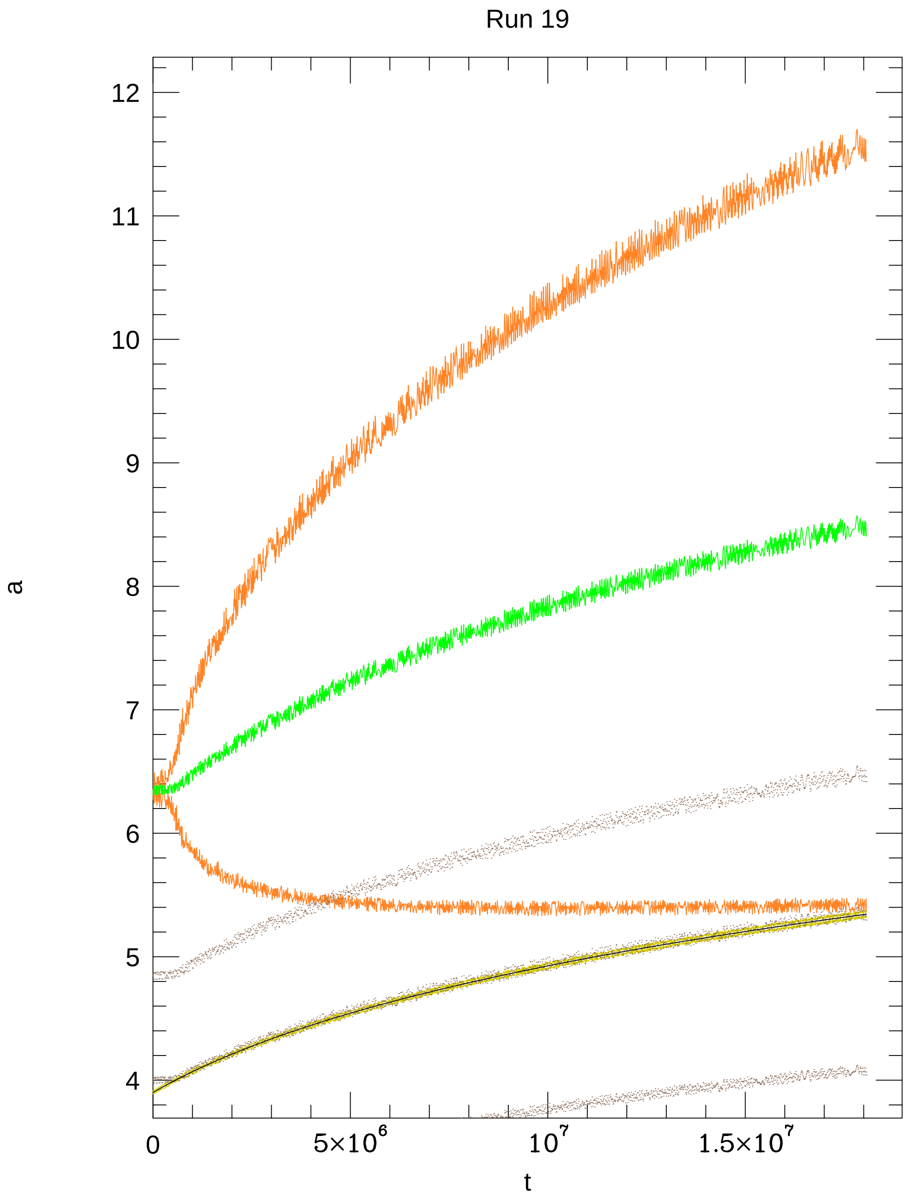

Fig. 4.— (a) Numerical simulation of the evolution of two moonlets ($m_1, m_2 = 10^{25}, 10^{23}$ g). The black and green curves are a_1 and a_2 respectively, while the yellow and orange curves show periapse and apoapse at each time step. The brown curves indicate the location of the 3:2 (at $\sim 4.8R_\oplus$ at $t = 0$), 2:1 (at $\sim 3.9R_\oplus$ at $t = 0$) and 3:1 interior mean-motion resonances. The y-axis is in Earth radii; the x-axis is (t(sec)/808). A terrestrial tidal time delay of $\Delta t = 11.54$ minutes and a terrestrial day of 5 hours were used. Effects of satellite tides are not included ($A = 0$). The moons are quickly captured into the 2:1-e_2 resonance, and e_2 continues to increase until the moons collide (at $t = 4.8 \times 10^8$). (b) **(NEXT PAGE)** Analytical predicted evolution of e_2 due to the 2:1-e_2 resonance for the case shown in (a) with $A = 0$ (solid line) and $A = 100$ (dashed line). Numerical results for $A = 0$ case are shown for comparison.

