

“Seven minutes of terror” – A look at Curiosity’s safe arrival on Mars



Paul Withers
Boston University
(withers@bu.edu)

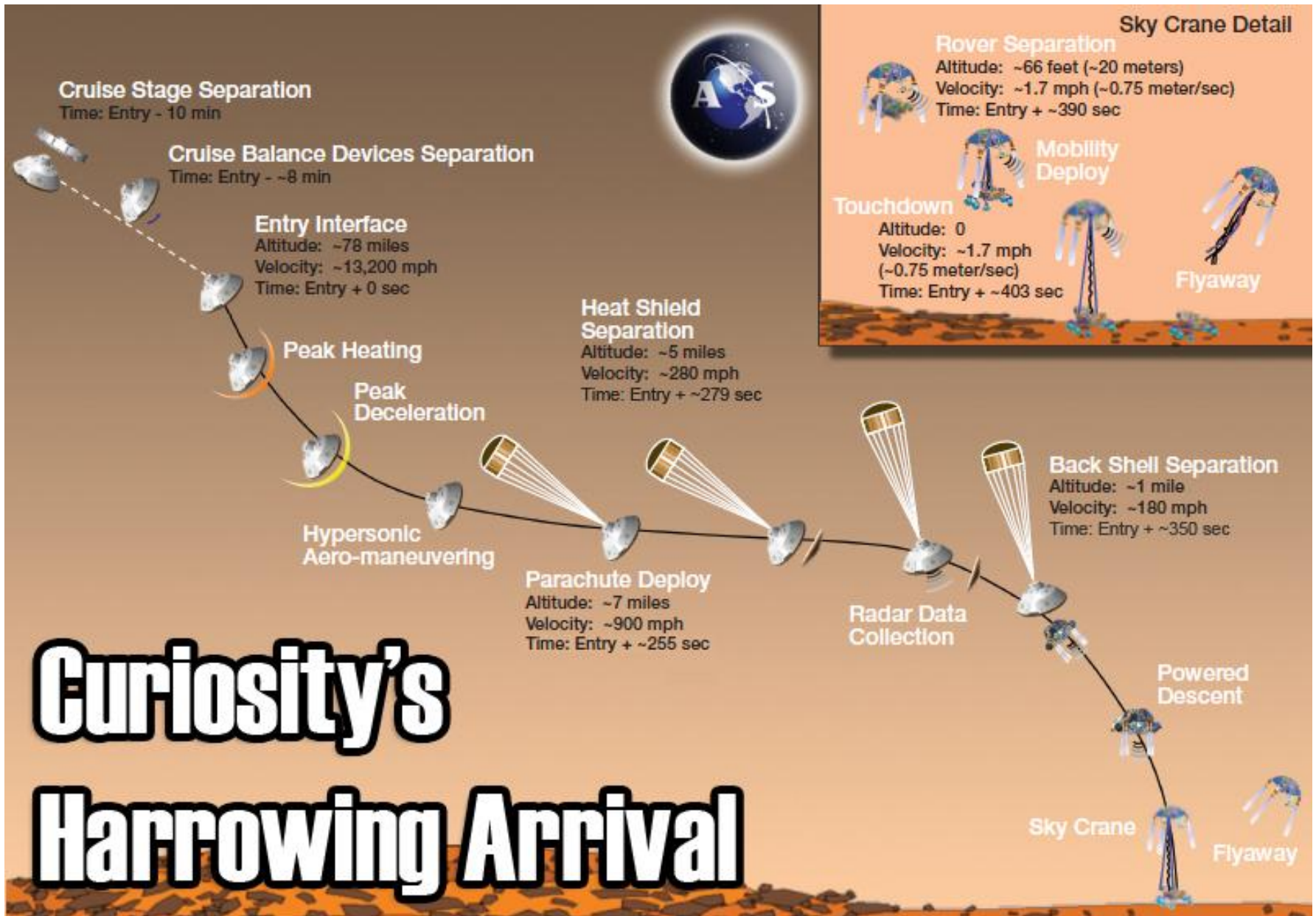
Boston University
Astronomy Society

Wednesday 2012.09.12
19:30, CAS 502



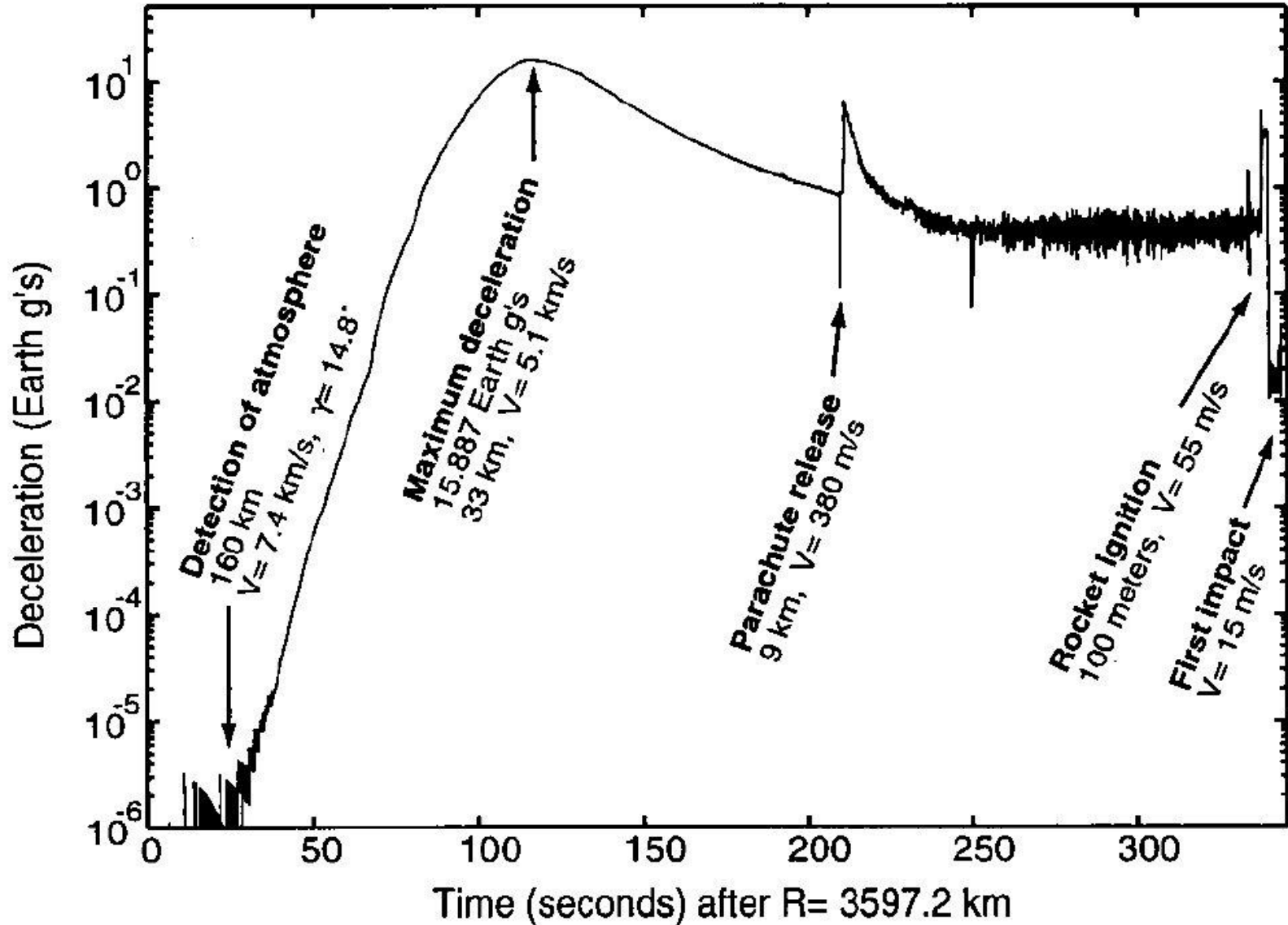






<http://www.youtube.com/watch?v=ISmWYyQxqqq>

Data from Pathfinder (1997)

