DREAM
Dynamic Response of the Environment at the Moon

EXOSPHERIC ESCAPE: A PARAMETRICAL STUDY

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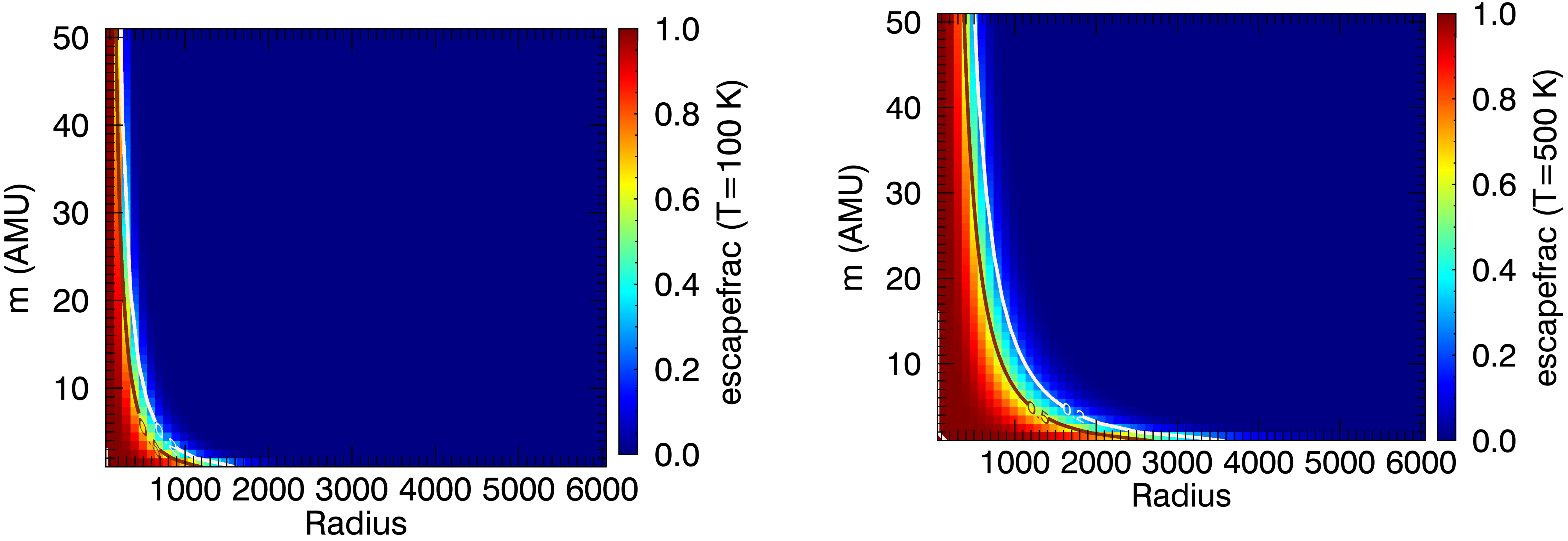
DREAM2

Outline

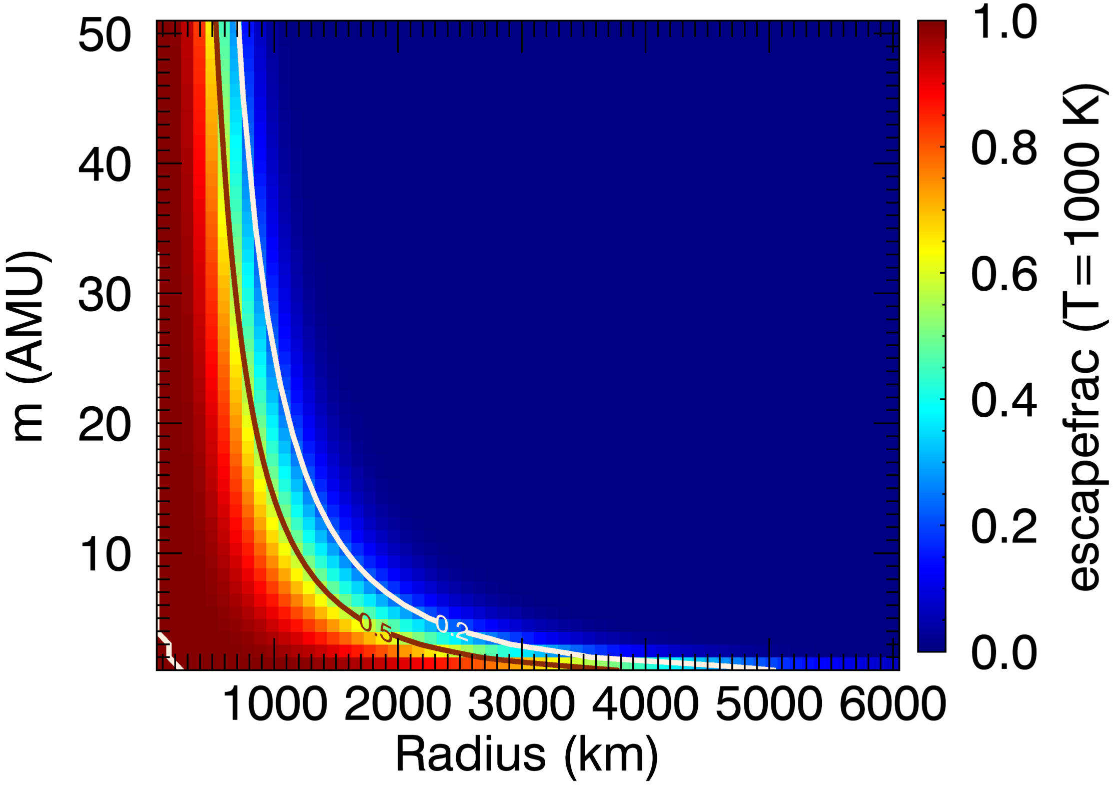
- Quick Look for estimates of gravitational escape
- Consider size of primary and mass of exospheric species
- Consider Maxwellian and two Sputter velocity distributions
- Direction for future work

