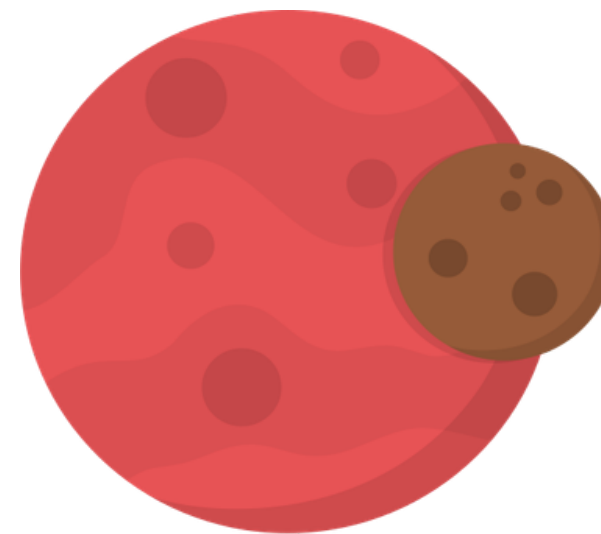




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Exploring the Origin of Phobos: the MMX Mission and Raman Spectroscopy



By: Julio Martínez Giménez



What is phobos?

- The largest of Mars' moons
- Irregular aspect, dark surface and low density
- The big mystery → What is the origin of Phobos? Two hypotheses:
 - Captured asteroid
 - Giant impact on Mars

Deimos



Phobos



Hypothesis on the origin of Phobos

Origin	Which explains	Problems
Captured asteroid	The spectral characteristics of the moon (shape, low density, color...).	Difficult to justify the capture of the asteroid by the circular orbit of Phobos.
Giant impact on Mars	Explain the circular orbit around Mars.	The spectral data don't match. To fit with the characteristics, require heavy thermal and spatial processing.



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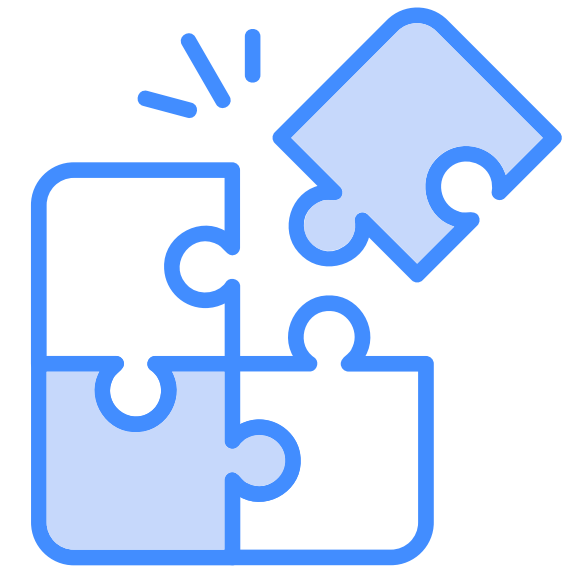


Solve this mystery...



Solve this mystery...

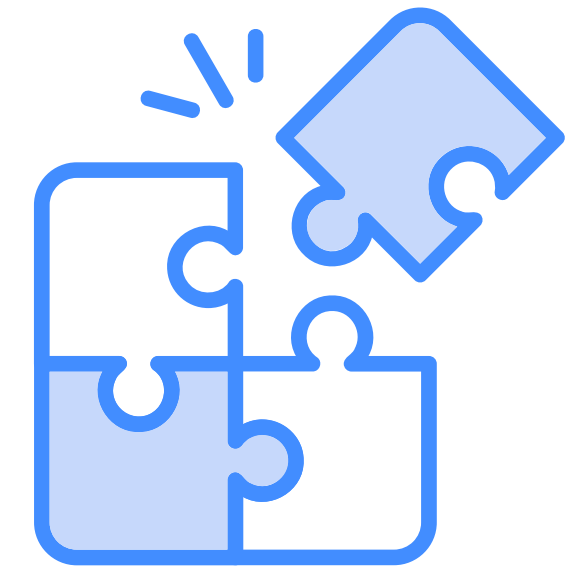
- To understand how the terrestrial planets were formed





Solve this mystery...

