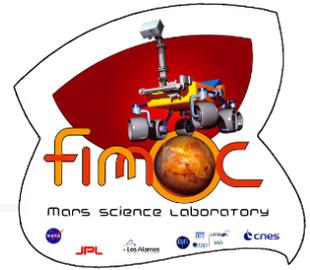


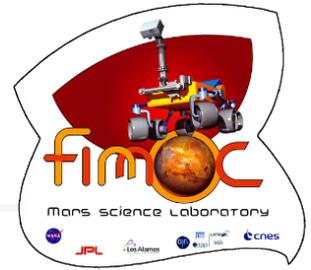
A close collaboration between scientists and engineers for CHEMCAM instrument operations

CONTENTS



- Quick presentation of Curiosity
- Quick presentation of our Operation Centre called FIMOC
- A typical day of operations on Mars
- Lessons learned after one year of operations
- Conclusions

INTRODUCTION

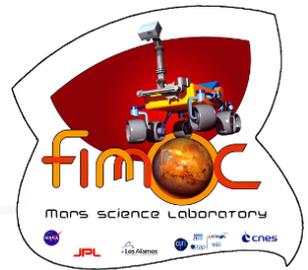


Curiosity landed the August 6th, 2012 on Mars.

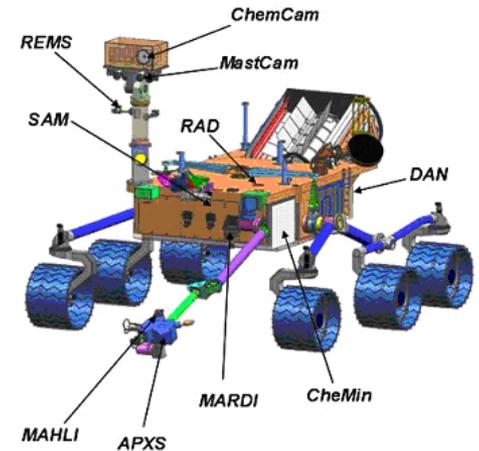
International cooperation with USA, France, Spain, Canada, and Russia for the instruments.

CHEMCAM and 9 others instruments.

Mars Science Laboratory

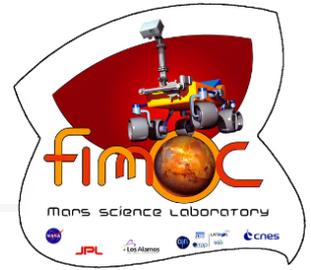


- France is involved in two among ten payload instruments
 - **ChemCam** : Mast Unit part made by IRAP/CNES (PI LANL)
 - **SAM** : Gas Chromatograph part made by LATMOS and LISA with support of CNES (PI GSFC)



- MSL Science Operations:
 - Operation shared between US and France for these 2 instruments
 - Operation teams composed of engineers and scientists
 - For a minimum of 4 years (now unlimited !) 5 days a week
 - Working during the night from 5pm to 3 am at JPL hours...

SOME NUMBERS



Curiosity=900 kg

Science instruments=80 kg

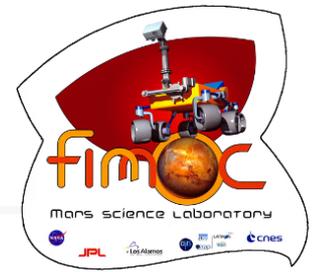
SAM= 40 kg

CHEMCAM=10 kg

2 instruments driven from FIMOC in France alternatively with Los Alamos National Laboratory (USA) and NASA/GSFC (USA).

