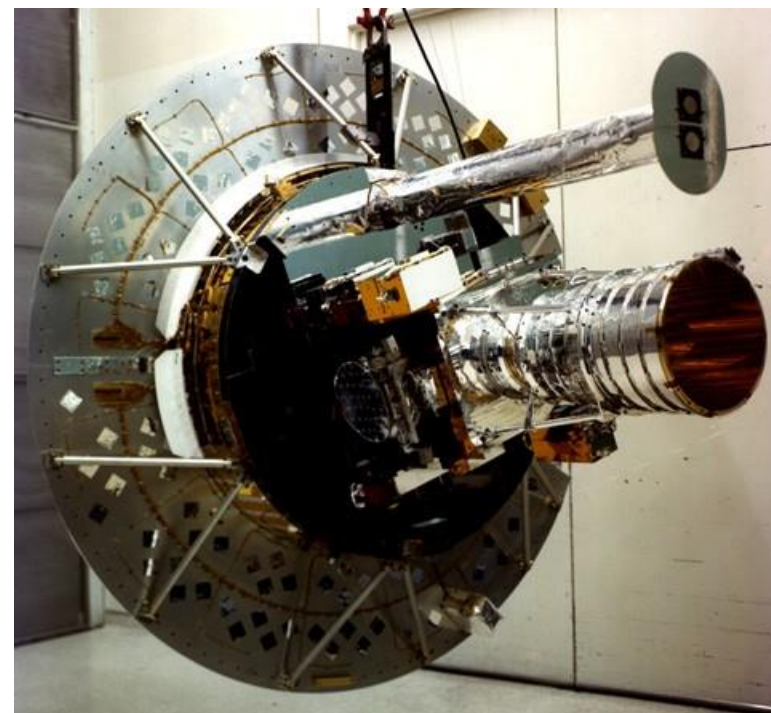
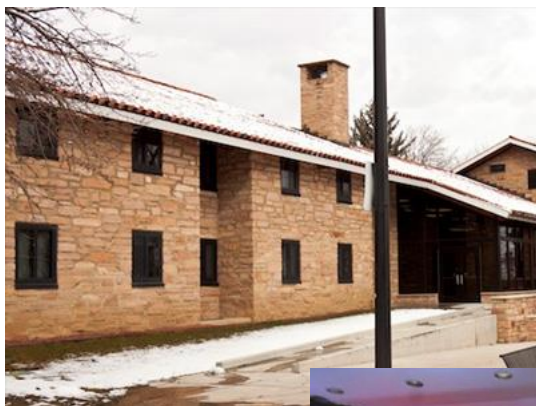


Deep Dips: Designing an Orbiter for a Mars Mission

Guy Beutelschies

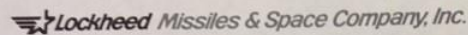
Former MAVEN Flight System Program Manager

With thanks to Dr. Bruce Jakosky, who unknowingly
provided many charts in this presentation



Aerospace Engineering
Sciences

UNIVERSITY OF COLORADO **BOULDER**



1111 Lockheed Way, Sunnyvale, California 94088

June 27, 1986

Guy Beutelschies
6048 S. Kenton Street
Englewood, CO 80111

Dear Mr. Beutelschies:

Thank you for your recent inquiry regarding employment opportunities with Lockheed Missiles & Space Company. In order to properly evaluate your background we request that you complete and return the enclosed application at your earliest convenience.

Due to the nature of our work, it is essential that all questions be completed regarding your past ten year employment history whether actually employed or not. Be sure to include your salary requirements.

Please return this completed application in the envelope provided to expedite the processing of your correspondence. In the event that an immediate opening is not available, your application will be retained in our files for future consideration. UNITED STATES CITIZENSHIP IS REQUIRED.

Thank you again for expressing an interest in employment with us. I look forward to receiving your application.

Sincerely,

Armando Gaytan
Employment Manager

Enclosures

Thank you for your interest in Martin Marietta Denver Aerospace.

We are now reviewing your background and qualifications in light of our present openings to determine whether we might have a position that would be of interest to you.

