MSL DAN Science Investigation: Background from MMRTG

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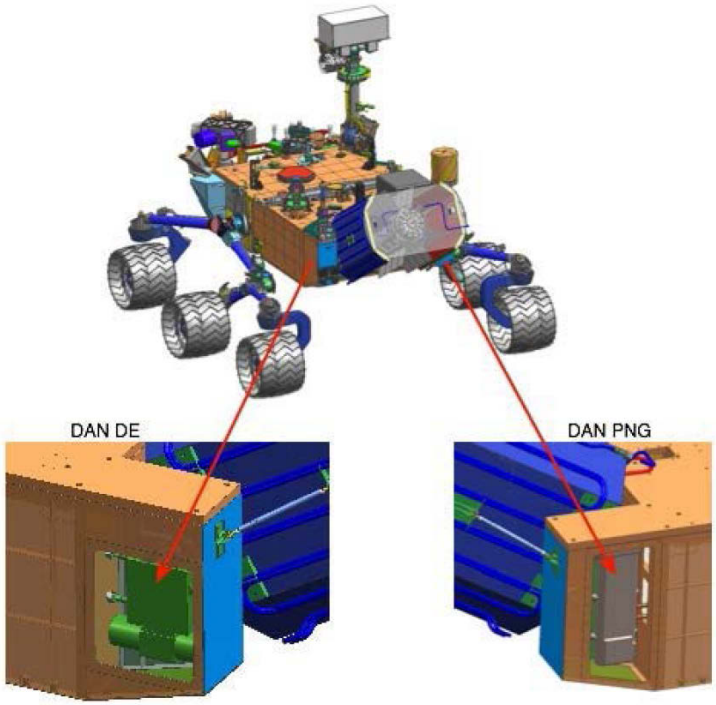
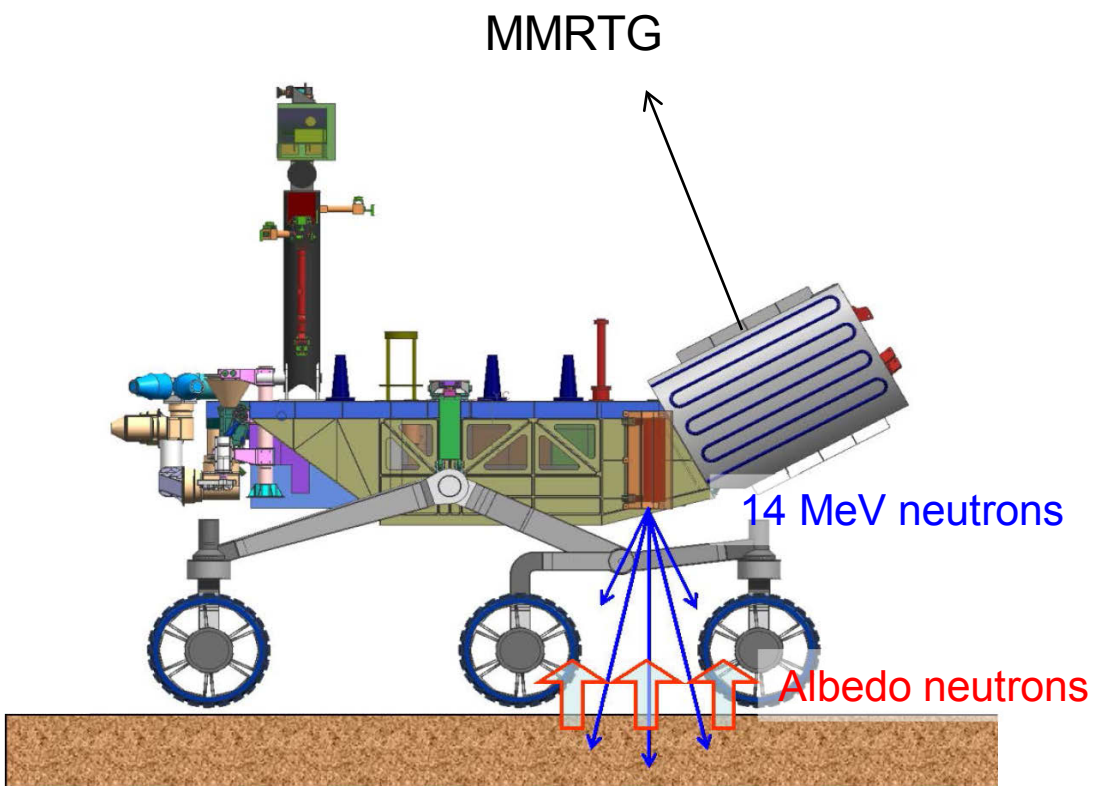
Outline

