Ultraviolet Imaging and Composite Infrared Spectrometers for the Measurement of Apophis Effects on Earth's Atmosphere. P. A. Johnson[1,2], J. C. Johnson[1,2,3], A.A. Mardon[1,2], J. Fisher[1], S. Zirnov[1], D. Santosh[1], G. Zhou[1], [1]The Antarctic Institute of Canada (11919- 82 Street NW, Edmonton, Alberta, Canada, aamardon@yahoo.ca). [2]Faculty of Medicine & Dentistry, University of Alberta (116 St & 85 Ave NW, Edmonton, Alberta, Canada, paj1@ualberta.ca). [3]Faculty of Engineering, University of Alberta (116 St & 85 Ave NW, Edmonton, Alberta, Canada, jcj2@ualberta.ca).

Introduction: Ultraviolet Imaging Spectrometry (UVIS) and Composite Infrared Spectrometry (CIRS) are two technique currently utilized in remote sensing equipment and for detecting changes in the atmosphere. Here, we would like to recommend these techniques for the detection and monitoring changes in the Earth's atmosphere for the 99942 Apophis fly-by.

Utilization of UVIS: Aurora on Earth and Mars are the outcome of disruptions to the magnetosphere brought about by sunlight based winds. The subsequent ionization from this collaboration between sun oriented breeze and climate emanate shifting degrees of light hues. UV imaging has been used in the detection of: (i) Discrete Aurora: connected to topology of crustal attractive fields, (ii) Diffuse Aurora: widespanning with close connection to sun based breeze, and (iii) Proton Aurora: most common Martian aurora but more difficult to capture though visualized with Lyman-α appendage profiles at elevations between 120 and 150 km. In September 2017, a discrete aurora was seen over the night sky on Mars. In this case, UV imaging enabled detection of aurora beginning from an elevation of 60km, suggesting its possibility to detect atmospheric changes resulting from Apophis from the Earth surface level. UVIS has additionally been utilized in the measurement of Titan's Thermosphere and Ignorosphere on the July 20, 1997 Cassini flyby to detect chemical compounds and elements in the atmosphere.

Utilization of CIRS: CIRS are often combined with UVIS to allow better detection of atmospheric parameters. In Cassini's Titan flyby, the combined use of UVIS and CIRS enabled the measurement of temperature and density of the atmosphere alongside better resolution signals, despite the presence of stellar occultations that may interfere with measurement in Apophis' trajectory.

Considerations for ground-level remote sensing tools and probes: Our group has previously proposed several considerations in the use of both remote-sensing tools and space probes in their use for extraterrestrial measurements, including: (i) power considerations, (ii) high climb and loiter speed, (iii) data-link bandwidth capabilities, and (iv) navigation. Further considerations for just probes include: (v) rotor use in at various gravitational fields, and (vi) emergency considerations for loss of contact with ground control.

Conclusion: Ultraviolet Imaging Spectrometry (UVIS) and Composite Infrared Spectrometry (CIRS) are two technique currently utilized in remote sensing equipment and for detecting changes in the atmosphere. Here, we would like to recommend these techniques for the detection and monitoring changes in the Earth's atmosphere for the 99942 Apophis fly-by.

References:

[1] B. Ritter, et al. (2018). Aurorae on Mars. From Mars Express to ExoMars Scientific Workshop.

[2] NASA Mars Exploration Program. (2018). Solar Storm Triggers Whole-Planet Aurora at Mars. Retrieved from https://mars.nasa.gov/resources/21334/solar-storm-triggers-whole-planet-aurora-at-mars/

[3] P.A. Johnson, et al. (2020). Remote Sensing Elemental Composition Analysis Technology for Analysis of Microorganisms In Outer Space. *Pac J Sci Technol*. 21(1):18-19.

[4] P.A. Johnson, et al. (2020). Application and Considerations for Nanoscale Vibration Remote Sensing Technology for Detection of Microorganisms in the Martian Polar Regions. Seventh International Conference on Mars Polar Science and Exploration, held 13-17 January, 2020 in Ushuaia, Argentina. LPI Contribution No. 2099, id.6005

[5] J.C. Johnson, et al. (2019). Design considerations to tailor unmanned aerial vehicles for Martian geoclimatic conditions. *ARJHSS.* 5(1): 1-2.

Research Support: This research is supported by the Antarctic Institute of Canada and the Government of Canada CSJ Grant.