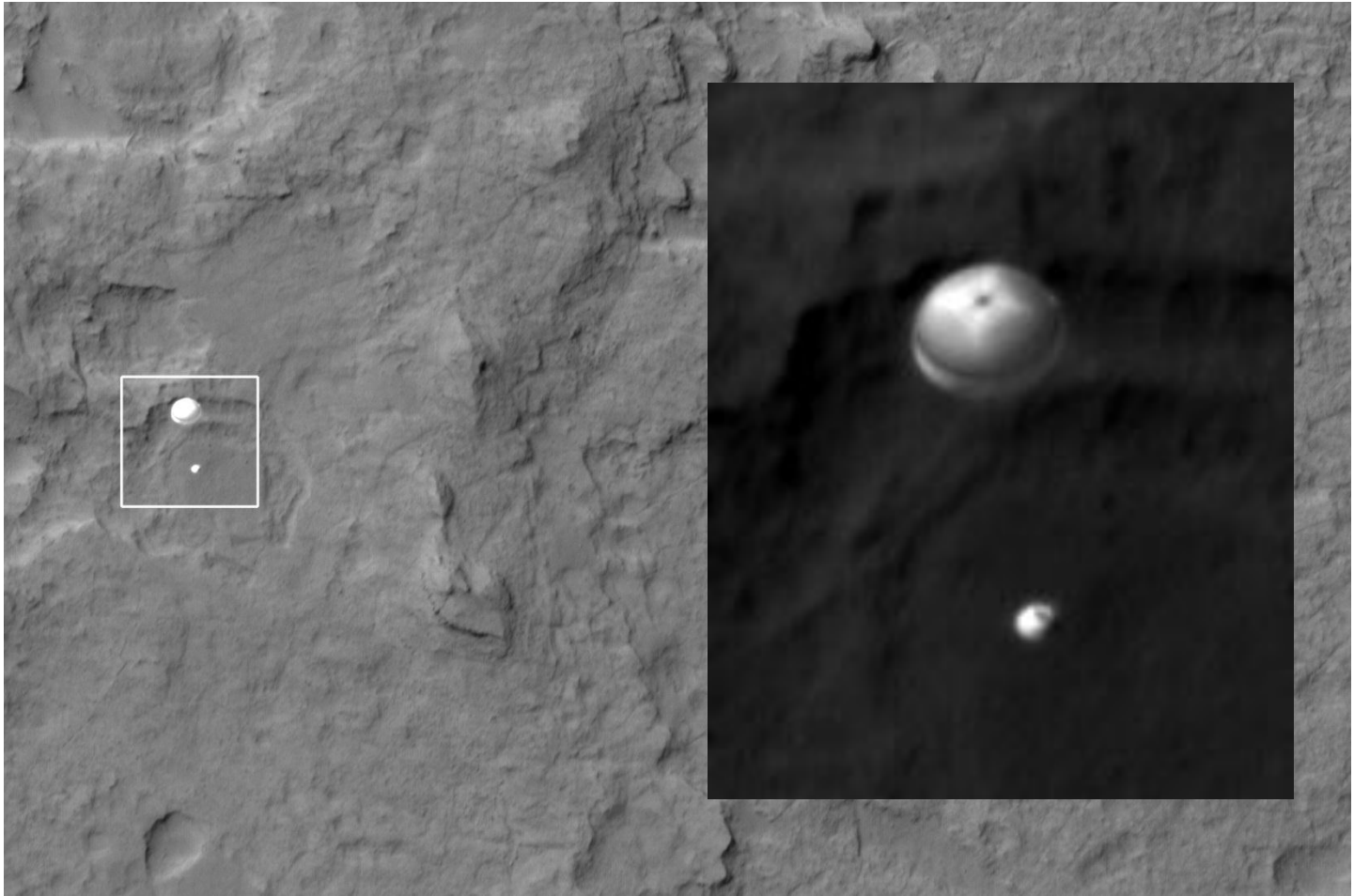


Drag alone is not enough

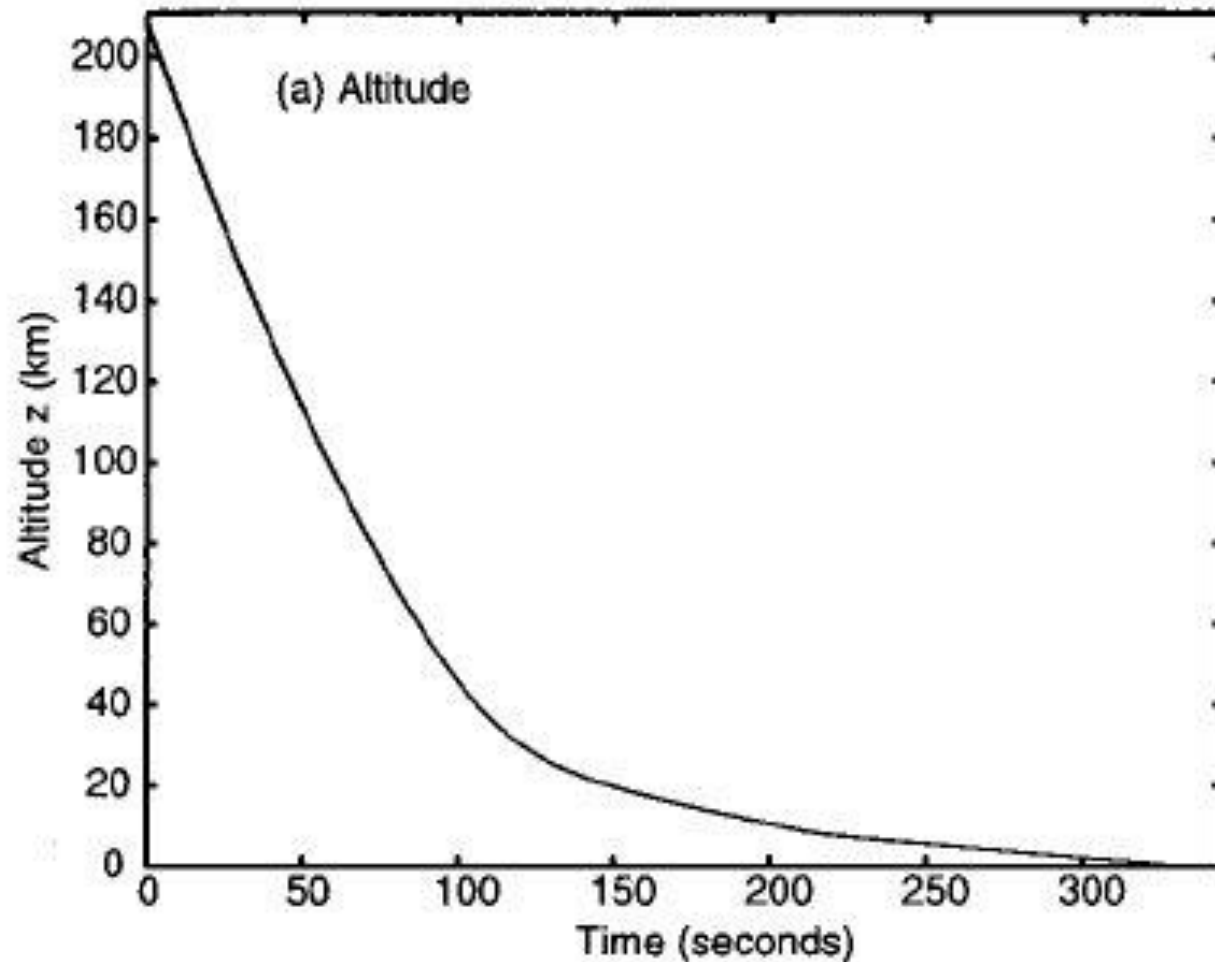


Genesis (sample return from solar wind)
