

# Fire Burn & Cauldron Bubble: Modeling Galactic Feedback with Adaptive Mesh Simulations

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## Motivation & Goals

There's strong evidence that **galaxies are self-regulating**

- Tight correlations between galaxy properties
- A limited number of stars form from available gas

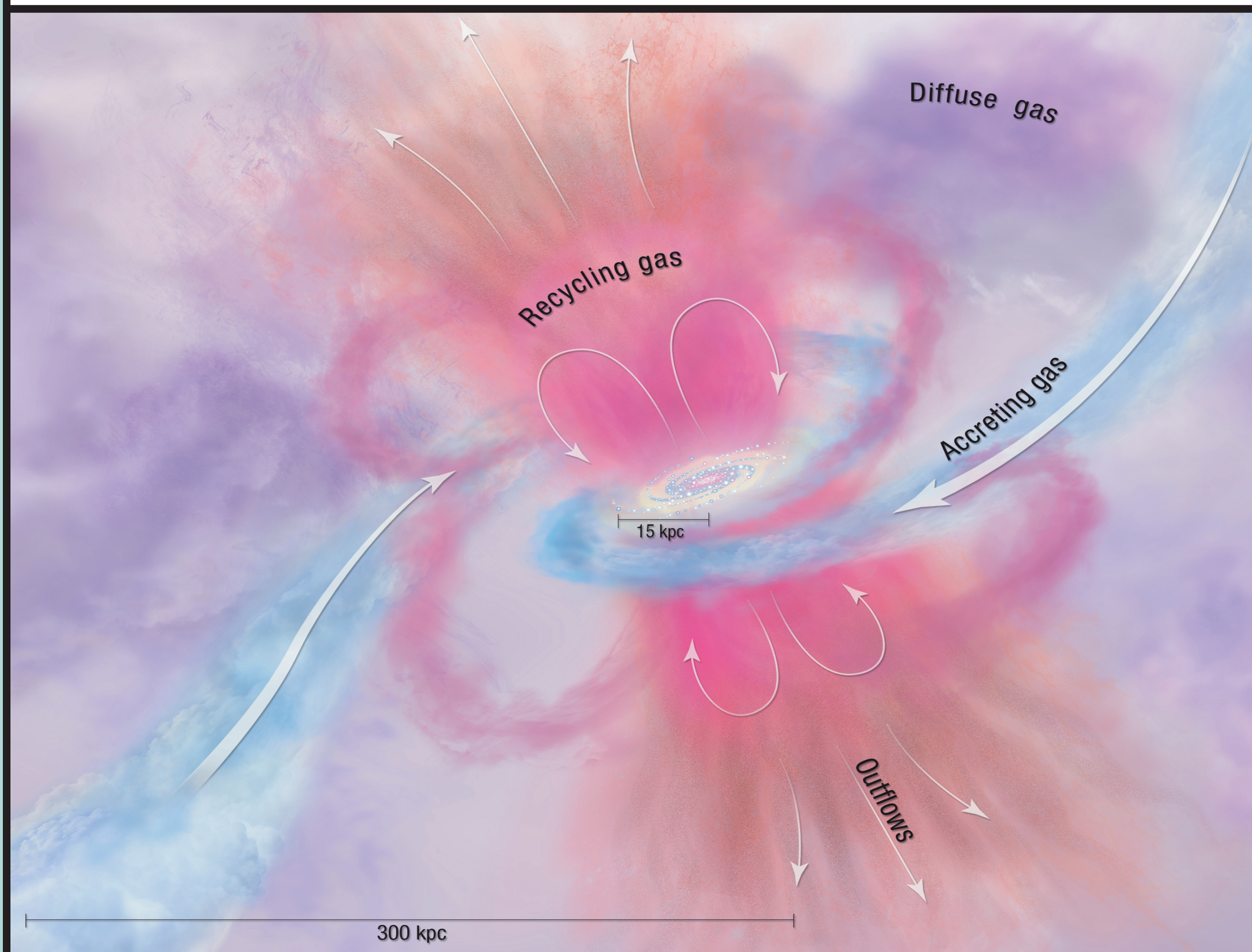
Supernovae can act as a feedback mechanism

How this feedback results in self-regulation is uncertain

- An analytic theory has been proposed [1]
- **This work tests that theory numerically**

**Can we produce a self-regulating system?**

And if so, does it reproduce the analytic results?

