

# Jorge Casas

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First-generation Columbia University graduate dual-trained in **astrophysics** and **mechanical engineering**.

## EDUCATION

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

**May 2023**

## ASTROPHYSICS & ENGINEERING 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.

**Rocket Project Lead & Propulsion Lead — Columbia Space Initiative**

**Sep 2019 – Jun 2023**

- Led Columbia University’s undergraduate rocketry program from early concept studies through flight hardware, mentoring dozens of new engineers each year and establishing the team’s modern propulsion and structural development pipeline.
- Directed a **50+ member** team in designing, building, and launching Columbia’s first **6-inch, 115 lb hybrid rocket**, culminating in a full-scale flight at the **Spaceport America Cup 2023**; coordinated propulsion, structures, avionics, recovery, and test operations.
- Served as **Propulsion Lead** for hybrid-engine development efforts, performing CFD, transient thermal modeling, and high-temperature FEA on graphite nozzles, injector assemblies, and combustion interfaces; validated models through **static hot-fire testing** and thrust-curve correlation.

## 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