- Overview of MMRTG
- ATLO measurement
- Cruise measurement
- Path-forward plan

MSL DAN Overview

Location of DAN DE and PNG on rover





MSL MMRTG

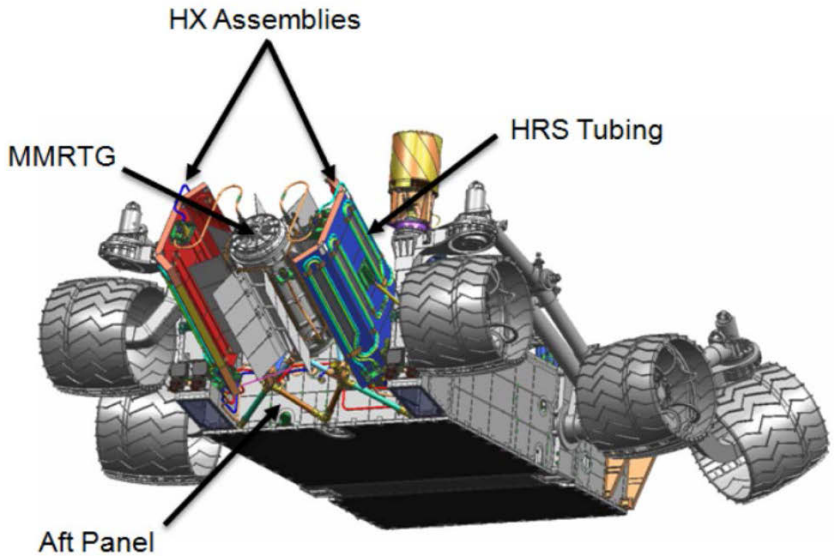
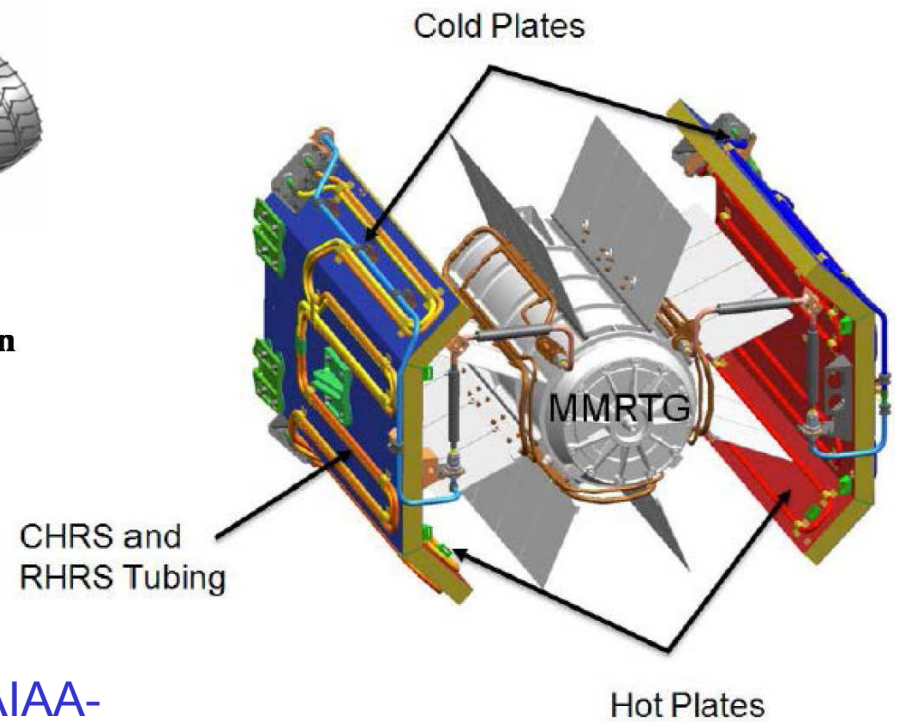


Figure 2. MSL Rover in Stowed Cruise Configuration Showing HXs Positioned on Both Sides of Finned MMRTG

