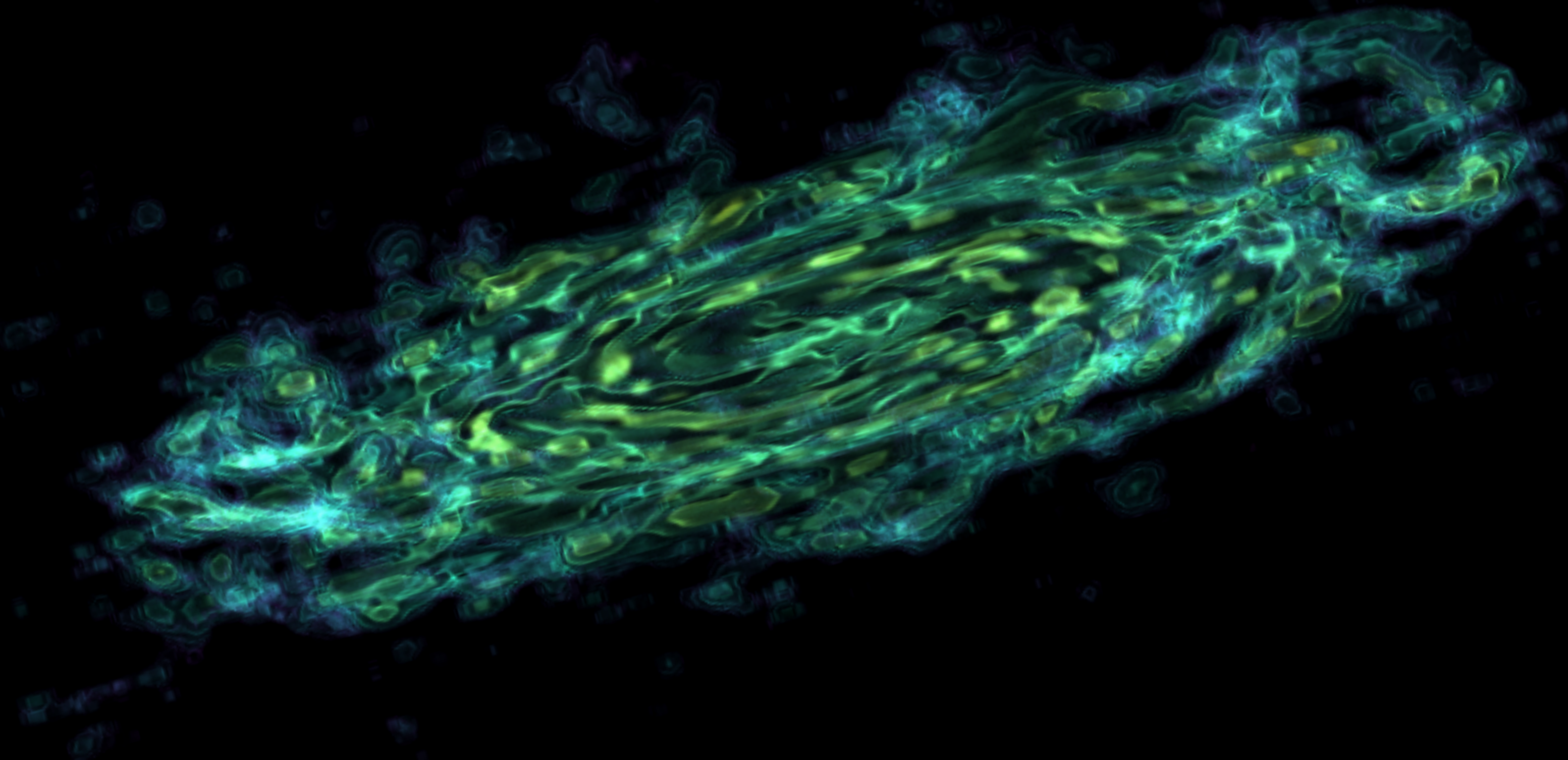


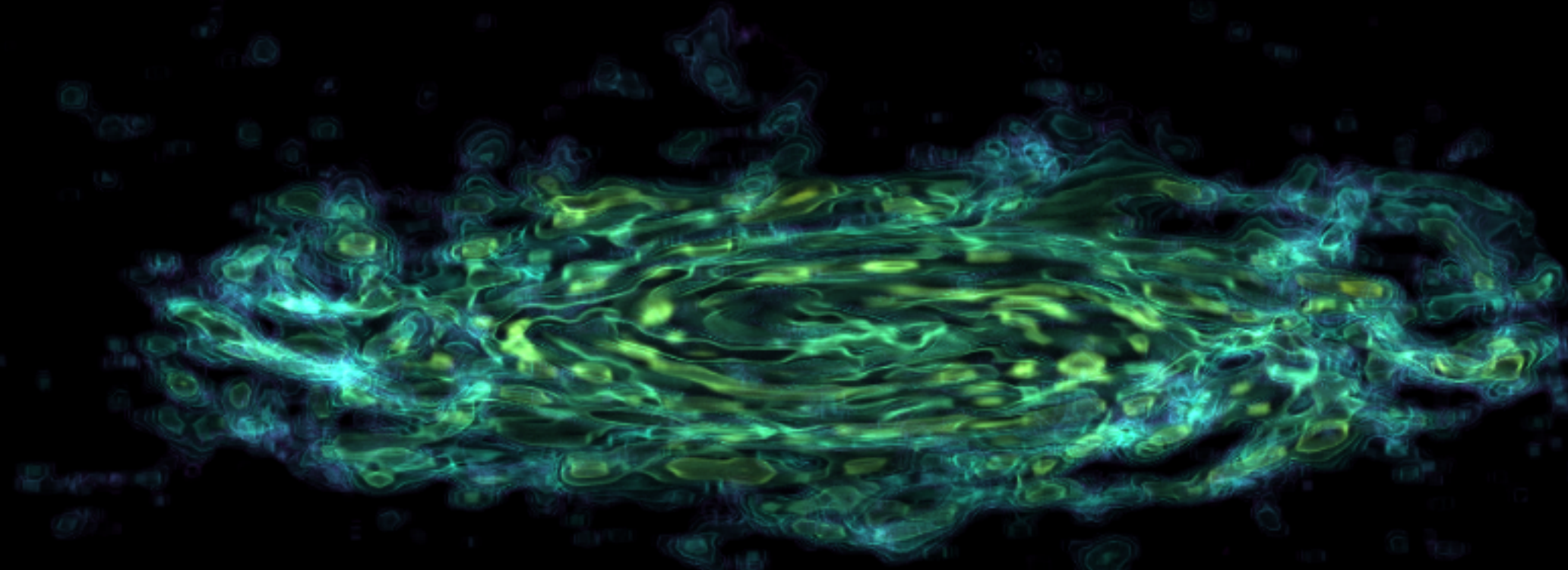
DEVIN W. SILVIA - 6.26.2017 - JINA FORGING CONNECTIONS 2017
HELPING TO PAINT A MORE REALISTIC
PICTURE OF THE CIRCUMGALACTIC MEDIUM



Collaborators:

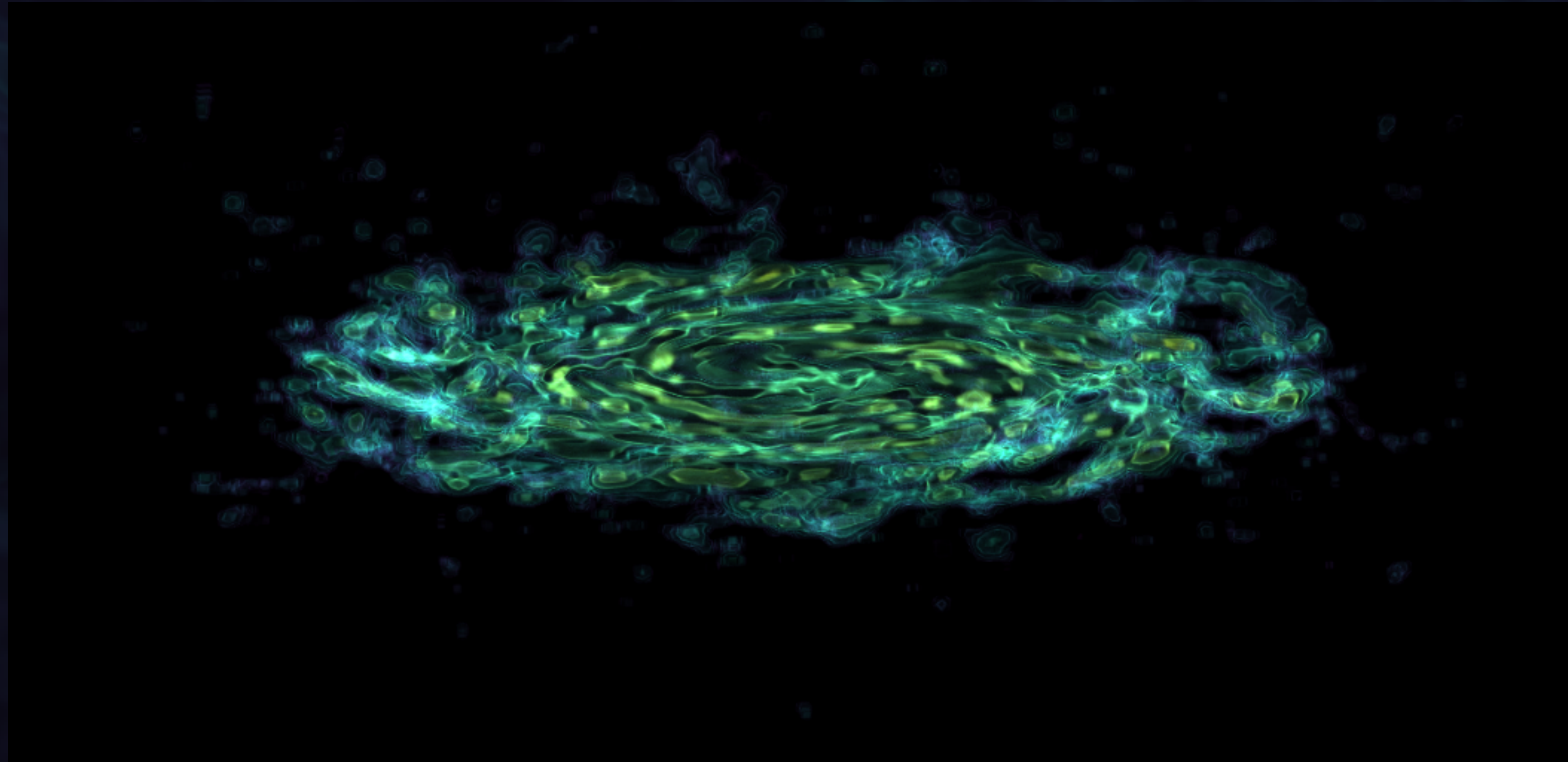
The Tempest Collaboration (Brian O'Shea, Britton Smith, Cameron Hummels, John Wise, Dave Collins)

So, galactic disks are cool and all, but...



So, galactic disks are cool and all, but...

...there's so much more out there!



We should probably try to understand it.

Finding answers isn't always easy.

OBSERVATIONS

Galaxies in the early universe

Stellar spectroscopy

Quasar sightlines

Molecular cloud chemistry

and so on...

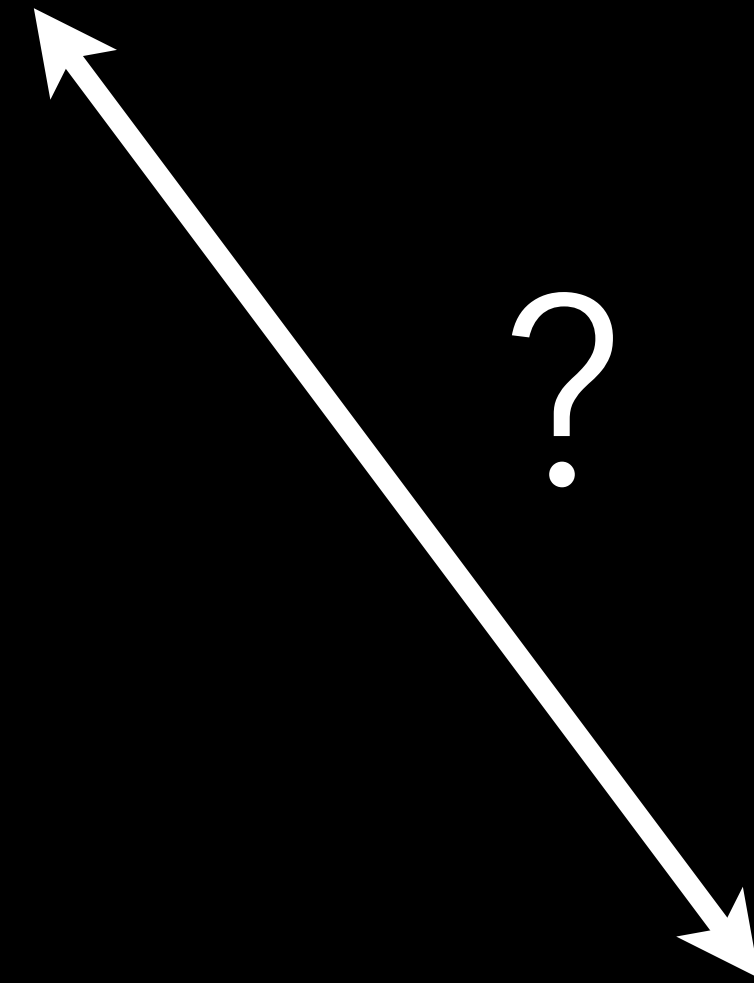
analytical

semi-analytical

THEORETICAL MODELS

Finding answers isn't always easy.

OBSERVATIONS



THEORETICAL MODELS

Finding answers isn't always easy.