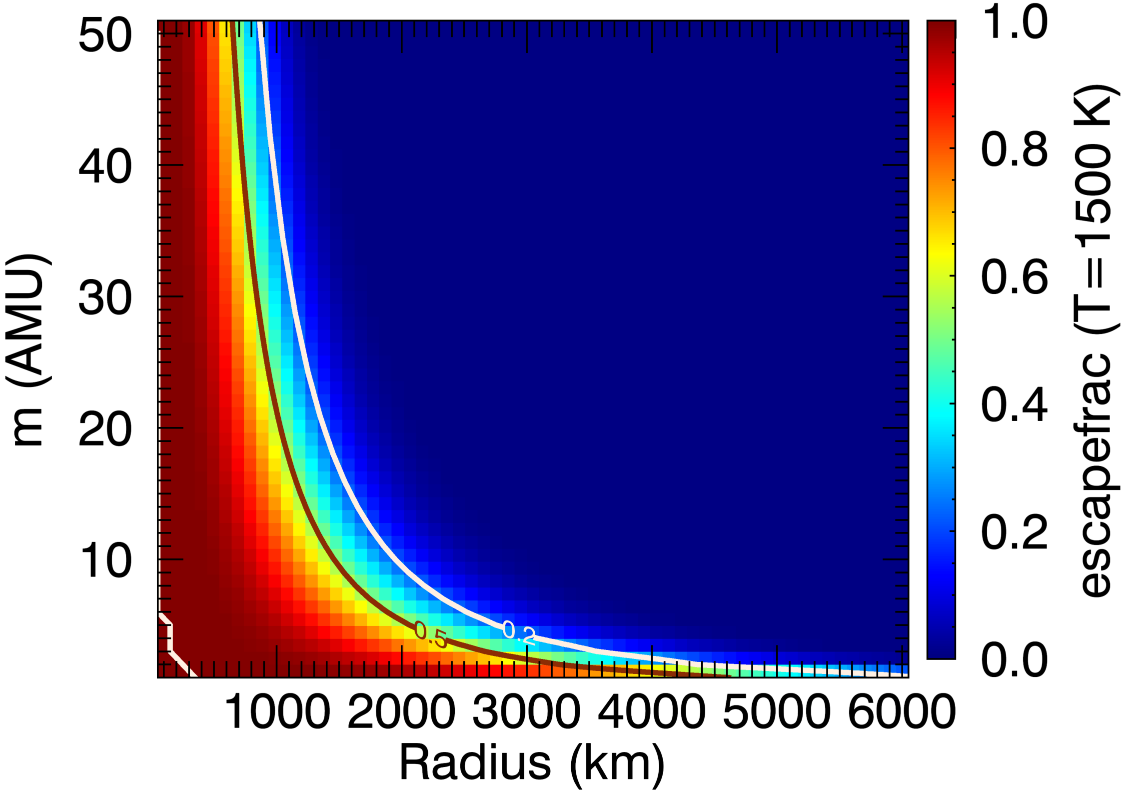
Escape Fraction for Mass m vs. Radius (km)
Maxwellian Temperatures 100 & 500 K