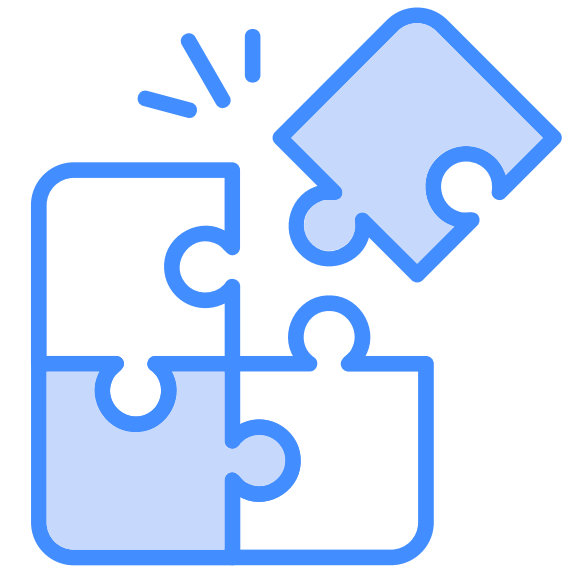
- To understand how the terrestrial planets were formed
- How Mars evolved in its early stages





Solve this mystery...

- To understand how the terrestrial planets were formed
- How Mars evolved in its early stages
- What processes dominated the early Solar System

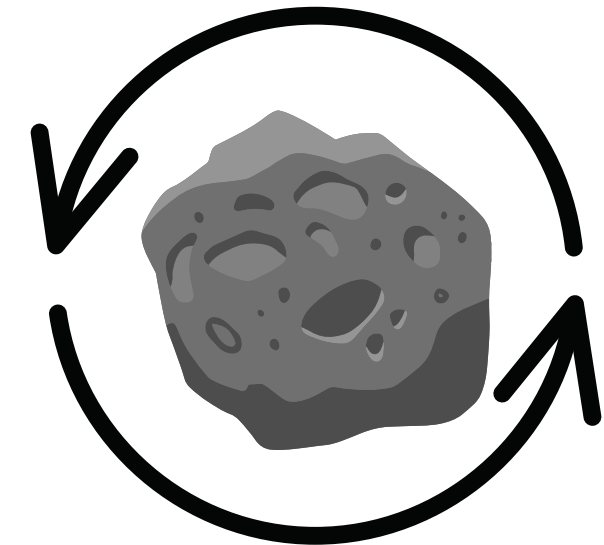
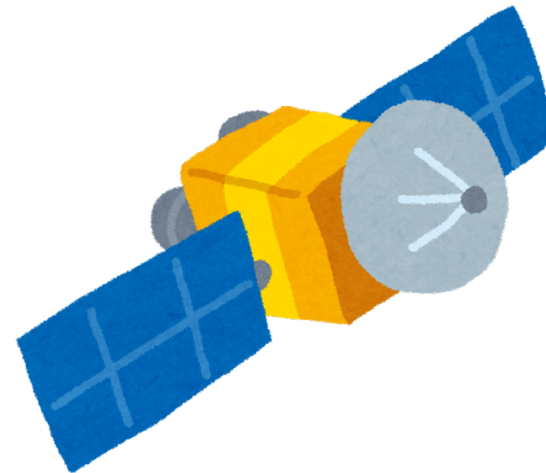