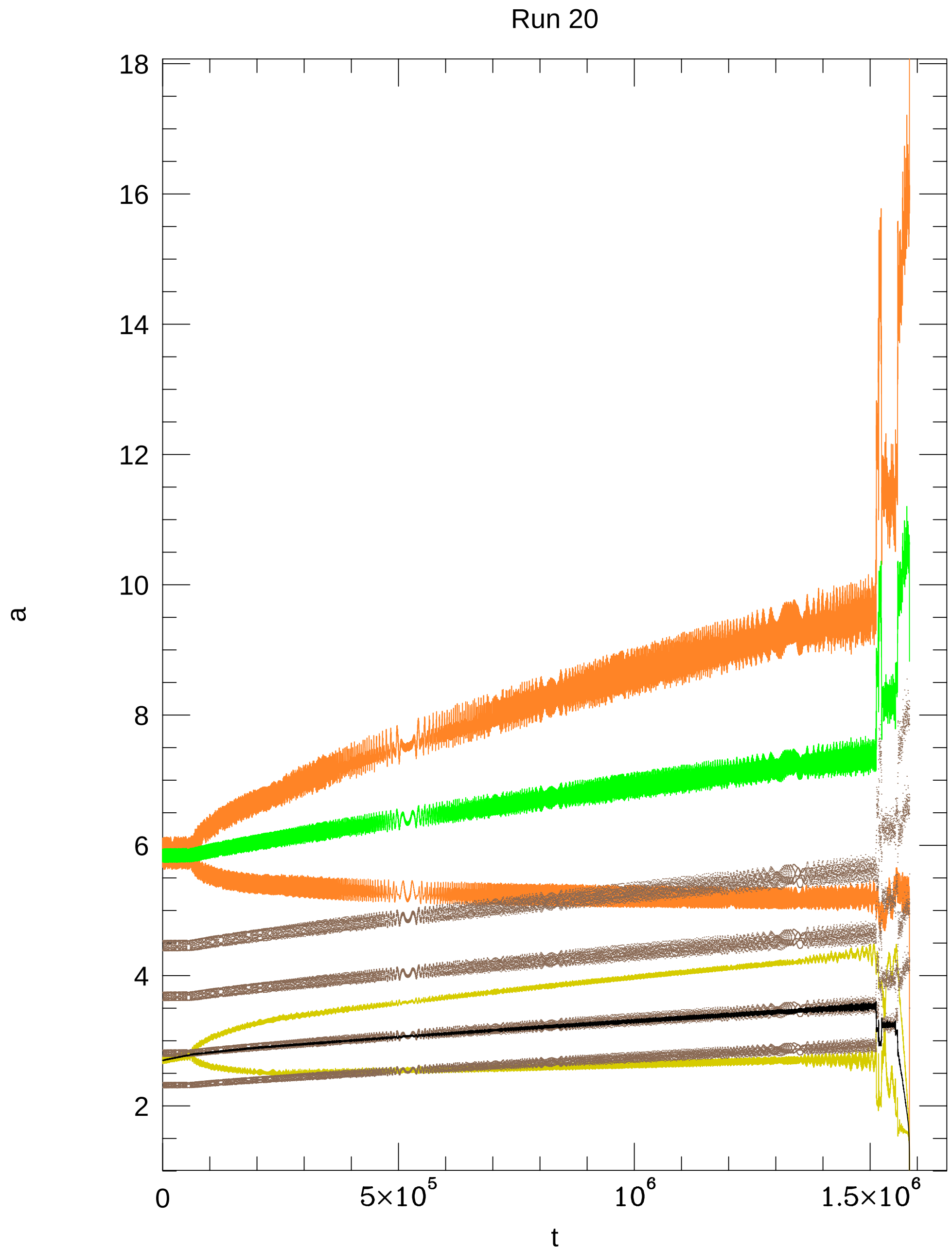

Fig. 5.— (a) Numerical integration of the evolution of the two-moonlet case from ICS97 shown in Figure 2 (their Run 13). A terrestrial day of 5 hours, or $a_{sync} = 2.33R_{\oplus}$ was assumed. Here the two moons are captured into the 3:1-e_1e_2 resonance until about $t = 1.5 \times 10^6$ (about 40 years). After a brief period of capture in the 4:1, perigee of the inner moon falls within synchronous