OBSERVATIONS

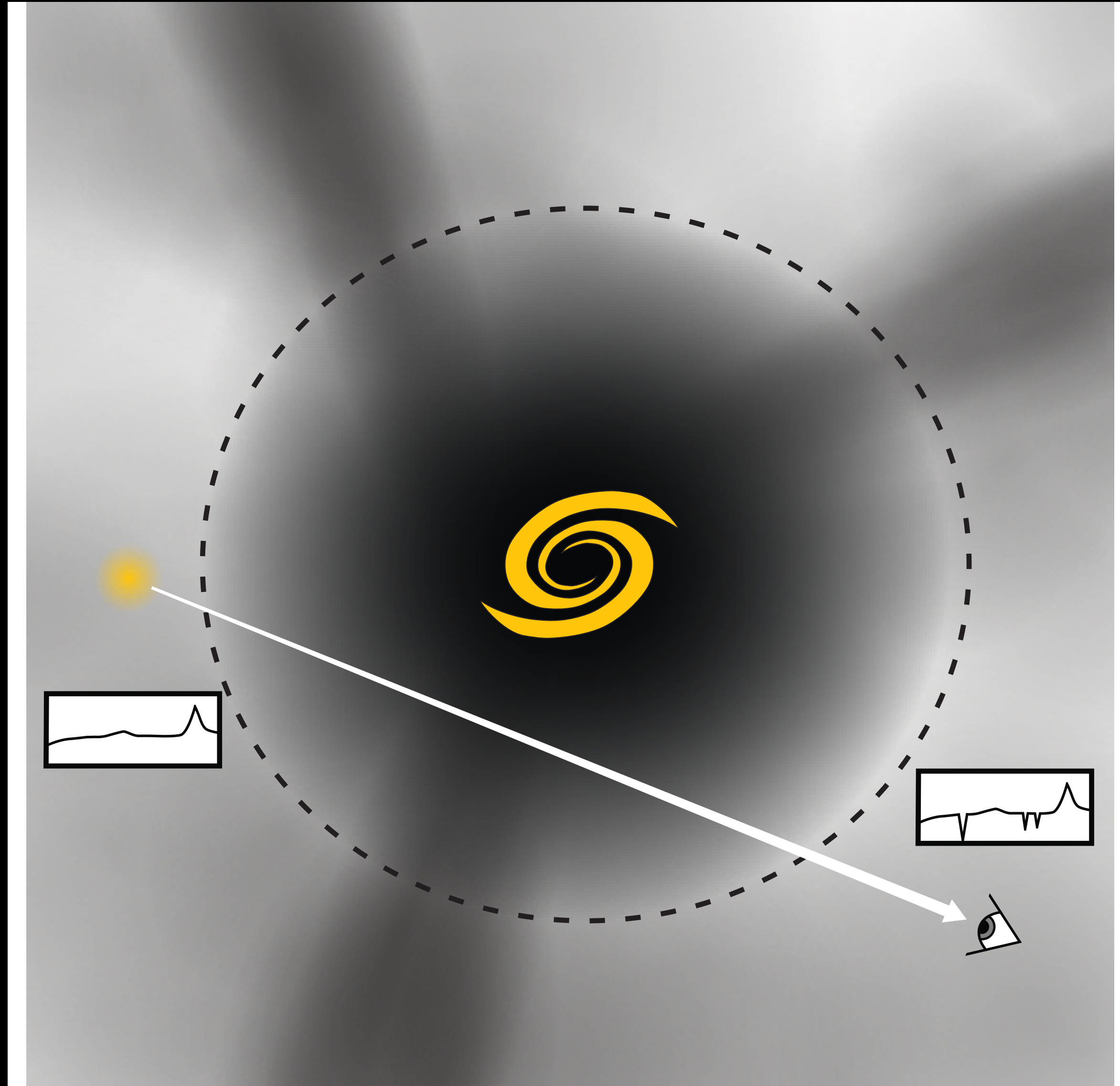
simulations and
synthetic observations

THEORETICAL MODELS



OBSERVING DIFFUSE GAS

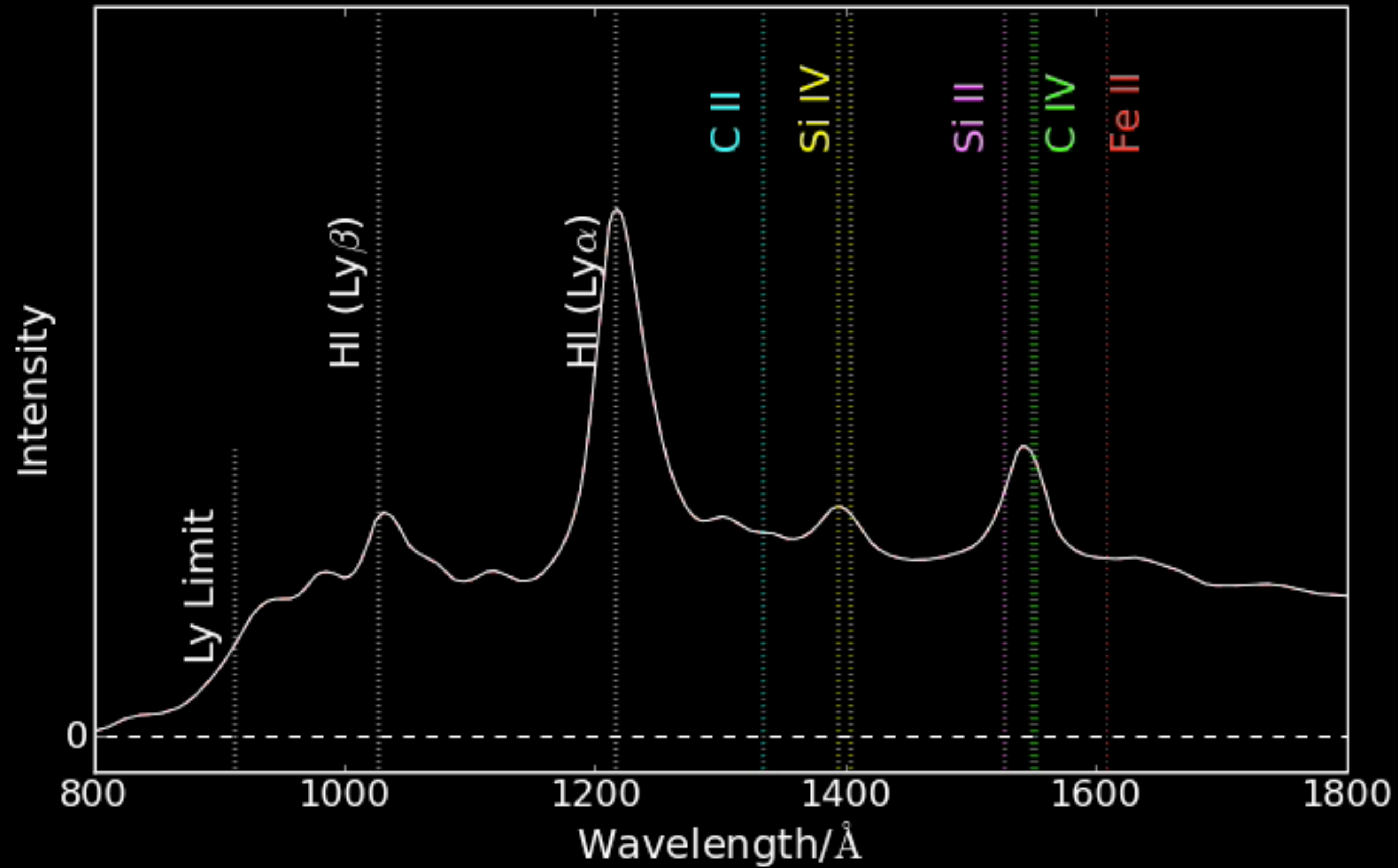
ABSORPTION LINE STUDIES



Hummels, Smith, & Silvia
([arXiv:1612.03935](https://arxiv.org/abs/1612.03935))

OBSERVING DIFFUSE GAS

ABSORPTION LINE STUDIES



SIMULATING THE IGM AND CGM

HOW CAN SIMULATIONS HELP?

Exploring the non-equilibrium ionization state of the IGM

Simulations of large-scale structure using Dengo

Mike Shull, Brian O'Shea, Britton Smith, Matt Turk, Dan Reynolds

Probing the evolution and structure of the CGM

Isolated galaxy simulations with Enzo

The Tempest Collaboration

Comparing simulated data to observations

Synthetic spectra with Trident

Cameron Hummels and Britton Smith

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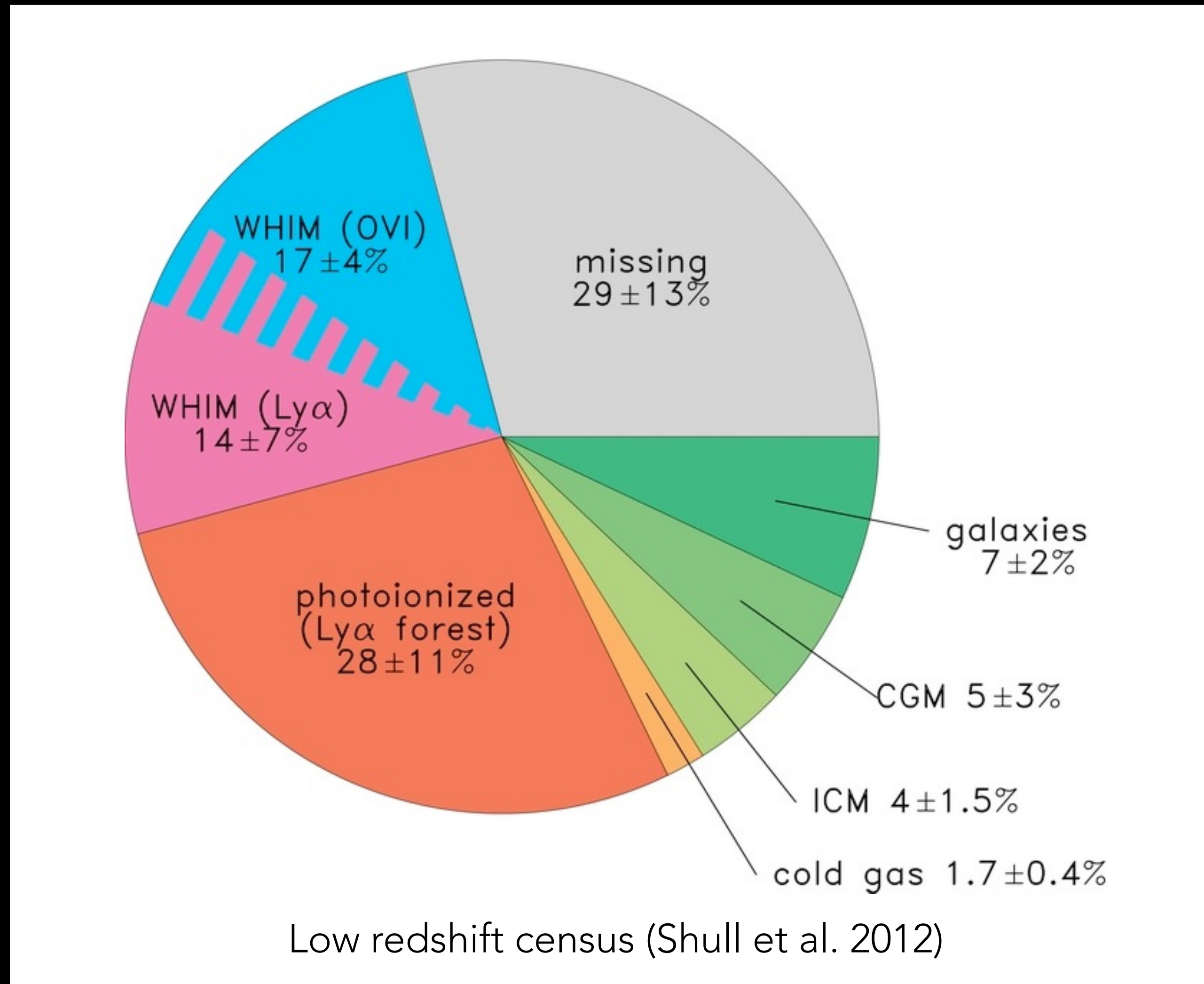
Cameron Hummels and Britton Smith