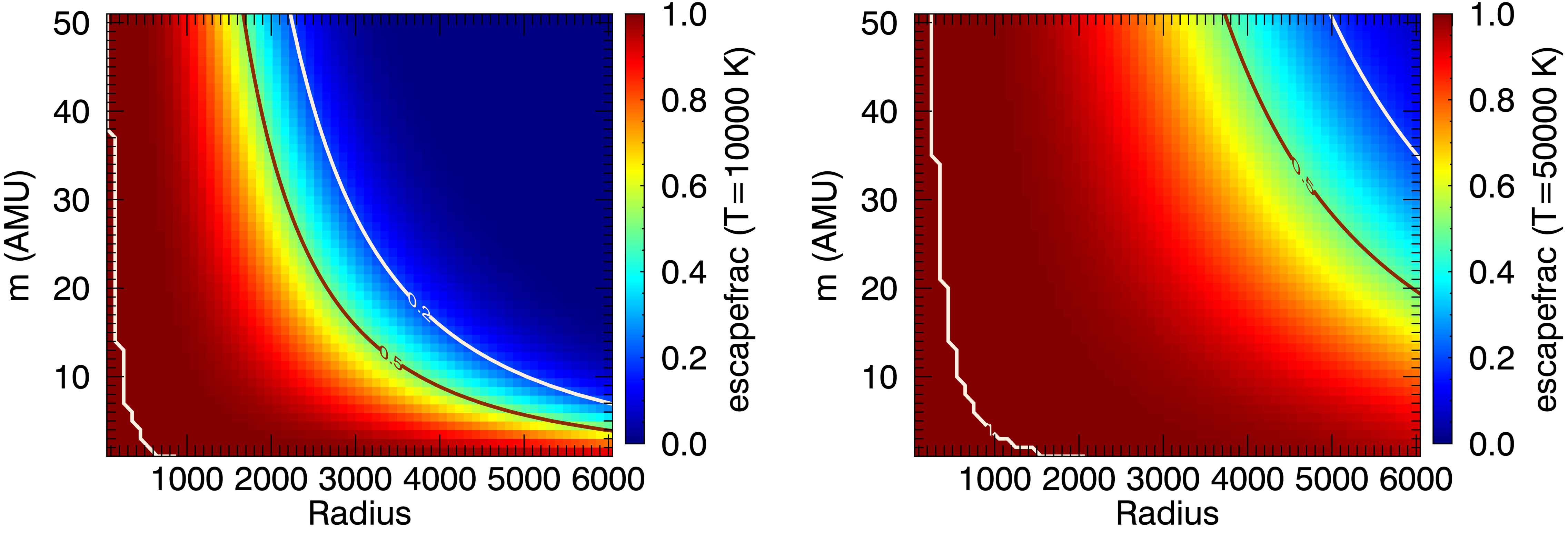
Escape Fractions

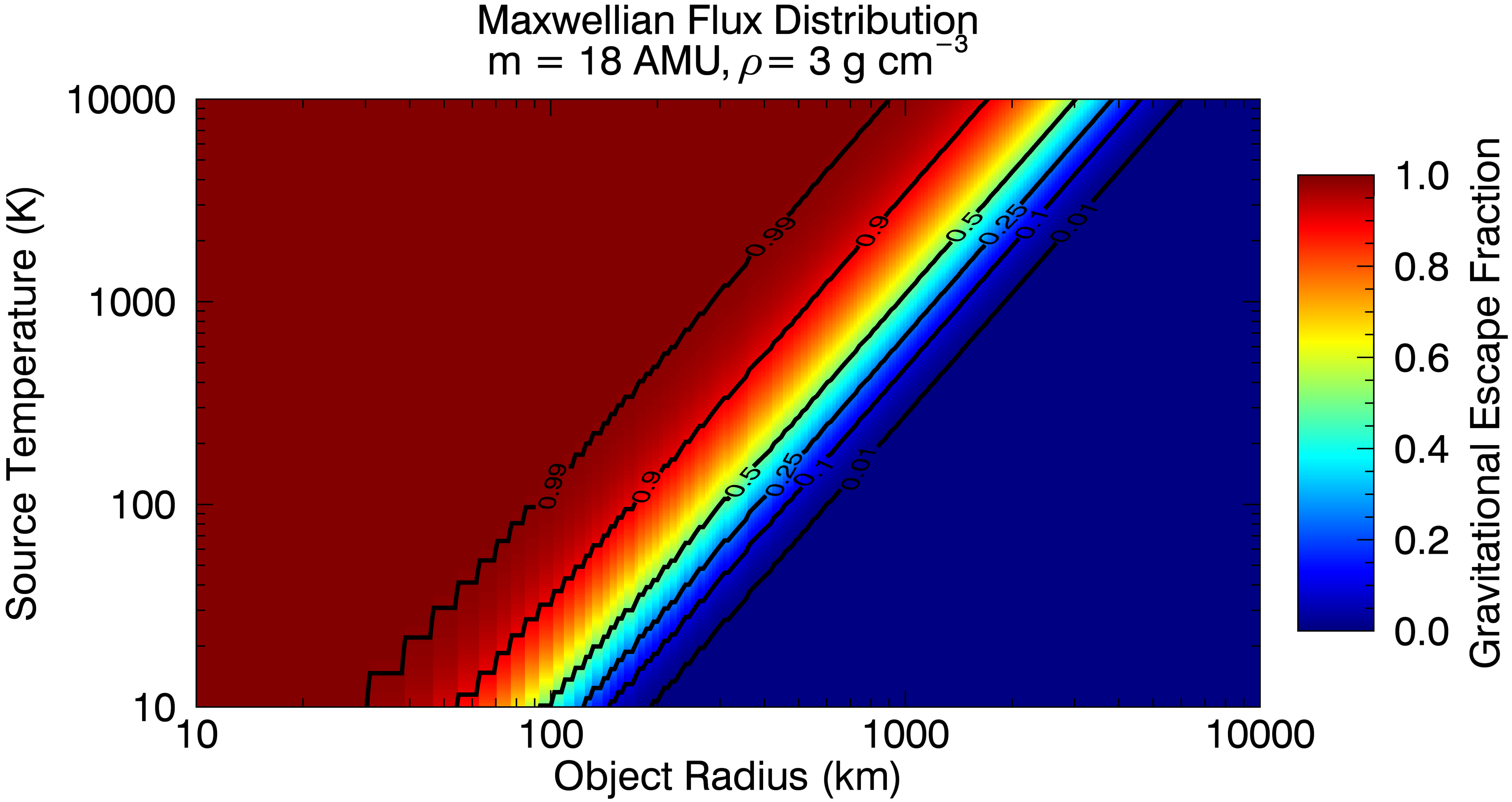