CHEMCAM more than 85 000 laser shots on Mars

French Instruments Mars Operation Centre



Scientists at FIMOC



FIMOC
French Instruments Mars
Operation Centre
at CNES, Toulouse, France



Engineers at FIMOC



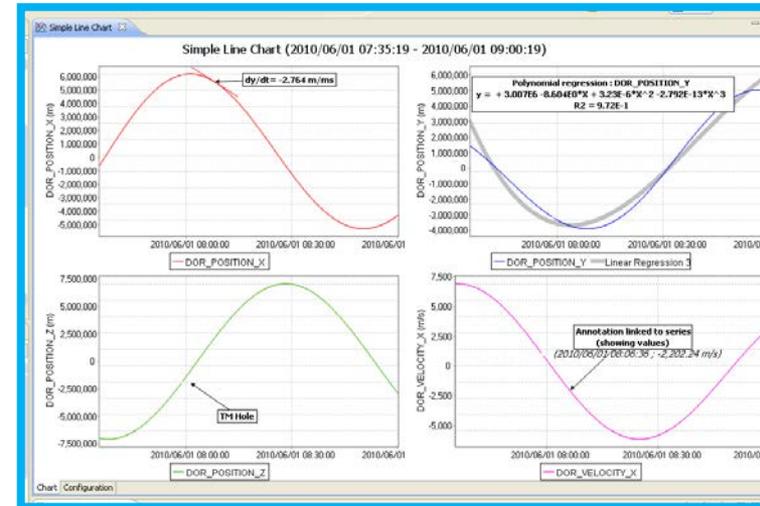
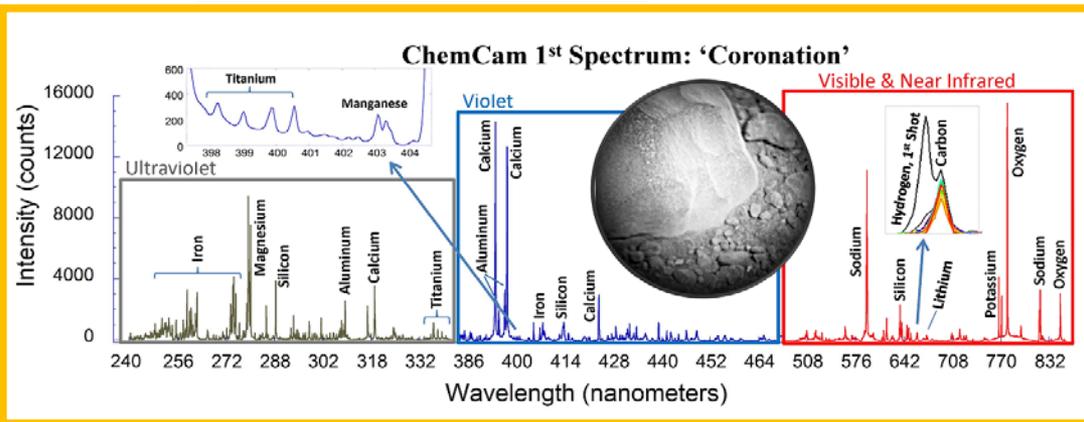
One day on Mars : First step downlink



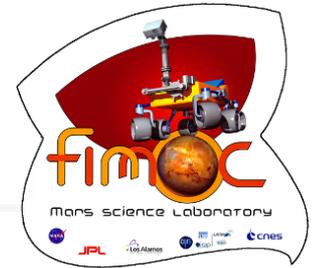
Downlink from Curiosity

Scientific products:
-Spectras,
-RMIs (image)

Engineering products:
-Temperature curves,
-Voltage curves,
-Housekeeping, ...



First step: roles in downlink



Scientists:

They analyse scientific data (spectres, images) and quickly determine the nature of the sample analyzed and provide it to the entire scientific community in order to planning the next sol.

Input: Data from curiosity rover

Output: Quicklook products, science report

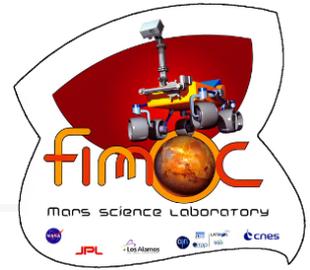
Engineers:

They look through all engineering data to check that the instrument has performed correctly his task. If everything is nominal, they give the information to the scientific community that CHEMCAM is ready for the next sol.