SIMULATING ISOLATED GALAXIES

THE NATURE OF GAS AROUND GALAXIES

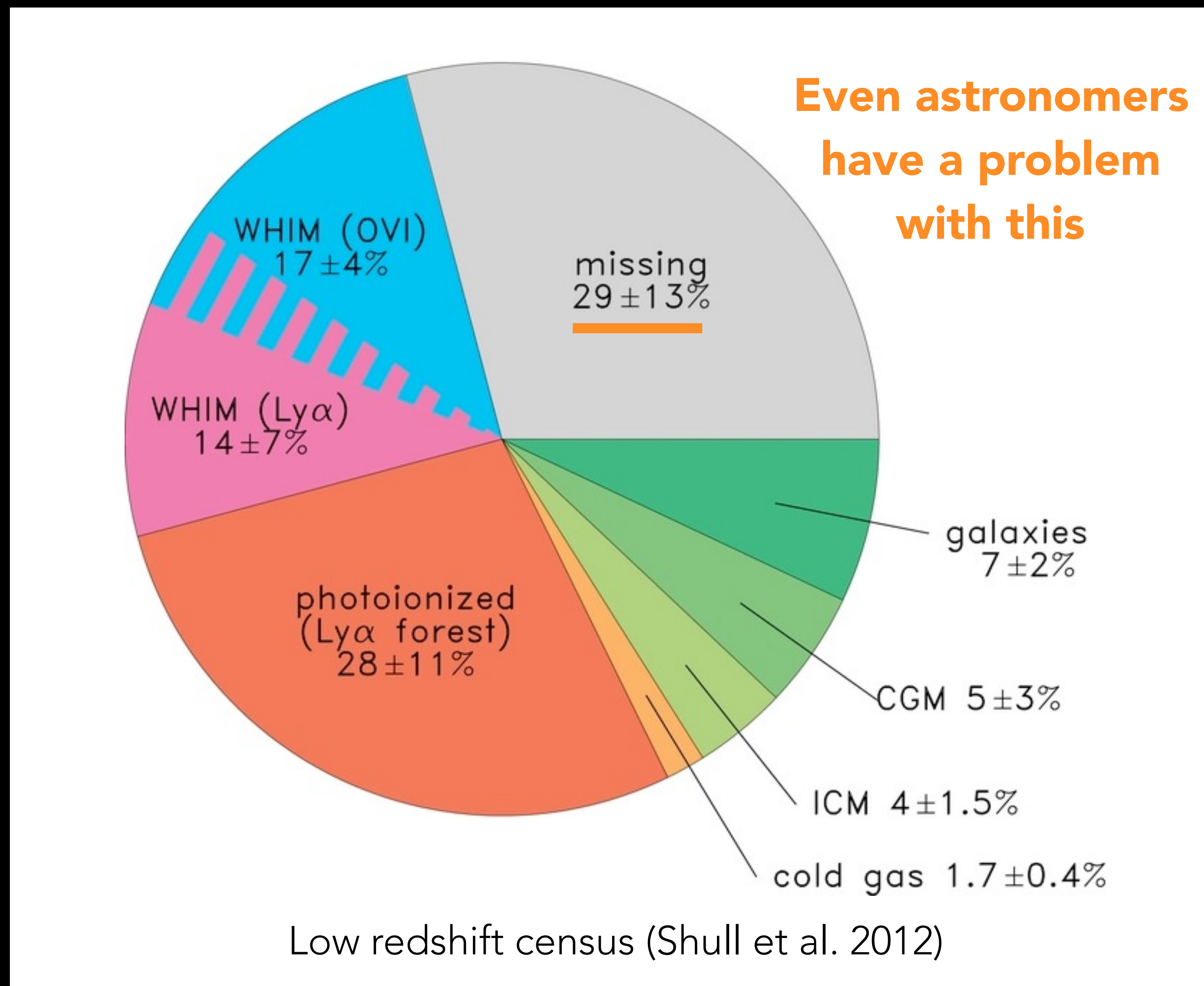
SIMULATING ISOLATED GALAXIES

THE NATURE OF GAS AROUND GALAXIES



SIMULATING ISOLATED GALAXIES

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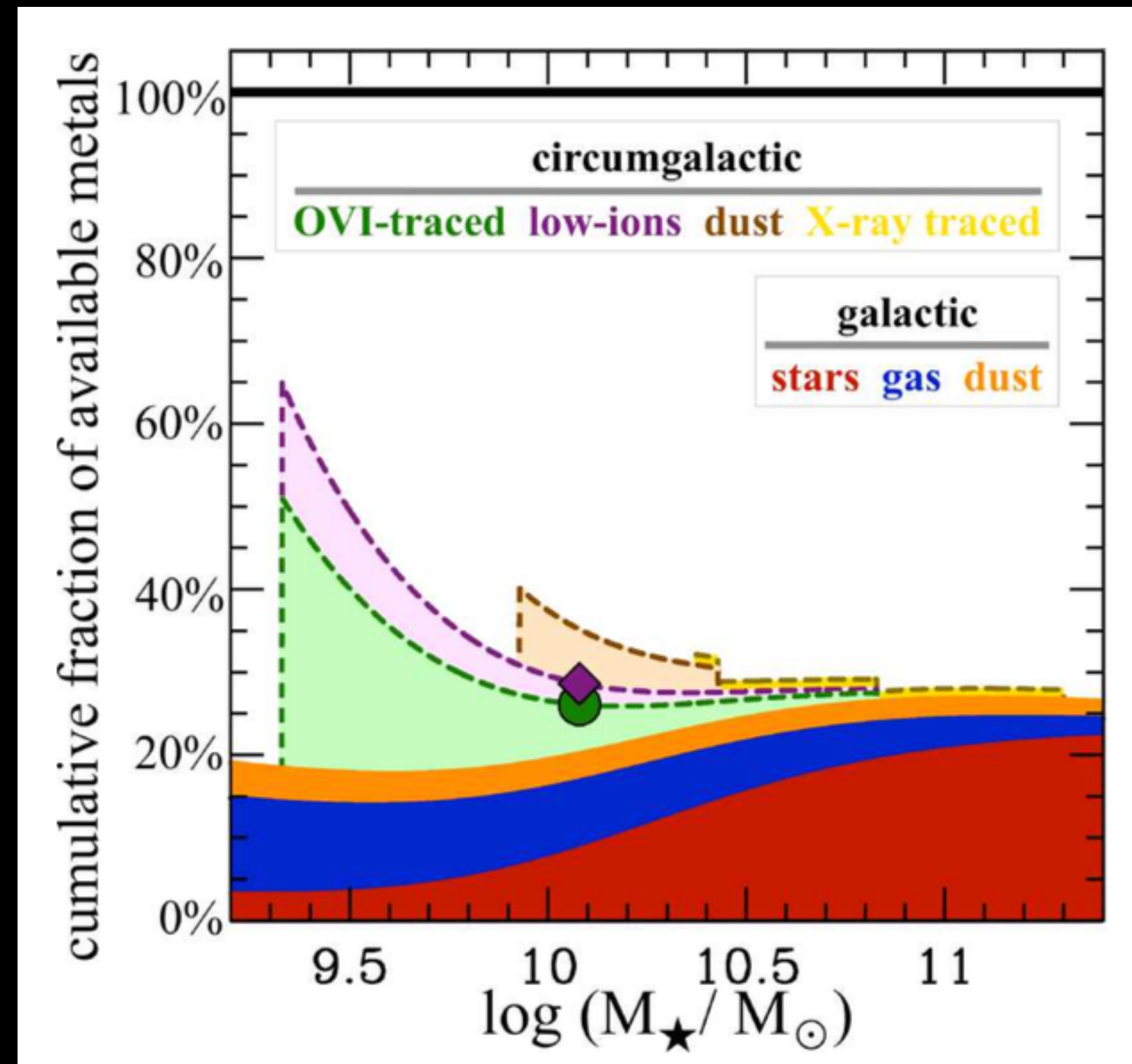


SIMULATING ISOLATED GALAXIES

THE NATURE OF GAS AROUND GALAXIES

Observations suggest the circumgalactic medium (CGM) is more baryon rich than expected.

(Tumlinson et al. 2011; Werk et al. 2014; **Peeples et al. 2014**)

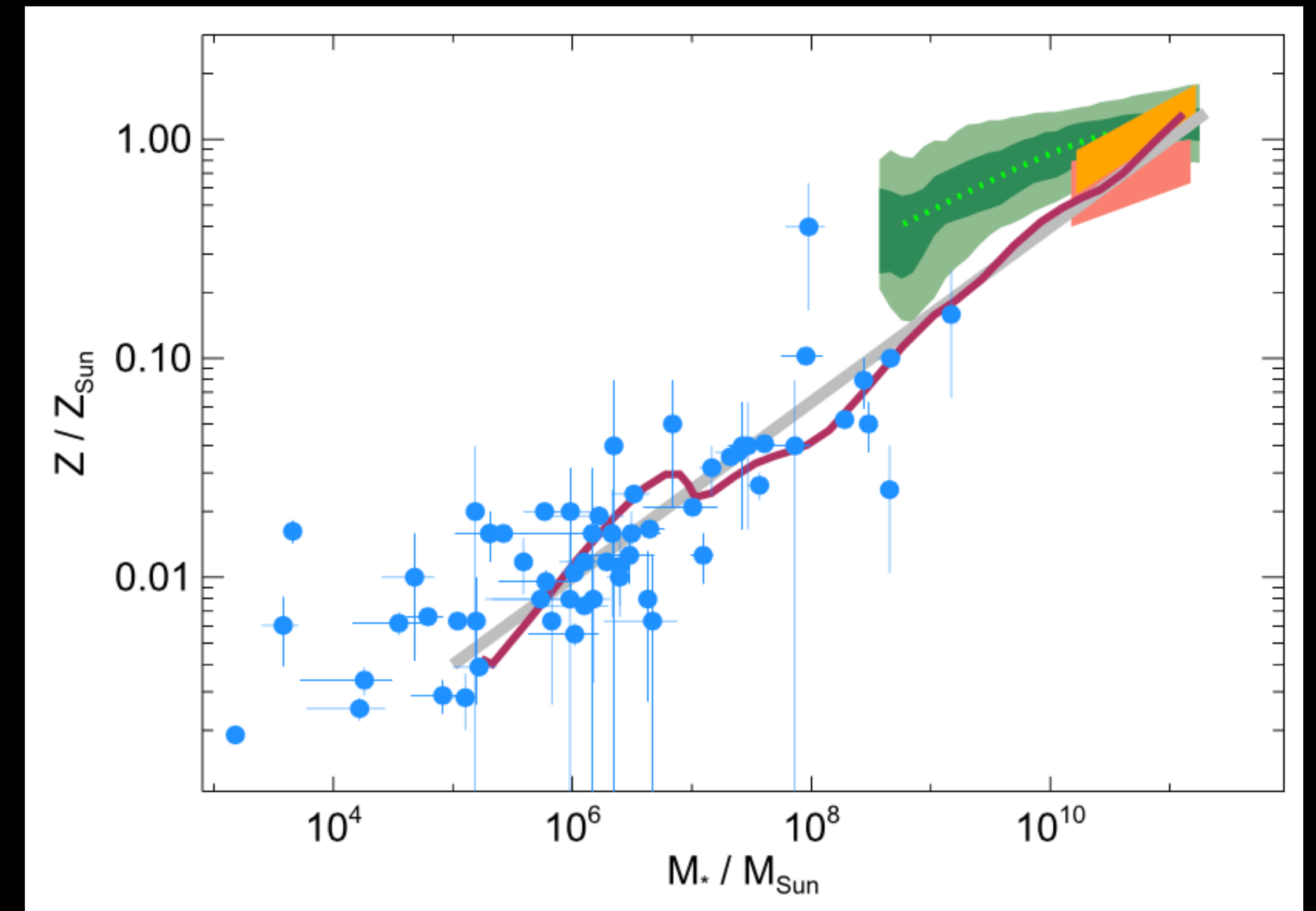
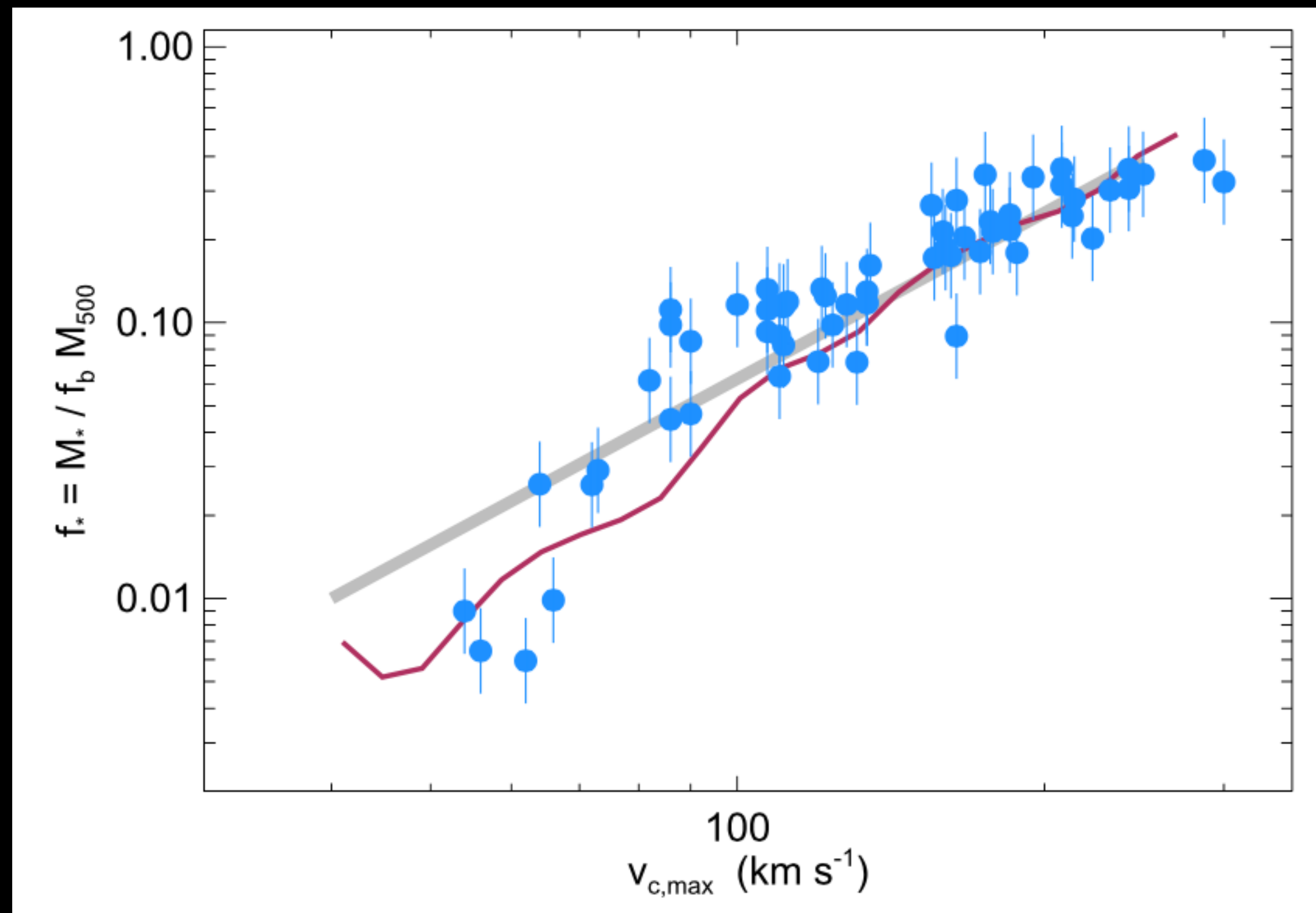


SIMULATING ISOLATED GALAXIES

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This medium plays a critical role in regulating star formation and galactic feedback.

(Voit et al. 2015)



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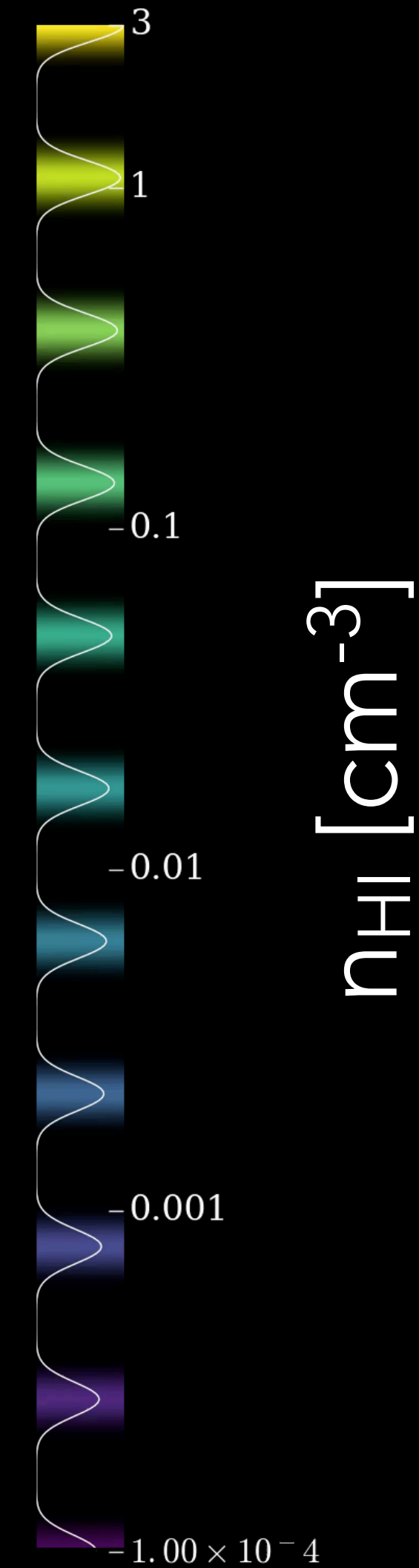
(Voit et al. 2015)

Can simulations be used to bridge the gap between observation and theory to better understand the CGM?

SIMULATING ISOLATED GALAXIES

THE NATURE OF GAS AROUND GALAXIES

$T = 0$ Myr



TempestCGM

THE SKY'S THE LIMIT

WHAT CAN WE DO WITH THESE?