Utah, 2004 – Parachute failed to open

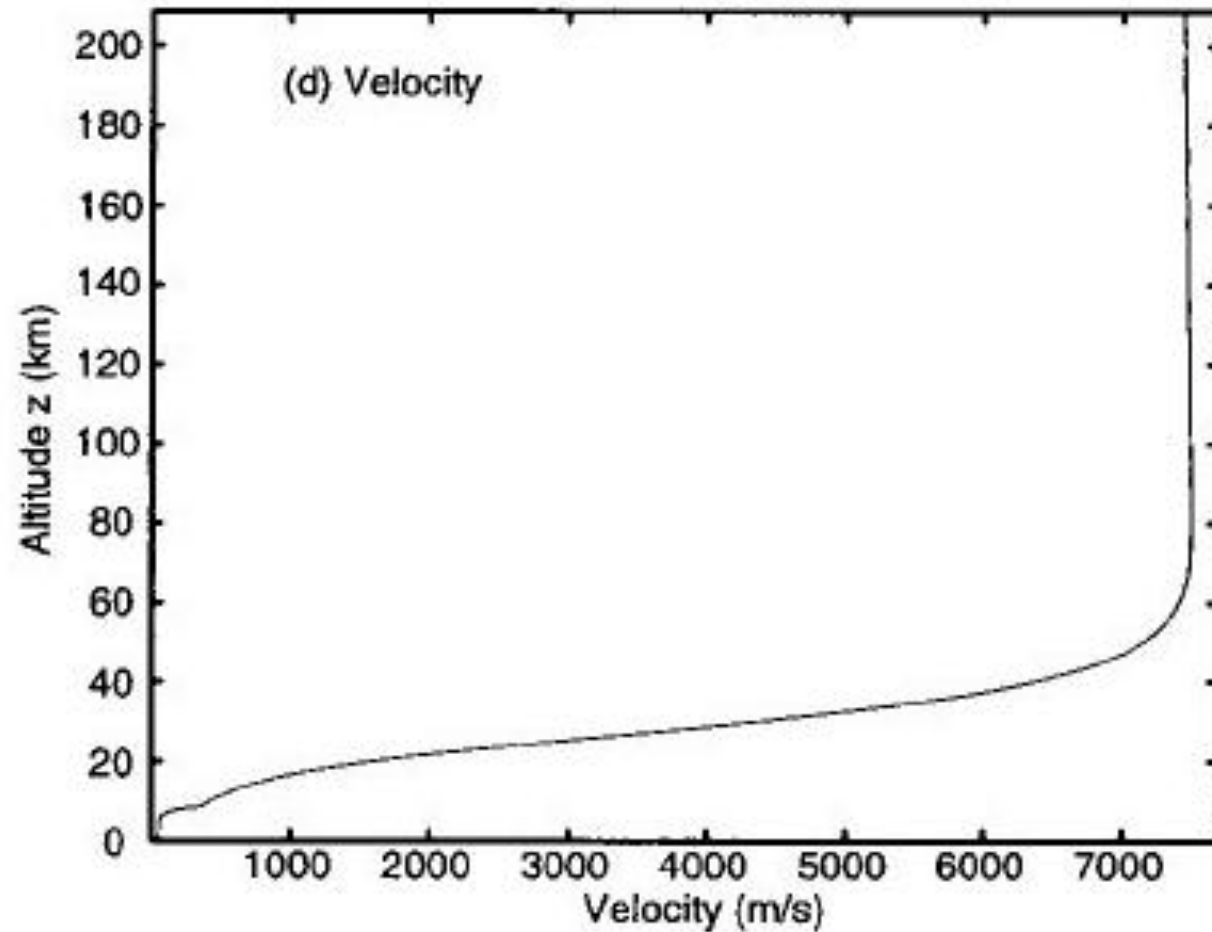
The view from orbit during entry