orbit and its orbit then circularizes and falls into the Earth. (b) **NEXT PAGE** The evolution of relevant quantities from the simulation shown in Figure 5a.

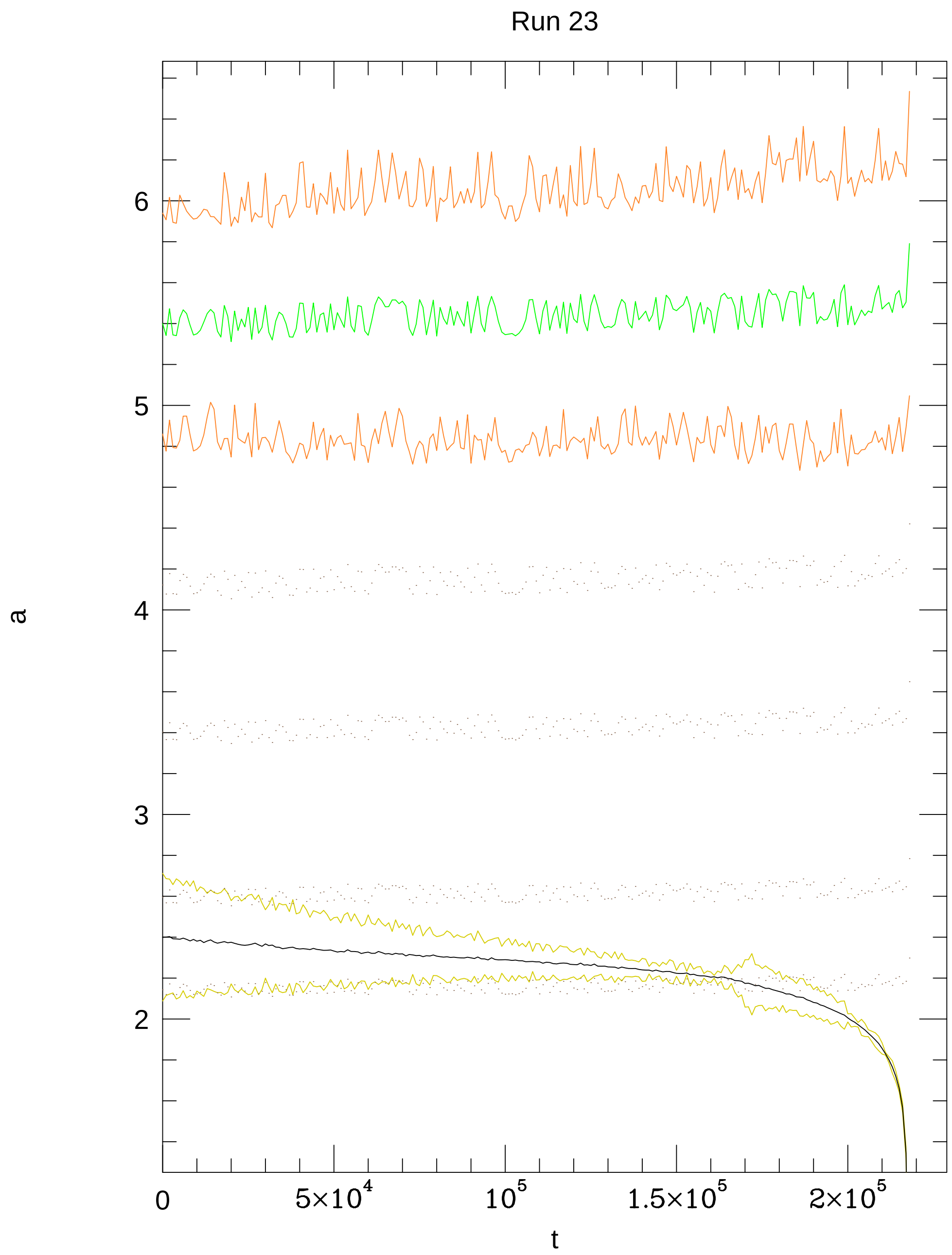

Fig. 6.— The evolution of another two-moon case from ICS97 (their Run 12). Here periapse of m_1 is initially inside synchronous orbit for a terrestrial day of 5 hours, and the inner moon collides with the Earth after about 5 years.

