$	$0.19^{+0.09}_{-0.07}$	
$\boldsymbol{a\ sin(i)}$	$3.64^{+0.41}_{-0.37}$	$7.64^{+0.45}_{-0.43}$	AU
$\boldsymbol{Minimum\ mass}$	$2.74^{+0.37}_{-0.34}$	$5.59^{+0.51}_{-0.49}$	M_{Jup}

Orbit Stability Analysis



Best-fit two-planet orbits proposed by Er et al. (2021).

The trajectory in **red** indicates for proposed inner body, trajectory in **blue** for the outer body. Orbits associated with the change of one uncertainty are shown as **black** lines. The binary star position is shown as a star at the center.

This figure is made by orbit simulation software ***rebound*** (Rein & Liu 2012) using best-fit parameters for each component in previous table

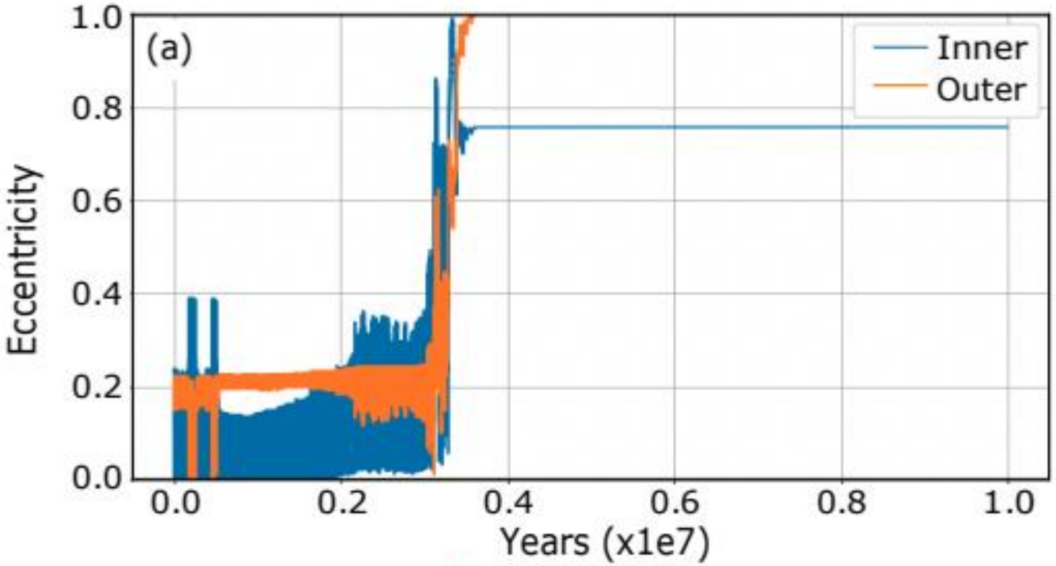
Orbit Stability Analysis

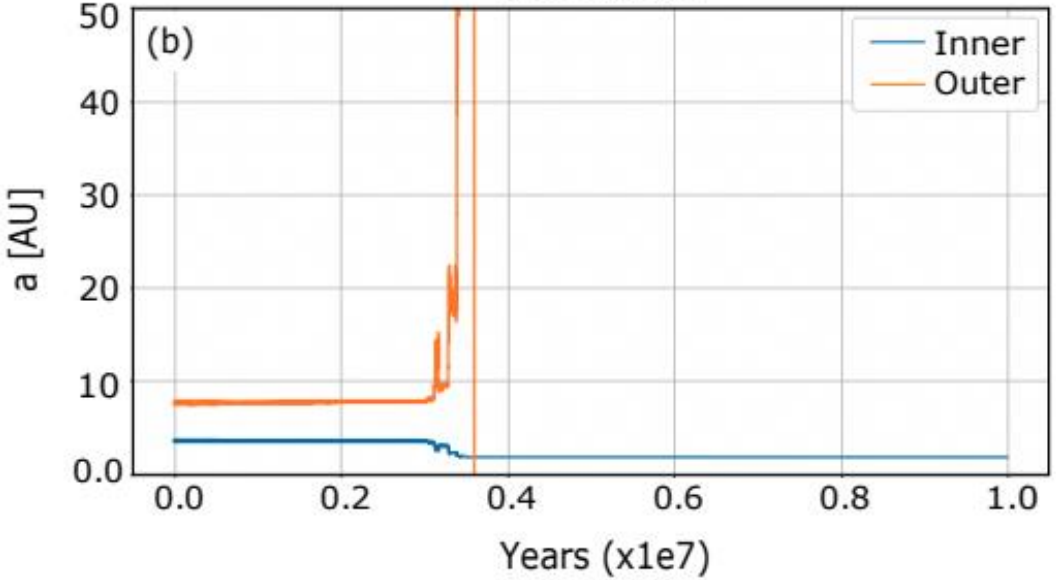
Orbital stability has been studied performing **dynamical simulation** with previous parameters using:

- N-body orbital integration package **REBOUND**
- The chaotic indicator program Mean Exponential Growth factor of Nearby Orbits (**MEGNO**) → simulations with *128 semi-major axes* and *128 eccentricity* for inner and outer planets

Initial time step of $0,1\ yr$ and integrated for $100\ Myr$

Binary star system treated as a single mass of $M_{tot} = 0.59\ M_{\odot}$



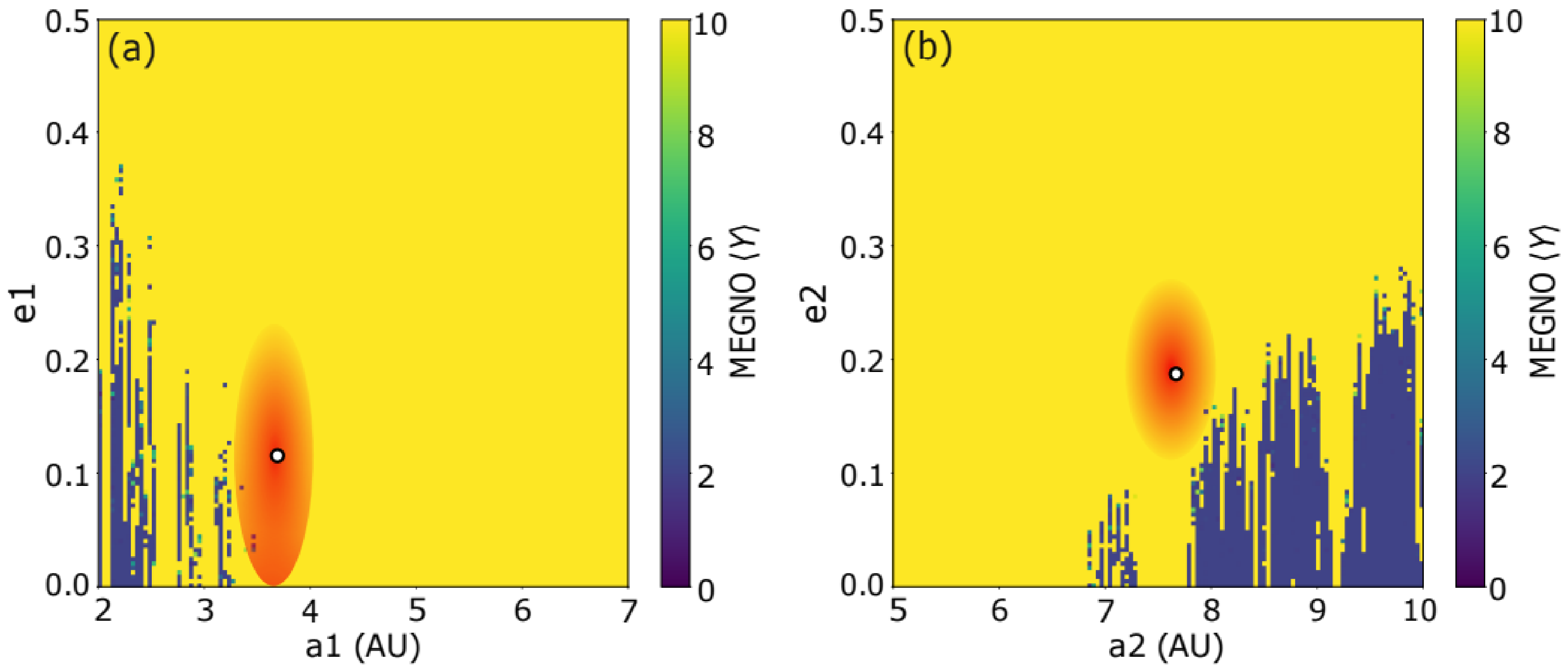


NY Vir stability plot

a) Time history of the eccentricities of both circumbinary companions over 10 Myr.

b) Time history of semi-major axes of both circumbinary companions over 10 Myr. Note that the outer planet (orange line) **escapes** the planetary system after 3.5 Myr

Results



MEGNO chaos parameter surface map for Er et al. (2021) **two-planet solution** for a range of eccentricities and semi-major axes for the (a) inner planet and (b) outer planet. The best-fit model parameter values are indicated by white dots with black borders. Both points lie in highly **chaotic regions**

Discussion and Conclusion

We find that the proposed two-planet model for the binary NY Virginis proposed by Er et al. (2021) becomes **unstable** after $\sim 3\ Myr$, a timescale much less than the estimated lifetime of the PCEB phase $(100\ Myr)$ of *sdB binaries* and is therefore **untenable**

CONCLUSION

Observed ETVs signatures must be at least in part a result of other physical mechanisms

THANK YOU FOR YOUR ATTENTION!