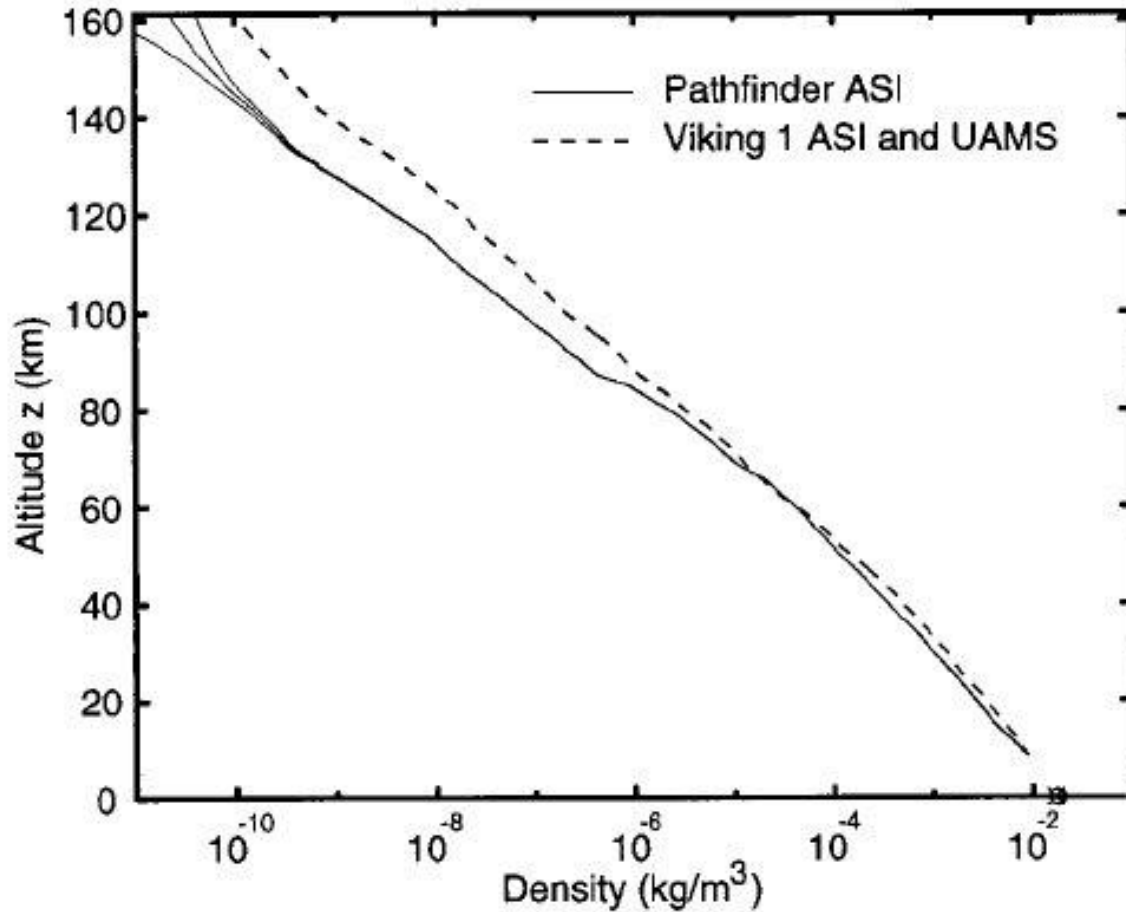
Pathfinder altitude profile



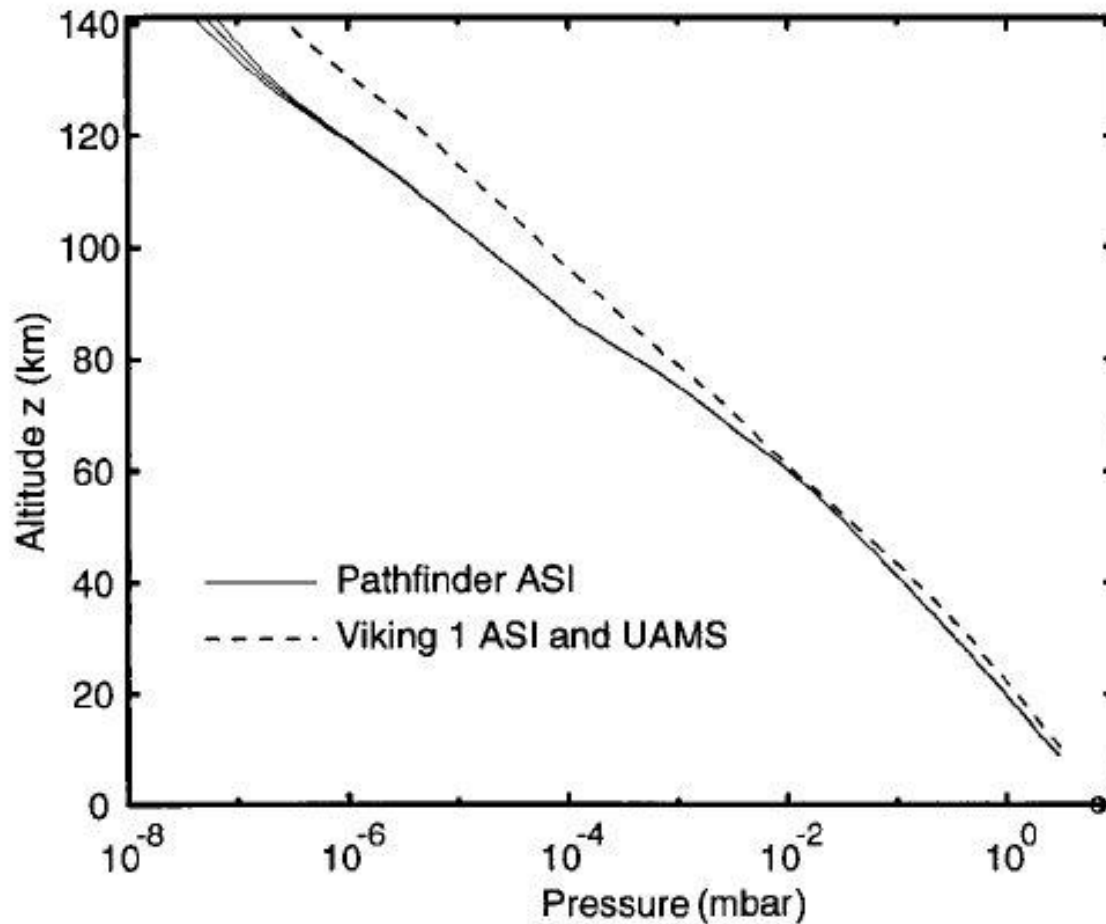
Pathfinder speed profile



