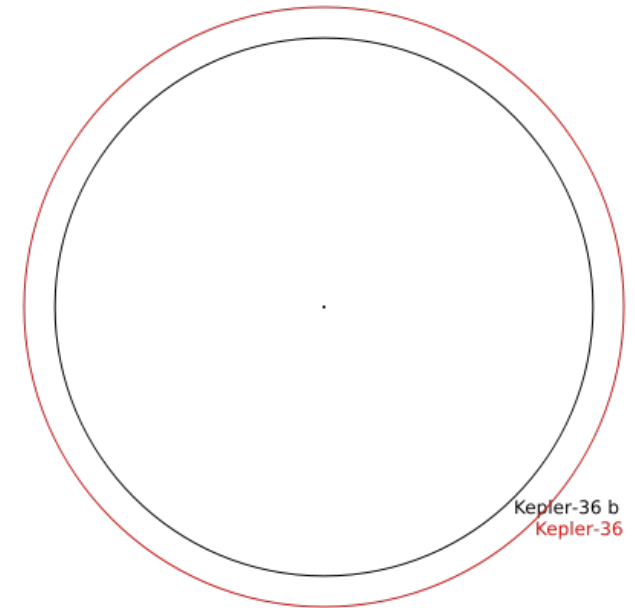


Stability of the Kepler-36 two-planet system



A close pair of planets

- Orbital period: 13.83989 vs. 16.23853 d ($\sim 6:7$ or $29:34$ main motion resonance)
- Semi-major axis: 0.1153 vs. 0.1283 AU
- Mass of planet: 4.45 vs. 8.08 M_{\oplus}
- Density of planet: 7.46 vs. 0.891 g/cm^3
- Consequences
 - The two planets have conjunction every ~ 97 days.
 - Minimal distance is ~ 1.9 million kilometers.
 - Significant tidal forces.
 - Volcanic activity?

