

The Dynamic Life of Spiral Arms: Our Galaxy in Motion

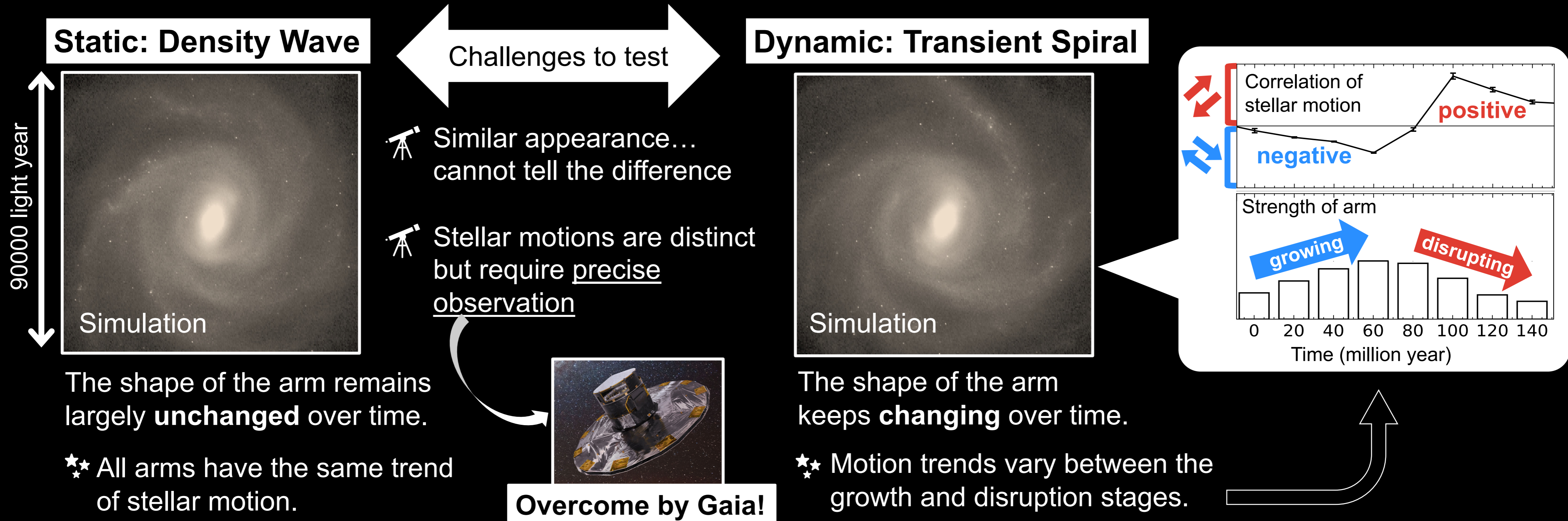
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1. Introduction - The Mystery of Spiral Arms with Two Competing Scenarios

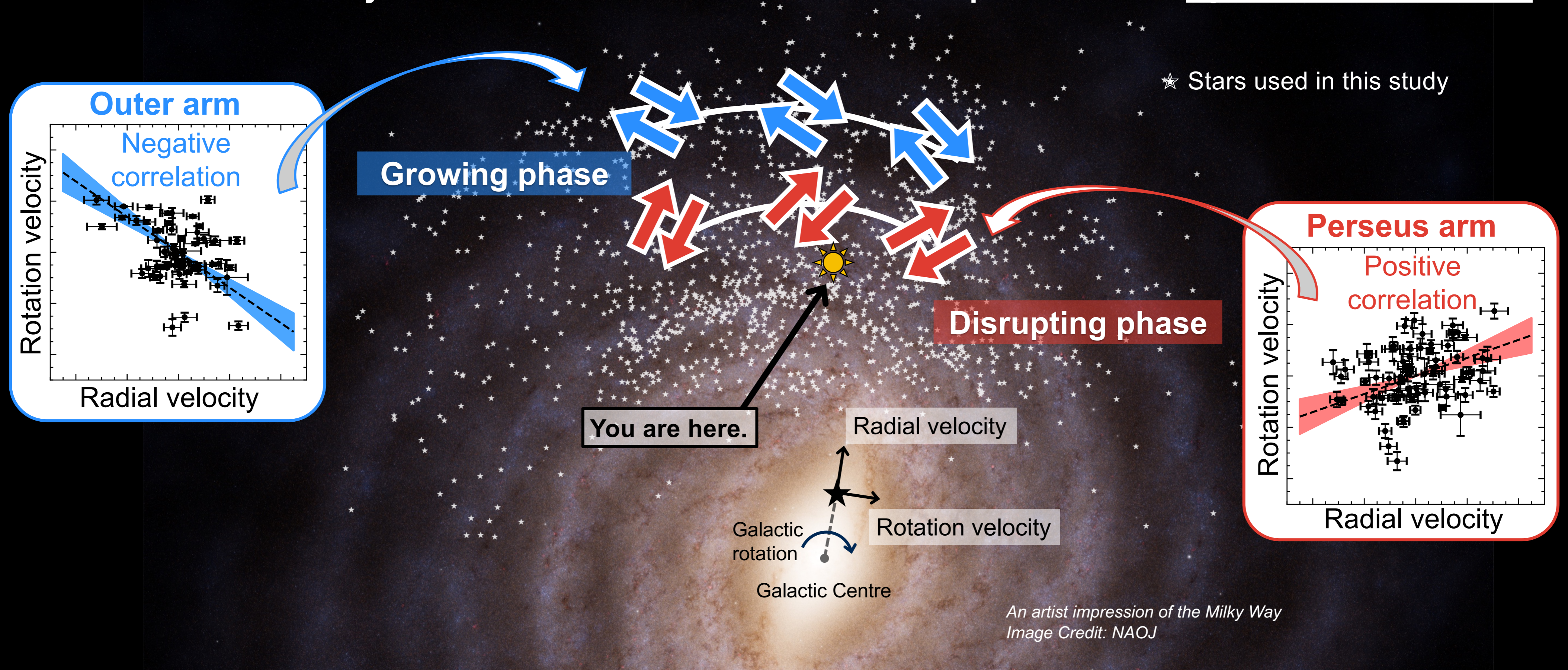
Many galaxies in the Universe, including our home, the Milky Way, show beautiful spiral patterns. Since the first “spiral-shaped object” was spotted in the sky in 1850^[1], the nature of spiral arms has remained a long-standing question in astronomy since our lifetime is too short to observe how spiral arms evolve. There are two competing scenarios;



2. Data and Method

Thanks to the European Space Agency's Gaia space mission, in which the UK heavily invested, we now have detailed maps of the positions and motions of over a billion stars^[2]. This incredible dataset enables us to examine the motion of stars around the spiral arms of our Galaxy—helping us get closer to solving this long-standing mystery. We studied the motion of stars in the spiral arms and found a clear link between stars' radial and rotational motions in the Perseus arm and Outer arm.

3. Result and Summary: Distinct Motions in Different Arms – Spiral arms are Dynamic and Transient



We found that stars around the **Outer arm** and **Perseus arm** have different trends in motion. This finding challenges the traditional density-wave scenario^{[3],[4]} and supports a more **dynamic** view of the Milky Way's structure^[5]. From the motion of stars, it is also revealed that the Outer arm is **growing**, while the Perseus arm is **breaking apart**^[5].

Spiral arms play a significant role in stars' migration in the Galaxy. The Sun may have formed closer to the centre of the Galaxy and later travelled to its current location, guided by spiral arms. By understanding spiral arms in more detail, we can learn more about the Sun's five-billion-year journey through the Galaxy^[6].