We get to choose:

galaxy mass

galaxy metallicity

halo mass

halo temperature/entropy profile

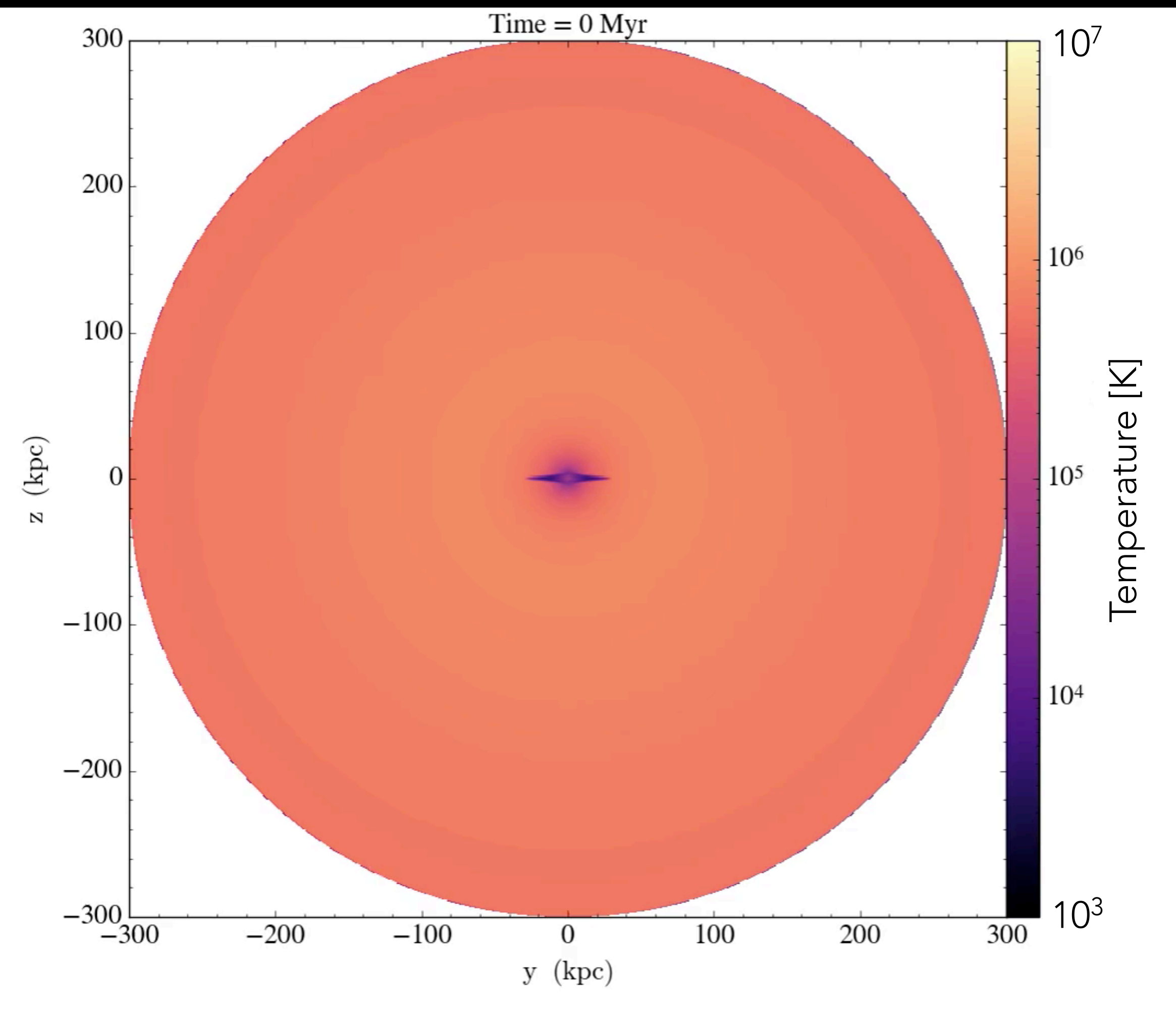
star formation prescription

stellar feedback model

...

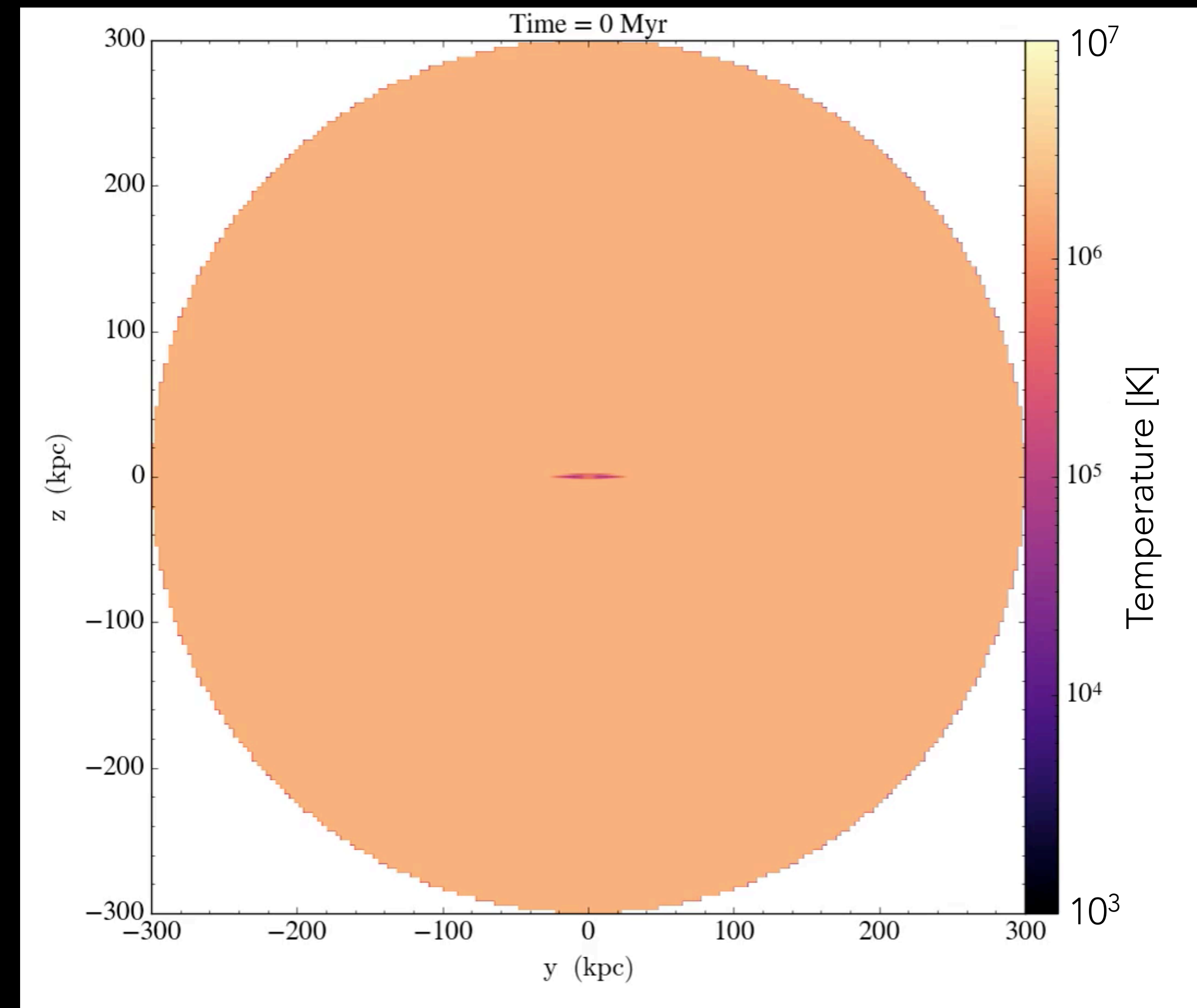
We also have a lot of control over resolution!

So, what do they look like?



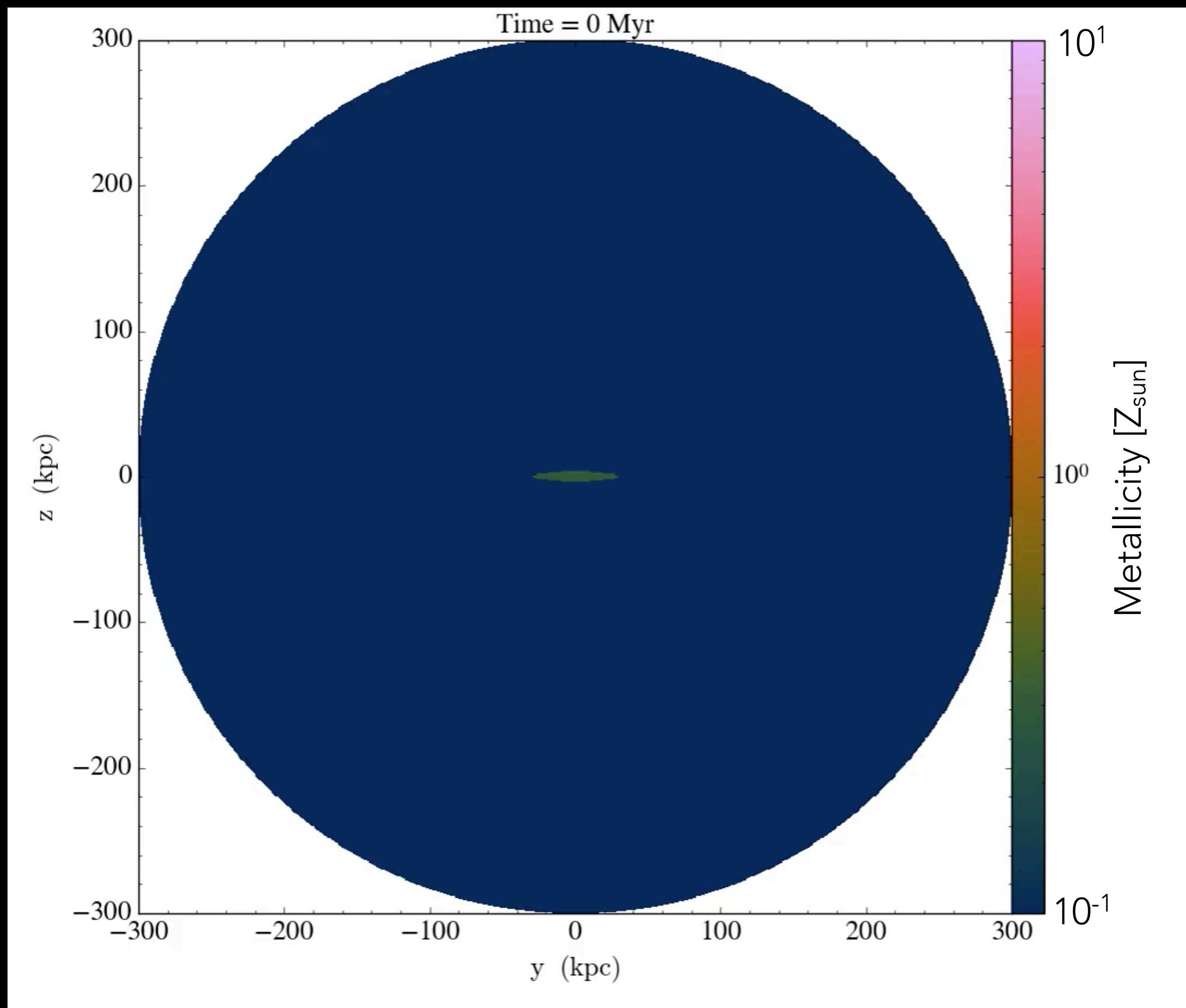
1600 pc CGM resolution
400 pc disk resolution

large $M_{\text{gas,disk}}$
 $Z_{\text{disk}} = 0.3 Z_{\text{sun}}$
 $Z_{\text{halo}} = 0.1 Z_{\text{sun}}$
 Cen Ostriker SF and FB
 steep power-law S-profile