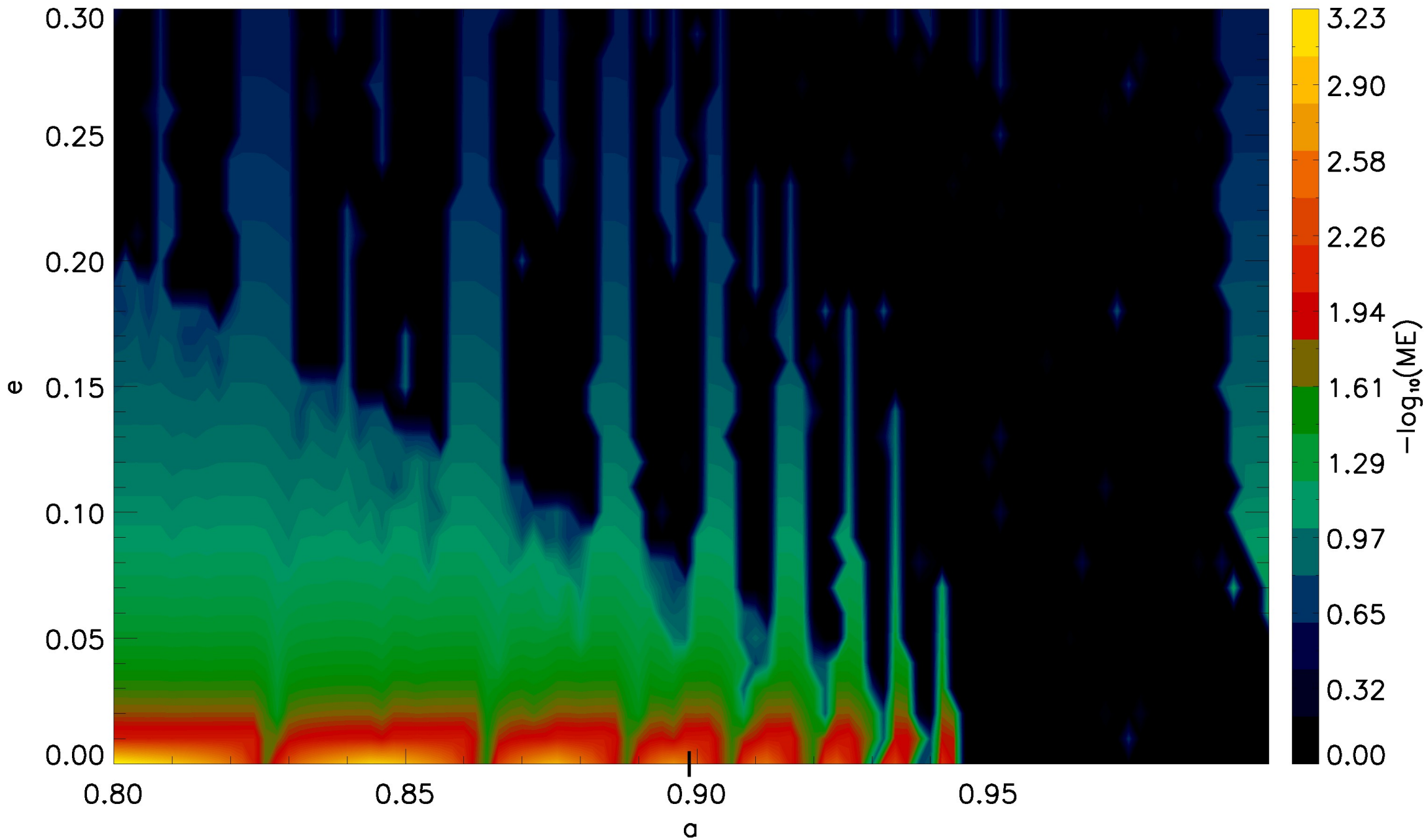


Model and methods

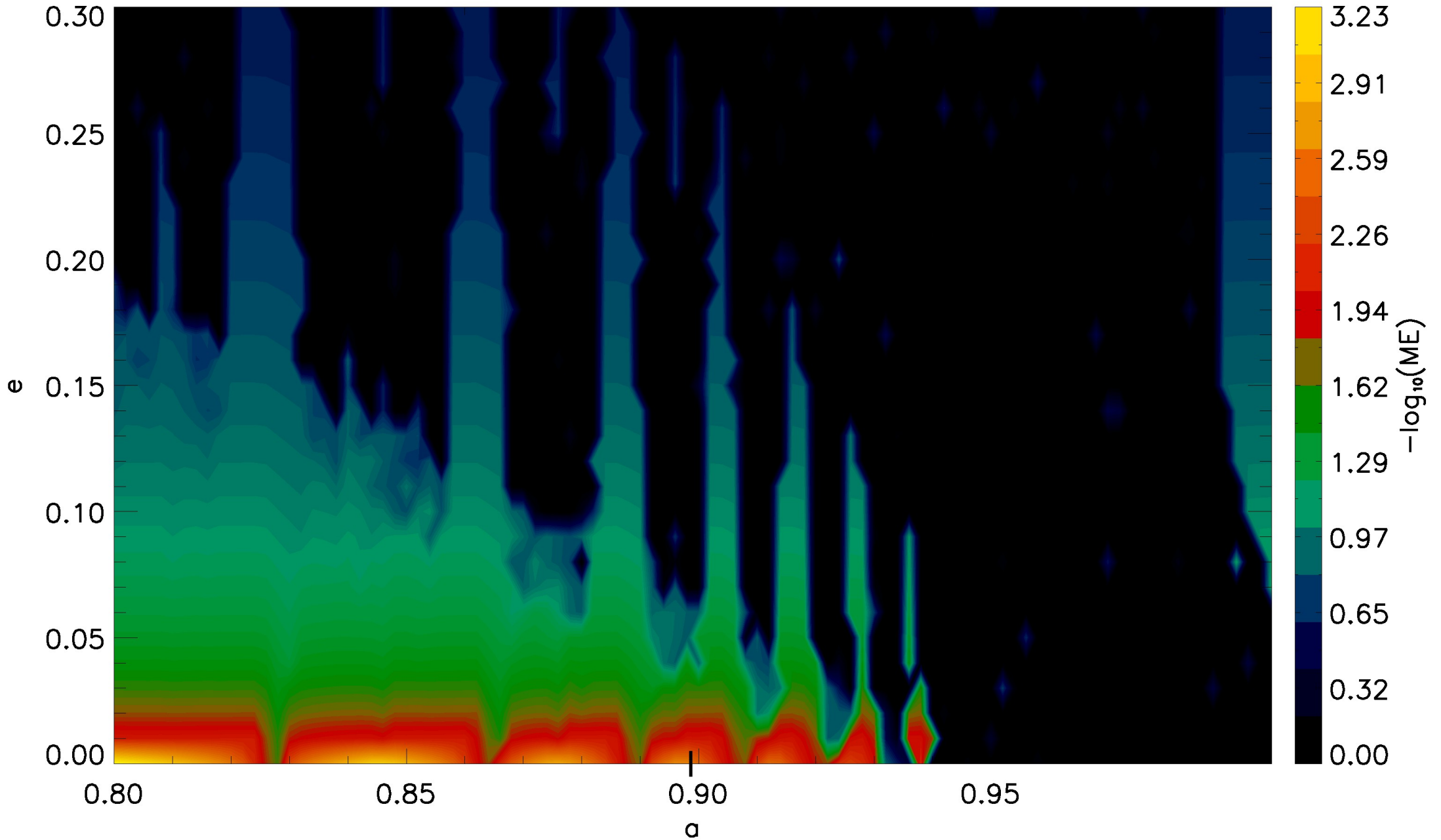
| Planet | a [AU] | e | ω | l |
|--------|--------|----------|----------|---------|
| b | 0.1153 | 0.0273 | 81.11° | 285.6° |
| c | 0.1283 | 0.000198 | 177.61° | 131.06° |