Maxwellian Temperatures 1000 & 1500 K





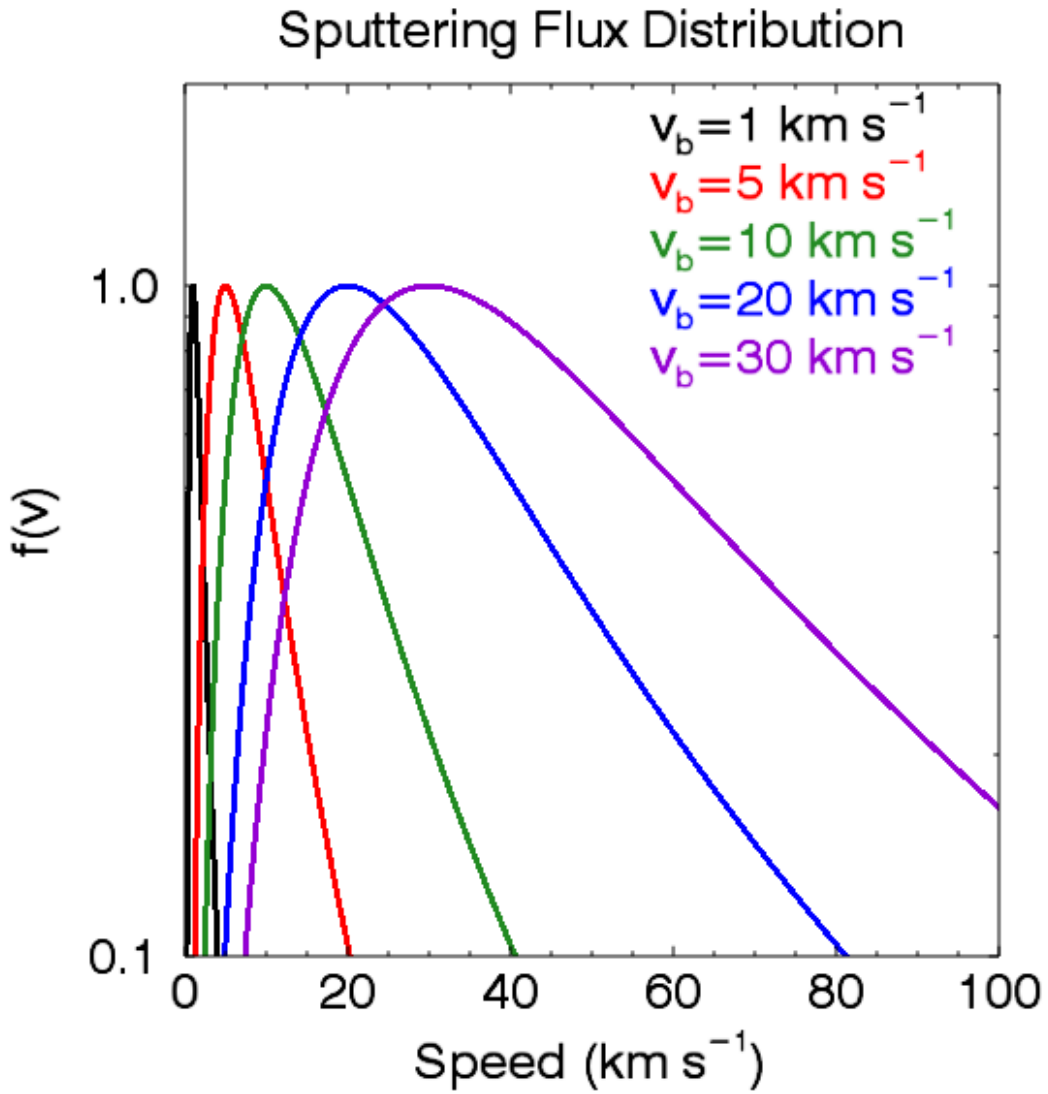
Escape Fractions
Temperature 10000 & 50000 K