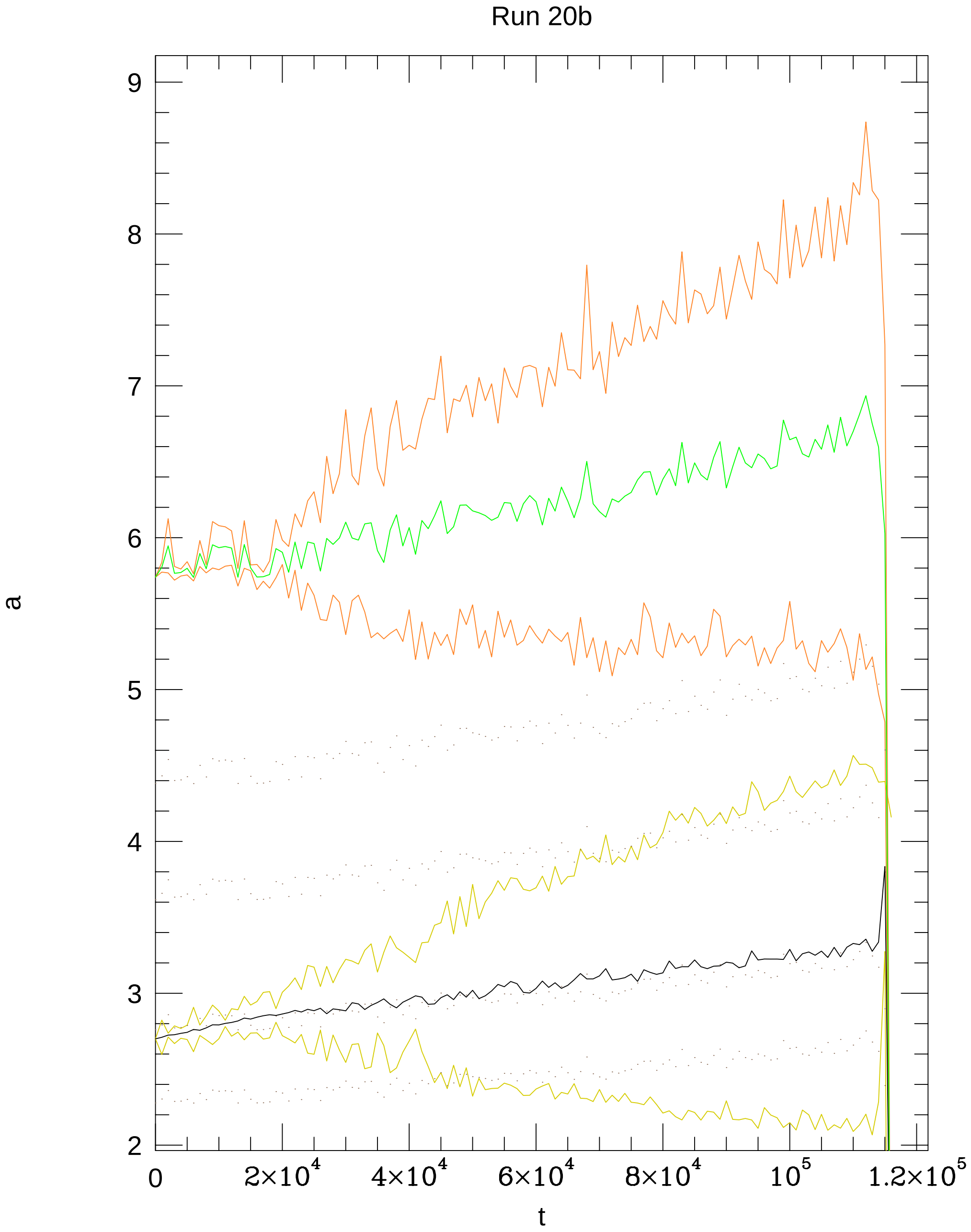

Fig. 7.— The evolution of same two-moon ICS97 case as shown in Figure 5, but here we have used a terrestrial day of 2.5 hours ($a_{sync} \sim 1.5 R_{\oplus}$). The moons are again captured into the 3:1-$e_1 e_2$ resonance, but in this case they experience a close encounter after about 3 years.