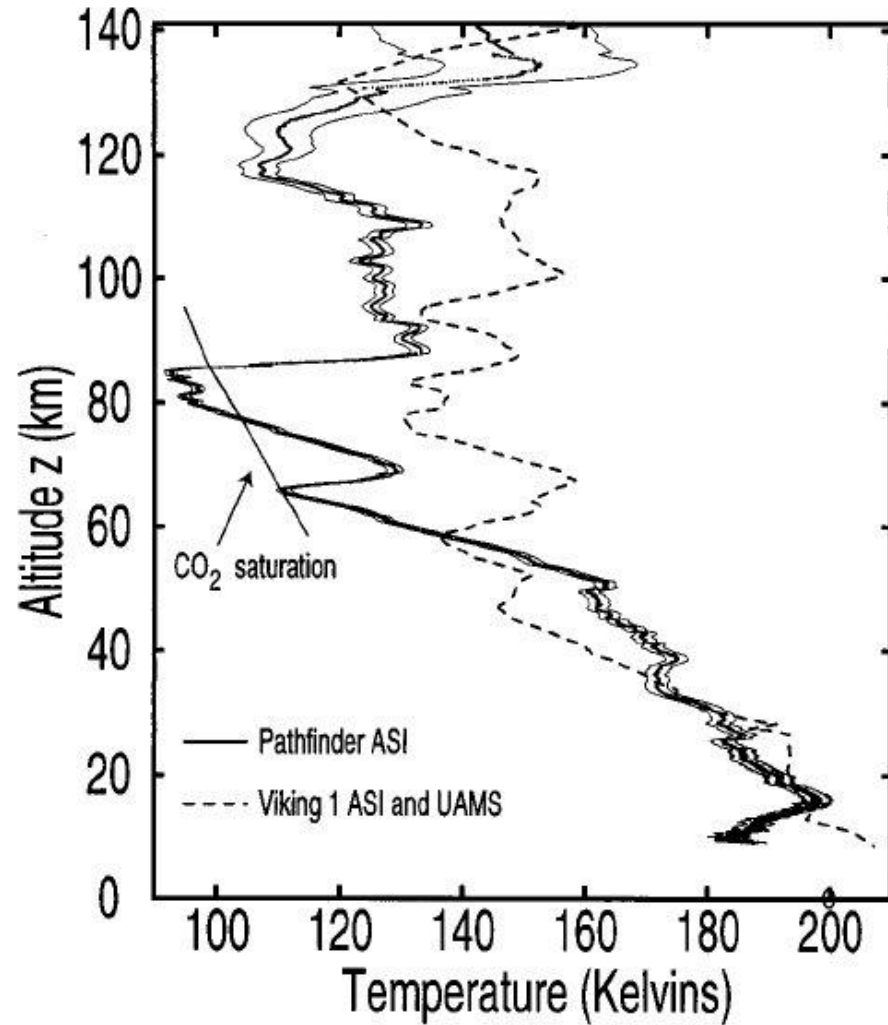
Pathfinder density profile



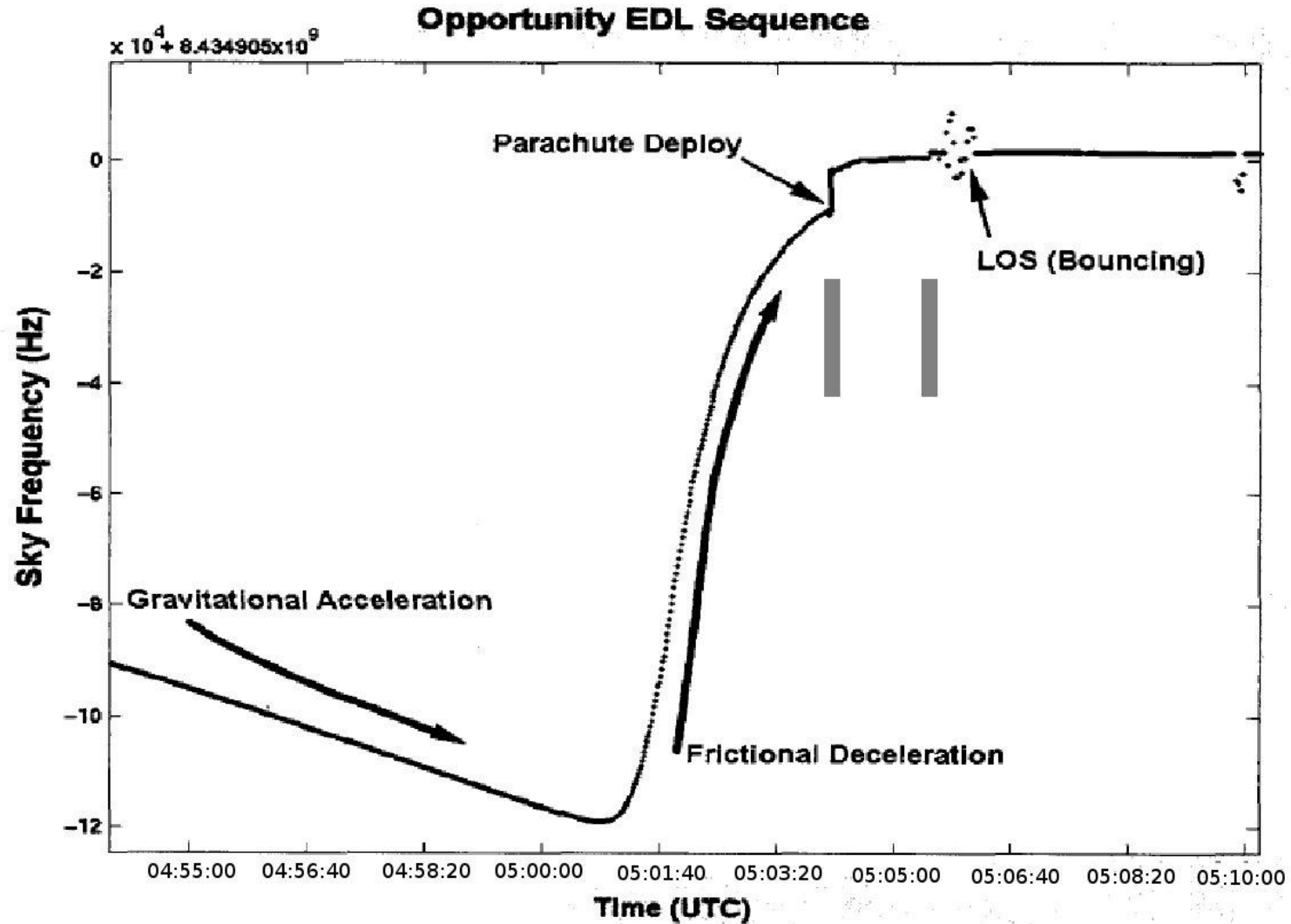