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Flyover

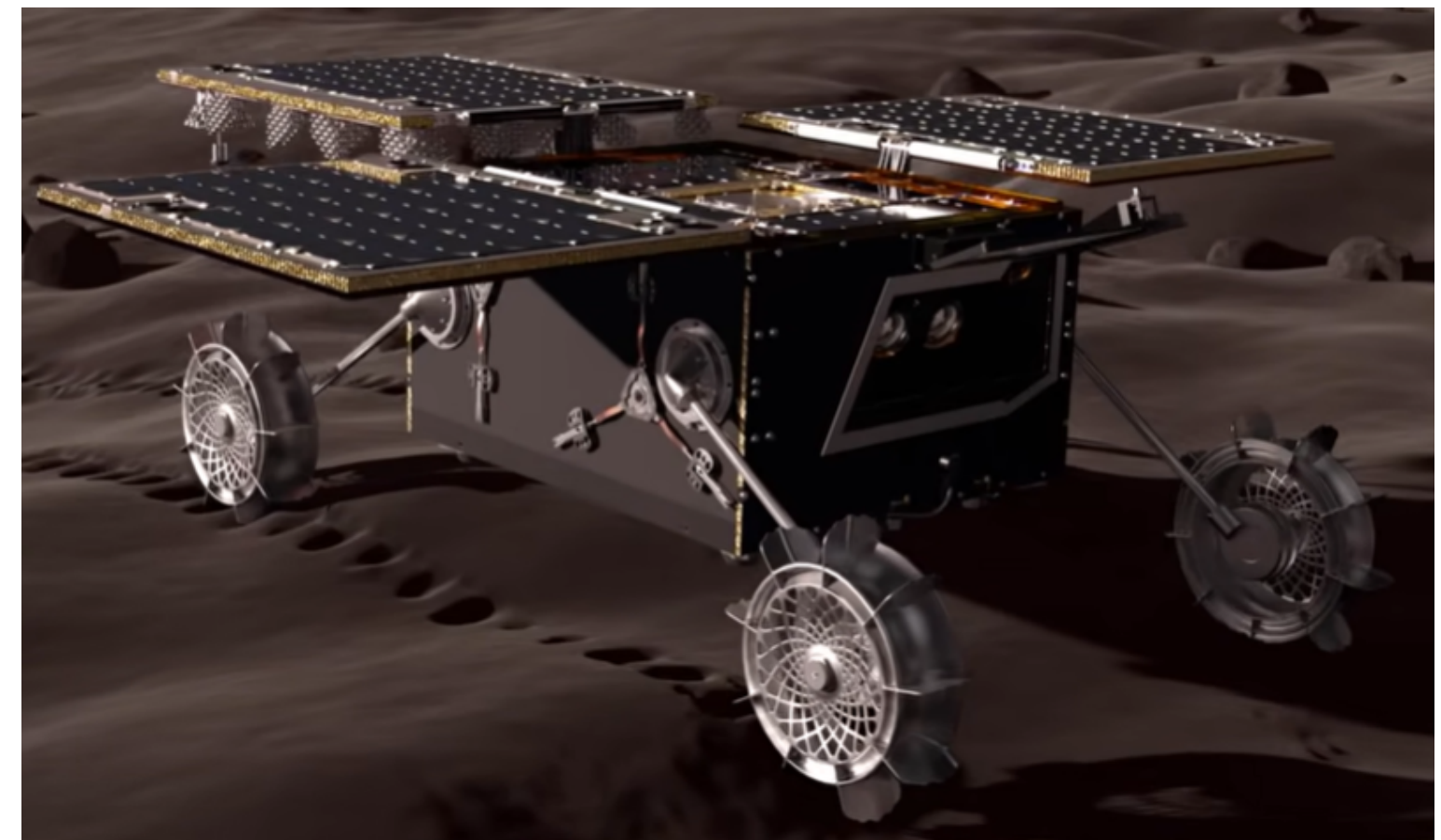
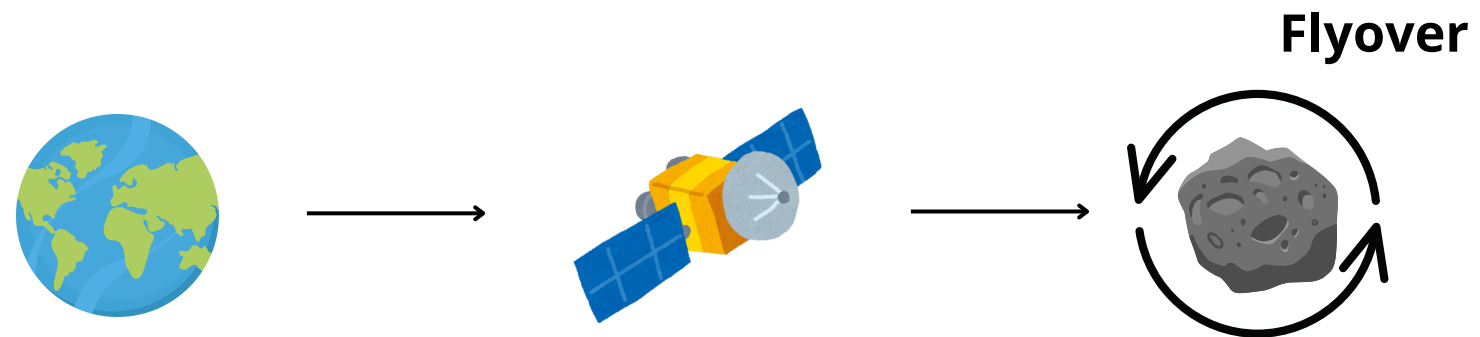




