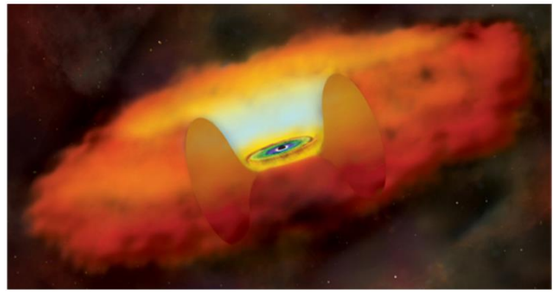
USRI SUMMER AGN RESEARCH

William Yuan[1], Dr. Viraja Khatu[1,2], Dr. Sarah Gallagher[1,2,3]

[1] Western University, [2] Institute for Earth & Space Exploration, [3] Canadian Space Agency

Project Overview

This summer my research was on Active Galactic Nuclei (AGN) with Dr. Viraja Khatu and Dr. Sarah Gallagher. My research involved simulating and generating AGN light curves from a realistic distribution of AGN in the sky as observed by the ***C****osmological* ***A****dvanced* ***S****urvey* ***T****elescope for* ***O****ptical and Ultraviolet* ***R****esearch (CASTOR).* At the end of the summer the data I have generated will be transferred to Dr. Viraja Khatu for further analysis.



Artist rendition of AGN; Image credit: NASA / CXC / M. Weiss

Facts on AGN

> AGN mass can range from millions to billions of solar masses.

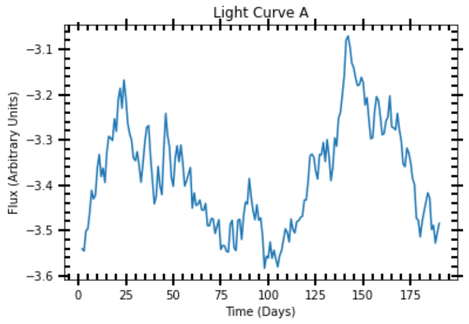
> AGN are supermassive black holes that are growing at the centre of massive galaxies.

> AGN have an accretion disk – disk of ionized gas orbiting the central black hole.

> The accretion disk emits the continuum observed in AGN.

> The light output from AGN is variable on several timescales (days or weeks to years) – energetic radiation is absorbed and is reprocessed as less energetic radiation. The time it takes to be reprocessed is the “time lag” – the light will be remitted again after some time but with less intensity.

> AGN are 100 000x smaller than their host galaxies but are brighter than the entire galaxy.

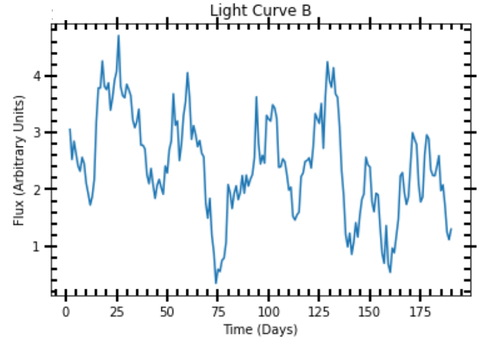


Light Curve Variability

> Variability in AGN is beneficial. The more variable the AGN is, the easier it is to detect the changes in the light output.

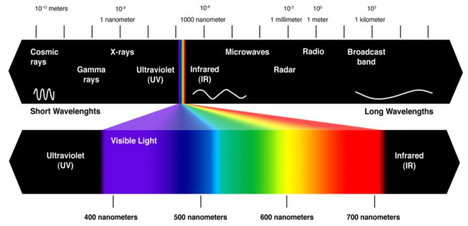
> Light Curve A is an example of a desirable light curve. This is because there are distinct features on the curve that would make it easier to calculate time lags. The high peaks in the curve are recognizable. This means when they are remitted again after a certain period, the emission will still be noticeable despite being less intense.

> Light Curve B is an example of a light curve that is less desirable. It follows a repetitive trend with no features that stand out. It will be harder to distinguish between the initial energetic radiation and the less energetic radiation that is emitted afterwards. This will make calculating time lag more difficult.



Light Filters

> AGN can emit at different wavelengths, from X-ray to radio. Studying AGN at different wavelenghts provides a holistic view of the AGN rather than being limited to only one part of the light specturm. CASTOR will observe simultaneously in three light filters: *UV (*150-300 nm*)*, *u (*300-400 nm), and *g (*400-550 nm).



Light spectrum; Image credit: https://www.once.lighting/visible-light-spectrum

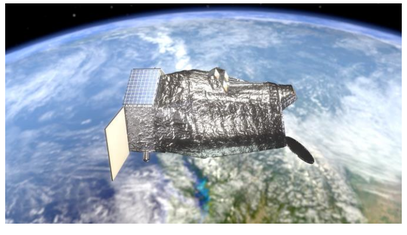
Overview of *CASTOR*

> *CASTOR* is a Canadian *UV* flagship mission proposed to the Canadian Space Agency (CSA).

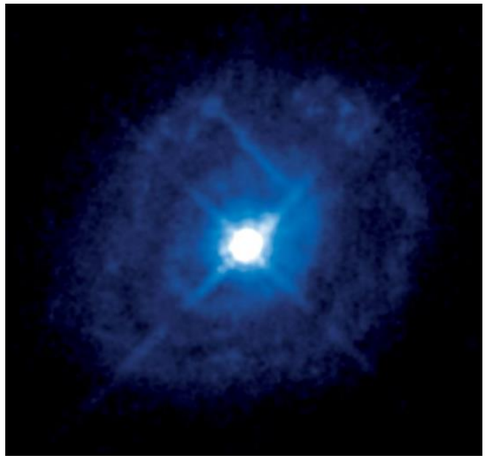
> *CASTOR* has a wide field of view, approximately equal to the size of the full moon.

> One of *CASTOR’s* major goals is to study the growth of supermassive black holes.

> The simulated data from this project will be used in the development of an AGN survey simulation for *CASTOR*.



CASTOR telescope; Image credit: https://www.castormission.org



Hubble picture of the Active Galaxy Markarian 509 (active galaxies have an AGN at the center).

Image credit: NASA, ESA, J. Kriss (STScI) and J. de Plaa (SRON)

Acknowledgements

Thank you, Western USRI, for giving me this amazing opportunity to do research over the summer! I am also incredibly grateful towards my supervisors Dr. Sarah Gallagher and Dr. Viraja Khatu for the guidance and help they have given me along the way. It has been an incredible learning experience, and one that I will never forget!

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