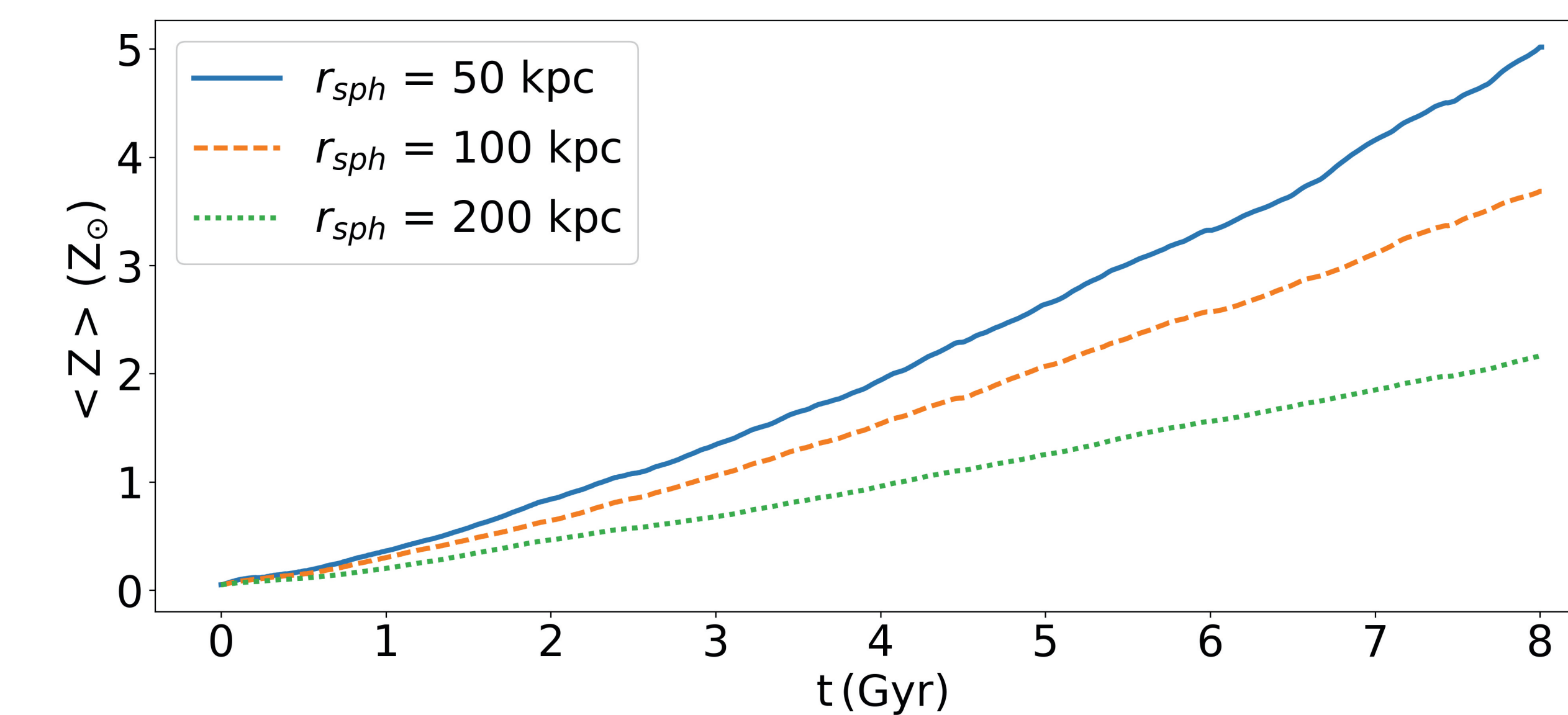