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Landing of MMX rover:



<https://www.youtube.com/watch?v=-a0e8AKOWg0>

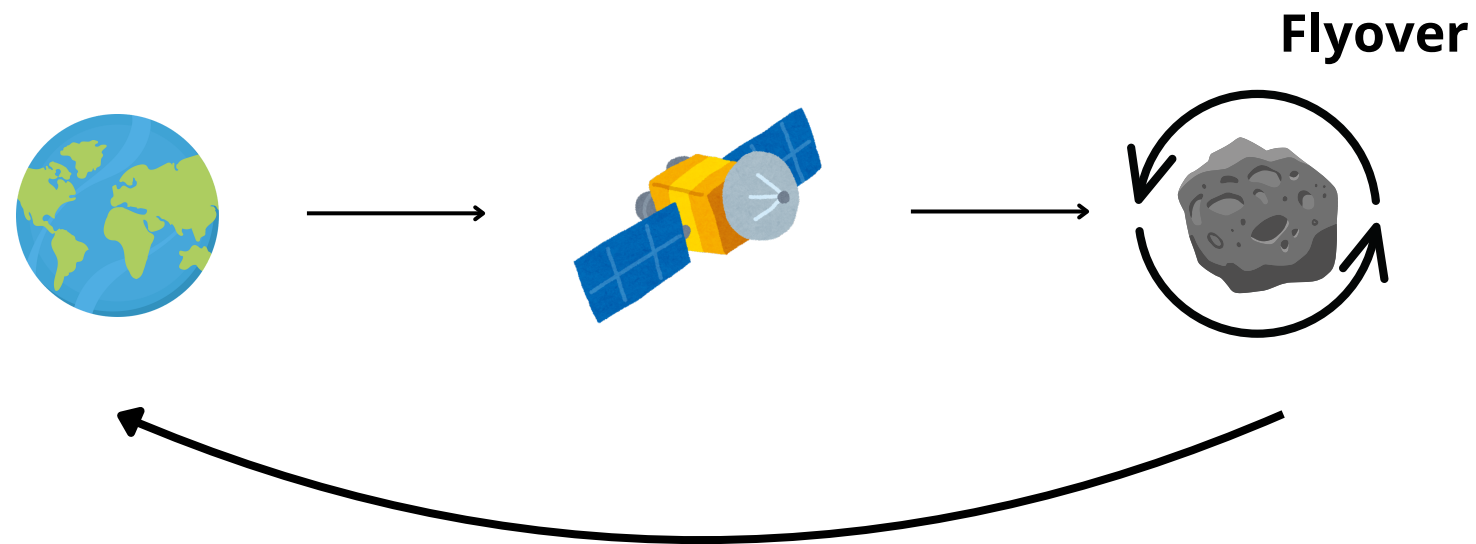