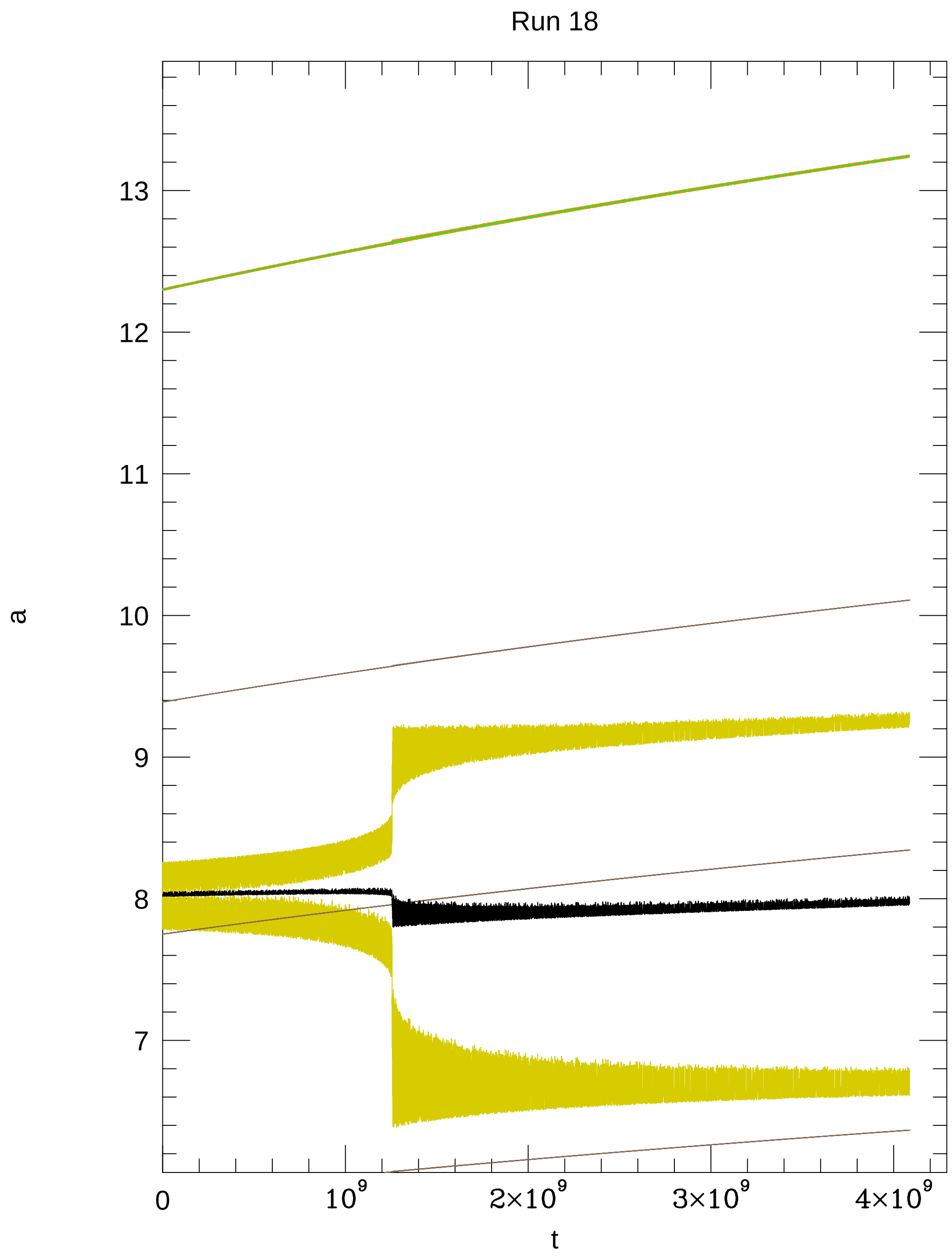

Fig. 9.— The evolution of two moonlets with $m_1, m_2 = 5\times10^{22}, 5\times10^{24}$ g. Here the moonlet orbits are diverging due to tides and so capture into resonance does not occur. The inner moonlet experiences a jump in eccentricity as it diverges through the 2:1-e_1 resonance.

