

# Jorge Casas

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First-generation Columbia University graduate dual-trained in **astrophysics** and **data science**.

## EDUCATION

**Columbia University**, New York, NY  
*Bachelor of Arts in Astrophysics*

May 2023

## DATA SCIENCE & ASTROPHYSICS EXPERIENCE

**Gravitational Slingshot 3-Body Simulation — Columbia University**

Sep 2024 – Present

- Leading an independent investigation into gravitational assists in multi-body stellar and planetary systems; developed a **Python symplectic  $N$ -body integrator** and **batch-injection pipeline** to simulate thousands of hyperbolic flybys across star–planet and compact-binary architectures.
- Implemented **chaotic-scattering diagnostics** and a custom **MCMC inversion module** to map high-boost, large-deflection trajectories; validated all results via analytic–numerical comparisons using barycentric- and planet-frame monopole reductions.

**Transit-Timing/Duration Variation Study — Columbia University**

2026 – Future

- Selected to model exomoon/co-orbital TTV–TDV signatures using the slingshot MCMC toolkit and  $N$ -body propagator developed in the Kepler-432 project.

**Astrostatistics Projects — Columbia University**

Jan 2023 – Jun 2023

- **Hubble-Constant Estimation:** Performed a Bayesian fit to Type Ia supernova distance–redshift data using a likelihood model incorporating intrinsic scatter and host–galaxy uncertainties.
- **Transit Light-Curve Analysis:** Built a custom MCMC sampler with a moving-median detrending filter to remove stellar variability in Python.
- **Bayesian Stellar Temperature Fitting:** Implemented a black-body SED Monte Carlo Markov Chain in Python fitter with calibrated photometric uncertainties and zero-point corrections, yielding precise posterior constraints on  $T_{\text{eff}}$  and radius–temperature degeneracies across multi-band photometry.
- **Gliese 581g Validation:** Reanalyzed radial-velocity time series using K-fold cross-validation and multi-planet Keplerian modelling in a custom Fast Fourier Transform Python project.
- **Galactic Rotation Curves:** Performed Bayesian model comparison (BIC/AIC/ $\chi^2$ ) on MOND vs. disk + halo dark-matter rotation-curve fits; explored parameter–degeneracy structure and goodness-of-fit trends to assess empirical support for modified-gravity vs. mass-distribution explanations.

**Summer Science Program (SSP) — New Mexico Tech**

Jun 2018 – Jul 2018

- Selected for the residential Near-Earth-Asteroid track; led a three-person team “Altitude” observing asteroid 1991 PM5 with the 0.36 m f/11 C-14 Schmidt–Cassegrain telescope at Etsorn Observatory (SBIG STL-1001E CCD).
- Wrote Python pipelines for centroiding, least-squares plate-reduction, and differential photometry, achieving  $\leq 1''$  astrometric accuracy and  $\leq 0.05$  mag photometric uncertainty.
- Implemented a 4<sup>th</sup>-order Method of Gauss with light-time correction and a 500,000-trial Monte-Carlo routine to recover heliocentric state vectors and converged orbital elements.
- Validated the solution against JPL *Horizons* and the Minor Planet Center (all six elements within  $1\sigma$ ); classified the object as an Amor-group NEO (perihelion = 1.28 AU) and submitted measurements to the MPC (MPEC 2018-Q11).

## TECHNICAL SKILLS

- **Programming:** Python (SciPy, NumPy, AstroPy, Pandas, Matplotlib, REBOUND), MATLAB, Mathematica, Arduino/C++, Bash, G-code, Git, Jupyter/Quarto
- **Astrophysics & Numerical Methods:** Symplectic  $N$ -body integrators, hyperbolic two-body solvers, ODE integrators, MCMC (emcee), Monte Carlo sampling, Bayesian inference, orbital dynamics, astrostatistics, data modeling & reduction