If an appropriate opening is identified after this review, we will be in touch with you to arrange for an interview. If we are unable to identify an appropriate opening at this time, we would like to retain the information you sent us in case something develops in the next six months or so.

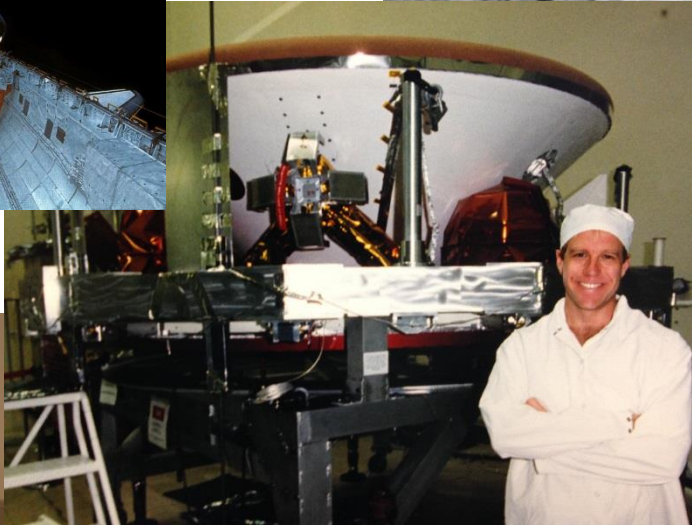
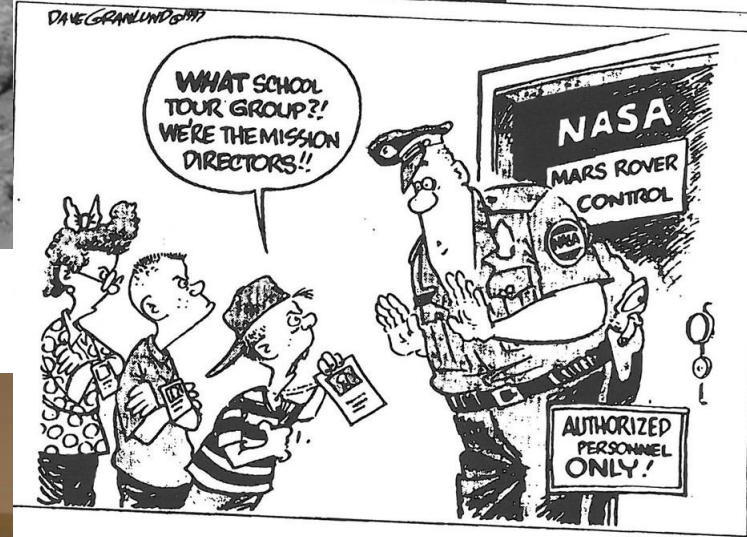
Due to the heavy volume of inquiries we receive regularly, we regret we cannot respond to each one personally.