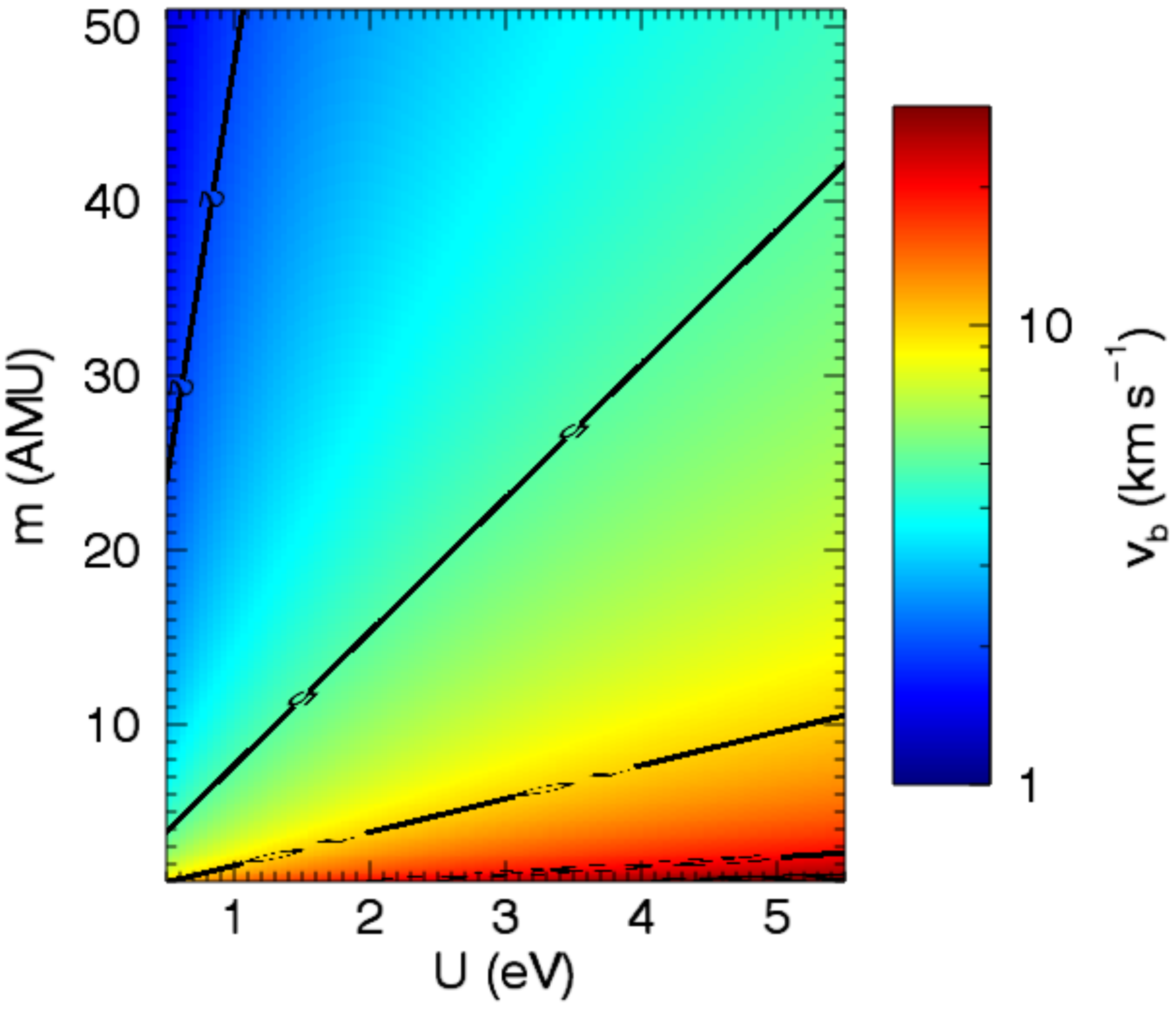


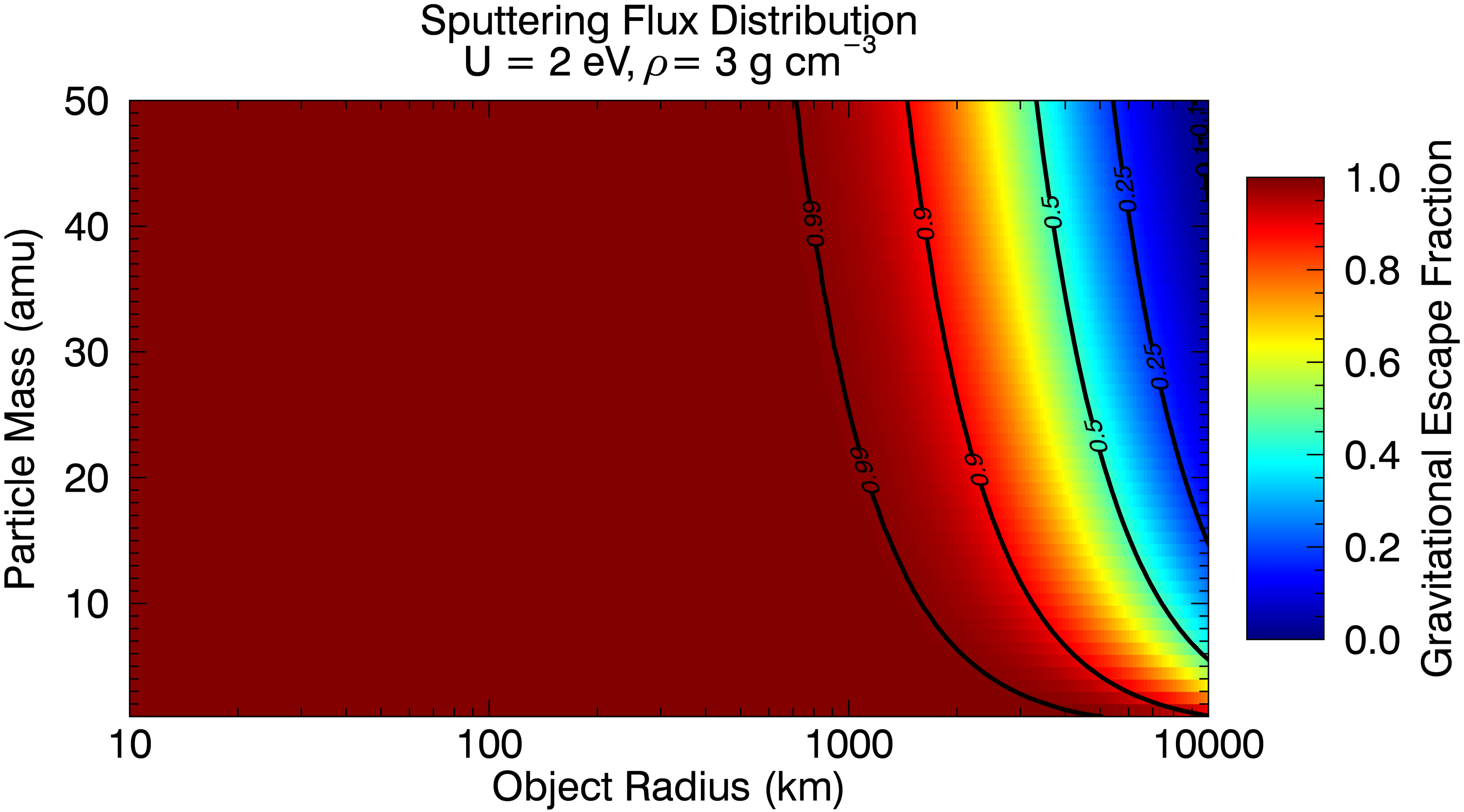


Maxwellian Flux Distribution
m = 18 AMU, ρ = 3 g cm^{-3}

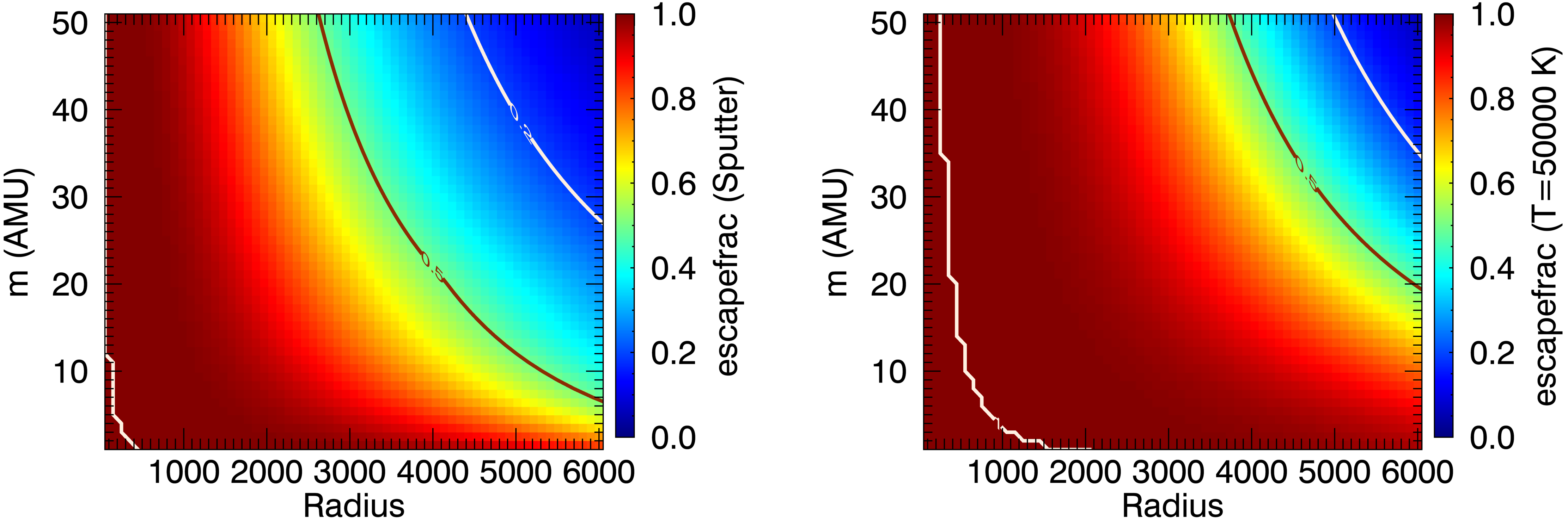
Sputter Velocity Distributions