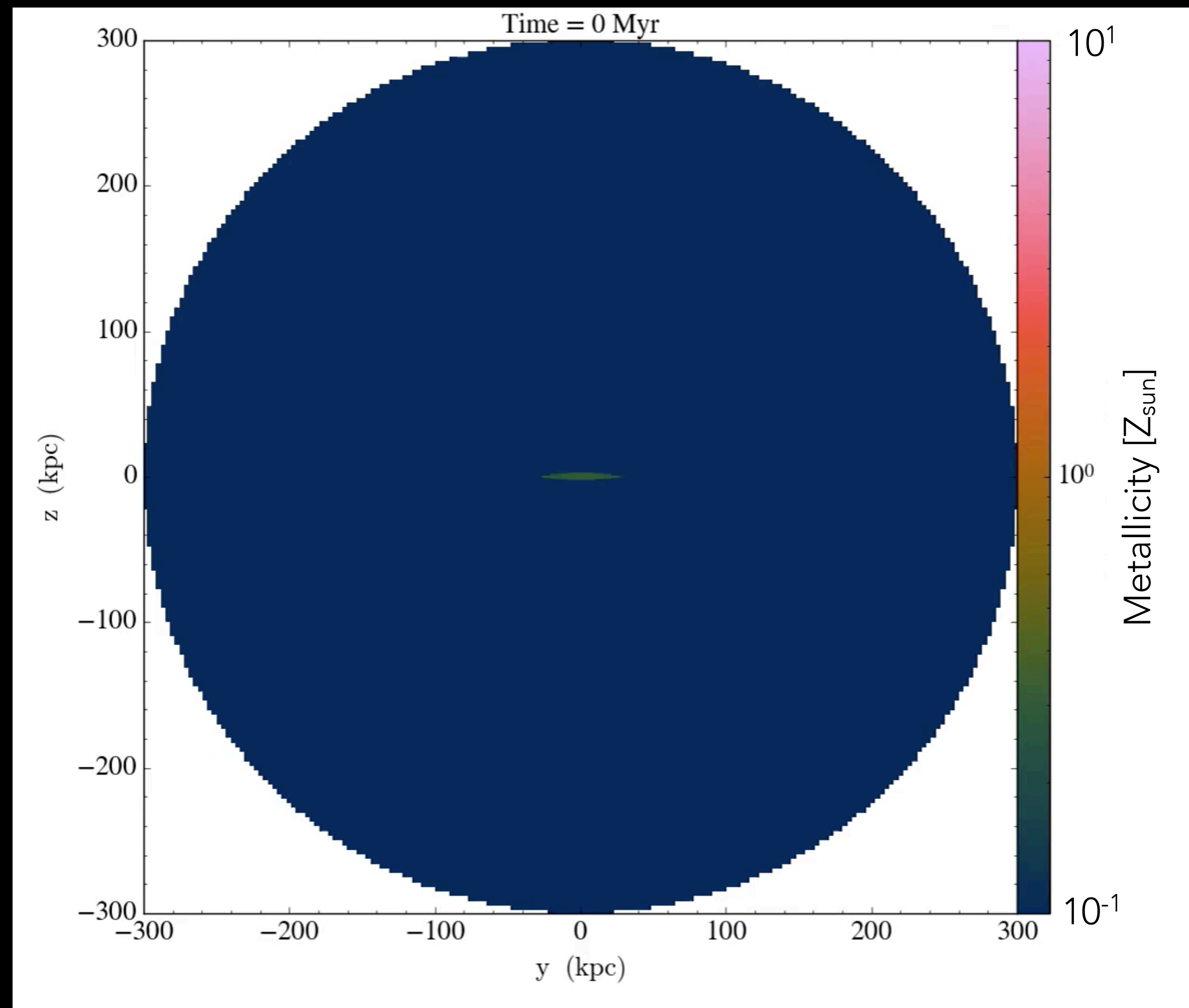
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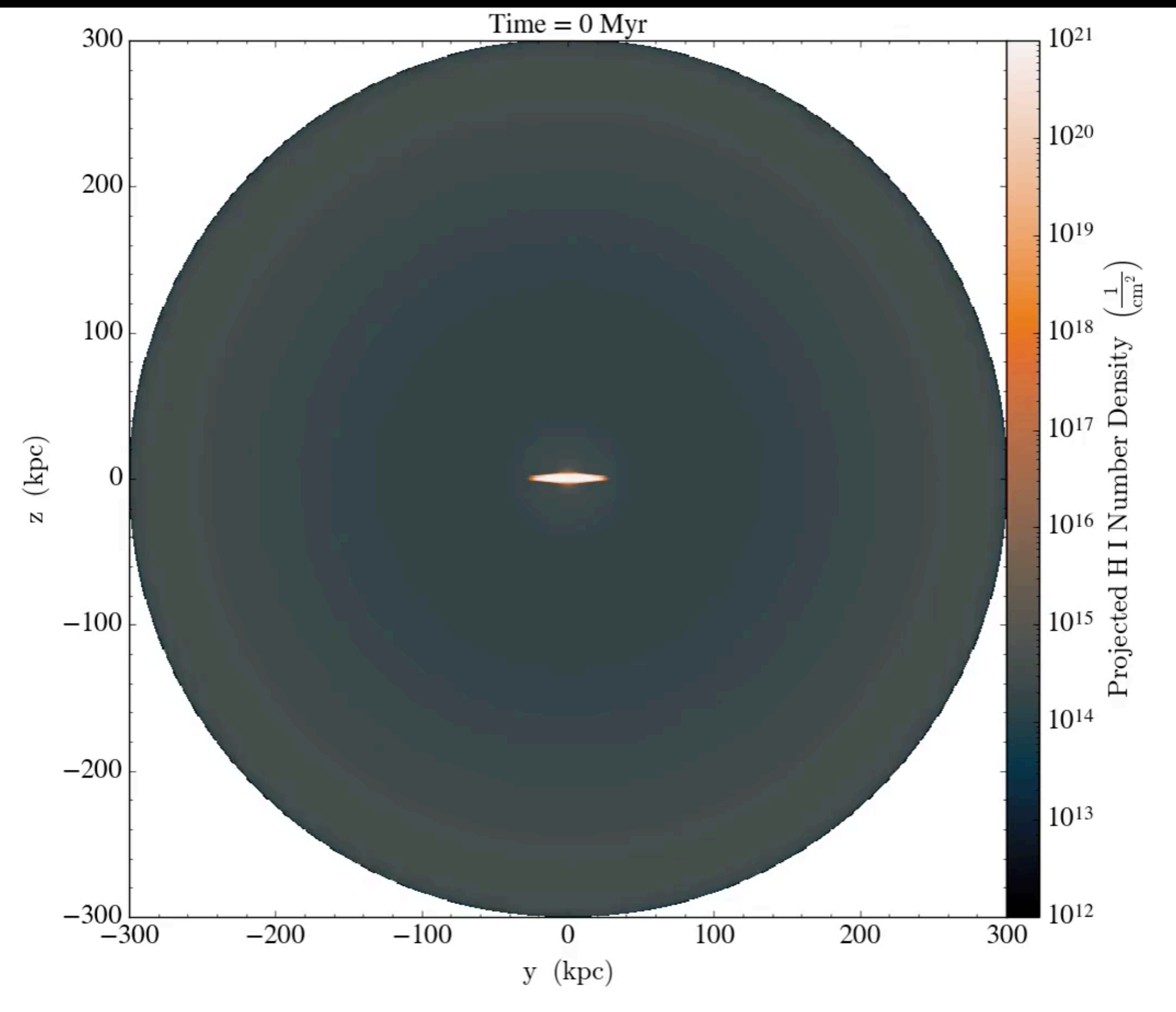
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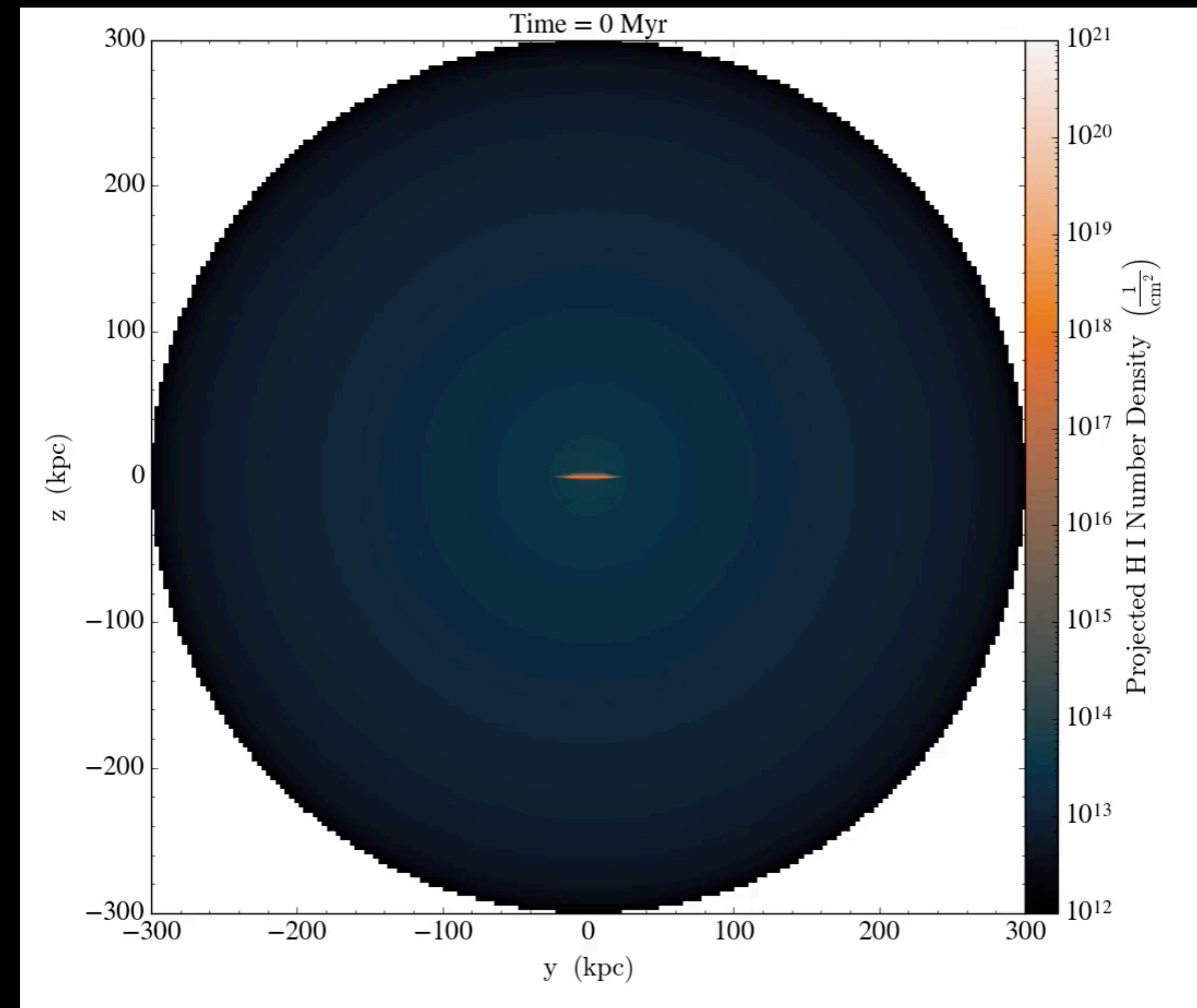
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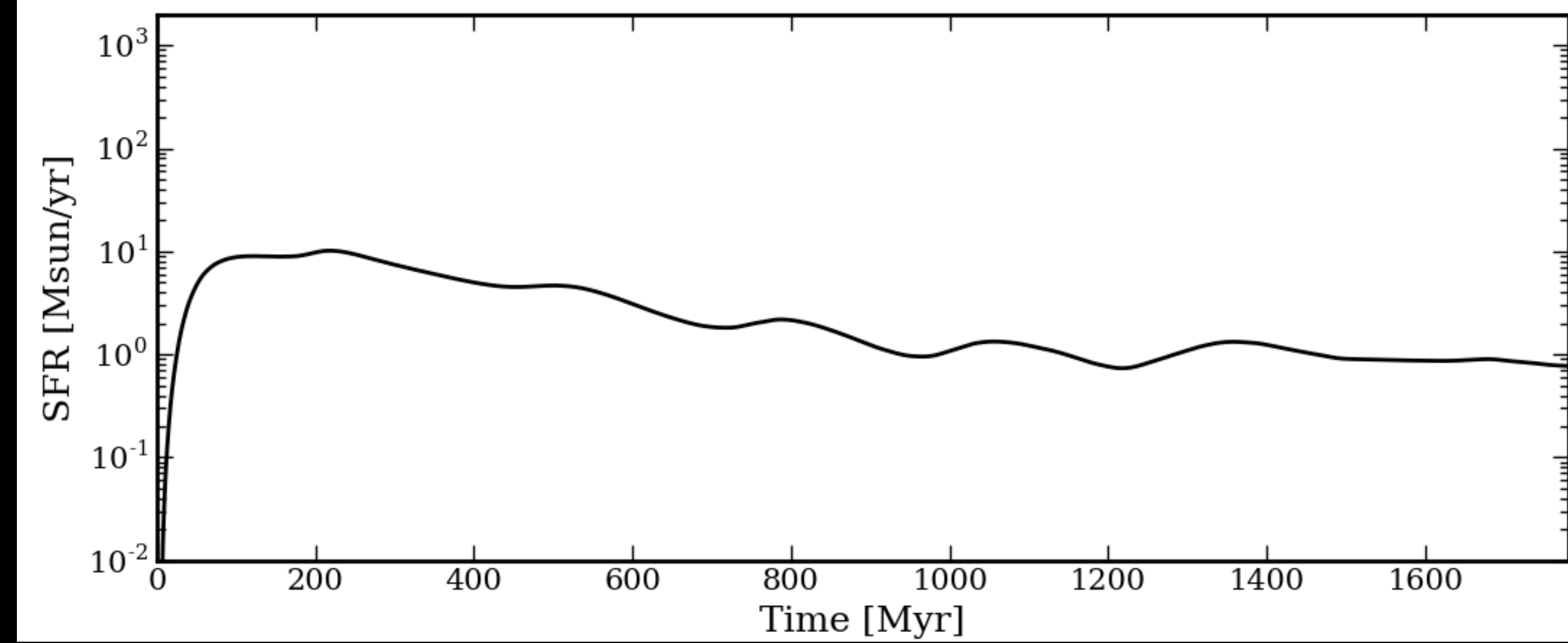