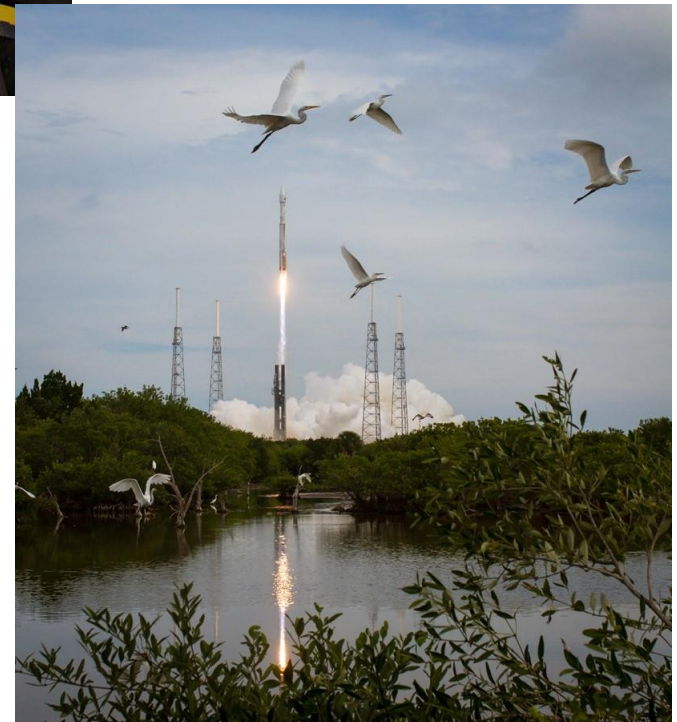
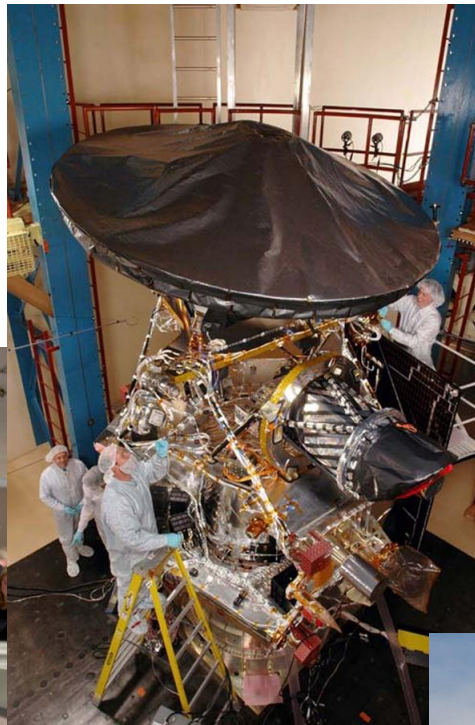
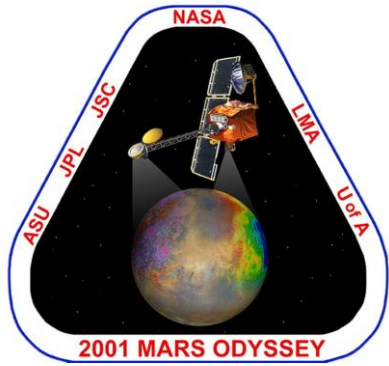
We do appreciate your interest in Martin Marietta.

MARTIN MARIETTA



JPL





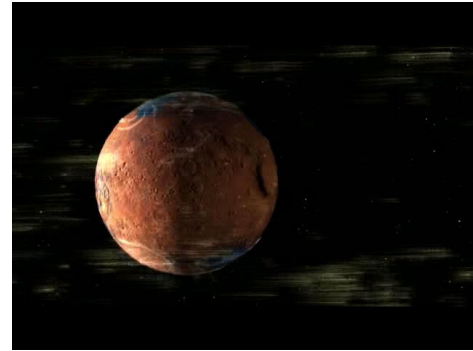
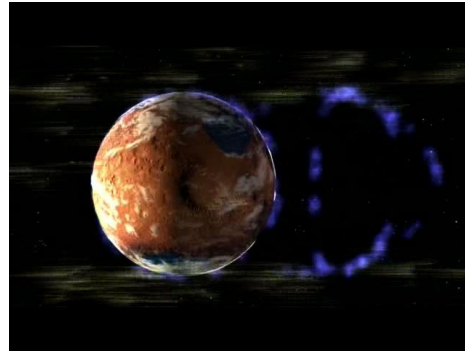
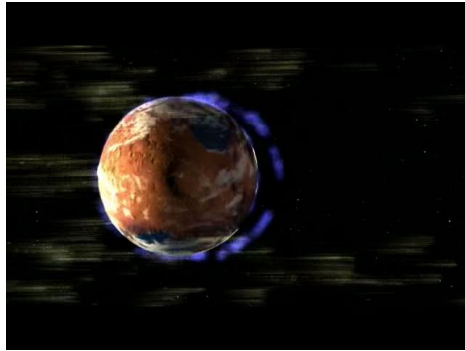
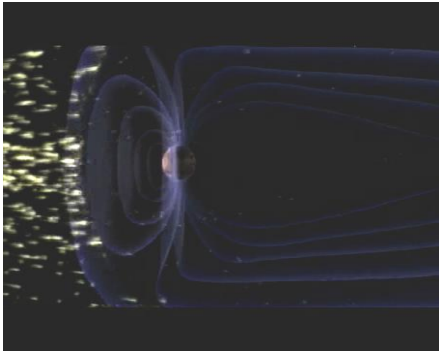
MAVEN (Mars Atmosphere and Volatile EvolutionN) Mission



Ancient River

We know from remote sensing and ground measurements that Mars once had liquid water on the surface.