Pathfinder pressure profile



Pathfinder temperature profile

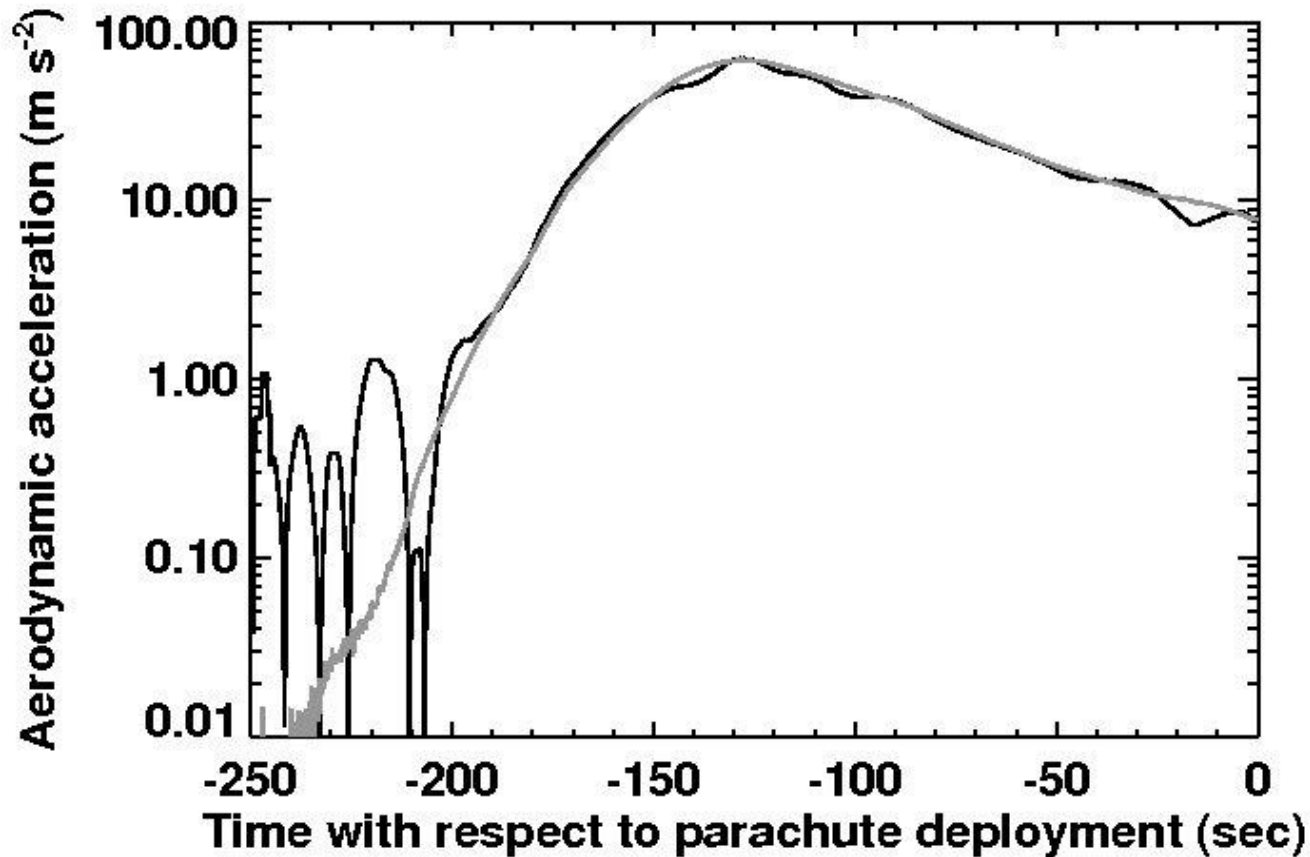


Doppler shift from Opportunity (2004)

