Cosmic Mining -AORkey Error Analysis & Reasoning

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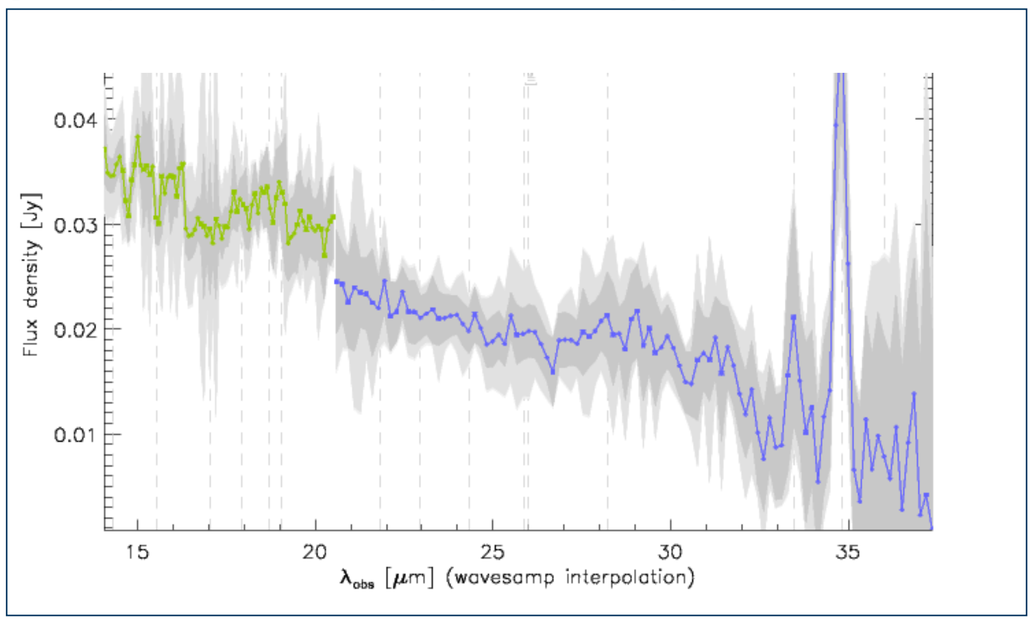
Summary

In this study, we analysed the trends of 114 spectral images from celestial objects across the galaxy collected by the **Spitzer Space Telescope**, a large telescope collecting data on celestial objects, many of which had never been seen by a human. Upon analysing these trends, we discovered that one of the spectra (**AORkey 3635200**[1]) **had readings beginning at 13.91 microns**, which is abnormal (most spectra start at around 5 microns due to the technological design of the telescope). **We decided to explore this further** and create a hypothesis for as to why this occurred in this graph but not in others. As it had not been analysed before, we were working with completely foreign data.

Research Aims & Context

Our primary aim was to **propose a hypothesis** explaining why the stellar object in question (**AORkey 3635200**[1]) **had its first reading at 13.91 microns**. However, we also wanted to gain a further understanding into how the analysis of spectral graphs and readings enables scientific proofs and theories, which we wanted to gain through this case study.

We had previously been tasked with analysing 50 spectra known and already analysed by the UKRI team and aimed to achieve **80% accuracy** before progressing into the unknown. All these spectra are freely accessible on the CASSIS website and database and are organised by AORkey (Astronomical Observation Request key). After achieving this goal, we were given a set of 64 spectra to analyse independently, 10 known (to check accuracy) and 54 unknown objects.

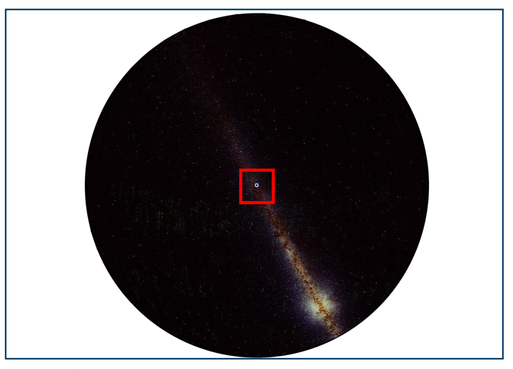


AORkey 3635200
Optimal extraction graph of AORkey 3635200[1] (pointing number 1) as taken by the Spitzer Space Telescope. Note the high level of uncertainty (as denoted by the grey area around the optimal extraction) and the graph starting at 13.91 on the x-axis. (Source: cassis.sirtf.com)

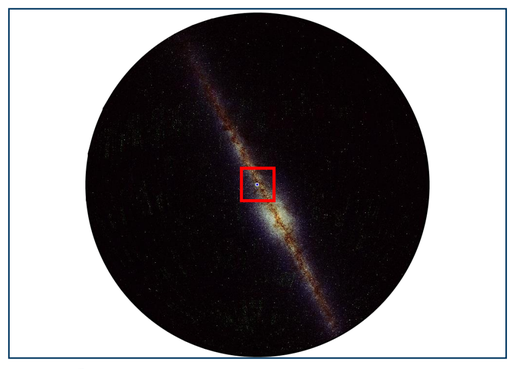
Experimental Method

After identifying the target spectrum to be analysed, we began by gaining an understanding into what the object is. After checking the spectral graph in our unseen set, **we identified the stellar object as "other"**, meaning its nature was unclear and it warranted further exploration. Due to this, it became impossible to explain the extraordinary spectral graph using the features of the stellar object, since it could not easily be deciphered. **We then explored the object further on the CASSIS website**.