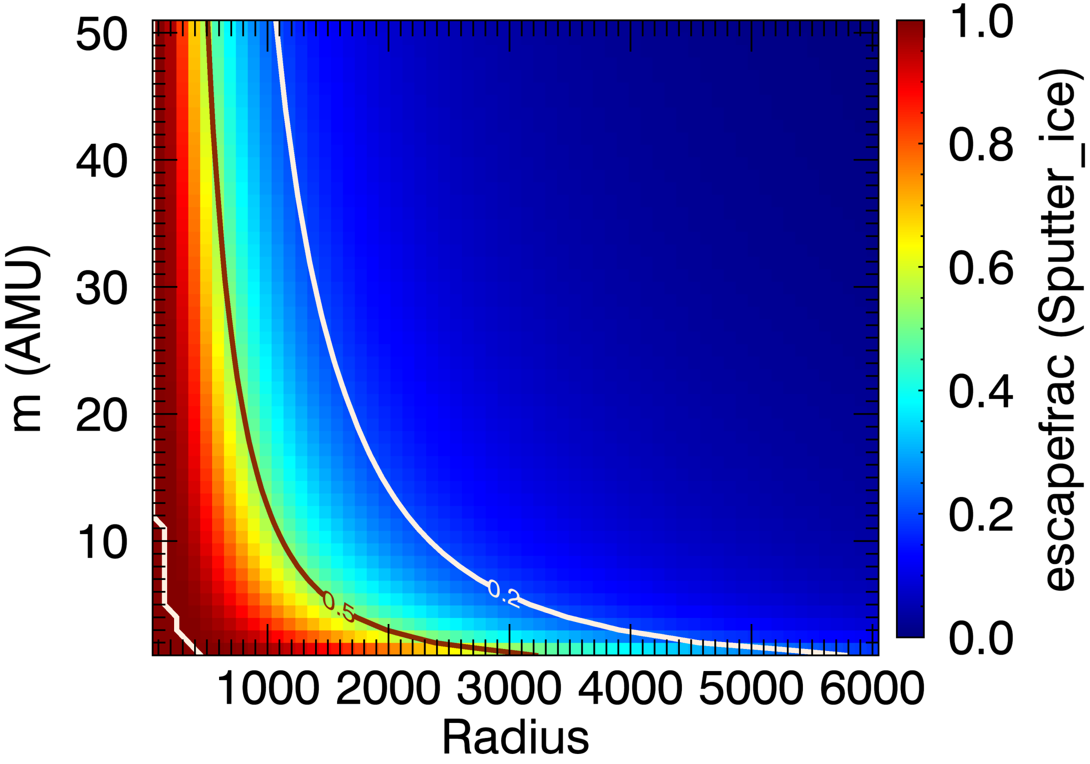

Sputtering Flux Distribution
U = 2 eV, ρ= 3 g cm^{-3}
Particle Mass (amu)
50
40
30
20
10
10
100
1000
10000
Object Radius (km)
0.99
0.9
0.5
0.25
0.1
Gravitational Escape Fraction
1.0
0.8
0.6
0.4
0.2
0.0