The atmosphere today is too thin, dry, and cold to support liquid water on the surface.



Mission: Find out what happened to the atmosphere.

The MAVEN Science Instruments:

Sun, Solar Wind, Solar Storms



SWEA



SEP



EUV



SWIA

Neutrals and Ions Plus Evolution



IUVS



NGIMS

Ion-Related Properties and Processes



STATIC

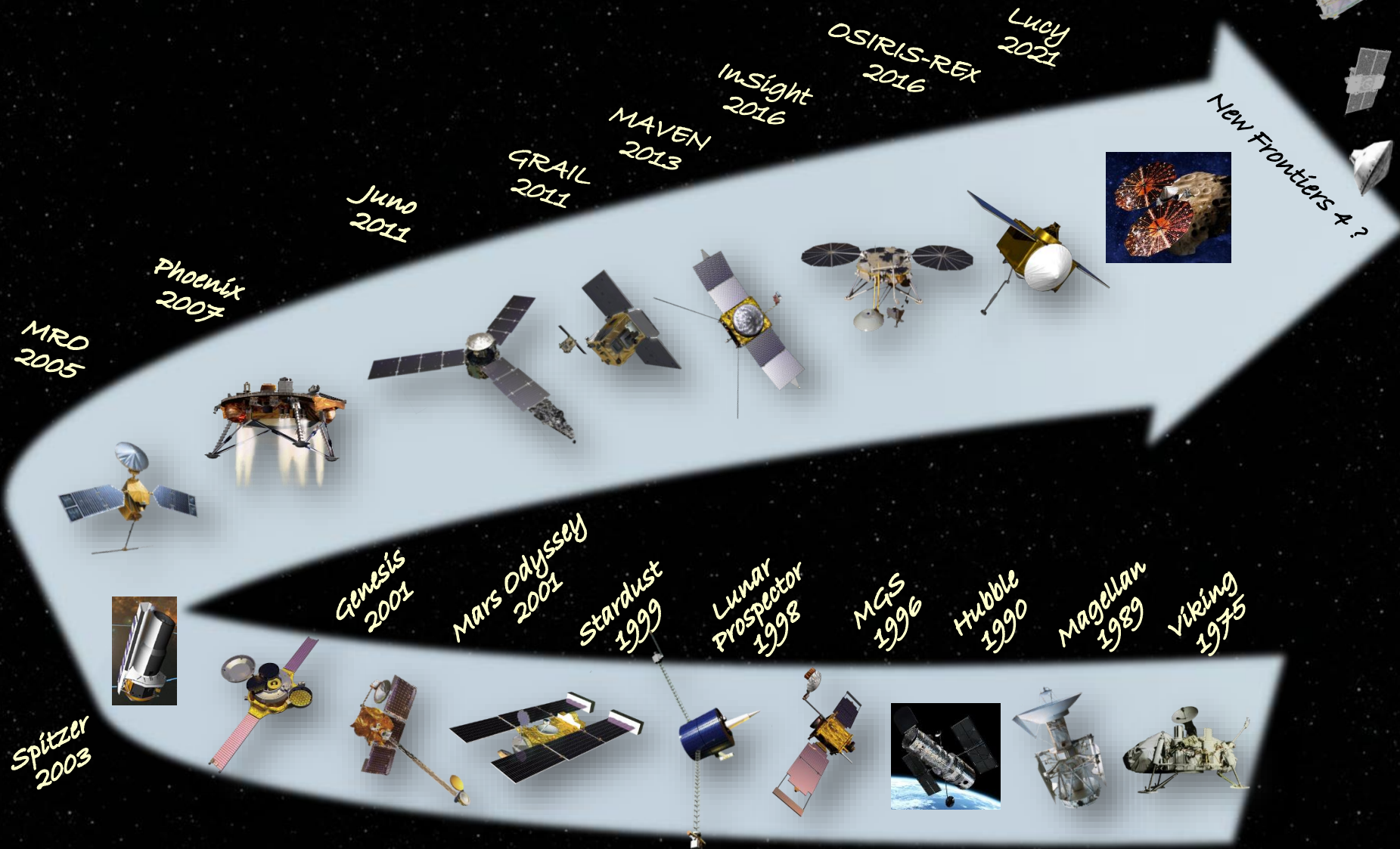


MAG



LPW

Lockheed Martin Deep Space Heritage