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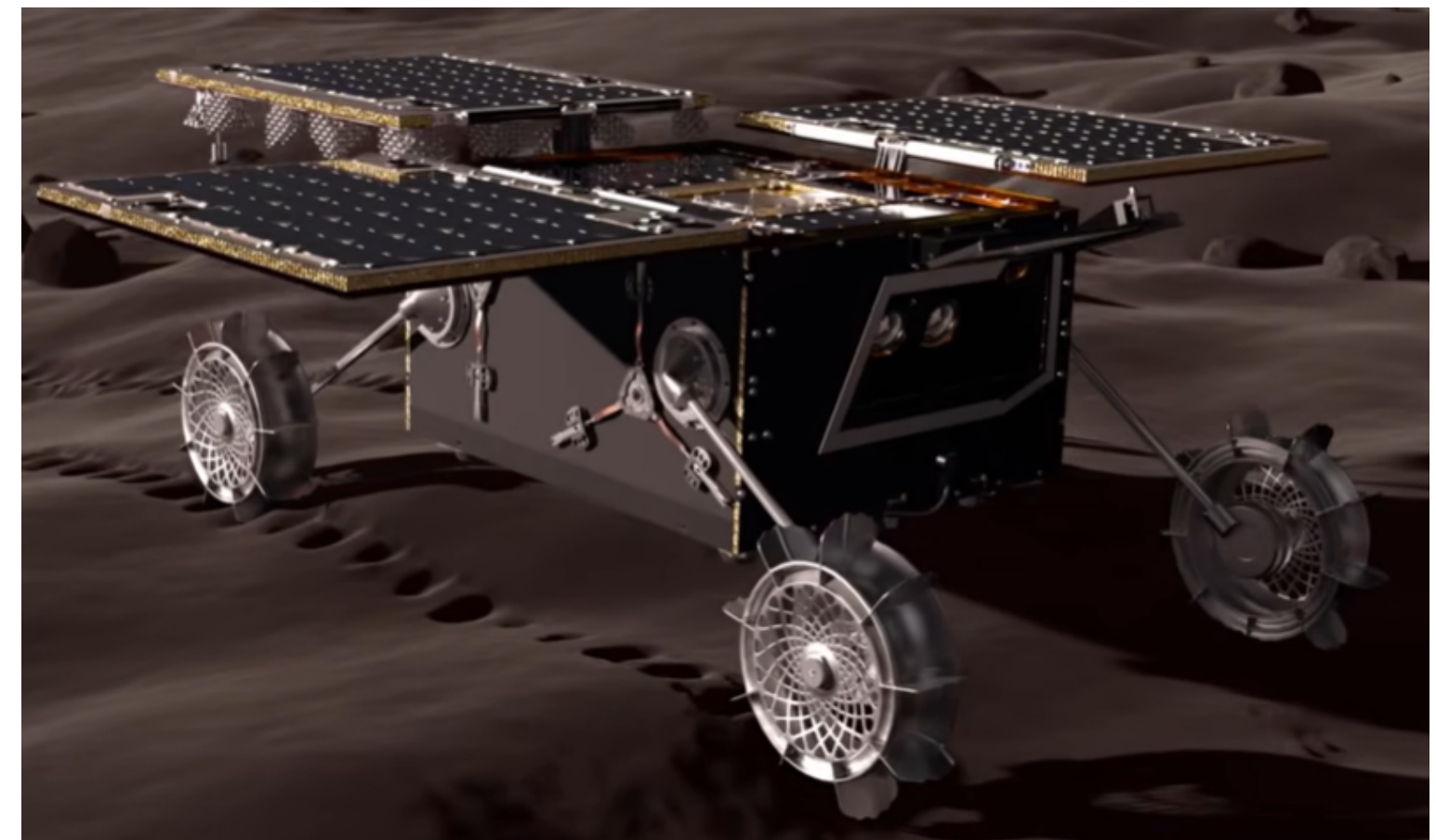
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Landing of MMX rover:

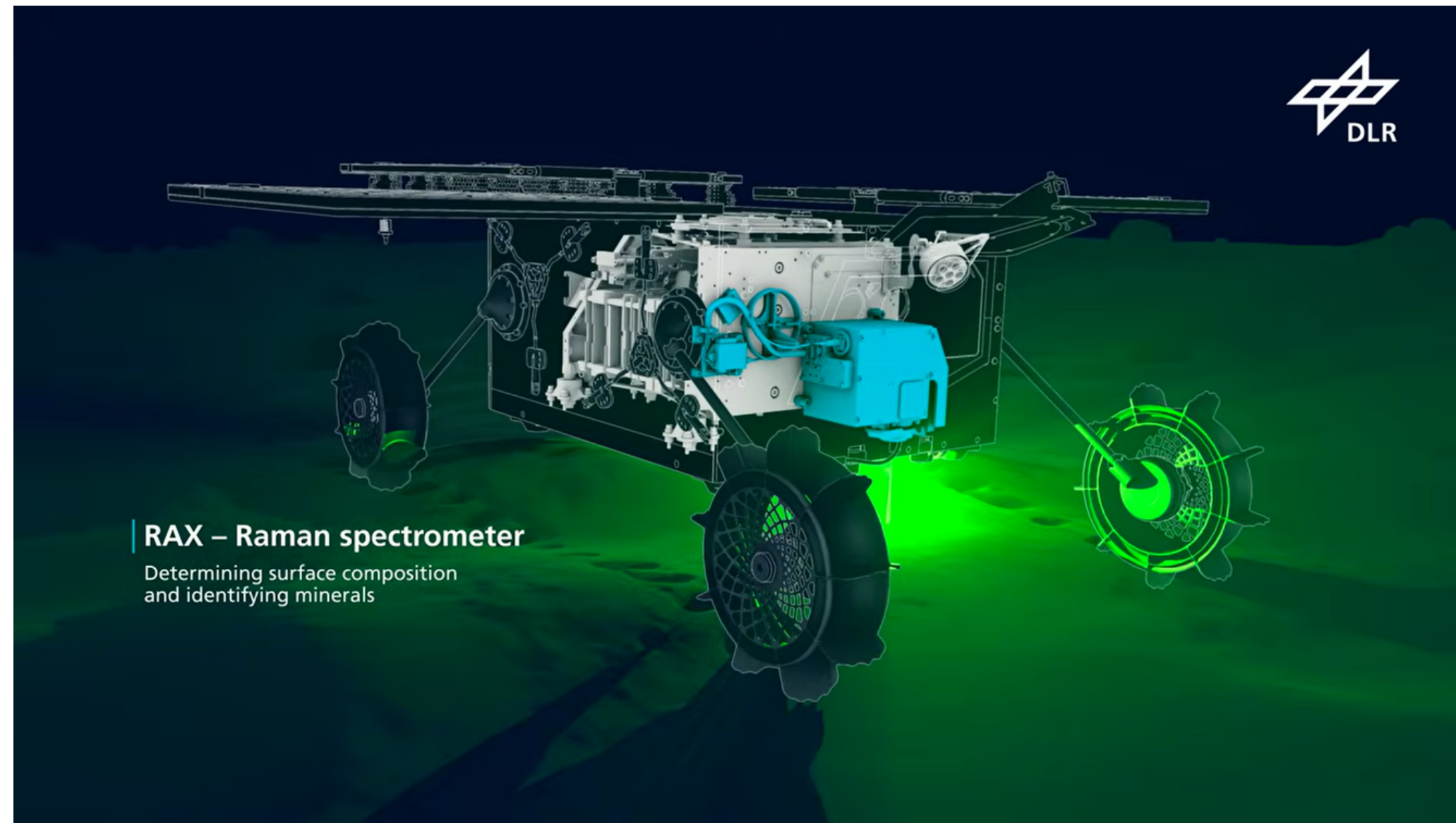


The first sample return from a Martian moon



<https://www.youtube.com/watch?v=-a0e8AKOWg0>

Idefix



developed by:

Area of specialization: Research and development of instrumentation for planetary exploration of INTA

