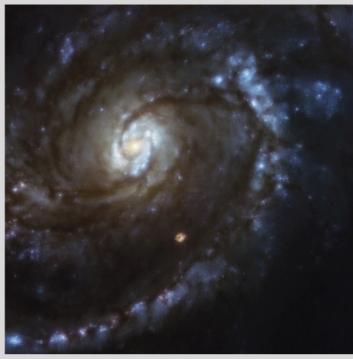


# Is the periodic impact flux on Earth sensitive to whether the Milky Way is a grand design or Flocculent spiral galaxy?

## What are Grand design and Flocculent spiral galaxies?

Grand design and flocculent spiral galaxies are two distinctive galaxies types. They can be differentiated by how their spirals are structured, in Flocculent galaxies it's hard to tell where one spiral begins and another ends as the galaxy looks like a circular disk with patches of stars bulging out, while in grand design spiral galaxies there are two long spirals originating from the centre on opposing sides of the galaxy, these are generally what the public imagine when thinking of the shape of the galaxy.

An Illustration of M100, a grand design galaxy. Credit: J. Trauger, JPL and [NASA/ESA](#) [1]



An illustration of NGC 2841, a flocculent spiral galaxy (Colombari, 2021)

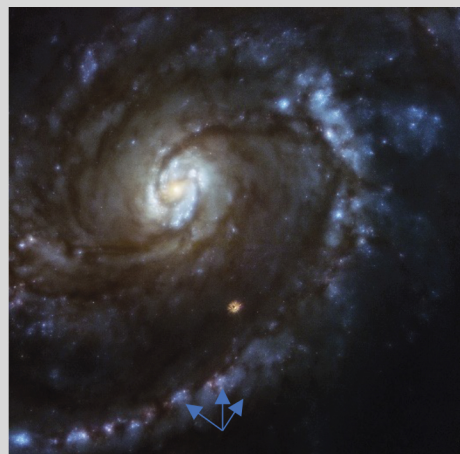
## Is the Milky Way Galaxy a Flocculent spiral or Grand design galaxy?

The question on whether the Milky-way galaxy being a Flocculent spiral galaxy or a Grand design galaxy is a difficult to answer, this is because we will have to somehow view the Milky-way from the same perspective we can detect other galaxies to definitively conclude the structure of our galaxy. However, from observational evidence of the Milky-way galaxy, we know that it shares various features of a grand design galaxy [3].

## Methodology of determining and calculating the orbit of the solar system in relation to specific galaxies.

By using gravitational constant equation  $F = G \frac{m_1 m_2}{r^2}$ , we can calculate and determine that within the Milky Way galaxy the solar system is attracted to the galaxy core with **1.5581291x10<sup>29</sup> N** of force.

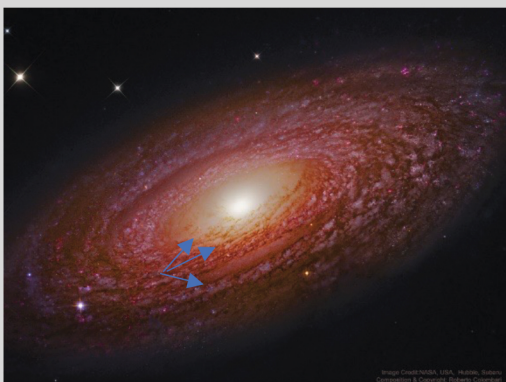
An altered [by myself] illustration of M100, a grand design galaxy. With a rough trajectory of one of the spirals. (Schmit, J. 2017)



## What is impact flux? And is the impact flux on earth sensitive as to whether we are in a flocculent spiral or grand design galaxy?

Impact flux on earth is when an asteroid impacts another celestial body in this specific case, the Earth, this can sometimes lead to radioactive particles being deposited on the asteroid's trajectory making it possible for us to track the movements of that asteroid through-out the galaxy. Because Flocculent spiral and grand design galaxies have unique orbital patterns, meaning the way the material and solar systems move around the galaxy's centre. This combined with the fact that the spirals in Grand design galaxies is  $\sim 218 \text{ km s}^{-1}$  and the spirals in flocculent galaxies is  $\sim 146 \text{ km s}^{-1}$  it is safe to say that the magnitude of the impact flux is influenced by the formation of the galaxy. [4]

An altered [by myself] illustration of NGC 2841, a flocculent spiral galaxy showing a rough trajectory of one of the spirals. (Colombari, 2021) [2]



## Summary

What does this all mean for us on earth as well as potential avenues for research? Well for everyone on Earth this is important as knowing which formation of galaxy the Milky-way is correct will help us to predict in which direction a potential planet-killer asteroid, an asteroid with sufficient mass to cause mass destruction on earth, would be coming from and use a system like DART to redirect the asteroid away from earth. While from a research perspective impact flux could help us deduce the more quantities about the Milky-way other than just which type it is, as the radiation emitted from some asteroids can be tracked far away from earth.

## References:

- [1] Schmidt, J. (2017). *Messier 100*. Available at: <https://www.nasa.gov/feature/goddard/2017/messier-100> [Accessed 5 Sep. 2023].
- [2] Colombari, R. (2021). *Massive Nearby Spiral Galaxy NGC 2841*. Available at: <https://apod.nasa.gov/apod/ap210124.html> [Accessed 15 Sep. 2023].
- [3] Hami, M., Balsler, D., Wenger, T. V., Anderson, L., and Bania, T., "Is The Milky Way A Grand Design Spiral?", vol. 233, 2019.
- [4] Sarkar, S., Narayanan, G., Banerjee, A., & Prakash, P. (2023, January). Identification of Grand-design and Flocculent spirals from SDSS using deep convolution neural network. *Royal Astronomical Society*, 518(1), 1022-1040. Retrieved from <http://doi.org/10.1093/mnras/stac3096>

Student Researcher: Kairan Laver (25687514)

Supervisor: Phil Sutton