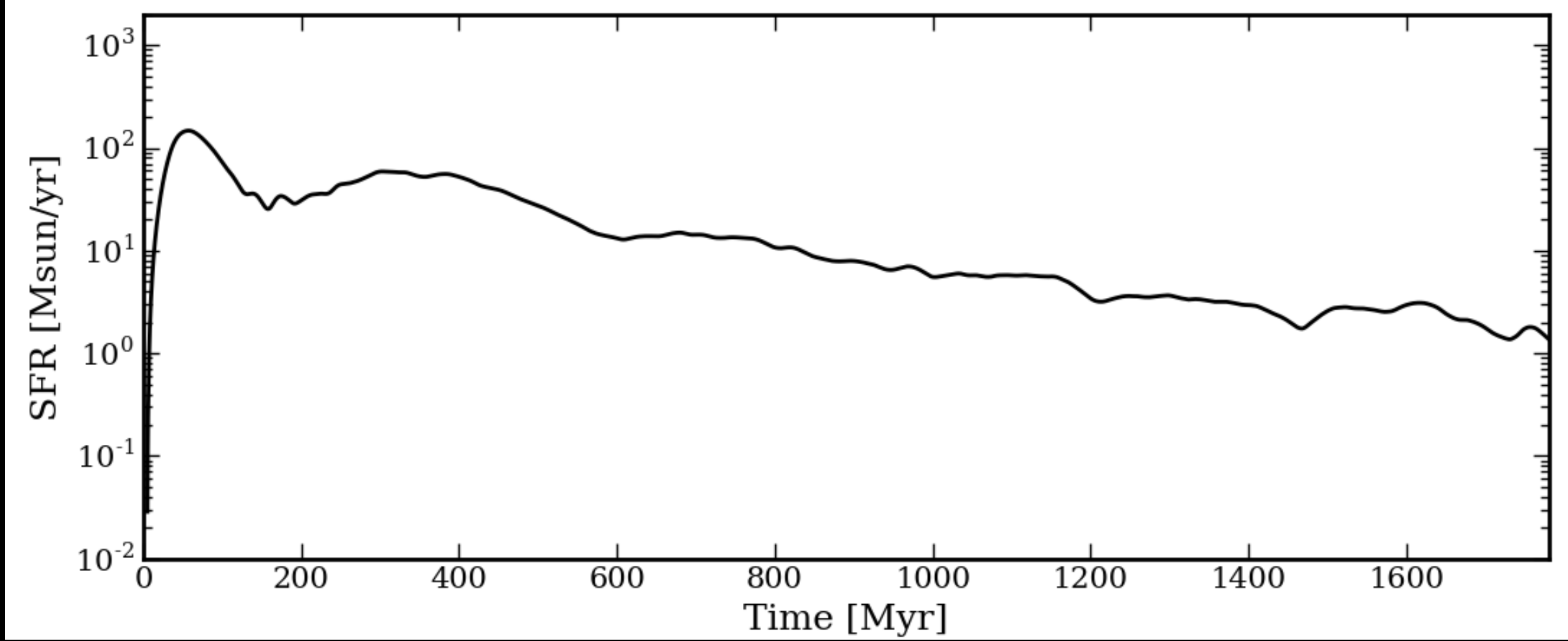
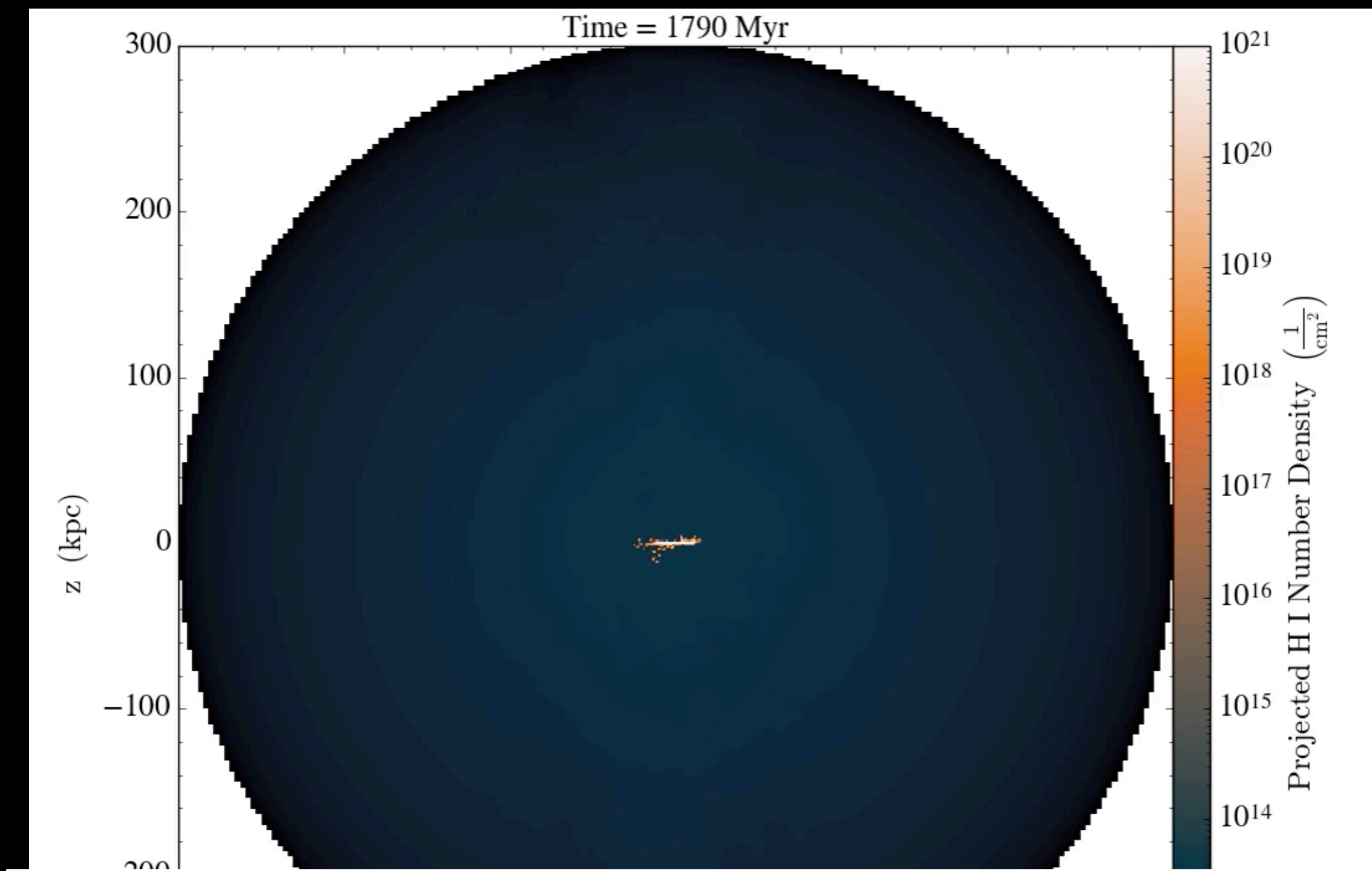
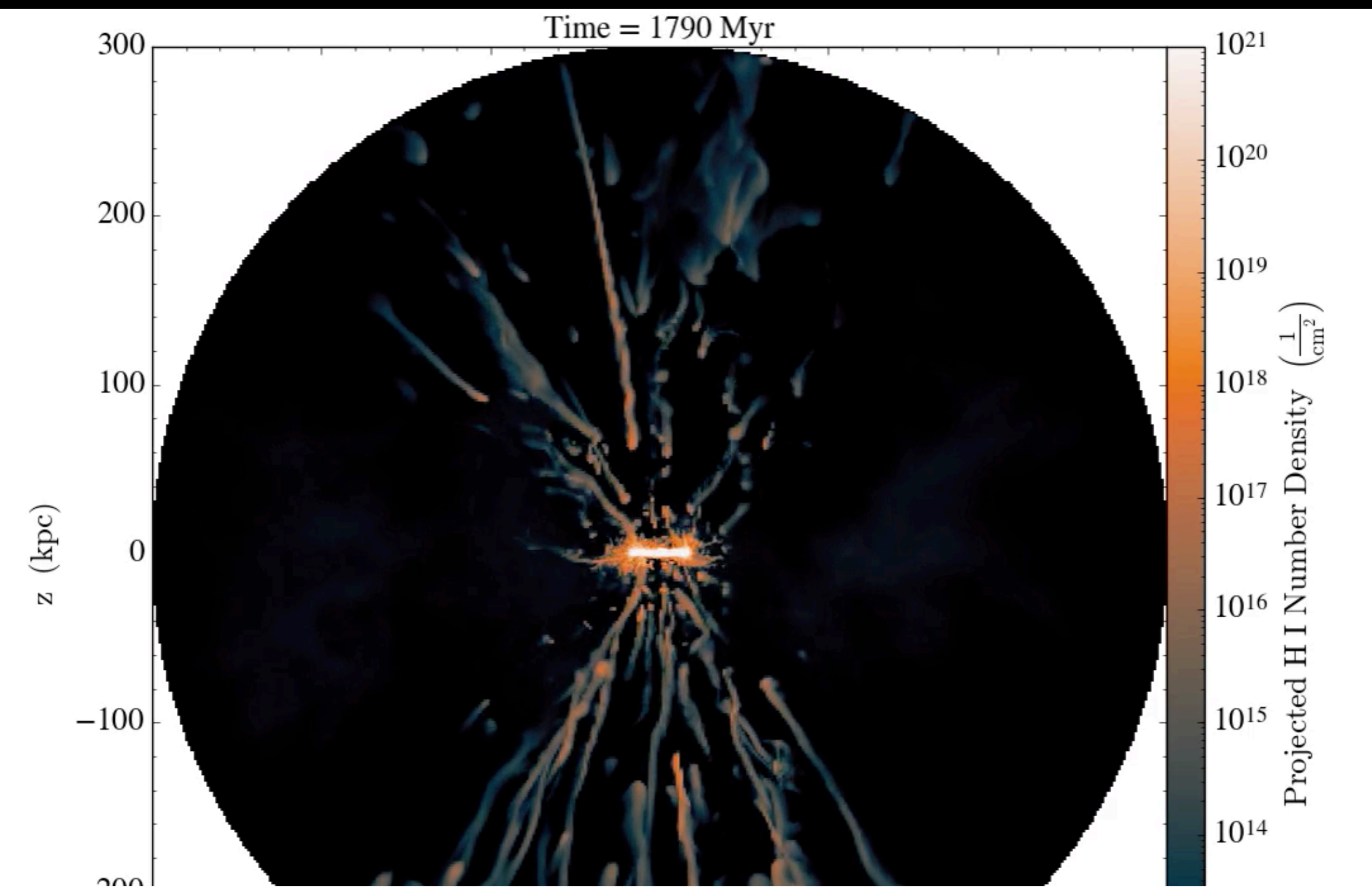
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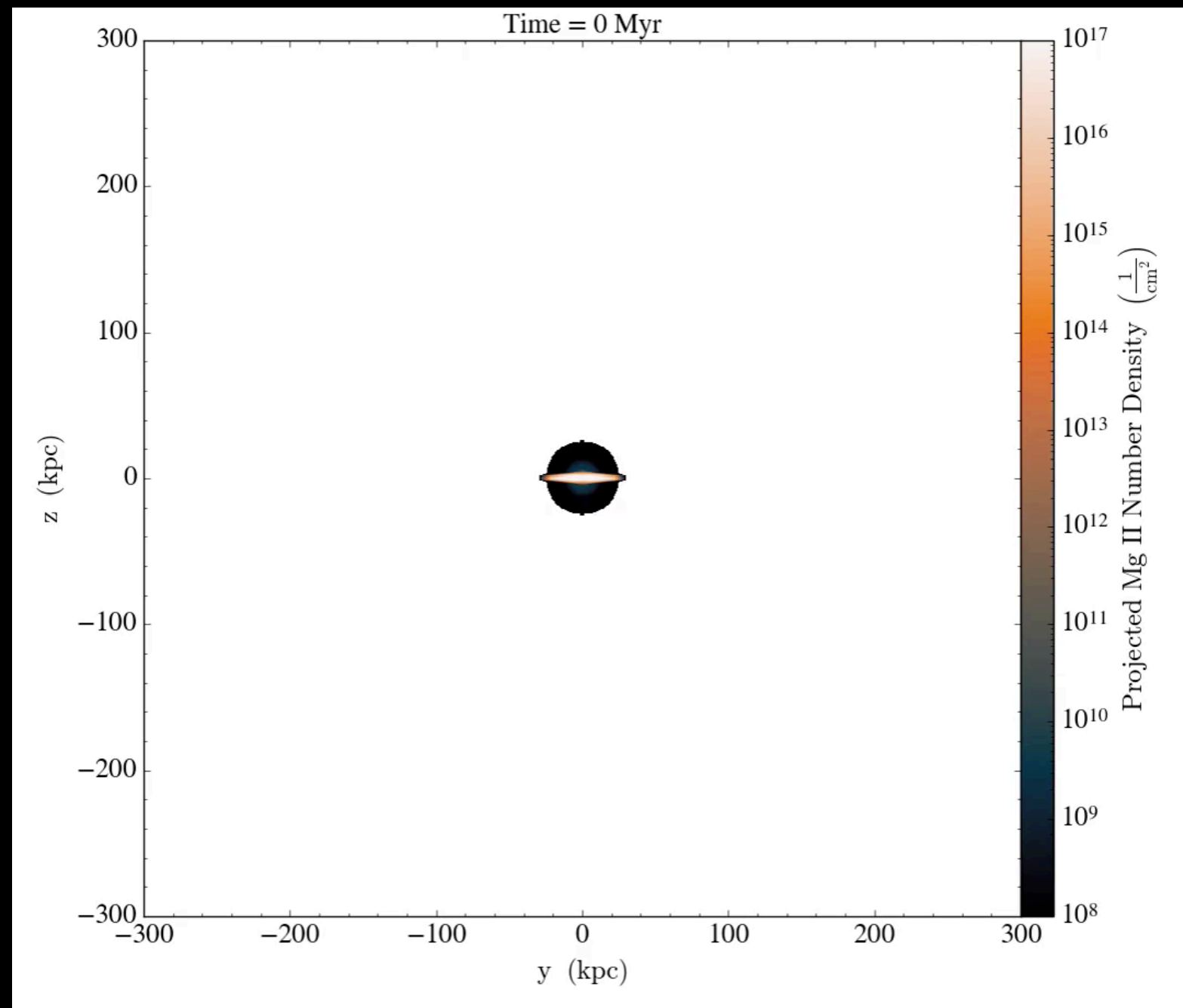
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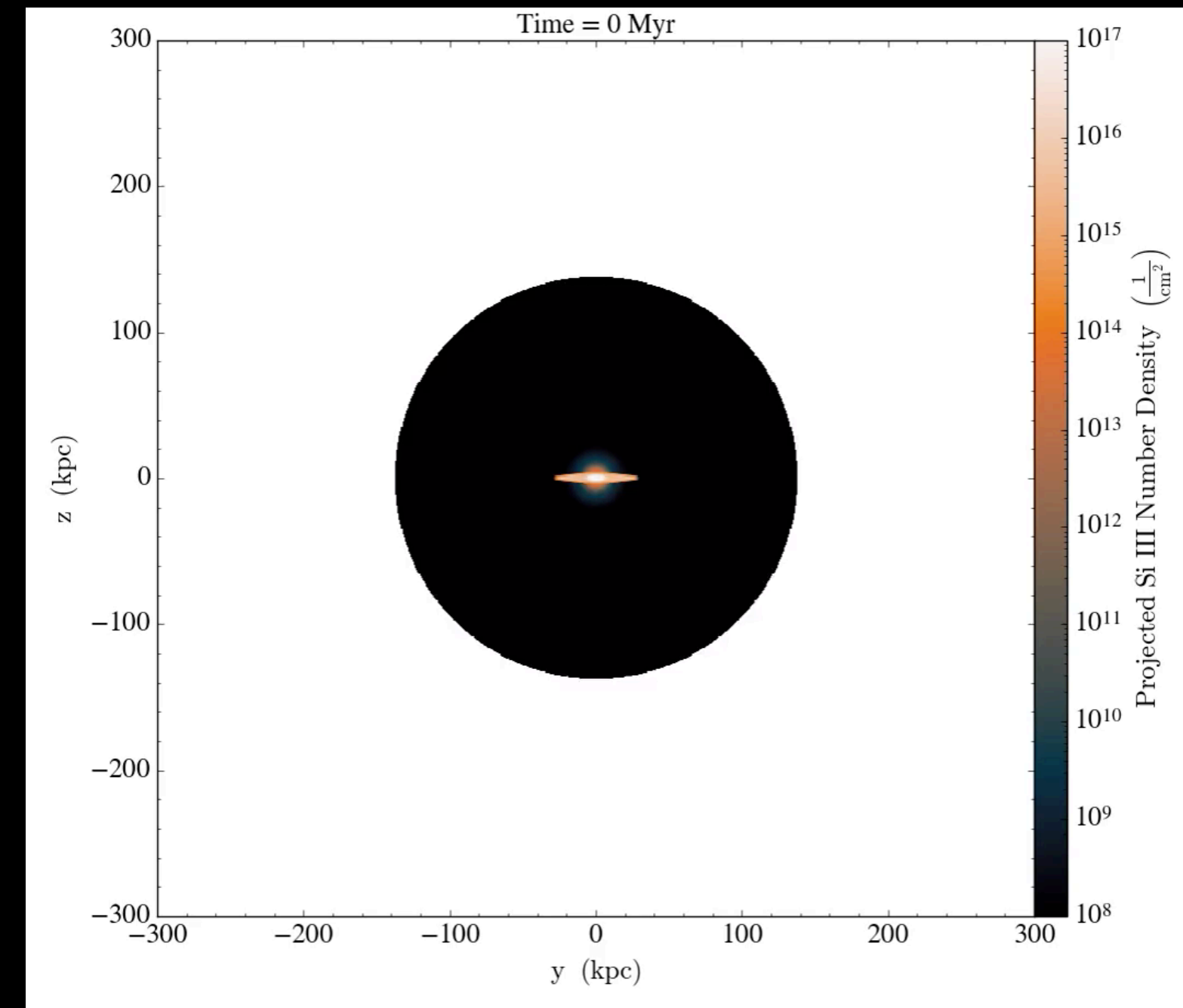