- Distance unit is the semi-major axis of planet c (0.1283 AU).
- Investigating the stability of planet b (and c) the semi-major axis and the eccentricity were changed. The ω -l plain was also investigated.
- Third planetary objects:
 - „Planet d”: a=1.01-11, e=0-0.99
 - Moons: a=0.0001-0.01, e=0-0.99, l=0-360°
 - Trojans: a=0.8-1.1, l=0-360°
- Indicators: LCI and ME (lieint 0.4)

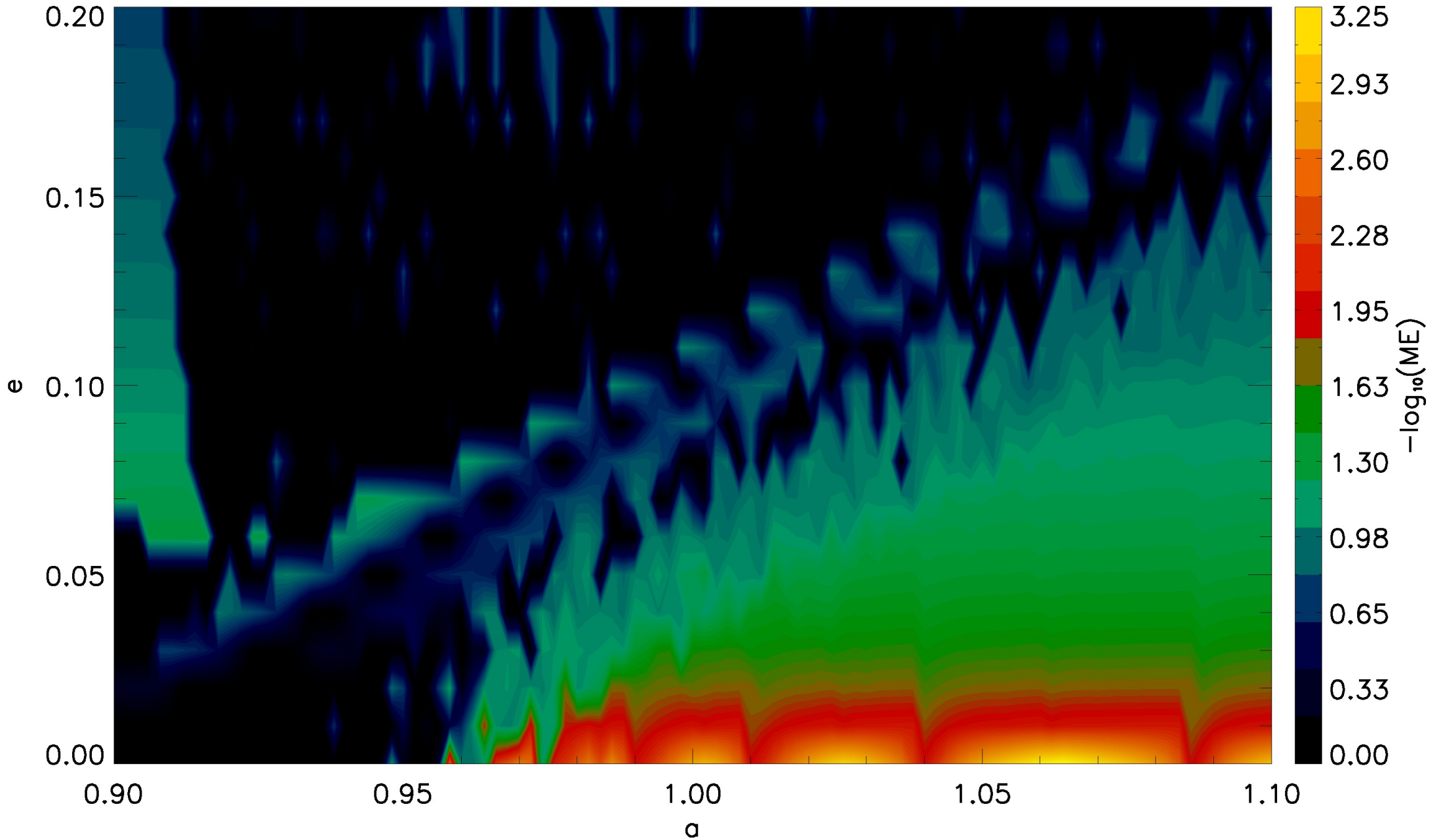
Stability of the planet b without mass



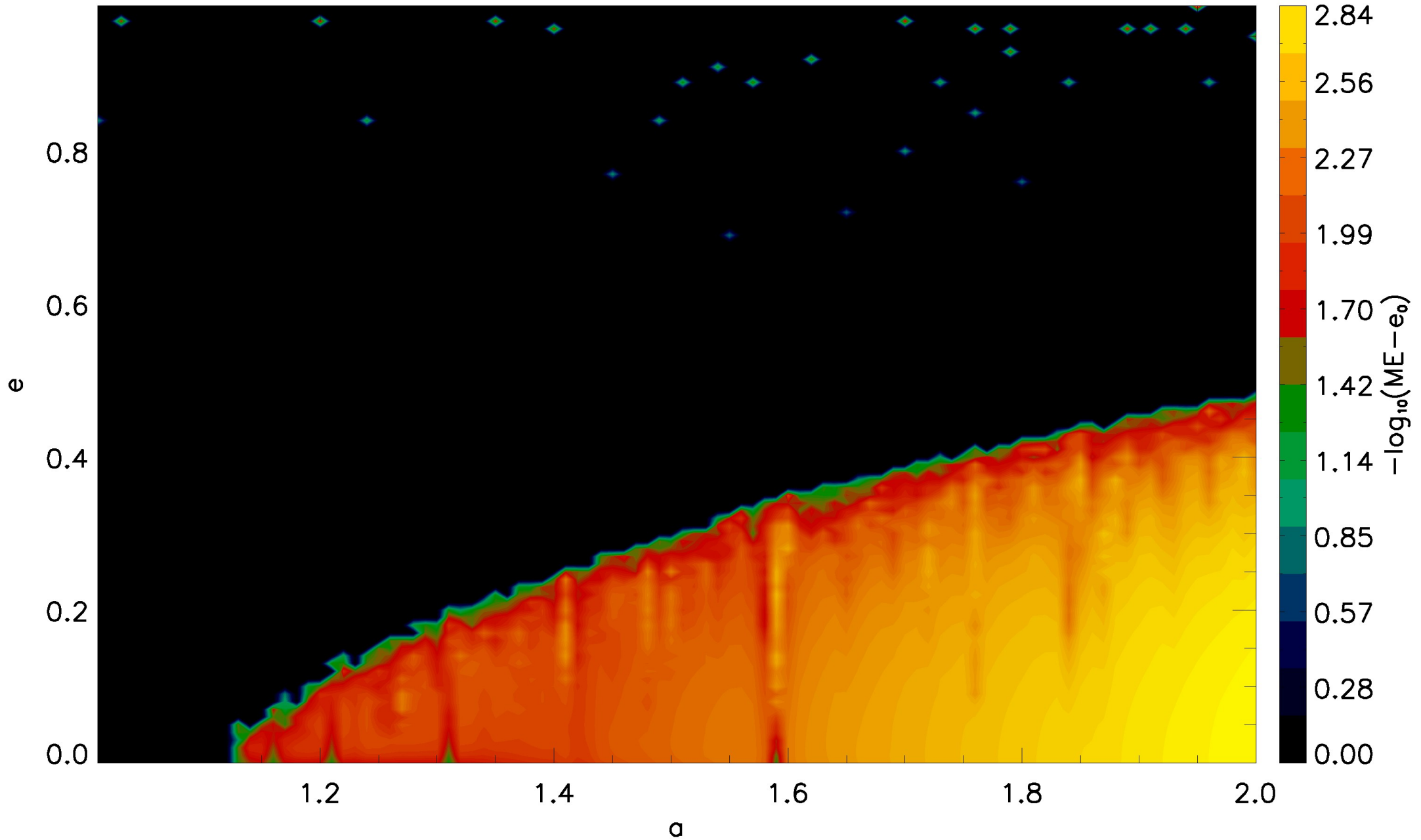
Stability of planet b with mass



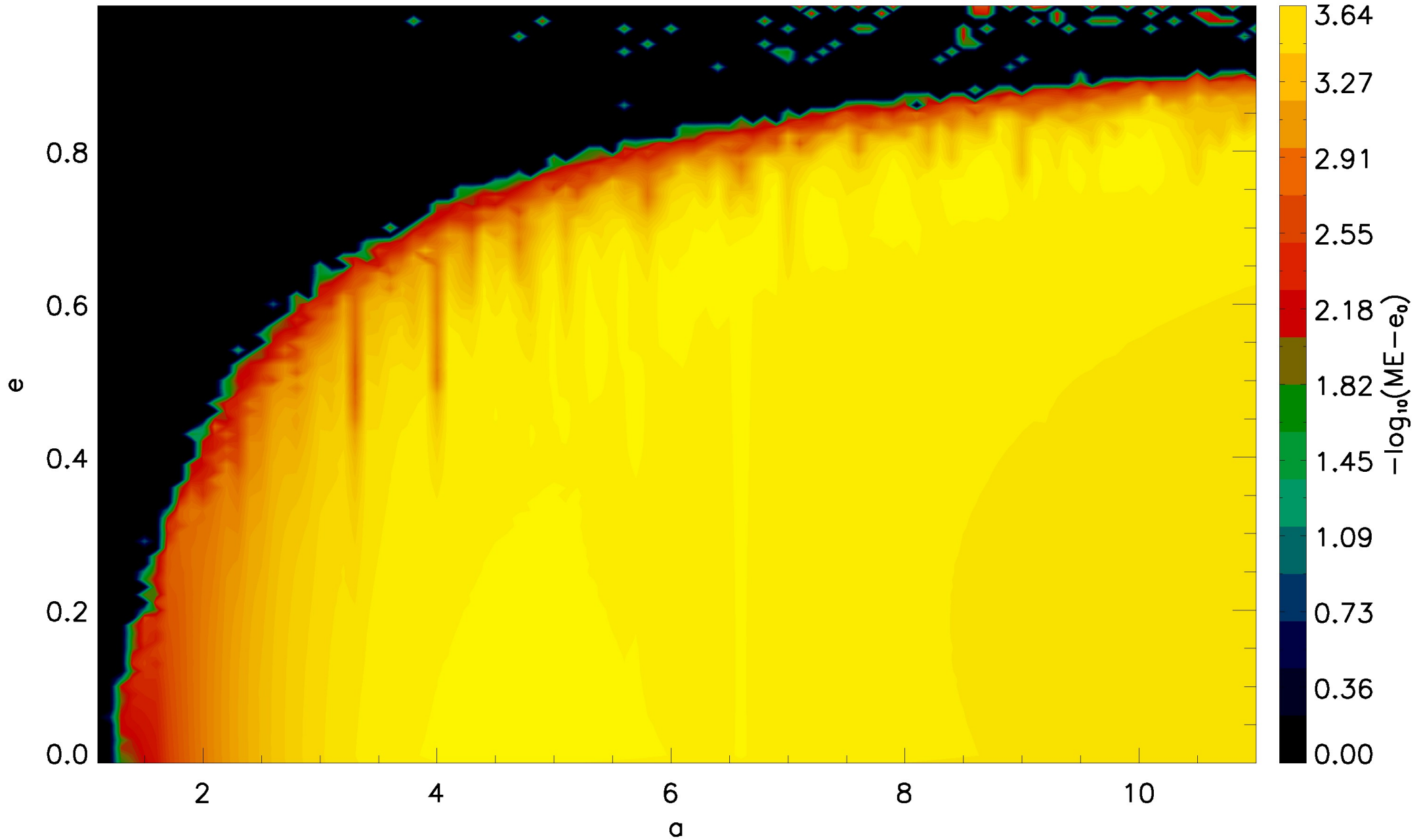
Stability of planet c with mass