Escape Fractions
Sputter Distribution & 50000 K Maxwellian

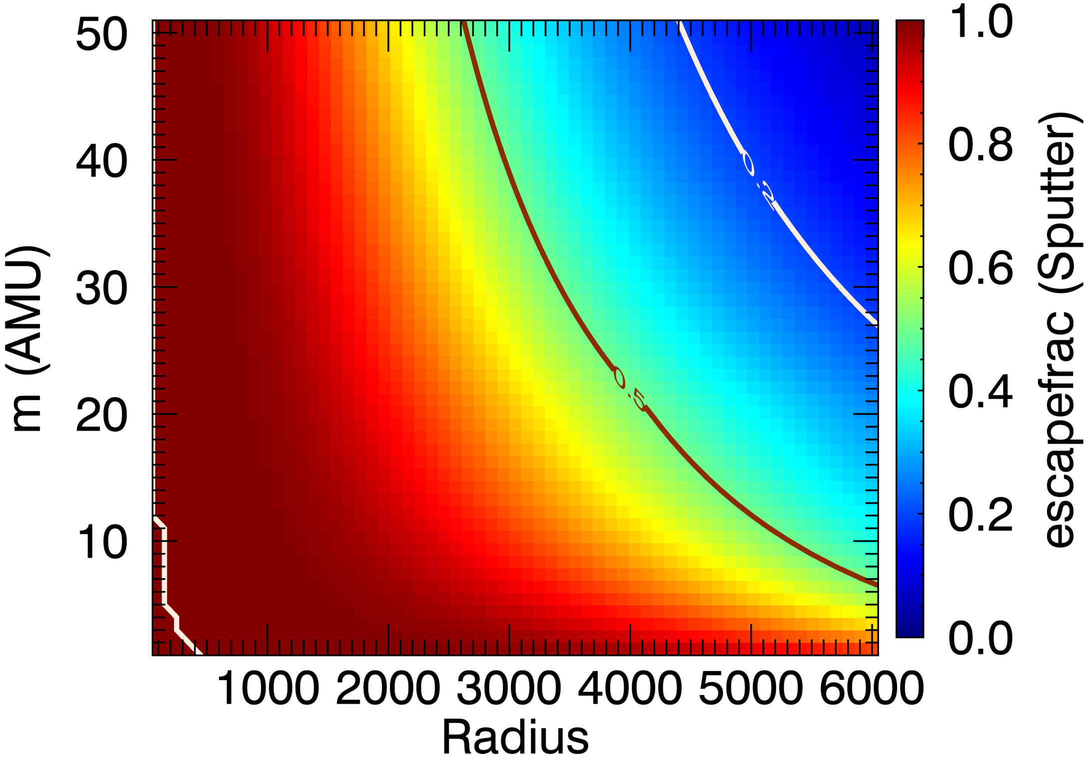


Sputter Velocity Distributions

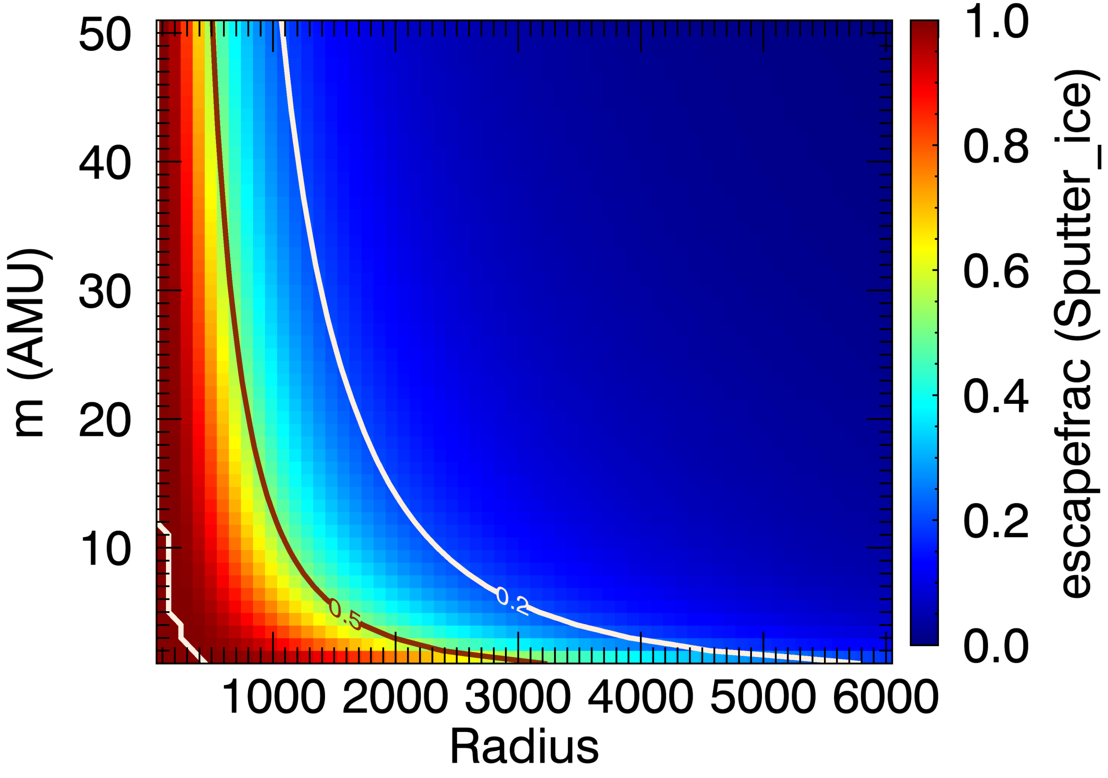
Sputter_Ice

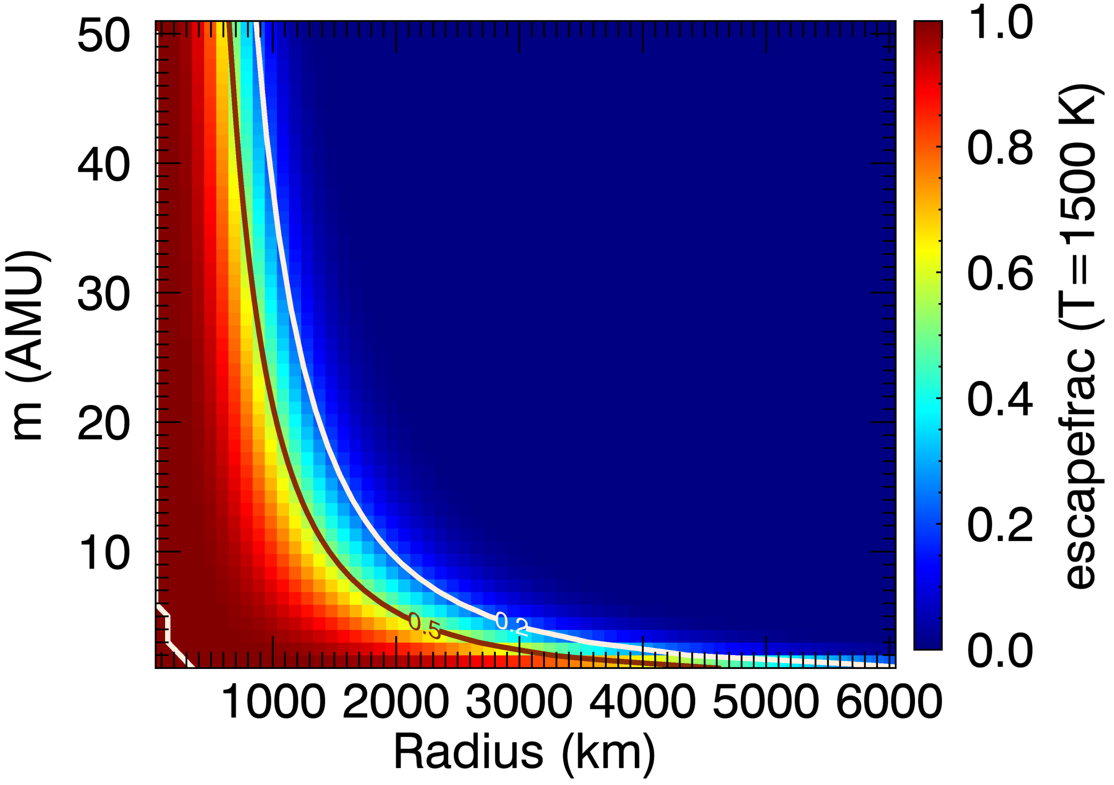


Sputter_Rock

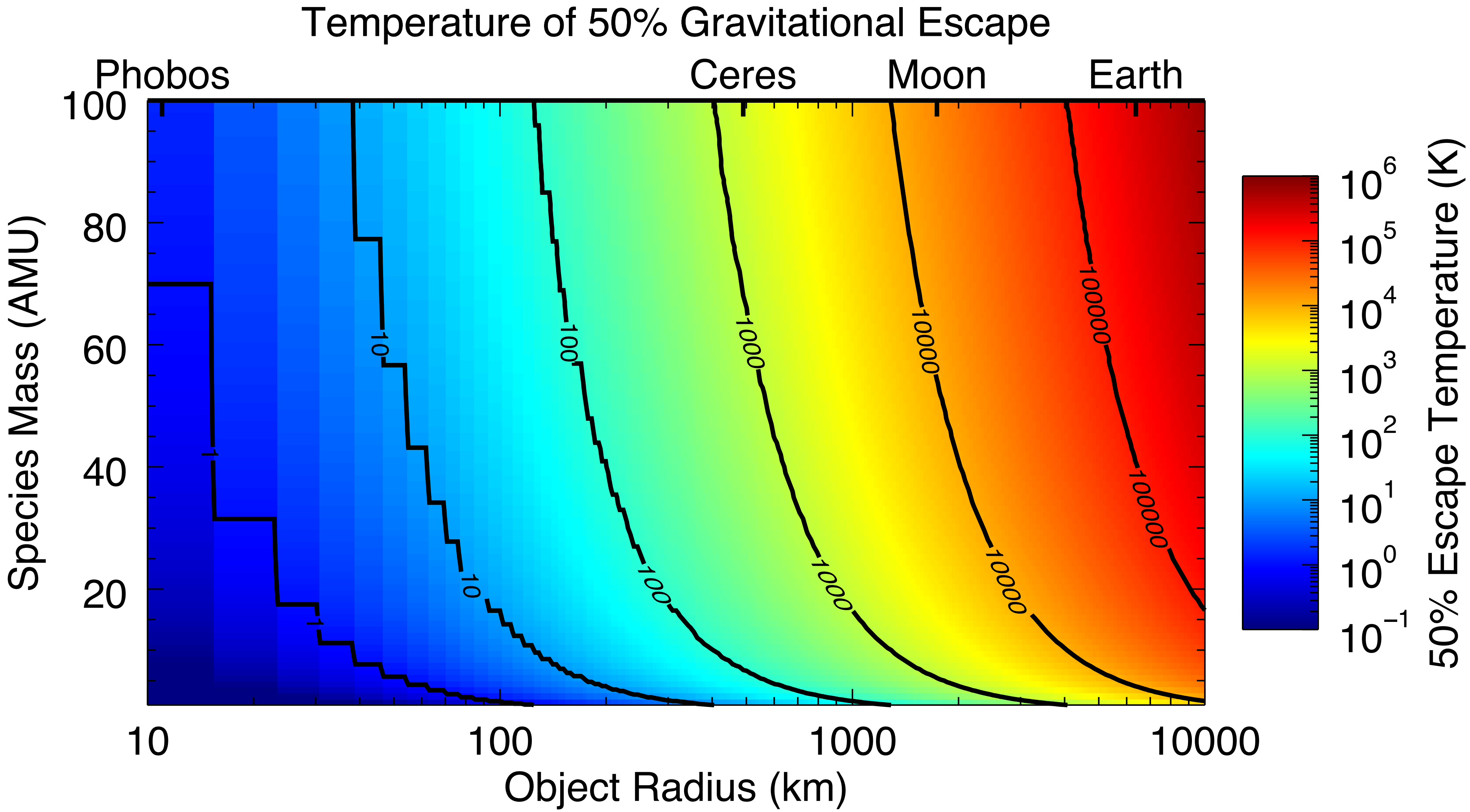


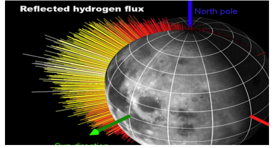
Sputter_Ice and 1500 K Maxwellian

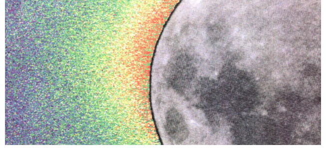




Temperature of 50% Gravitational Escape







A Scaling Law

$T_{50\%} = 30\mathrm{K}\ (R/100\ \mathrm{km})^2\ (m_{atom}/60\ \mathrm{amu})$

- Mean velocity ~ sqrt $(T_{process}/m_{atom})$
- Escape velocity ~ sqrt(M_{body}/R) ~ sqrt(R^2)
- **Equate velocities: $T_{process}/m_{atom}R^2$ ~ constant**
- Defines the Killen & Burger curves

$T_{50\%}/R^2 m = 5 \times 10^{-5}\ \mathrm{K}/(\mathrm{km}^2\text{-amu})$

Conclusions

- Escape Fraction varies with mass of primary body and mass of particle
- Escape Fraction is a strong function of source temperature
- Escape Fraction is a strong function of source velocity distribution

Future Work

- Consider dust particles
- Consider rotation
- Consider other velocity distributions like Gaussian