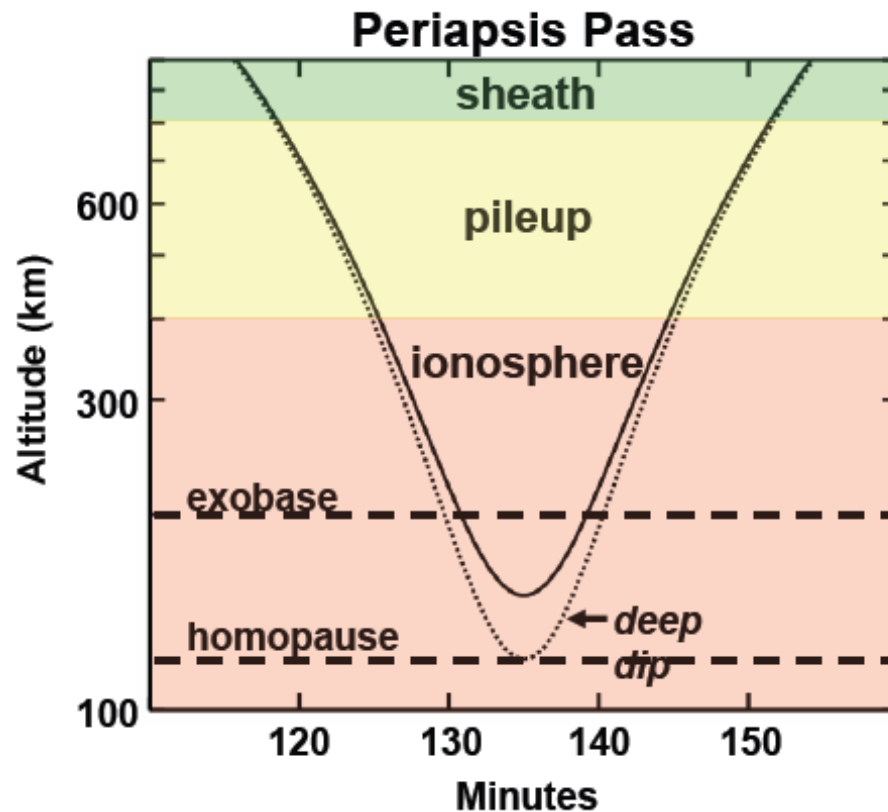
MAVEN Engineering Challenges



- **Half the instruments want to look at the sun (continuously), the other half at the atmosphere.**
- **Instruments want to directly measure everywhere from the upper atmosphere to free space**
- **The uncertain drag from every periapsis pass changes the timing of the orbit changes**
- **Costs of the Deep Space Network limits number of communication passes per week**