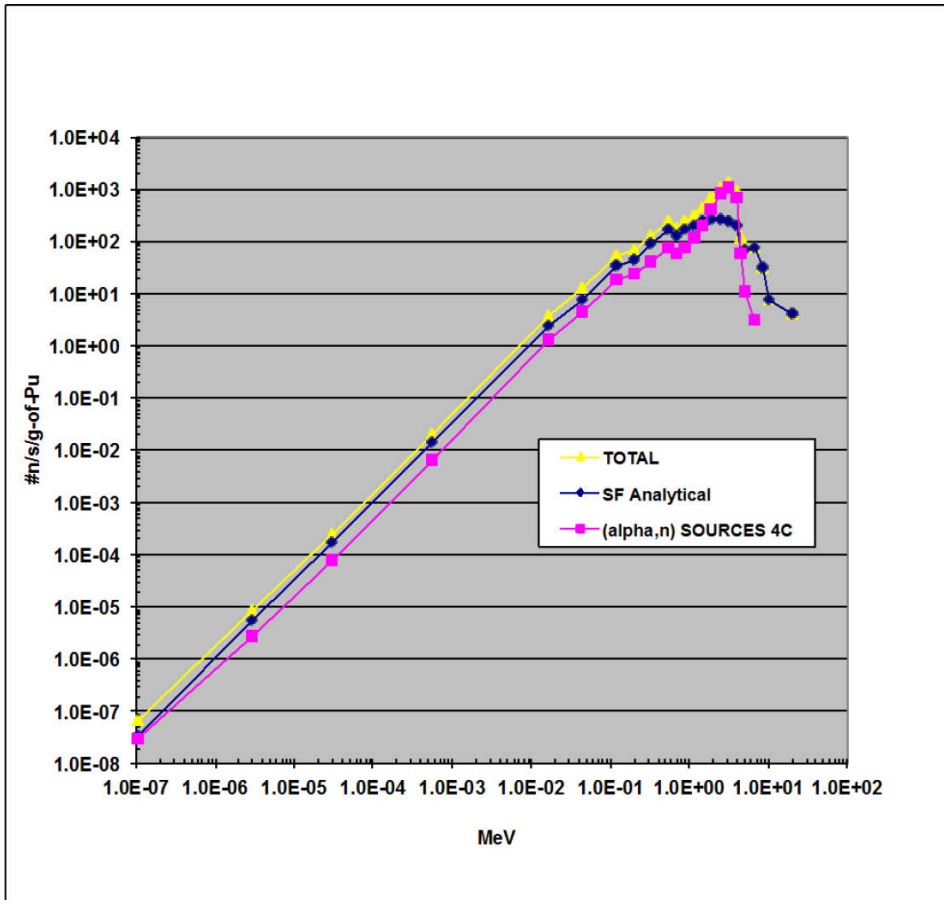


Figures are from Mastropietro, et al., AIAA-2010-6194 (2110)