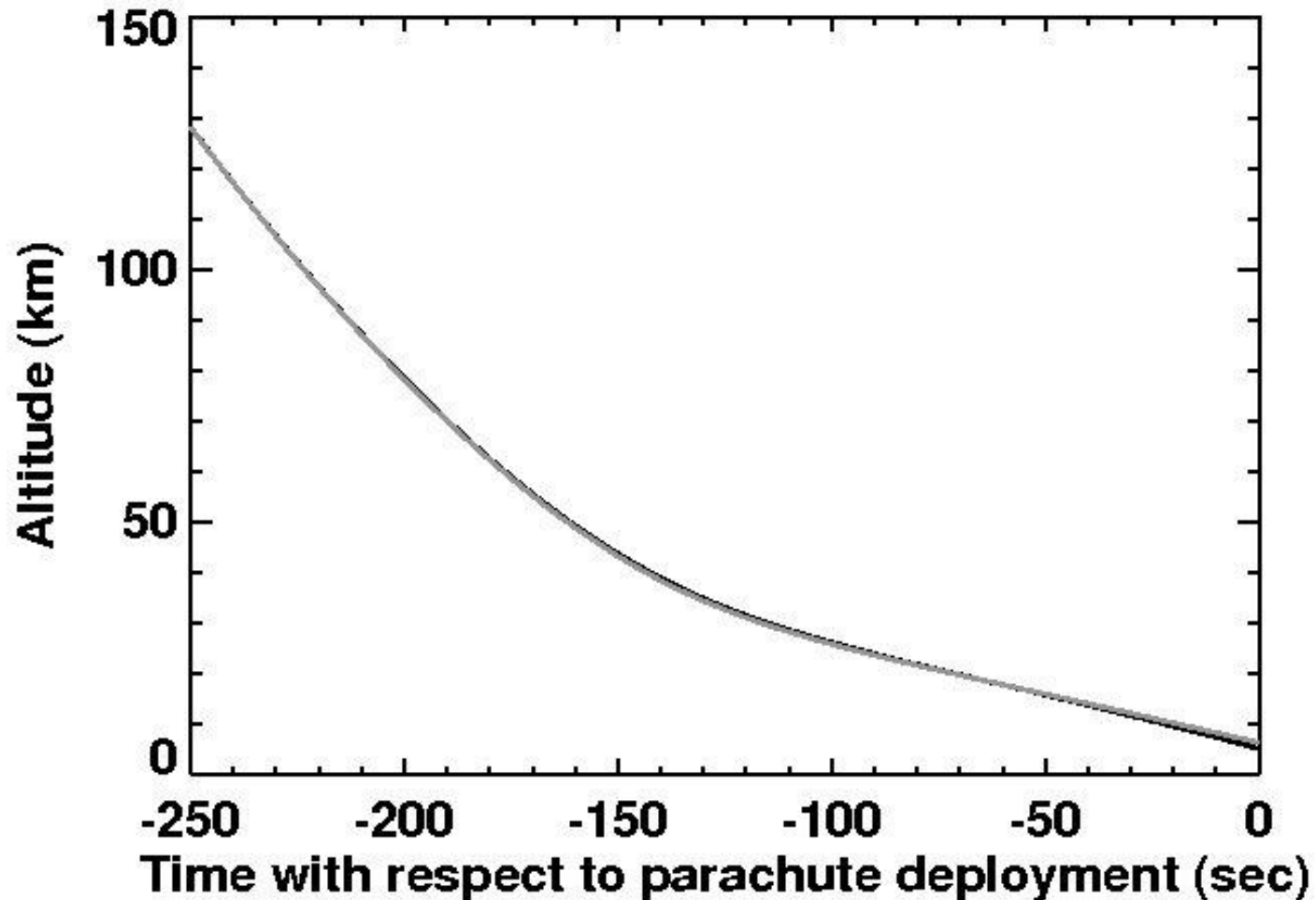


Opportunity acceleration profile

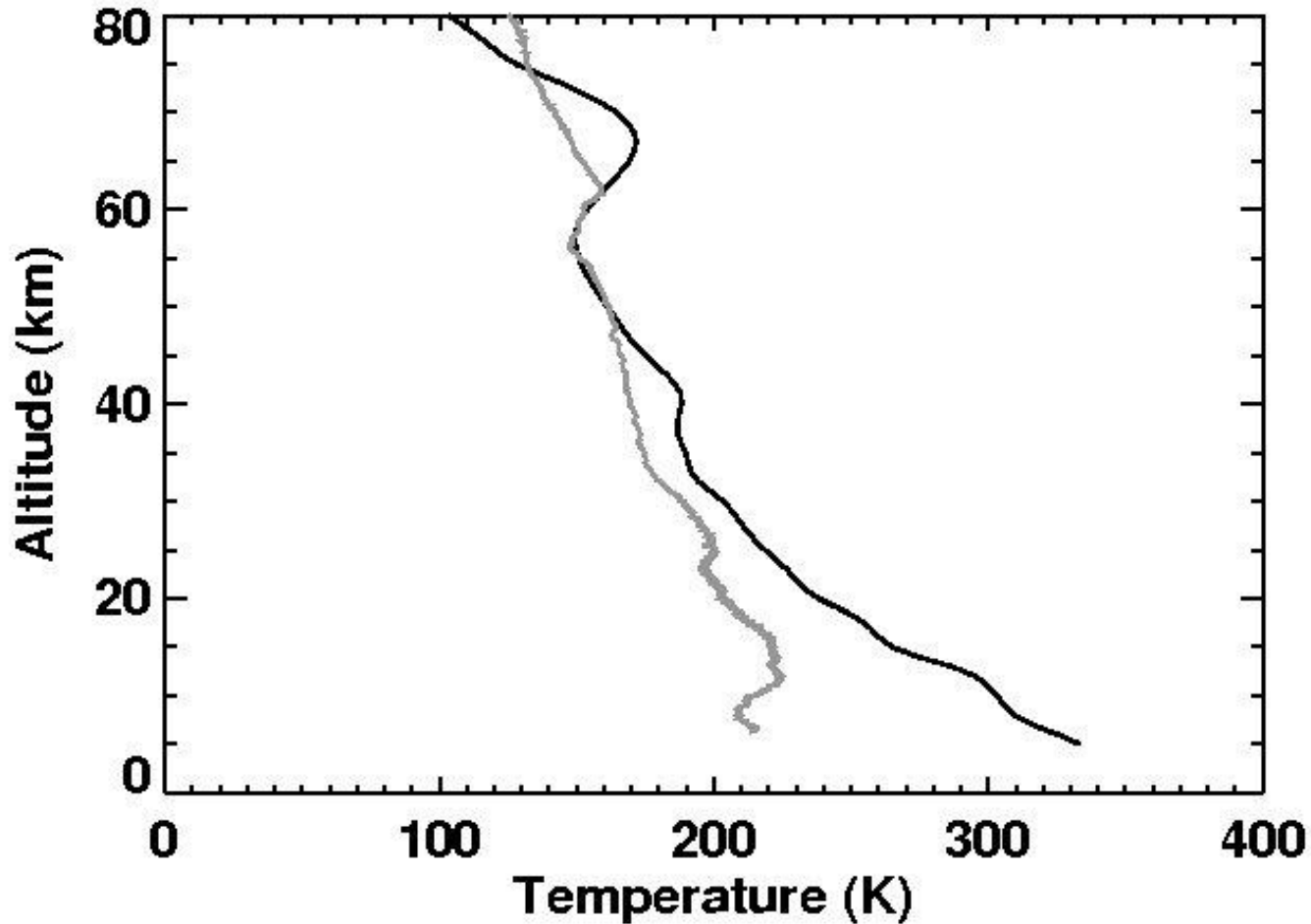
- Measured and Dopplered



Opportunity altitude profile – Measured and Dopplered



Opportunity temperature profile – Measured and Dopplered



Closing remarks

- Landing on Mars is difficult
- Familiar physics shows limitations of atmospheric drag
- Familiar physics shows limitations of parachutes

- Engineering measurements during entry (accelerations) give useful atmospheric science
- Doppler shift of radio signals during entry provide information in case of a crash landing