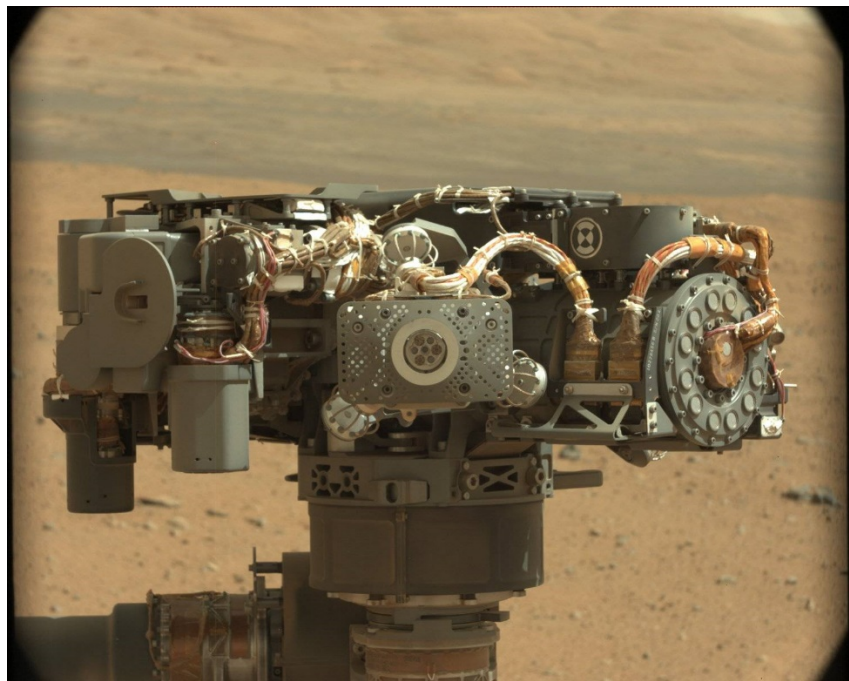


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Making Lemonade on Mars: Using Physics to Enhance the Capabilities of Landed Interplanetary X-ray Spectrometers

In the 1970s, the Viking landers carried the first X-ray spectrometers to another planet. Since then, instruments utilizing the principles of X-ray fluorescence have flown on Soviet Venera missions to Venus, international missions to comets and the satellites of Mars, several lunar payloads, and every NASA Mars rover to date. The Alpha Particle X-ray Spectrometers (APXS), on the Mars Exploration Rovers (MER) *Spirit* and *Opportunity* and on the Mars Science Laboratory (MSL) rover *Curiosity*, represent the newest iterations of X-ray spectrometers currently operational on the surface of Mars. To date, the MER and MSL APXS instruments have conducted over 1500 in situ analyses of Martian samples, contributing to our growing understanding of the ancient Martian environment. X-ray spectroscopy on the surface of Mars presents many unavoidable challenges compared to the pristine and controlled laboratory environment on Earth. In this presentation we will discuss the MER and MSL missions, talk about the robotic exploration of the surface of Mars, and examine the physics principles at the heart of the APXS method. We will investigate how the Martian environment, and quite simply being on another planet, adds complexity and challenges our ability to explore and conduct science. Several novel innovations to address these challenges will be presented, as will discoveries pertinent to *Curiosity*'s ongoing quest to locate and characterize past habitable environments on Mars.



MSL APXS on sol 32 (Image Credit: NASA/JPL/MSSS)