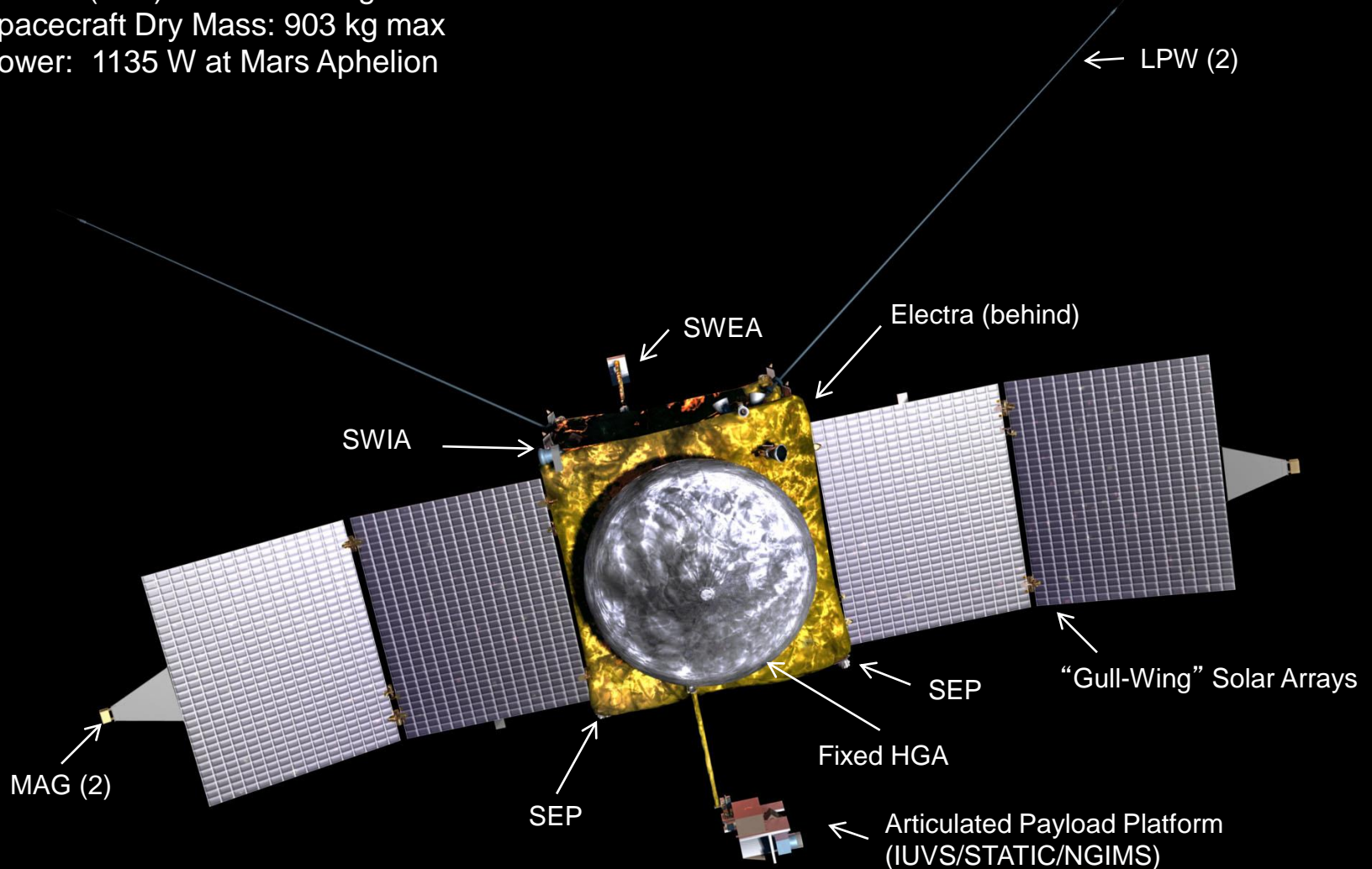
Elliptical Orbit Allows Measurement of All Relevant Regions of Upper Atmosphere

- Nominal periapsis near 150 km.
- Five “deep-dip” campaigns with periapsis near 125 km.
- Provide complete coverage of entire upper atmosphere

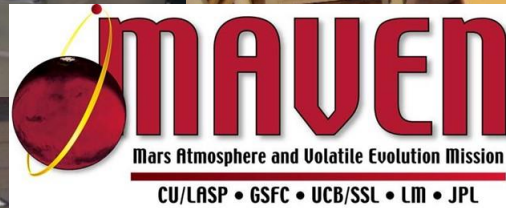


The MAVEN Spacecraft

- Launch (Wet) Mass: 2550 kg max
- Spacecraft Dry Mass: 903 kg max
- Power: 1135 W at Mars Aphelion