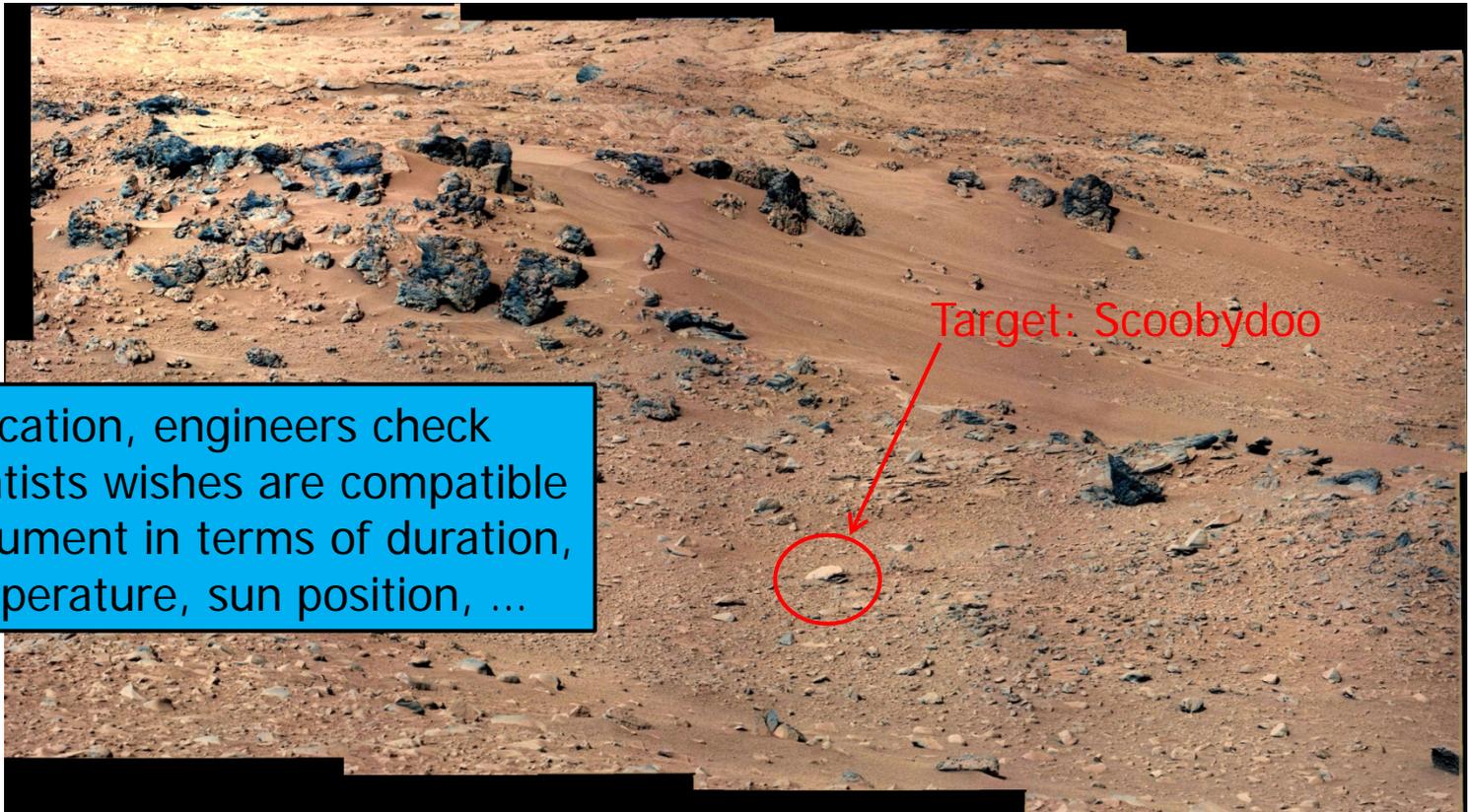
Input: Data from Curiosity rover

Output: Health instrument report,

One day on Mars : second step planification

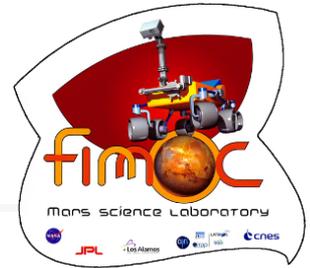


With results from previous sols, scientists look through mosaics from Mars and find new scientific targets



During planification, engineers check that the scientists wishes are compatible with the instrument in terms of duration, distance, temperature, sun position, ...