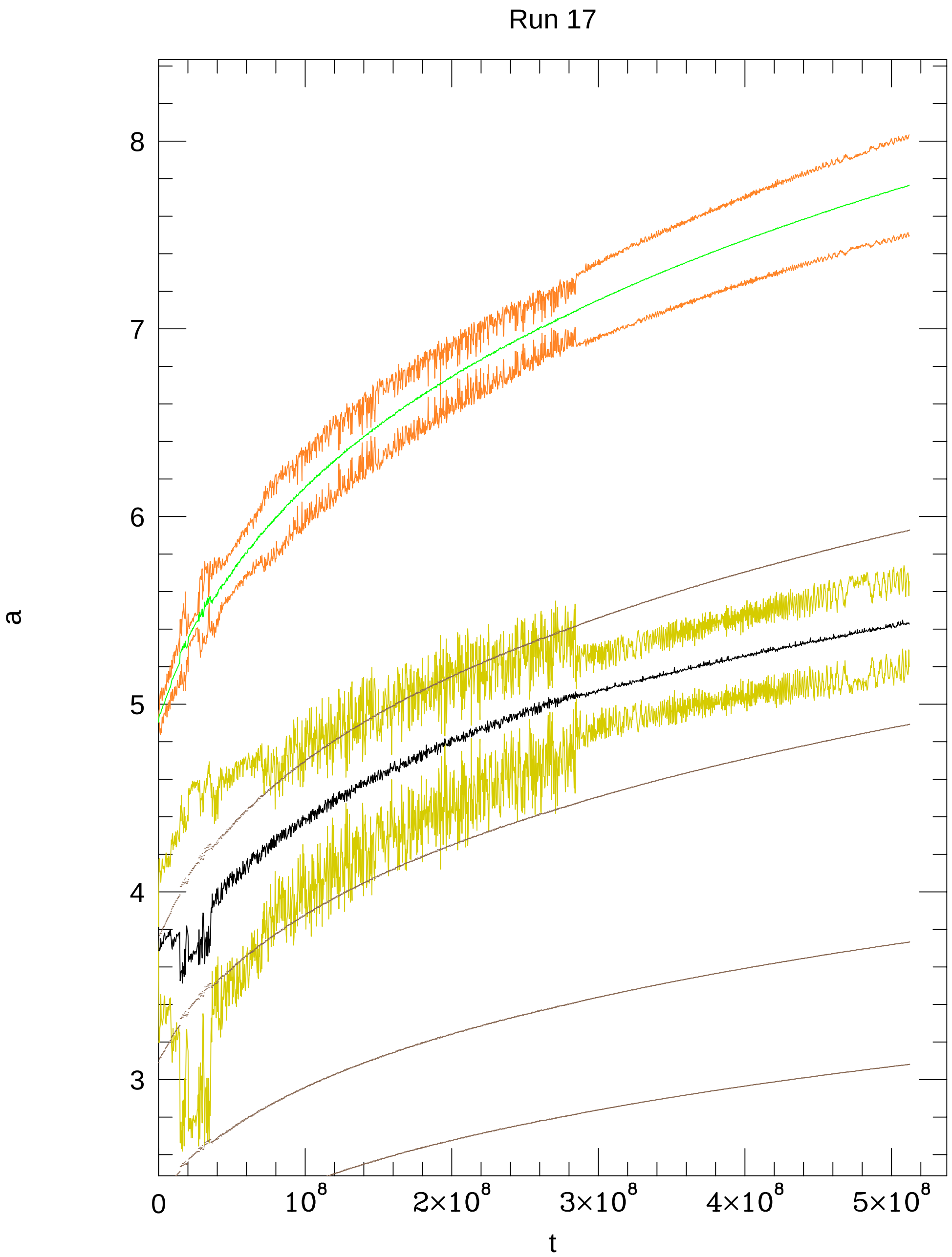

Fig. 10.— The evolution of two moonlets with $m_1, m_2 = 3.6 \times 10^{23}, 3.6 \times 10^{24}$ g. The moons are initially just outside the 3:2, and remain on diverging, potentially stable orbits at the end of the simulation.

