Active Neutron Investigations on the Curiosity Mars Rover

Dr. Craig Hardgrove
Arizona State University

Monday, July 30, 2018
10:00-11:00am
Quantum Room
(03-0040-N101)

Abstract: The Dynamic Albedo of Neutrons (DAN) instrument onboard the Curiosity rover has been operating in Gale Crater at the surface of Mars for over 5 years. DAN can measure thermal and epithermal neutron counts between pulses of a 14.1 MeV D-T pulsed neutron generator. The resulting neutron die-away curves can be used to interpret the bulk hydration, subsurface geology, and layering structure of the shallow subsurface of Gale Crater. Analyses of neutron data from DAN have revealed high-silica materials extending to depths of over 50 cm at several locations along the rover's traverse, and have been used in correlation with other rover datasets to test hypotheses about the formation and evolution of these features. DAN has also been used to characterize the bulk hydration of active sand dunes, which were determined to be some of the least hydrated features identified in Gale thus far. The hydration state of the dunes can then be used to constrain the abundance of amorphous phases within the dune sand, which is an important indicator for environmental conditions during sediment transport as well as providing information about the composition of the source material. Analysis of data from active neutron investigations requires a careful approach to modeling and a detailed understanding of the geologic setting and hypotheses to be tested at the site. To date there are thousands of DAN active observations across the rover traverse, which provide a rich dataset with which to test hypotheses about the geologic history of Gale. The success of the DAN instrument demonstrates the value of nuclear instrumentation for planetary science investigations.

Bio: Dr. Craig Hardgrove is a professor in the School for Exploration and Space Studies at Arizona State University. He is a Participating Scientist on the Mars Curiosity rover science team and neutron detector team. He is the Principle Investigator for the Lunar Polar Hydrogen Mapper (LunaH-Map) mission and the Single Scintillator Neutron and Gamma Ray Spectrometer (SINGR) instrument development project. Craig has nearly 10 years of experience working on
Mars spacecraft in many roles: as downlink operations specialist for the Mars Exploration Rovers Spirit and Opportunity, as a scientific targeting specialist for the Mars Reconnaissance Orbiter’s Context Imager (CTX), and in both scientific and technical operations for the Dynamic Albedo of Neutrons (DAN) instrument on Curiosity. He is a Co-I on the upcoming Mars 2020 Mastcam-Z investigation.