Second step: roles in planification



Scientists:

They are divided in 2 groups (Geology and Atmosphere) preparing targets or samples to shoot or analyse.

Input: Quicklooks and science reports from each instrument

Output: 3 preplannings (one by group) merged in one final

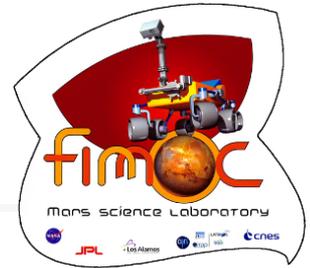
Engineers:

They help each group of scientists to prepare plans, check instrument safety, parameters, field of view, depending instrument health.

Input: Instrument health and engineering report

Output: No output except the ones of scientists

One day on Mars: Last step Uplink



When final plan is ready for next sol...

Scientists:

- Check with engineers that every science goals are clearly understood.
- Switch to the preparation of the pre-plan for sol $n+1$
- Follow science discussion

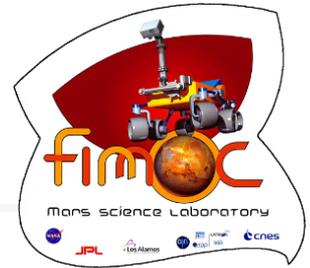
Engineers:

- Write sequences for the instrument to reach all scientific targets scheduled in the plan.
- Check these sequences with JPL and others instruments.
- Check flight rules, instrument safety, ...
- Perform modeling
- Deliver these sequences to JPL

Then JPL radiate sequences to the rover on Mars



Last step: roles in uplink



Scientists:

They have some science discussion on previous sols results and they discuss about the preplanification of the sol N+1.

Input: Final plan

Output: pre planning of the sol N+1

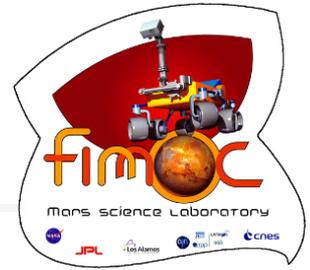
Engineers:

They help each group of scientists to prepare plans, checking instrument safety, parameters, field of view, depending instrument health.

Input: Final plan

Output: Final sequences sent to the rover, reports showing that sequences are safe.

Lessons Learned



Very busy operation days. Medical monitoring on operators and stress evaluation must be filled twice a year.

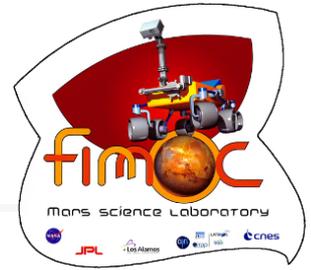
Different tools developed at CNES to help engineers and scientists in their tasks and save some time.

IMIS: Monitoring tool for health instrument check

FIMOC Web: database with all science products.

Core system: To supervise and schedule processes.

Conclusions

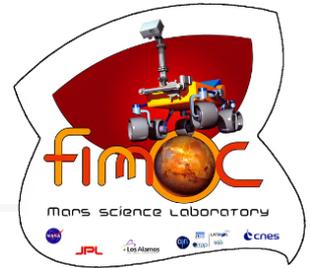
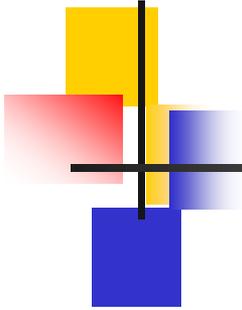


MSL is a very complex rover with 10 instruments.

Each night, more than one hundred persons work together to prepare one unique plan for next sol on Mars.

Even if scientists and engineers have different approaches, they perfectly work together and it is really a success.

InSight will probably use FIMOC infrastructures, Exomars could be also a candidate and why not MSL2020...



Thank you !