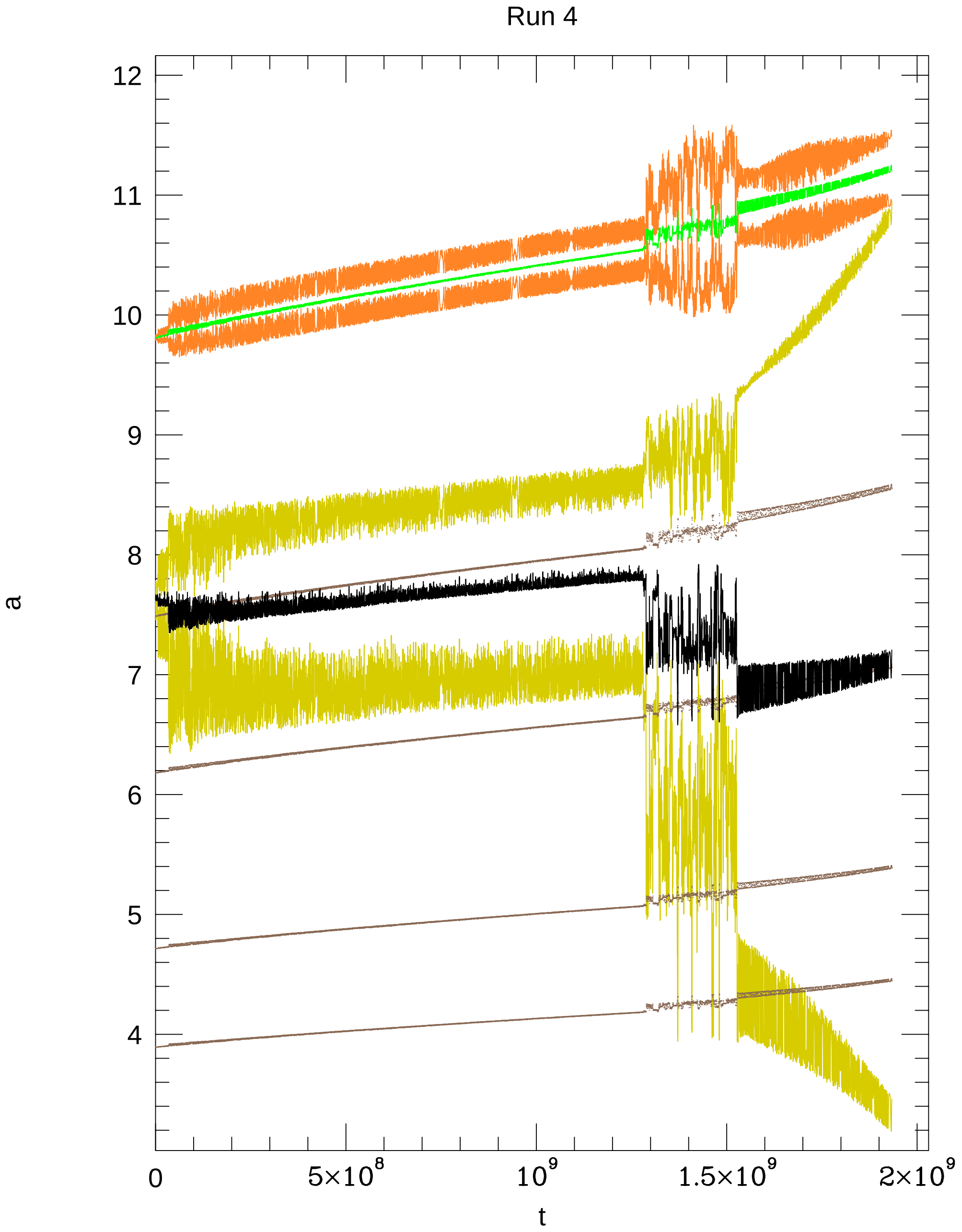

Fig. 11.— A simulation using the same m_1, m_2, and a_1/a_2 values as in Figure 10, only here the moons are initially farther away from the planet. In this case, capture into the 2:1 leads to orbit crossing.