Neutron Source from MMRTG

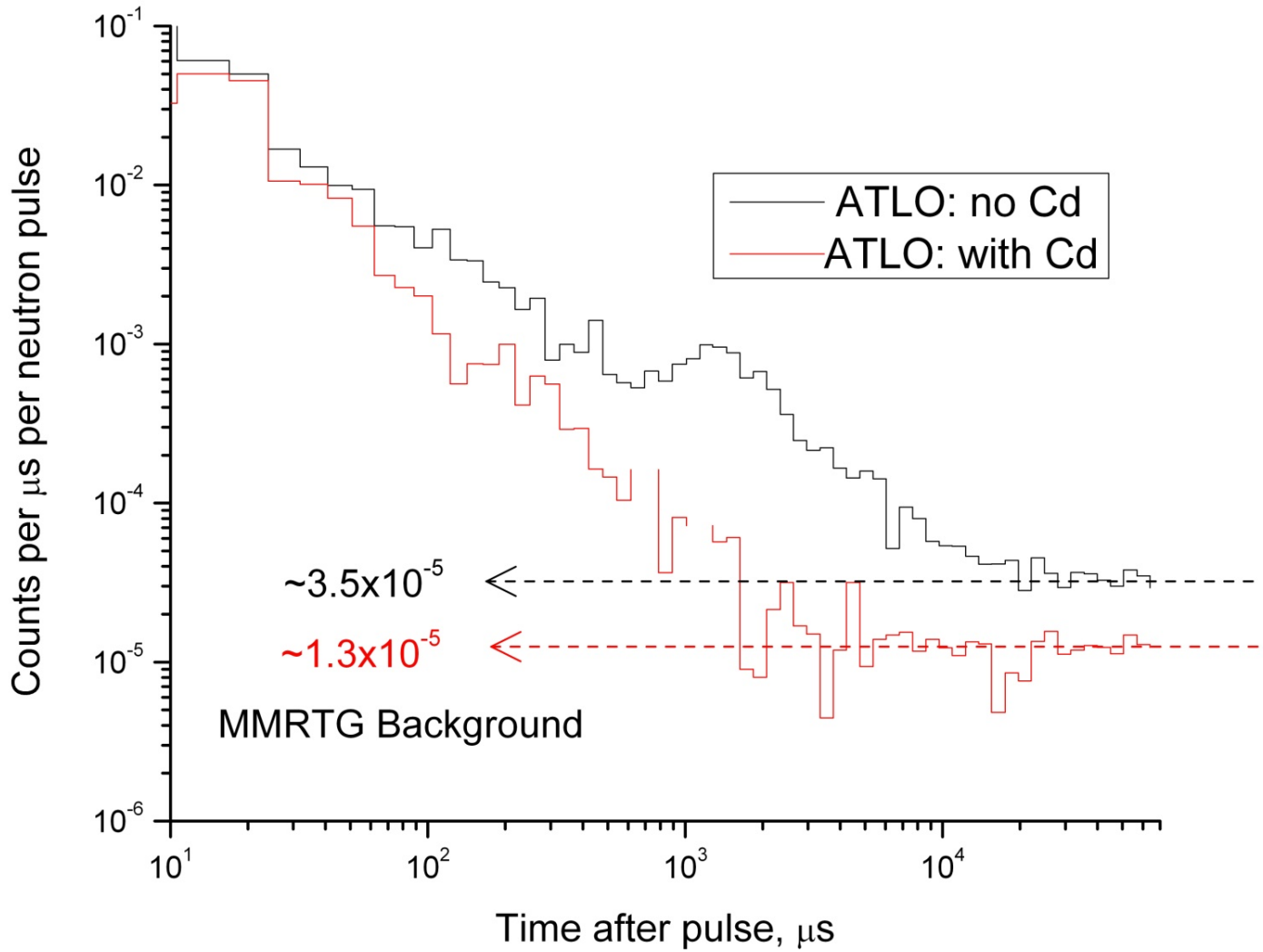
- Major Assumptions:
  - Used 8 brick GPHS MMRTG
  - Assumed 600 g of PuO_2 in 1 GPHS brick → 4.8 kg of PuO2 in one MMRTG unit
- Used the maximum neutron source strength from the LANL's fuel characteristic assessment
  - ~8000 #n/s/g-of-Pu238 → ~6860 #n/s/g-of-Pu → ~5970 #n/s/g-of PuO2
  - Included:
    - Spontaneous fission neutrons
    - Neutrons from (α,n) reactions

MMRTG Neutron Spectrum



Elow	Ehigh	#n/s/g-of-PuO2
2.50E-08	1.07E-07	6.31E-08
1.07E-07	3.00E-06	7.81E-06
3.00E-06	3.00E-05	2.39E-04
3.00E-05	5.55E-04	1.94E-02
5.55E-04	1.70E-02	3.49E+00
1.70E-02	4.49E-02	1.18E+01
4.49E-02	1.22E-01	4.90E+01
1.22E-01	2.01E-01	6.62E+01
2.01E-01	3.31E-01	1.22E+02
3.31E-01	5.46E-01	2.28E+02
5.46E-01	7.02E-01	1.75E+02
7.02E-01	9.00E-01	2.24E+02
9.00E-01	1.16E+00	3.02E+02
1.16E+00	1.49E+00	4.21E+02
1.49E+00	1.91E+00	6.63E+02
1.91E+00	2.45E+00	1.11E+03
2.45E+00	3.14E+00	1.39E+03
3.14E+00	4.04E+00	9.10E+02
4.04E+00	4.46E+00	1.15E+02
4.46E+00	5.18E+00	7.44E+01
5.18E+00	6.66E+00	6.87E+01
6.66E+00	8.55E+00	2.76E+01
8.55E+00	1.00E+01	6.55E+00
1.00E+01	2.00E+01	3.73E+00
	TOTAL	5.97E+03

Neutron Measurement During ATLO



Background Measurement During Cruise (March)

- No Cd: ~3.55×10^{-5} counts/μs (1 hour average)
- With Cd: ~1.55×10^{-5}/μs (1 hour average)

Future Plan

- Further refine the rover structure model in MCNP simulation
- Estimate background neutron level due to GCR/SEP interactions with the Martian atmosphere/regolith