Explaining Bright Radar Reflections Below The Martian South Polar Layered Deposits Without Liquid Water
D. E. Lalich, A. G. Hayes, and V. Poggiali

Summary
- Bright radar reflections were discovered below the Martian South Polar Layered Deposits (SPLD) using the MARSIS radar sounder.
- Originally, the bright reflections were interpreted as evidence for liquid water.
- However, that interpretation is not consistent with other evidence.
- We suggest an alternative hypothesis, that bright basal reflections are caused by interference between thin layer boundaries.

Observations and Previous Interpretation
- A localized area of the SPLD below ~1.5 km of ice was found to exhibit bright radar reflections at the basal interface.
- Given the thickness of the ice cap, this should not have been possible with common dry materials, but could be explained by basal melting and liquid water.
- Geothermal models do not predict temperatures capable of causing melt, even for brines.
- Bright area is not consistent with lake locations predicted by basal topography.

A New Hypothesis
- Visible layers in outcrops tend to be much thinner than MARSIS resolution.
- Sub-resolution interfaces can constructively interfere, resulting in reflections that are much brighter than would normally occur for the given materials.
- To test if constructive interference could cause the observed reflections, we simulated three basal stratigraphy scenarios (see above) allowing basal layer thickness to vary.
- We found that both scenarios with basal layering were capable of reproducing observed echoes.

Results
- To compare our simulations to observations, we measured the subsurface to surface power ratio.
- We found that thin subsurface layering could reproduce observed echoes at each MARSIS frequency.

Supporting Evidence
- All materials used in simulations are already known to exist in the SPLD.
- Observed reflection power is frequency-dependent, which is a predicted result of interference but not for liquid water.
- Reflections caused by interfering layers have been discovered elsewhere in both the North and South Polar Layered Deposits.