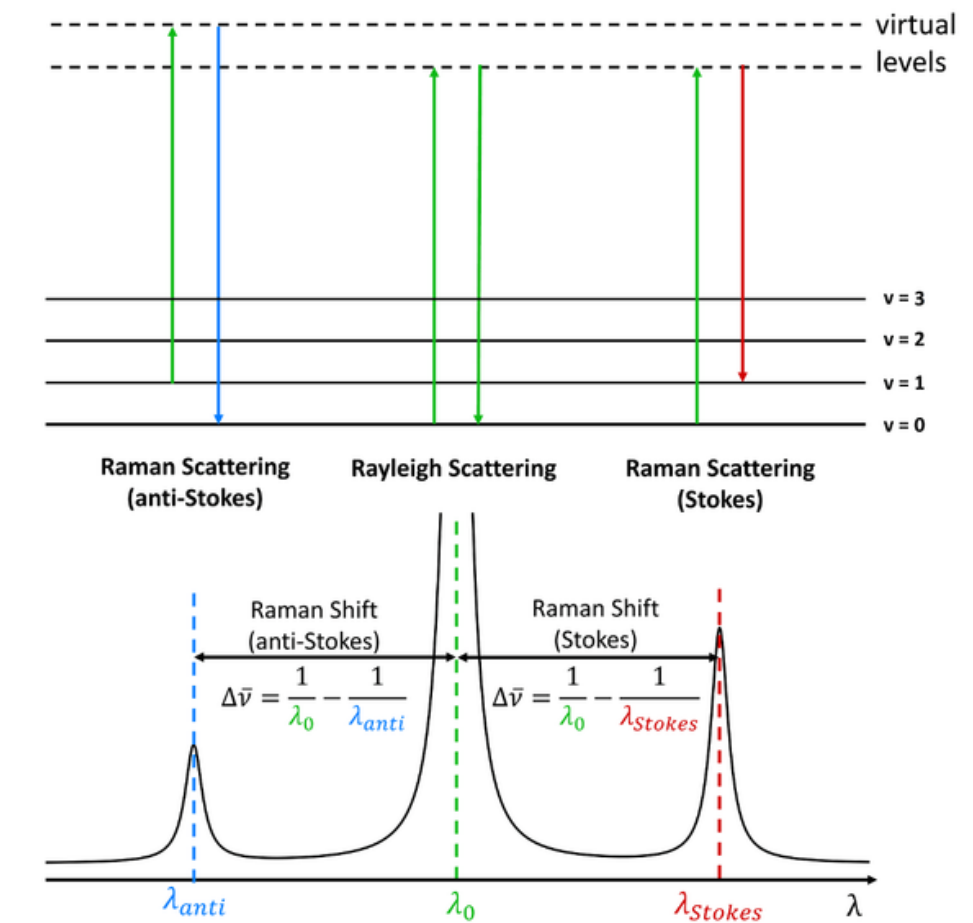
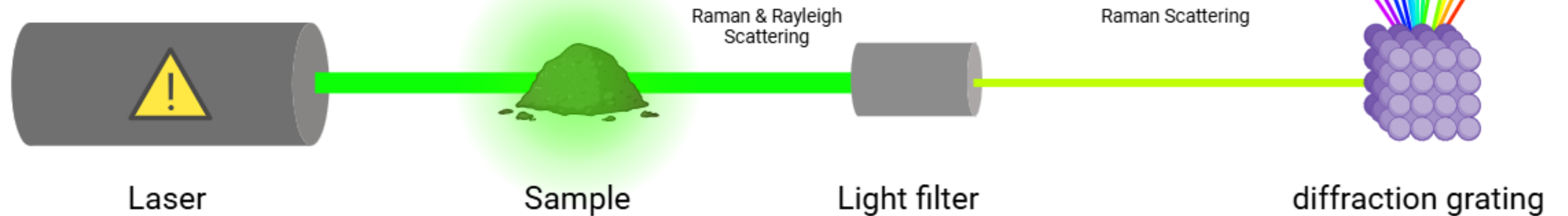
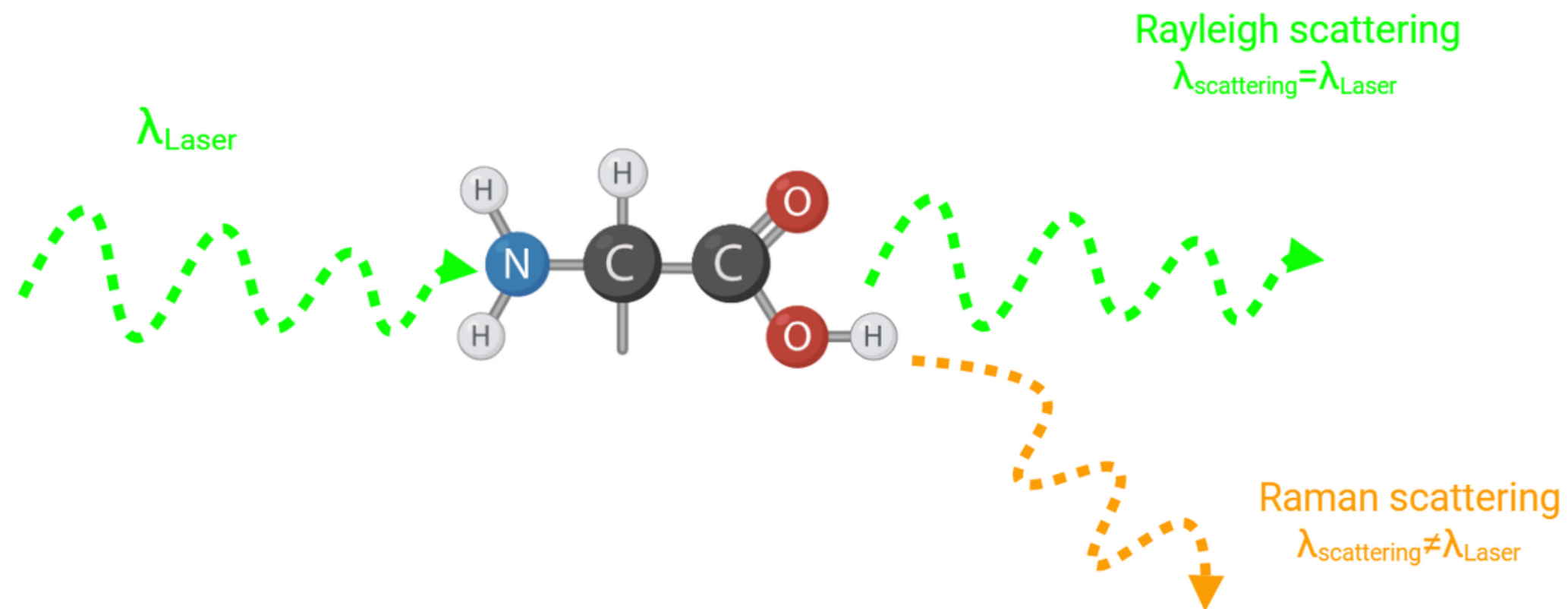
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Raman spectroscopy



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Why Raman spectroscopy?

- No sample preparation is required
- Doesn't destroy it
- Works in extreme conditions
- Fast results





In the case of MMX:

- It will be used to characterize the surface composition of Phobos, crucial because each hypothesis for its origin has distinct signatures:
 - Bands associated with organic material, disordered carbon bands, and hydrated minerals if it is a captured asteroid
 - Bands associated with minerals from the Martian crust such as pyroxenes or olivines if it formed after an impact
- Raman and other instruments will allow the creation of a detailed map of the surface of Phobos



To conclude:

- Phobos is a key piece in understanding the history of the Solar System, but it also aims to be an engineering milestone: the first mission to operate a rover in microgravity to explore a Martian moon, collect samples, and bring them back to Earth.
- Through this mission, we will be able to characterize Phobos: distinguish between Martian materials and primitive asteroids, and identify organic compounds to finally answer the big question: Is Phobos a lost piece of Mars or a captured visitor?
- Whatever the final answer, MMX will offer us a unique opportunity to advance planetary geology, understand the evolution of Mars, and improve our analytical techniques for future missions.



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THANK YOU
FOR
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