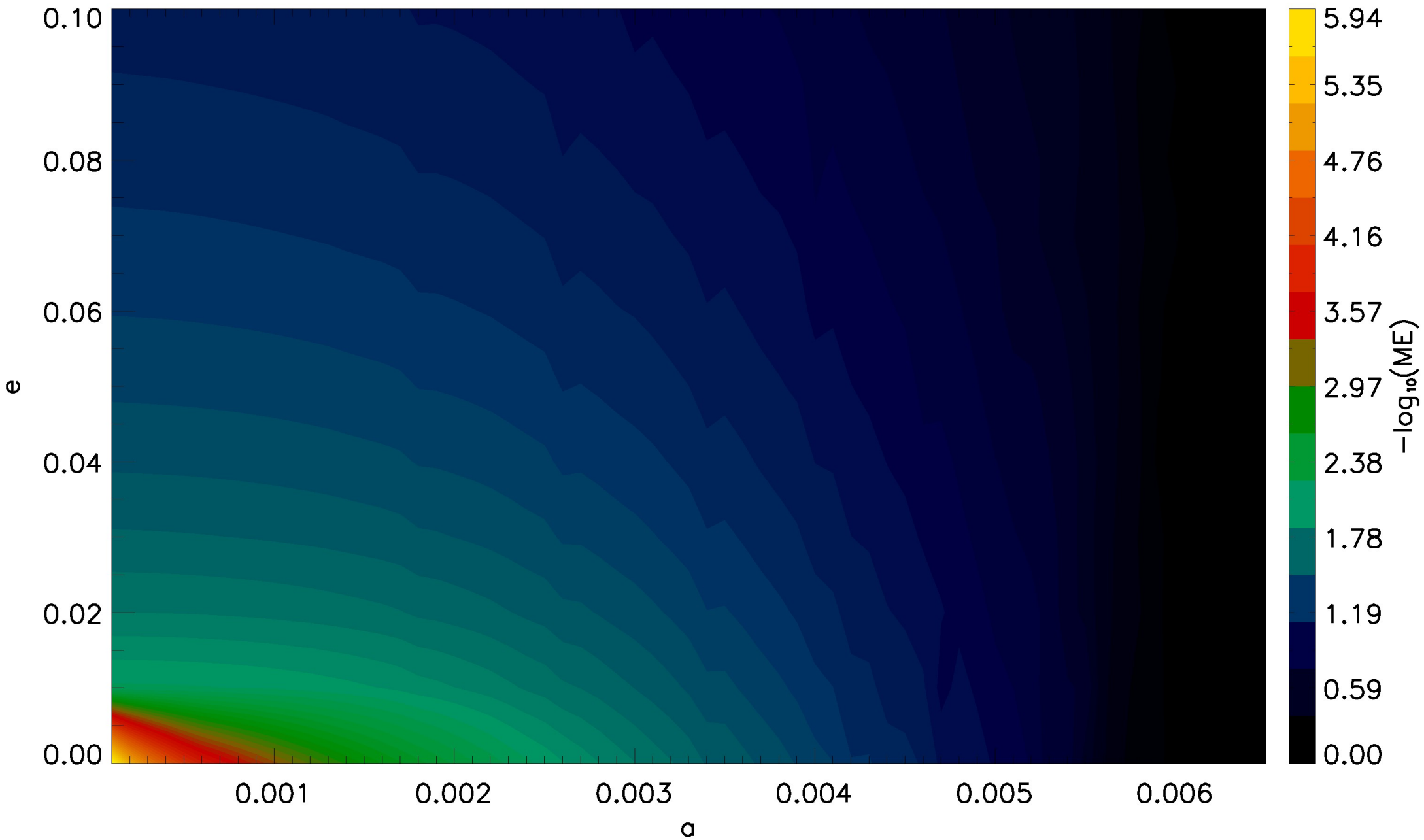
An other planet I



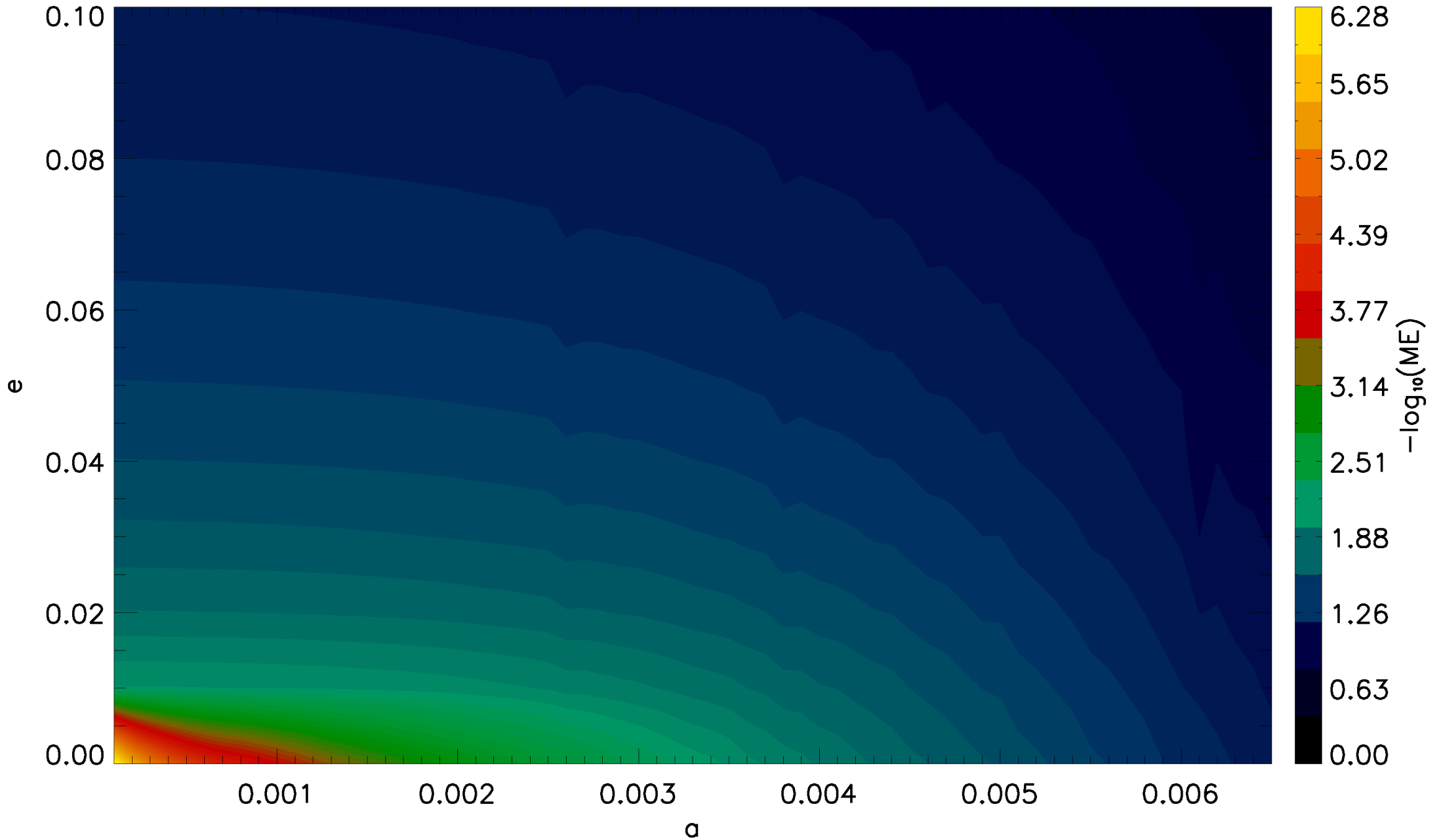
An other planet II



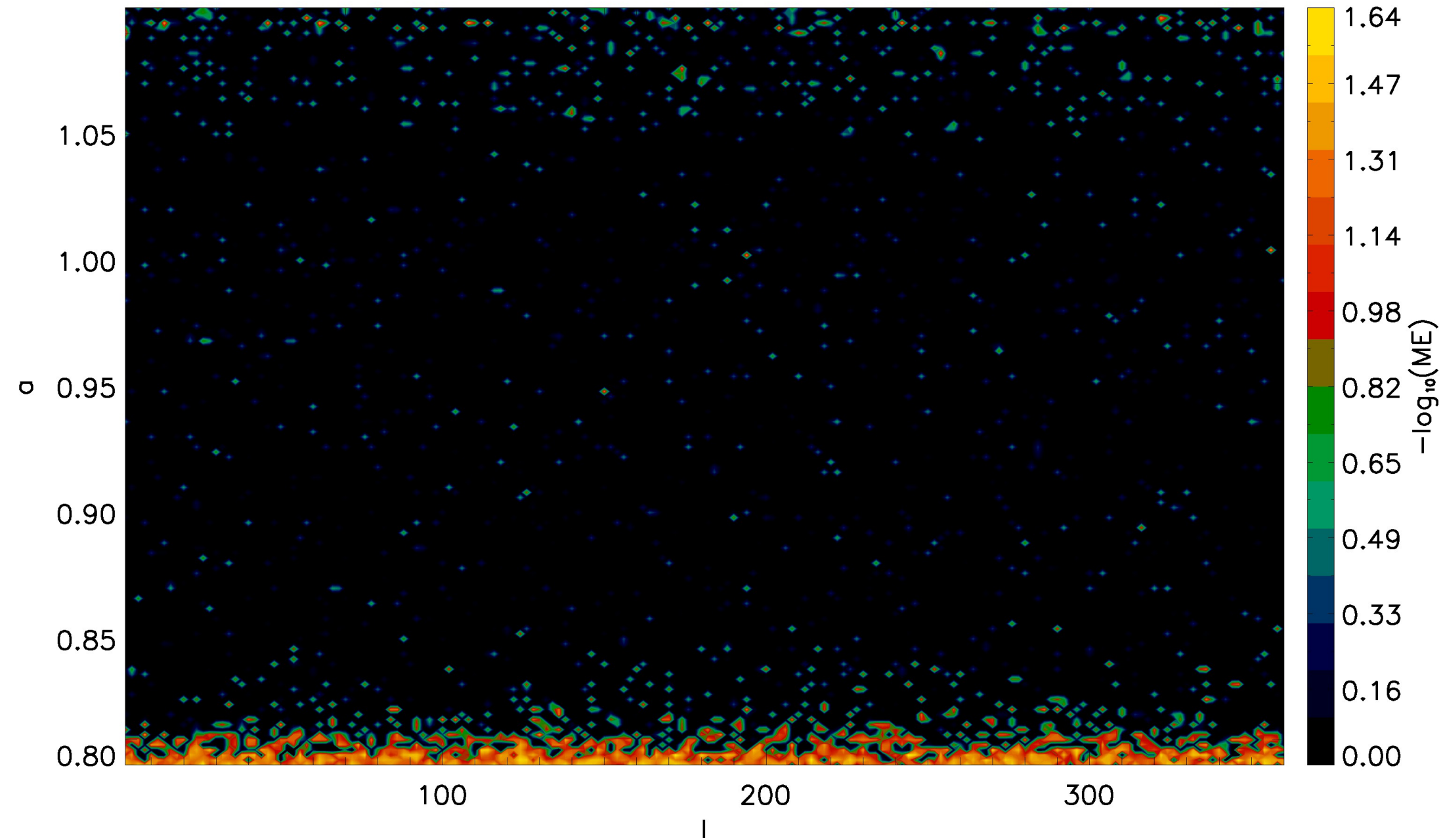
Moons around planet b



Moons around planet c



Trojans



Summary

- The system seems to be stable.
- However, the stable region extends to a small part of the parameter space. As a consequence, this system is very vulnerable to perturbations, so if there is any other planet in this system, it is likely to be relatively small and/or distant.
- An other planet can be stable from 0.1475 AU.
- This pair of planets does not influence the stability of the habitable zone.
- Moons can exist around planet b and c with density of 1.8 g/cm^3 and 0.96 g/cm^3 or more respectively. The stability of the moons can be influenced by the perturbations caused by the shape of the planets.
- Because of the resonance, there cannot be trojan type of objects belonging to planet b or c.