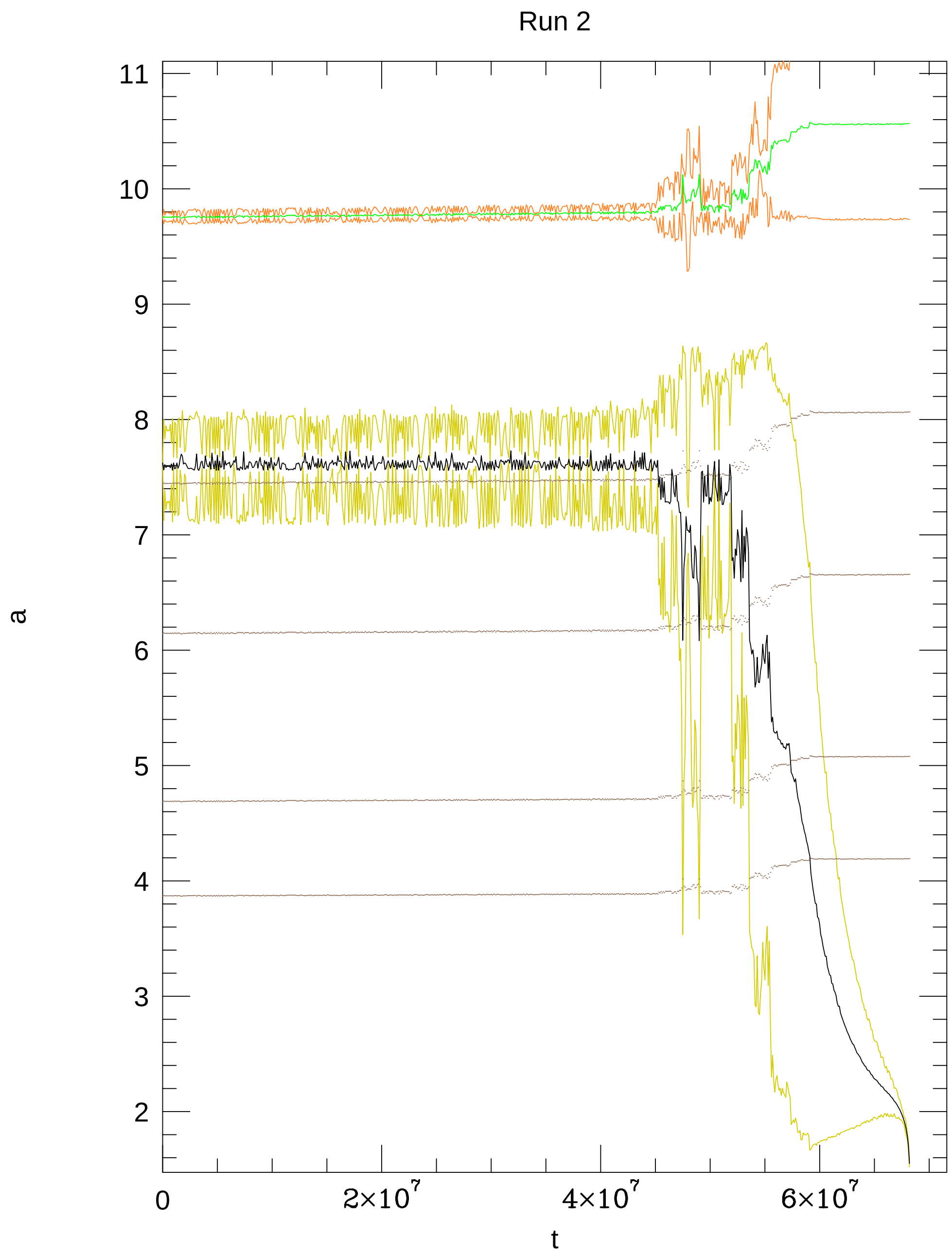

Fig. 12.— Numerical integration of two moons with $m_1, m_2 = 5 \times 10^{23}, 5 \times 10^{24}$ g. Jumps in e_1 eventually bring periapse of the inner moon to within synchronous orbit (about $2.3 R_\oplus$), where tides cause it to evolve inward and collide with the Earth after about 2060 years.