Pushing the boundaries of lunar ice: the effects of vertical volatile transport in seasonally shadowed regions

Kristen Luchsinger[1]

[1] *Astronomy Department, New Mexico State University*

The recent discovery of volatiles on the lunar surface enables both human exploration and scientific study. In particular, the possible active water cycle due to the chemical interactions between solar wind protons and oxygen within lunar rocks could be a source of water, hydrogen, and oxygen for human exploration, and could also serve as a laboratory for scientists to explore this process as a possible delivery mechanism for water to the inner Solar System. However, in order to truly understand this process, we need to understand both the actively forming and migrating water and the reservoirs of water that have been captured by permanently shadowed regions at the lunar poles. In order to better understand the water in both states, actively migrating and captured, I will be exploring locations on the lunar surface where water regularly transitions between these two states: seasonally shadowed regions.

Seasonally shadowed regions are locations on the lunar surface where the sun rises above the local horizon at least once and that does not see the sun rise for at least one full lunar day. The regions that fulfill that description represent a broad range of illumination conditions. For each of these regions, I will model the volatile transport and deposition over one lunar year. Over this year, volatiles are deposited on the surface and allowed to migrate and escape, with residence times given by local thermal conditions. For each chosen region, I will explore whether the volatiles have time to migrate far enough below the surface to be stable; how much ice mass might be present within that possible stable volatile reservoir below the surface; and if there is a temporal lag in escaping volatiles. Such a temporal lag might be measurable via remote sensing or *in situ* measurements, and might provide constraints on the solar wind implanted volatile process, on the vertical migration of volatiles within the lunar regolith, and on the water that could be captured and sequestered beneath the surface of permanently shadowed regions. I will identify boundary case SSRs where a buried water ice reservoir may be present, depending on the vertical mixing rate. A detection or non-detection in such a boundary case SSR would therefore constrain the vertical mixing rate of water ice within lunar polar shadowed regions.