We noted an exceptionally long error log on the first pointing number on the object (the one we had analysed previously). This error log can be seen below. **We could not at this point explain the error log**, so we explored further. Next, we explored the location of the object in the galaxy. Each object that is analysed by the Spitzer Space Telescope has its spectra stored alongside a more understandable image of the object as taken by the telescope. **We consulted these and compared the astro-geographical location of the object under investigation** and compared these to other objects given to us to analyse. We decided on 3 AORkeys we identified as "stars" [AORkeys 27563520[2], 22292480[3] and 23359744[4] to be specific]. The AORkeys 27563520[2] and 23359744[4] can be observed below.



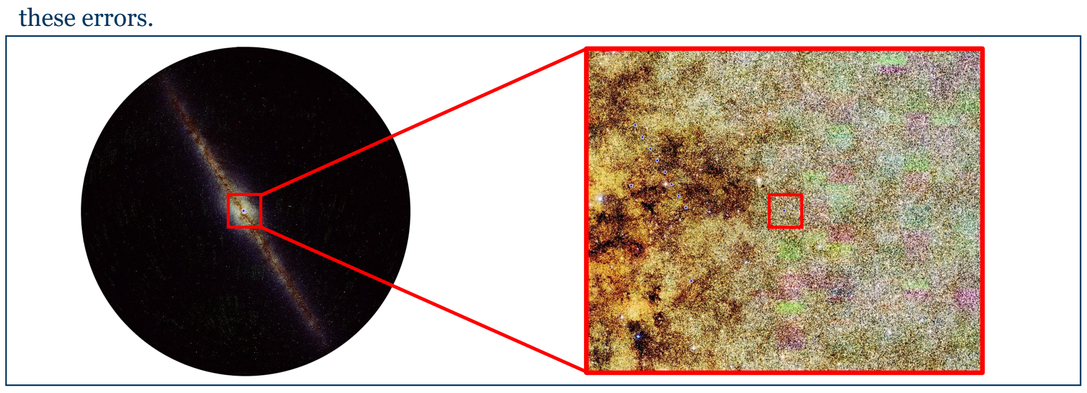
AORkey 2763520
Image of AORkey 25763520[2] as taken by the Spitzer Space Telescope.
(Source: cassis.sirtf.com)



AORkey 23359744
Image of AORkey 23359744[4] as taken by the Spitzer Space Telescope.
(Source: cassis.sirtf.com)

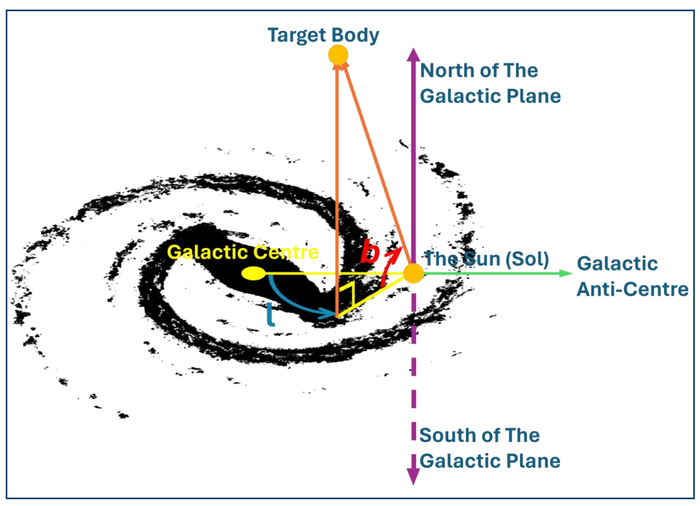
Results

One of these objects we were tasked with analysing was AORkey 3635200[1] (pointing number 1) which, as previously mentioned, featured an abnormal gap in values – **there was no luminosity value given for wavelength values between 5 and 13.91 microns**, which we had not seen before. We unanimously agreed to explore this further to develop our understanding and reach a conclusion to this predicament. Furthermore, the multiple extraction warnings of AORkey 3635200[1] derived from the log produced by the Spitzer Space Telescope enhanced this want for understanding to conclude the reason for these errors.



AORkey 3635200
Image of AORkey 3635200[1] as taken by the Spitzer Space Telescope.
(Source: cassis.sirtf.com)

AORkey 3635200
Zoomed-in image of AORkey 3635200 as taken by the Spitzer Space Telescope. The highlighted box indicates the object with the provided graph. (Source: cassis.sirtf.com)



Galactic Coordinate System
To locate objects within the Milky Way Galaxy we used this system:

The Galactic Coordinate System creates a sphere around the Galaxy with the Sol at the centre, onto which galactic latitude (b) and longitude (l) are projected. Galactic latitude is +90° to -90° above and below the Galactic Plane, while Galactic longitude ranges from 0° to 360°.

AORkey 365200 Coordinates:
99.42° x 53.86°

Analysis & Conclusions

We have theorised that **the object under observation is in front of the galactic core**. The galactic core releases lots of **circumstellar dust emission**[5], which is commonly present in evolved stars as silicate emissions (which can be detected with **an emission feature at 18 microns**, which is somewhat noticeable on AOR3635200[1]). We hypothesise that the circumstellar dust emission has contaminated the reading and therefore **the 5-13.91 micron region was ignored**, which could explain the long error log presented when viewing the AORkey on the CASSIS website. We checked this using our control AORkeys. Two of them [27563520[2] and 22292480[3]] appeared to be present near the edge of the observable galaxy and at a substantial distance from the galactic core. Their corresponding spectra were very clear, with little to no uncertainty – further concluding that circumstellar dust has led to abnormalities in the target graph. However, AORkey 23359744[4] appeared to be closer to the galactic core, yet still at a noticeable distance away. It contained some degree of uncertainty, although much less that AORkey 3635200[1]. This gave us solid evidence to believe that **our hypothesis was valid**.

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Scan for References

CASSIS
COMBINED ATLAS OF SOURCES WITH SPITZER IRS SPECTRA

NASA

UKRI

E08