star formation histories

Mg II

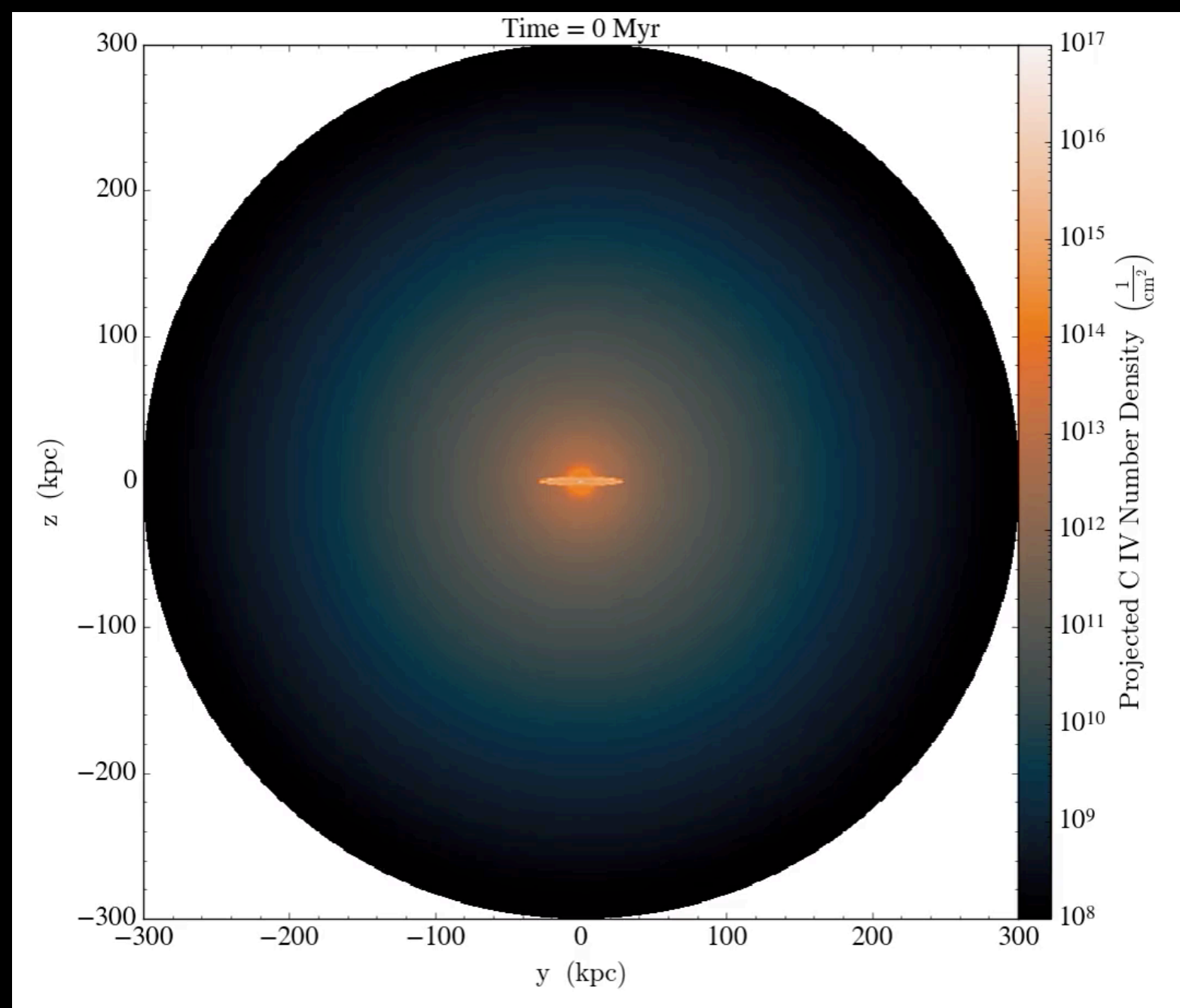


Si III

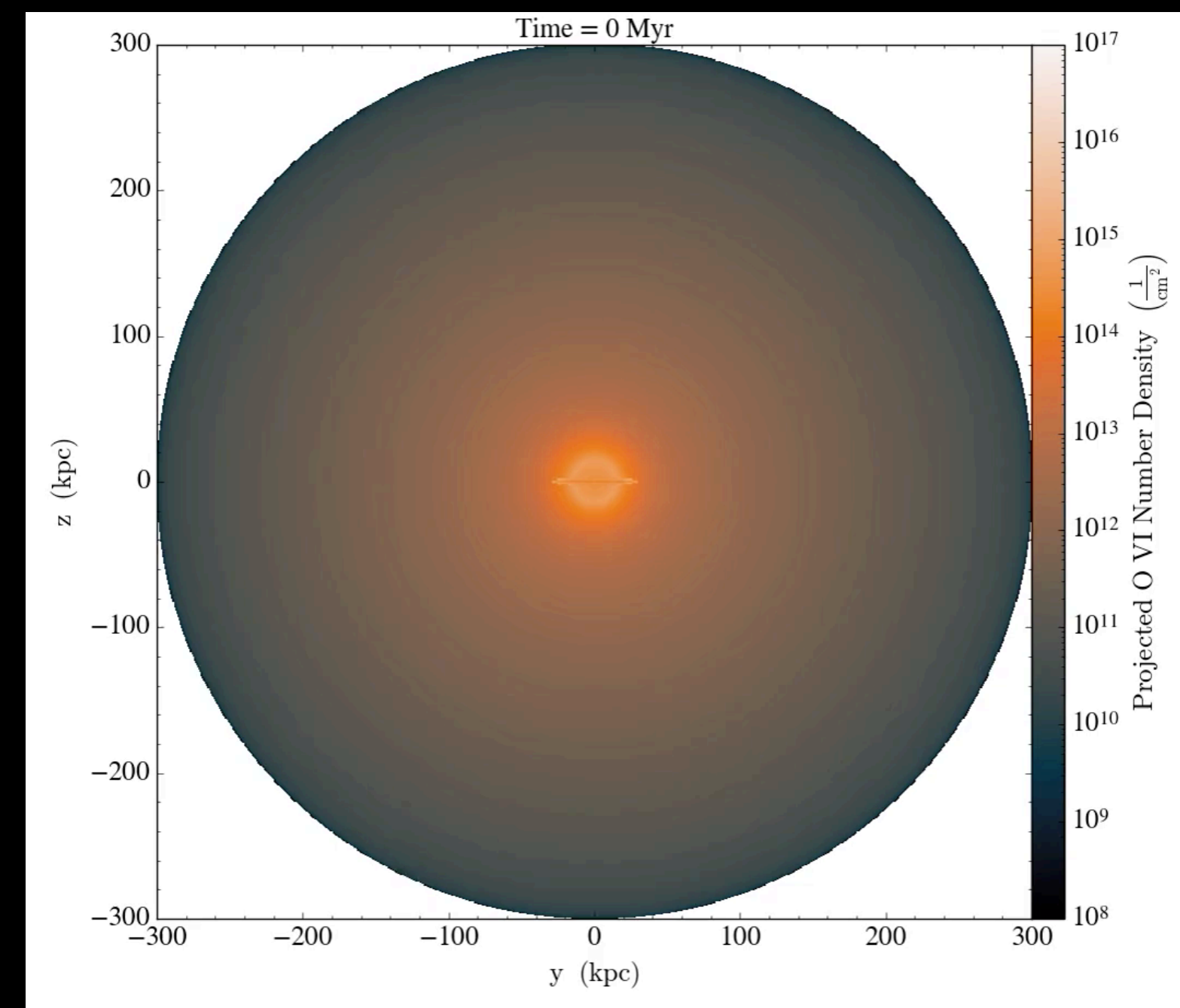


 **Trident** <http://trident-project.org>
Documentation: <http://trident.readthedocs.io>

C IV

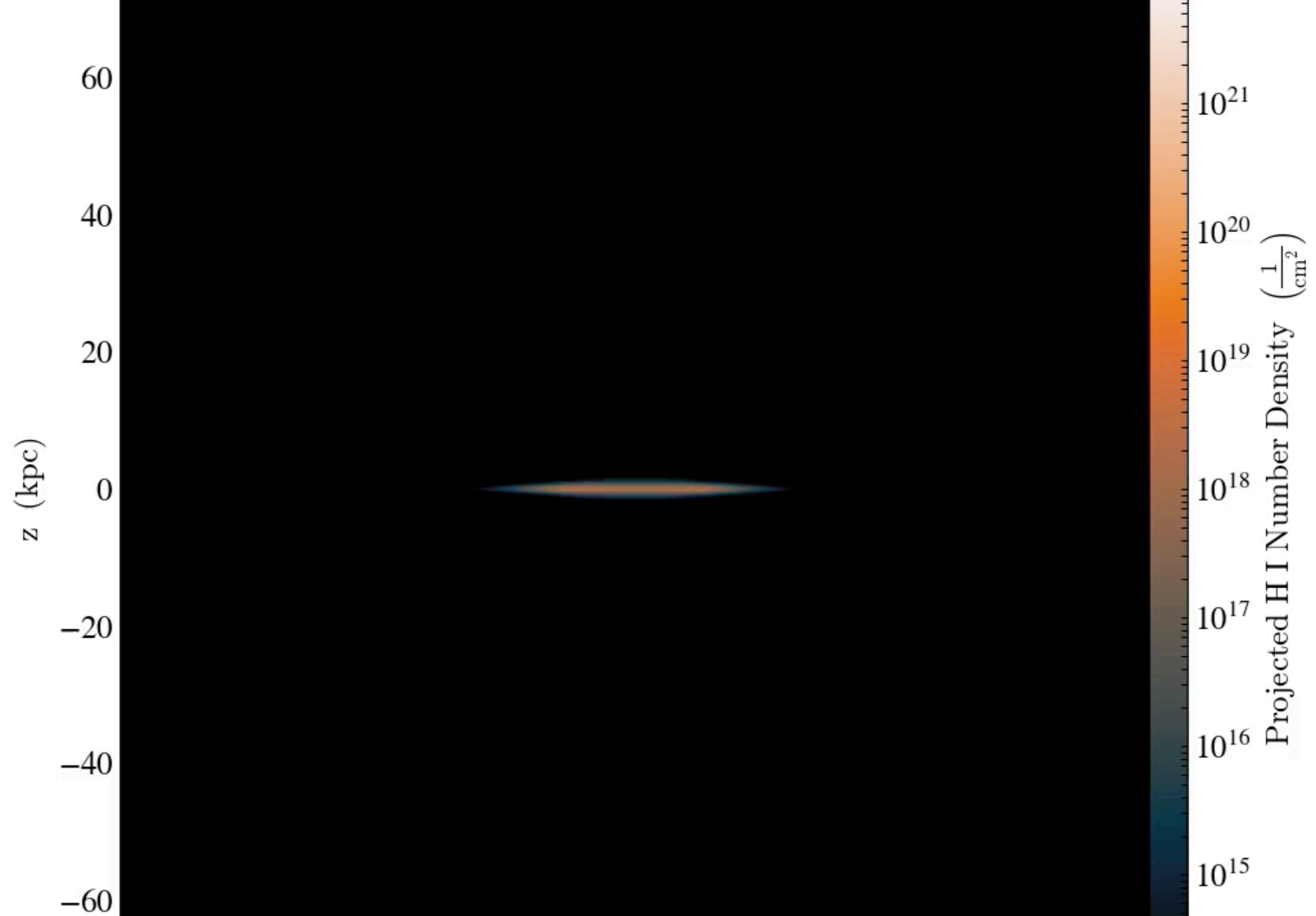


O VI



(for "starburst" simulation)

Diving in...

