Simulation movies:

The structure and evolution of spiral galaxies

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ABSTRACT

We are conducting simulations made to replicate well-studied nearby spiral galaxies. This work forms the backbone of the Better Extragalactic Simulation Physics On Known Examples (BESPOKE) project, involving an international team of researchers. Simulation work is well under way, with models of three spiral galaxies already completed with varying physics inputs, such as strength of energy ejection of supernova. First results indicate that a galaxy's rotation rate has little effect on how well it forms stars, and even strong differential shearing flows have only a weak impact. Spiral arm features, however, act to sweep up large quantities of interstellar gas, which drive the locations of future star formation events. Future work will focus on smaller scale patches within these galaxies.

BACKGROUND

Galaxies effectively act as "*star formation engines*" for the Universe. However, exactly how each individual galaxy does this on the small-scales is still not well understood. Why do some form more than others? What is the role of spiral arms and disc rotation, do they act to impede or promote star formation?

Figure 1: Spiral galaxy M74 in optical light. Credit: ESO/PESSTO/S. Smartt.

SUMMARY OF WORK

After several months of simulation time on hundreds of processors, the first galaxy models are complete and analysis is now beginning. Below left is an image of one such simulation as if photographed by a telescope. Clear dark patches indicate dust lanes that block out light from stars. On the right is a map of the radial motion of the gas, with red patches moving inward and blue moving outward from the centre, clearly highlighting the complex asymmetrical flows induced by the spiral pattern.

Figure 2: Mock-optical image of a simulated spiral galaxy.

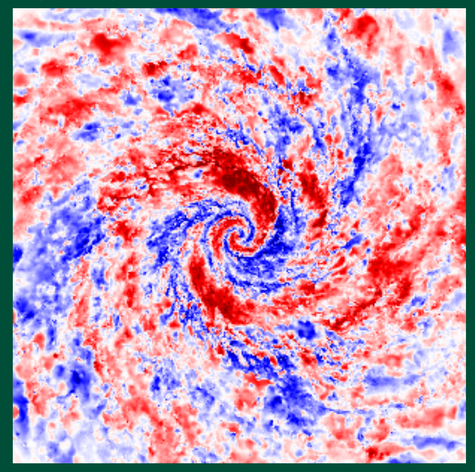

Figure 3: Changes in the radial velocity of the gas in the same galaxy (red=outward, blue=inward)

IMPACT ON COMMUNITY

As with most astrophysical research the community impact is perhaps less direct than some other work. However, videos of simulations will be disseminated to the public in hopes of sparking greater interest in galactic-scale physics, and I plan on incorporating dome-scale simulation movies into future CSUS planetarium shows.

POTENTIAL COLLABORATION AREAS

There is potential for collaboration with those who work in low-temperature chemistry, mechanics of fluids, and high performance numerical computations. All of these aspects are key to performing the highly scalable, multi-core calculations essential for this work.