CASPEN Program Report

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Overview

This visit was organised to discuss the implementation of SIMBA sub-grid physics in SWIFT, and took place from the 18th to the 21st February 2020, with Daniel Anglés-Alcázar hosting me at the Center for Computational Astrophysics.

Our previous work (Borrow et al. 2020) investigates the displacement of baryonic matter in simulated universes, relative to the background dark matter, with the initial paper focusing on the SIMBA (Dave et al. 2019) simulations.

Thankfully, the visit coincided with the SIMBA collaboration meeting, so there were many extra people for myself and Daniel to discuss our work with.

I gave two talks at the SIMBA collaboration meeting, one on SWIFT (the new cosmological simulation code that I am a lead developer on), and one on my previous work on baryonic displacement with Daniel. The SIMBA collaboration meeting coinciding with my visit allowed us to make significant progress with many core SIMBA developers on discussions around the porting of physics from the GADGET cosmological simulation code to SWIFT.

This work was supported by collaborative visits funded by the Cosmology and Astroparticle Student and Postdoc Exchange Network (CASPEN).

Porting SIMBA to SWIFT

Currently, the SIMBA galaxy formation model is implemented into an older version of the GIZMO code (Hopkins 2015). The SWIFT cosmological simulation code (Schaller et al. 2016) provides significant speed-ups (10-40X, see Borrow et al. 2018) and a much firmer code-base to implement sub-grid models on top of.

During the SIMBA collaboration meeting, I met with the SIMBA core developers to discuss not only the porting of SIMBA to SWIFT, but also their current version of the code. During this meeting it became apparent that Douglas Rennehan was able to work with a staff computer scientist at UVic on the porting. This work is now underway, and they are currently getting set up with SWIFT.

Extra Science

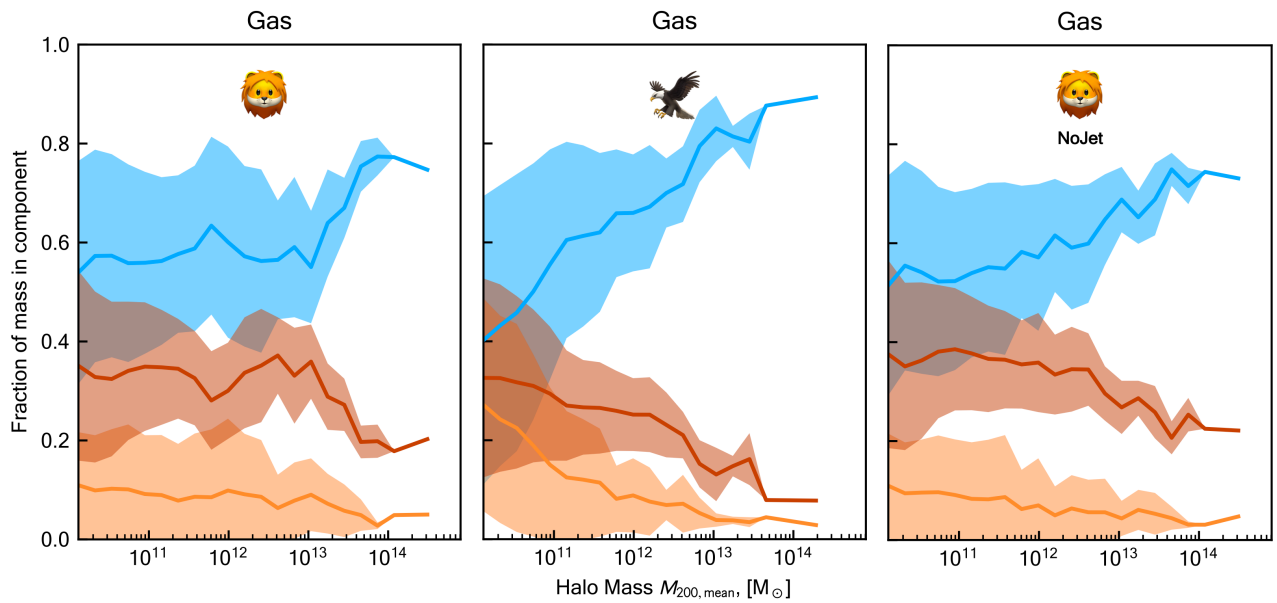

Figure 1: Fraction of gas mass present in haloes at redshift z=0, binned by origin relative to the initial z=100 dark matter distribution, as a function of their mass. The blue line shows gas that originates from the same region as the dark matter in that halo, with red showing the fraction originating from a region where the dark matter ends up outside all haloes. Finally, the orange line shows the fraction of gas mass in these haloes that originates from a region where the dark matter ends up in another halo at z=0. Left shows SIMBA, center shows EAGLE, and right shows SIMBA without AGN jets. The shaded regions show 1 standard deviation of scatter.

During the meeting, I was able to discuss our extension of the Cosmological Baryon Transfer science to the EAGLE (Schaye et al. 2015) and Illustris-TNG (Springel et al. 2018) galaxy formation sub-grid models, with results already presented for EAGLE at the meeting.

We were then able to collaborate with Katarina Kraljic (RoE, Edinburgh), Joanne Cohn (UC Berkeley), and Chris Duckworth (CCA, St. Andrews) on possible follow-up projects. Work is currently underway to complete this analysis and we expect publications shortly.

Post-Visit

Thanks to extra funding from Intel and Durham University, I was able to travel to Cambridge, MA, to give two follow-up talks in the week after my visit. At MIT, I gave a lunch talk on my Baryonic Transfer work, and at Harvard, I gave a group meeting talk about my work with SWIFT.

References

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