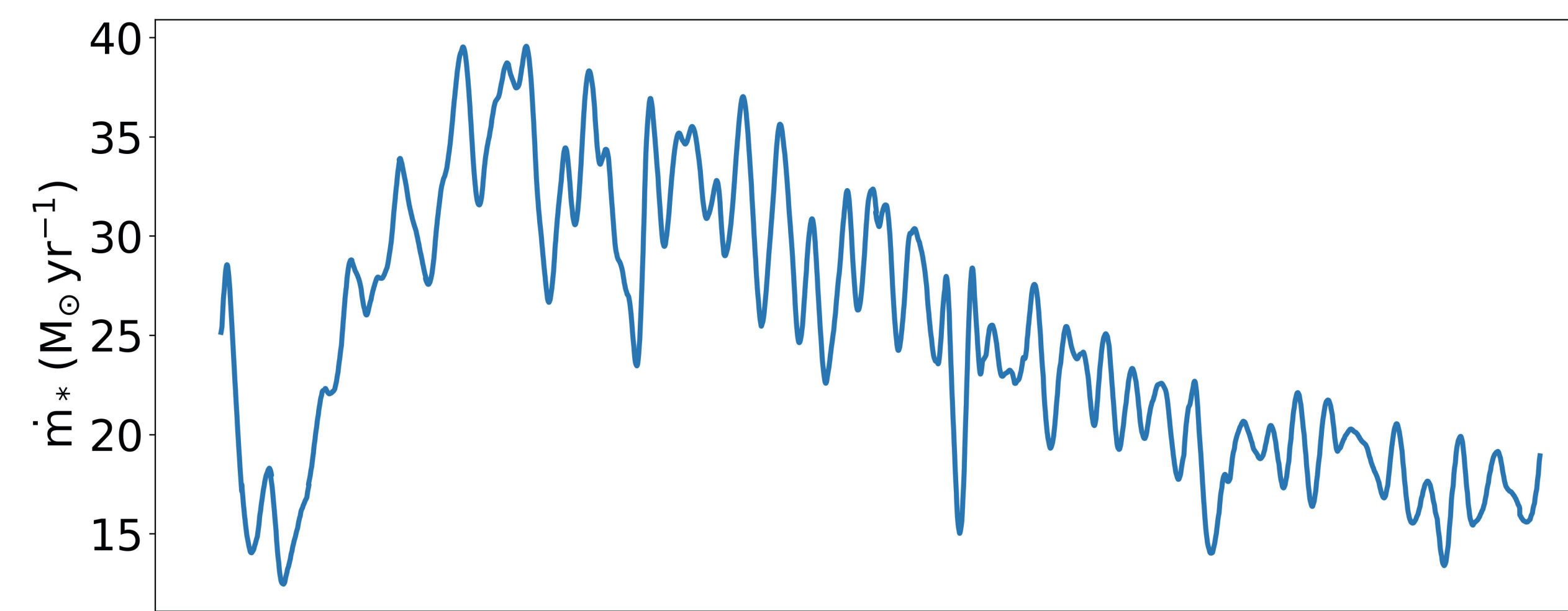


