BOSTON UNIVERSITY

Boston University College of Arts & Sciences
Center for Space Physics

2025 SPACE PHYSICS SEMINAR SERIES

Unraveling the Redox Enigma: Mars and the Pursuit of Extraterrestrial Life

Mars has presented one of the most tantalizing puzzles in its extensive exploration history - the redox dichotomy. We find evidence of a reduced state with complex organics such as chlorobenzene, thiophene, hydrogen sulfide, and nitriles in the soil. Conversely, the Martian regolith boasts highly oxidized compounds like perchlorate and nitrate.

From an astrobiological lens, this suite of molecules indicates that Mars is in a state of chemical disequilibrium. This paves the way to several fascinating implications: 1. Mars may have once harbored life; 2. Life might still be present on Mars; 3. The Martian habitat holds potential for the genesis and sustenance of life.

What is behind this peculiar chemical duality of Mars? Geological imprints and geochemical markers intimate that Mars underwent a significant shift: from an anaerobic atmosphere during its Pre-Noachian and Mid-Noachian phase (3-4 Ga) to a predominantly aerobic one later on. This transition could mirror Earth's Great Oxygenation Event (GOE) around 2.7 Ga, attributed to the rise of photosynthetic oxygen. The Martian version might have seen alternating reducing and oxidizing periods, leading to organic synthesis during anaerobic spells and the birth of oxidized compounds in aerobic times.

How then do we define a Martian biosignature? This talk will address the search for life on Mars, spanning the Viking missions of 1976 to the recent. Extending our horizons beyond Mars, the hunt for biosignatures takes us to the enigmatic realms of Titan, Europa, and Enceladus, and to the distant study of exoplanets via high-precision spectroscopy.

Thursday, February 20th

3:30 - 4:30 p.m.

725 Commonwealth Ave | Room 502

Prof. Yuk Yung

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