Proposal, Site Visit, and Presentation at NASA HQ



How to Get a S/C from Colorado to Florida (August 2, 2013)

Lockheed Martin



Buckley AFB, Colorado



Shuttle Landing Strip, KSC



PHSF, KSC



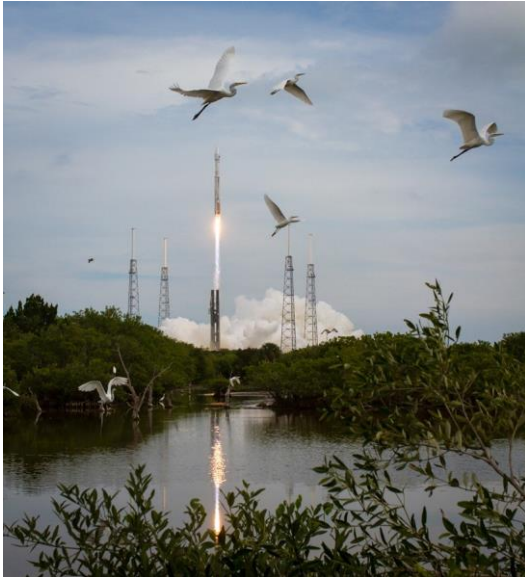
The Spacecraft Undergoes Final Testing



Into the Fairing, Onto the Rocket

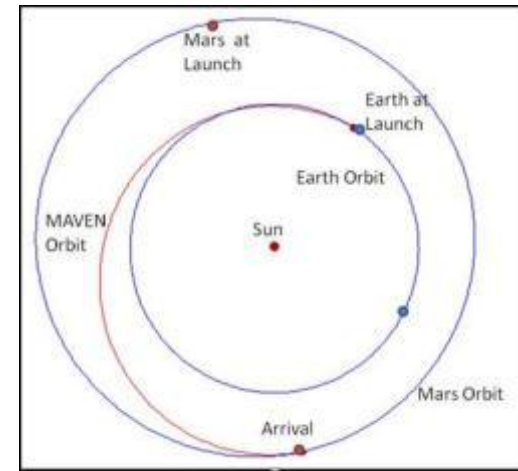


MAVEN Mission Architecture



**Launched
Nov 18, 2013**

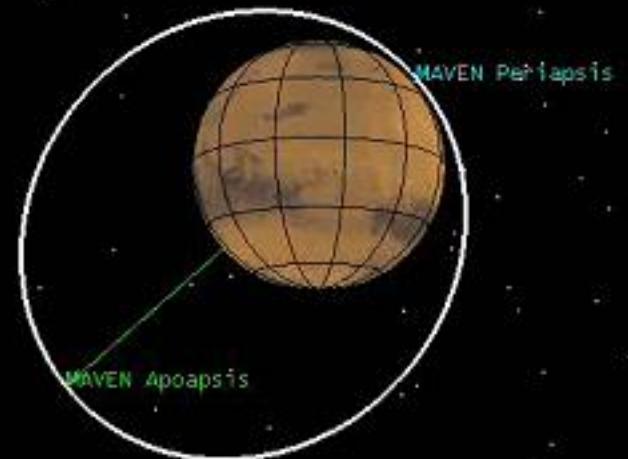
Ten-Month Ballistic Cruise to Mars



**Mars Orbit Insertion
Sep 22, 2014**



One Year Primary Science Operations



Currently on 2nd Extended Mission

A fertility company that
defies the textbooks p. 620

Multigenerational effects
on development pp. 634 & 652

Microbial ecology and
evolution pp. 649 & 662

Science

\$10
6 NOVEMBER 2015
science.sciencemag.org

AAAS

MAVEN at Mars

Probing a dynamic upper
atmosphere p. 643



The MAVEN Team



Questions?