Cartoon diagram of a galaxy & its gaseous circumgalactic medium (CGM) [2].

## References & Acknowledgements

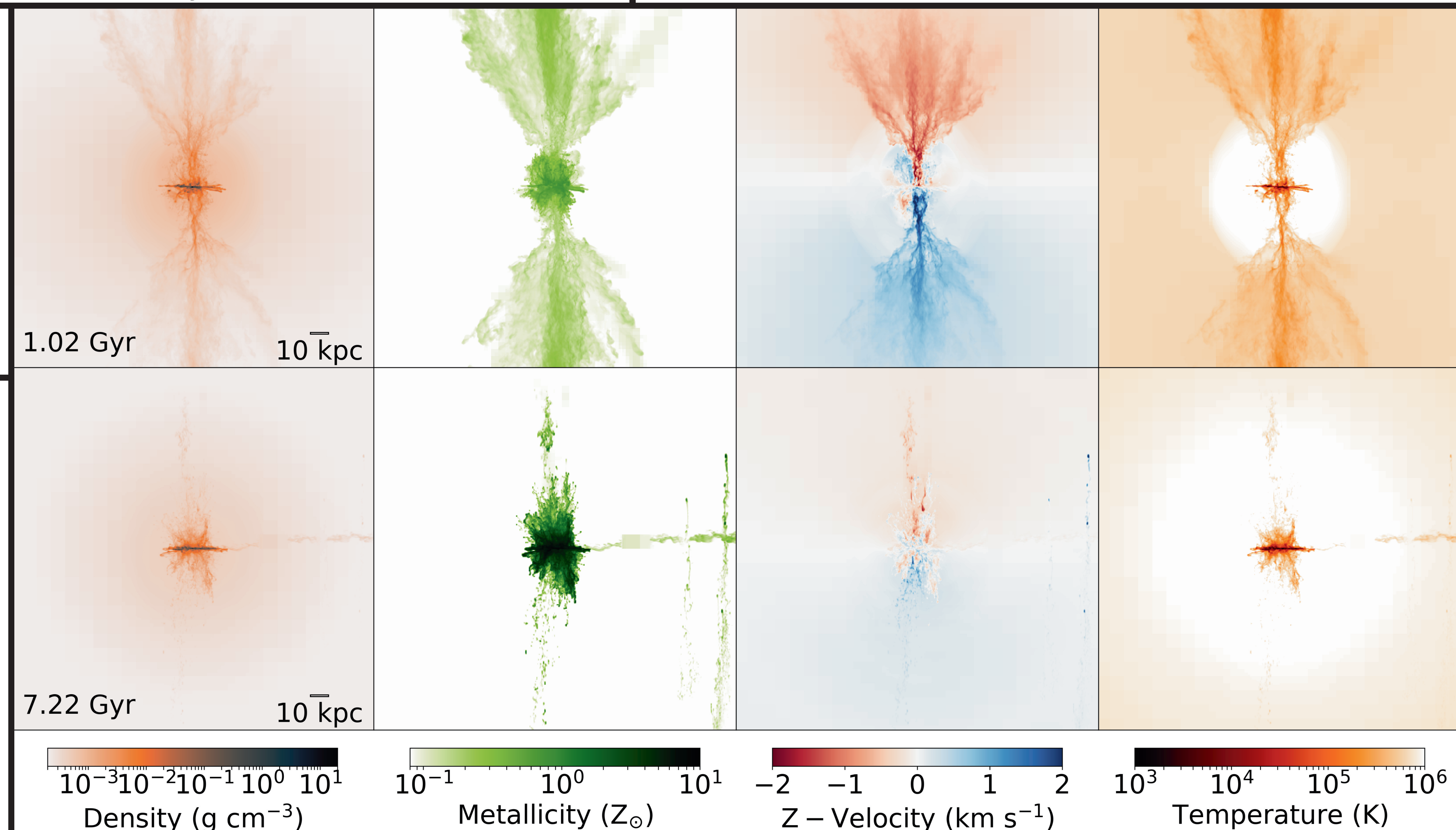
1. Voit, G.M.; Bryan, G.L.; O'Shea, B.W.; Donahue, M. 2015, ApJL. 808:L30.
2. Tumlinson, J.; Peebles, M.S.; Werk, J.K. 2017, ARA&A.
3. Bryan, G.L.; et al. 2014, ApJS. 211:19. See enzo-project.org

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[ABOVE]  
Top - star formation rate over time.  
Bottom - average metallicity over time inside spheres of 50 (solid blue), 100 (dashed orange), & 200 kpc (dotted green), centered on the galactic disk.

[RIGHT] Four edge-on projections of the simulated galaxy after 1.02 Gyr (top) and 7.22 Gyr (bottom) of simulation time. From left to right: baryon density, metallicity, outward velocity (z-direction), and temperature. The latter three projections are density-weighted. The width of each is 200 kpc.



## Method

Simulations with Enzo [3], an astrophysical block adaptive-mesh refinement (AMR) code

Idealized, isolated Milky Way-like galaxy

Idealized star formation & feedback algorithm triggered by cold, dense gas

- Feedback is divided into thermal & kinetic components

## Summary

We're testing an analytic theory of galaxy self-regulation in simulations with idealized star formation & feedback.

We're able to model bulk properties such as outflows, but our simulations are not self-regulating.

More analysis is needed to determine precisely why this is, in order to modify our simulations.