DEATH STARS: HOW ALPHA CENTAURI THREATENS PROXIMA'S PLANETARY SYSTEM. R. Deitrick[1,2], T.R. Quinn[1,2], R. Barnes[1,2], N. Kaib[3], R. Luger[1,2], P.E. Driscoll[4,2], D.P. Fleming[1,2], B. Guyer[1,2], D.V. MacDonald[1,2], V.S. Meadows[1,2], G. Arney[1,2], D. Crisp[5,2], S.D. Domagal-Goldman[6,2], A. Lincowski[1,2], J. Lustig-Yaeger[1,2], E. Schwieterman[1,2]. [1]Univ. of Washington, Astronomy Dept., Box 951580, Seattle, WA, 98195 (contact: deitrr@uw.edu), [2]NASA Astrobiology Institute: Virtual Planetary Laboratory, [3]Univ. of Oklahoma, Dept. of Physics and Astronomy, 440 W. Brooks St., Norman, OK, 73019, [4]Dept. of Terrestrial Magnetism, Carnegie Institution for Science, 5241 Broad Branch Rd NW, Washington, DC, 20015, [5]Jet Propulsion Laboratory, California Institute of Technology, M/S 183-501, 4800 Oak Grove Dr., Pasadena, CA, 91109, [6]Planetary Environments Laboratory, NASA Goddard Space Flight Center, 8800 Greenbelt Rd, Greenbelt, MD, 20771.

Introduction: The recent discovery of a terrestrial mass planet orbiting Proxima Centauri has generated renewed interest in the stellar system system Alpha Centauri, of which Proxima may be a member. If Proxima is, or was, gravitationally bound to Alpha Cen, the galactic tide and stellar encounters play an important role in the history of the system. These forces can drive wide binary systems into highly eccentric orbits, leading to close encounters between the stars. As shown by previously [1], planetary systems orbiting either star can be disrupted by these close passages.

Furthermore, because of the observed high abundance of heavy elements of these stars, this triple system almost certainly formed within about 4.5 kpc of the galactic center, and hence has undergone significant radial migration [2]. The time spent in a higher density environment makes close encounters between the stars more likely by increasing the tidal force and the frequency of stellar encounters.

Methods: We use a secular model for the galactic tides [3] and a Monte-Carlo scheme [4] for the stellar encounters to model possible histories of the Alpha Centauri system. We use a simple radial migration scheme, scaling the densities according to galaxy models [5], with randomly selected initial radial distances and migration times. Initial orbital properties for Proxima are also randomly selected.

Results: Approximately one third of initial conditions considered lead to encounters between Proxima and Alpha Cen AB within 200 au. Extrapolating from the planetary disruption scenarios presented in [1], 200 au is approximately the distance at which we would expect to see damaging effects on an extended planetary system, if Proxima has or ever had one. Proxima b is likely too deep within Proxima's potential well to be disrupted, but close encounters may excite its eccentricity and lead to tidal heating. Such tidal heating can impact Proxima b's habitability by generating additional heat and affecting outgassing rates.

References: [1] Kaib, N., et al. (2013), *Nature*, 493, 381-384. [2] Loebman, S., et al. (2016), *ApJL*, 818, L6. [3] Heisler, J. & Tremaine, S. (1986), *Icarus*, 65, 13-26. [4] Rickman, H., et al. (2008), *CeMDA*, 102, 111-132. [5] Kordopatis, G., et al. (2015), *MNRAS*, 447, 3526-3535.

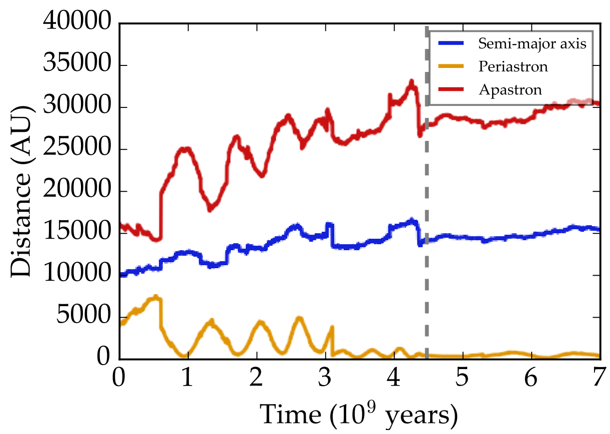

Figure 1: Evolution of Proxima's orbit in one simulation over 7 Gyr. The semi-major axis is represented in blue, periastron in orange, and apastron in red. The dashed vertical line shows the time of migration, when the system moves from 3.8 kpc from the galactic center to the solar neighborhood.

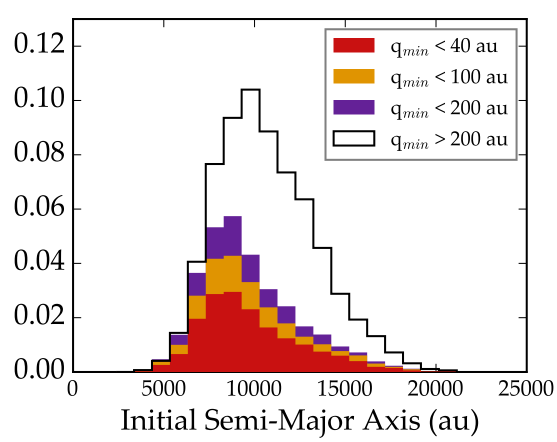

Figure 2: Histogram showing the number of simulations in which Proxima's periastron reaches within a given distance of Alpha Cen AB, as a function of initial semi-major axis. About 1/3 of cases get within 200 au.