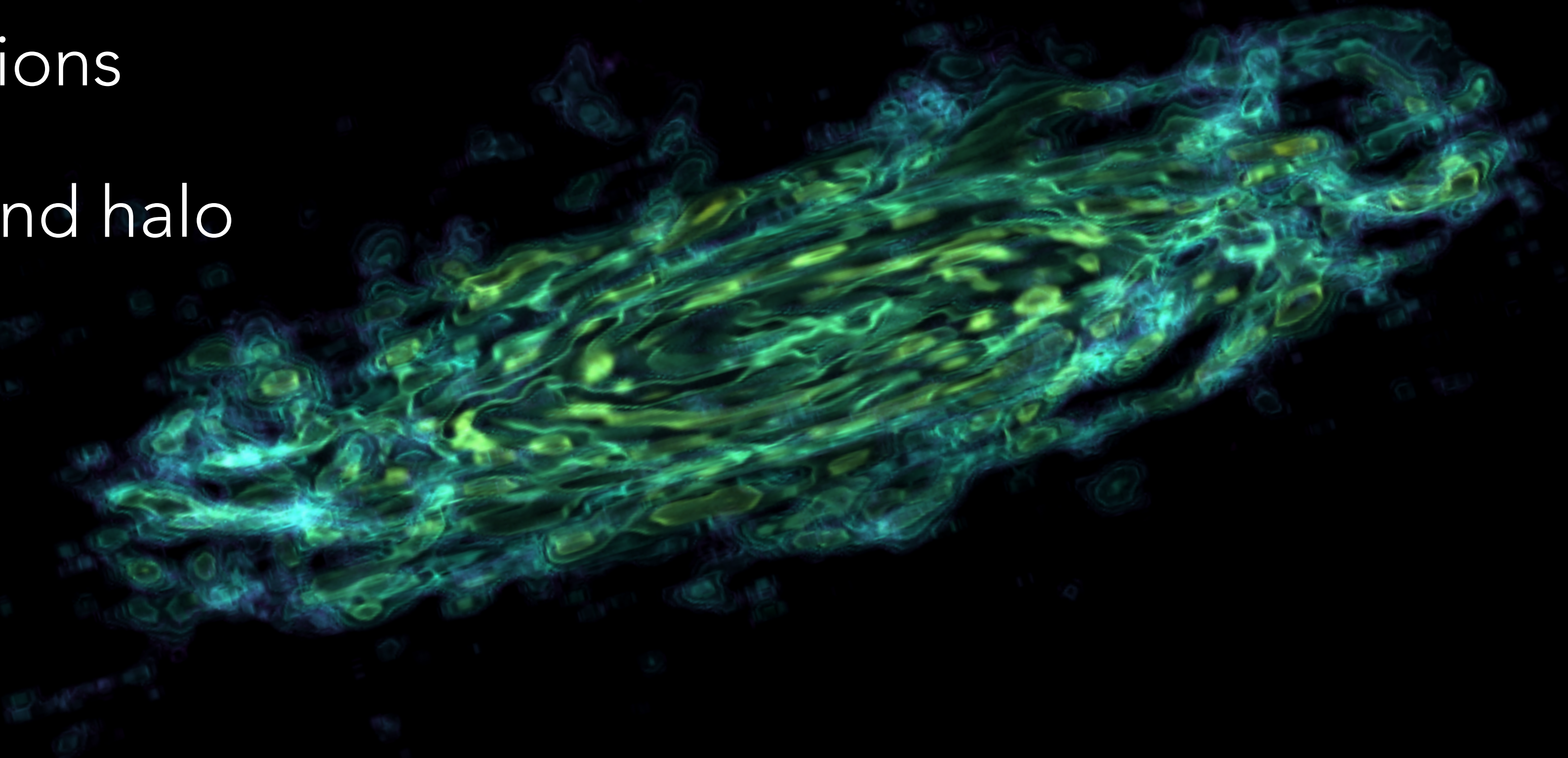


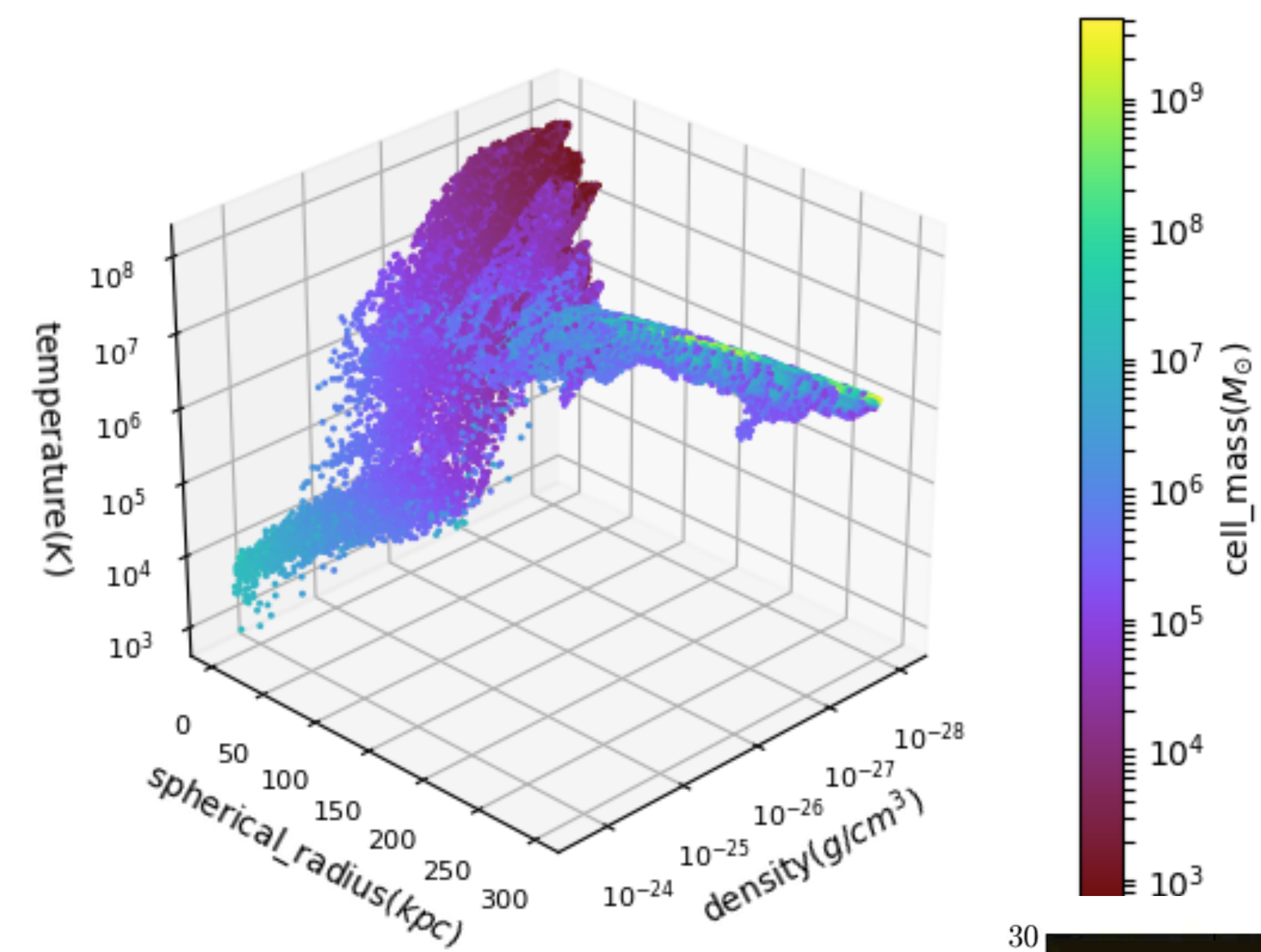
Other things we're exploring

Looking for condensation/
precipitation as a function of radius

Changing star formation and
feedback prescriptions

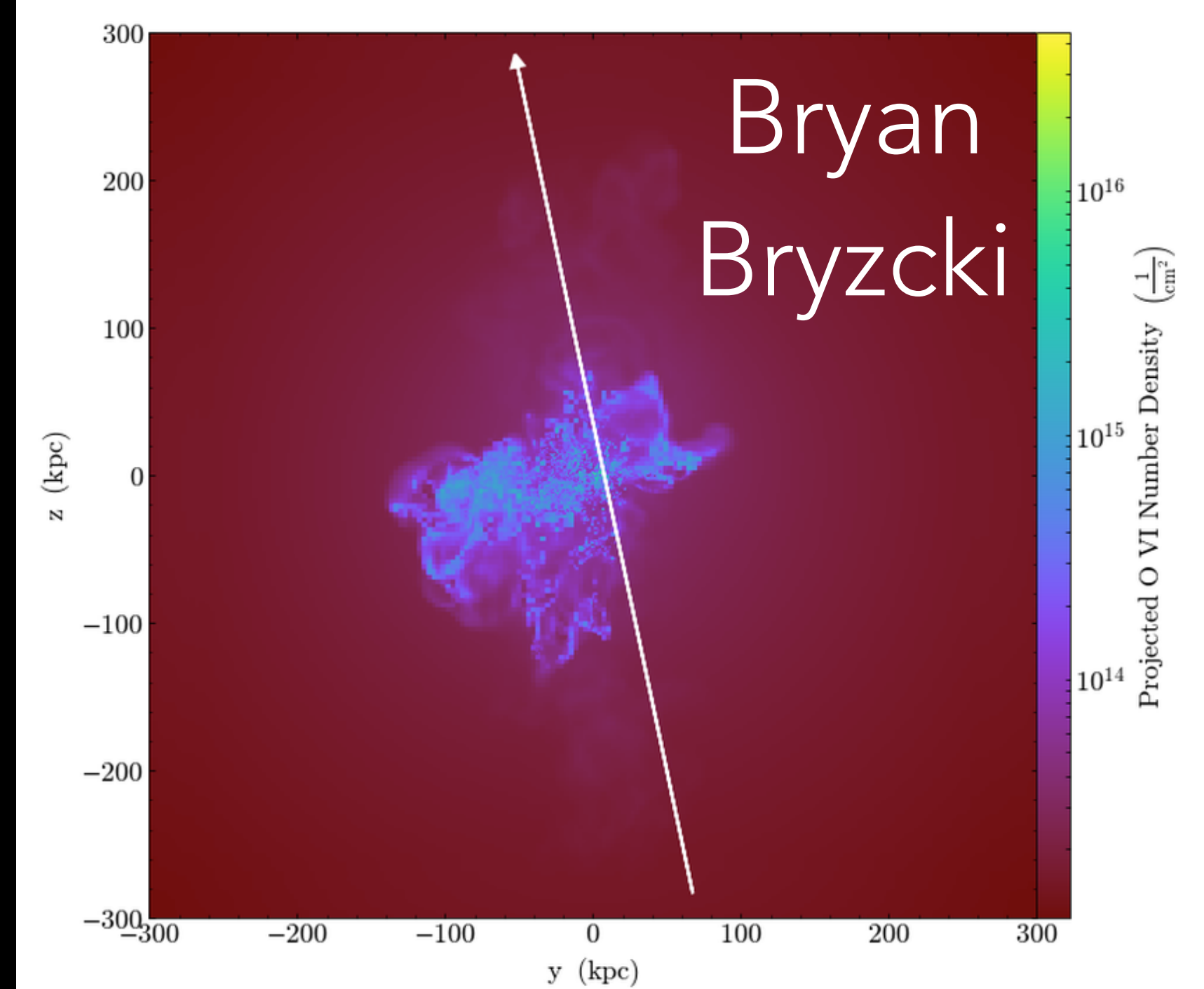
Altering galaxy mass and halo
properties





AWESOME STUDENT
DRIVEN SCIENCE!

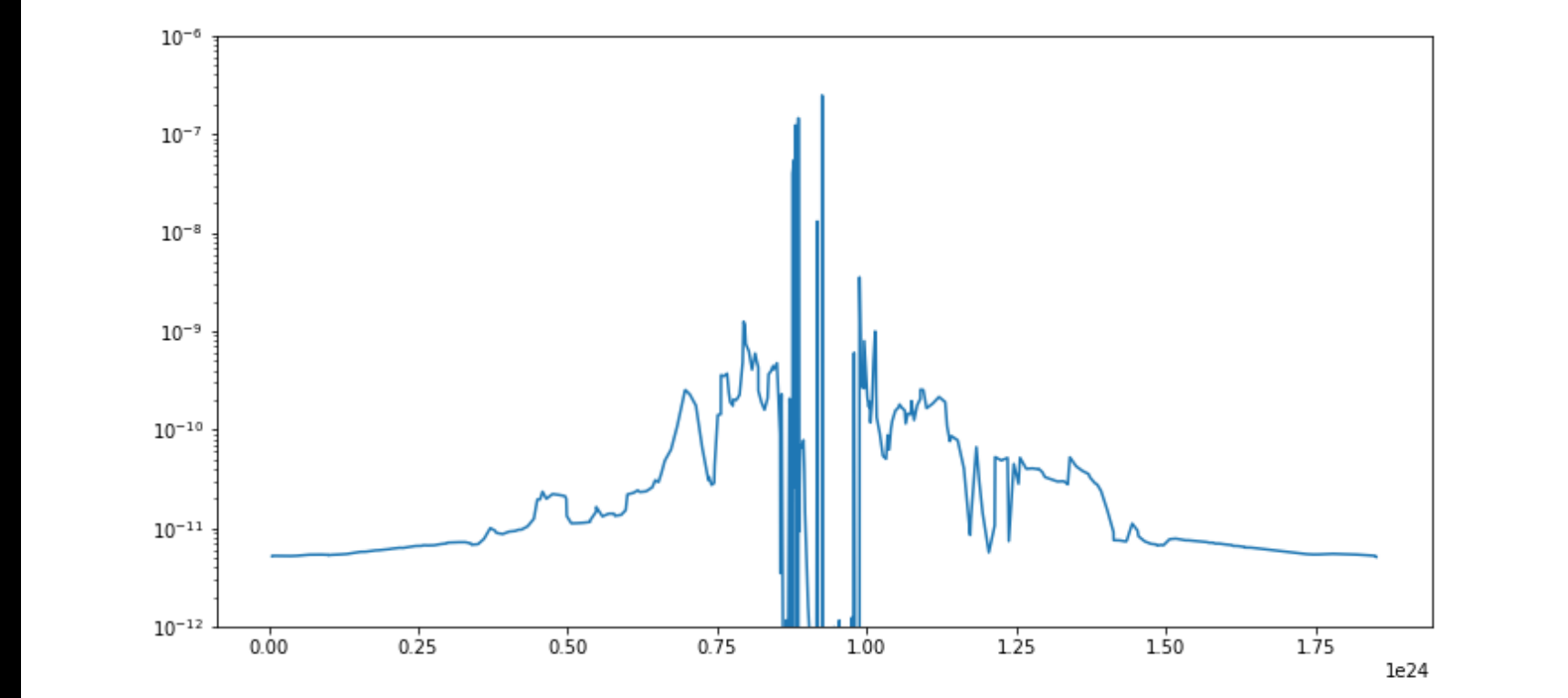
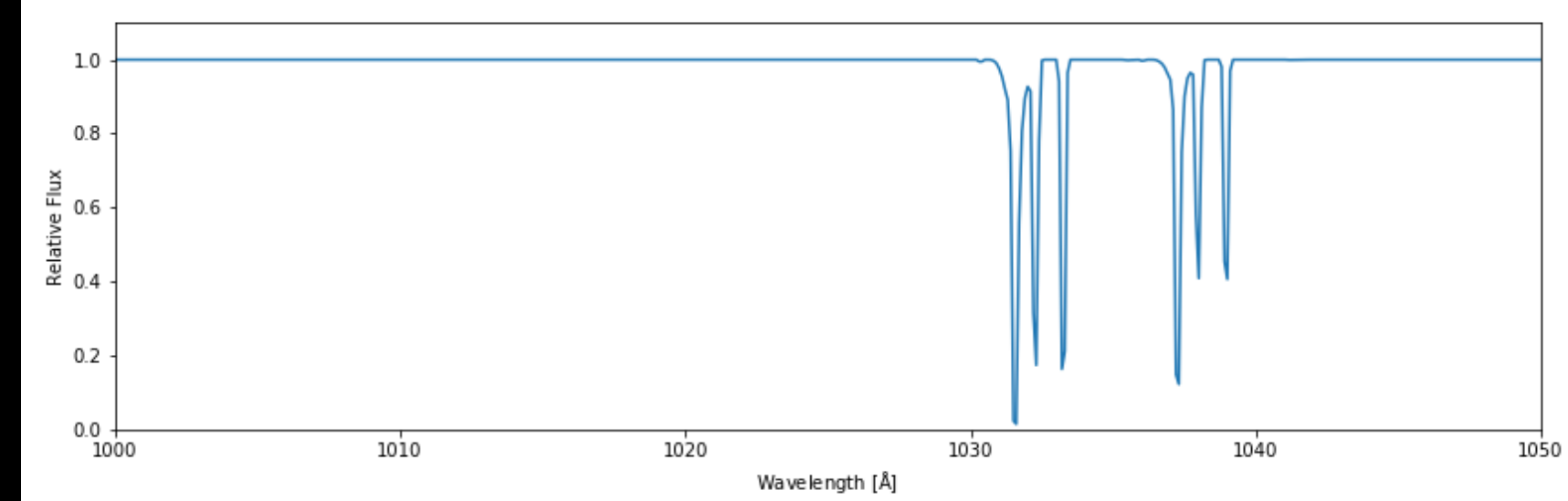
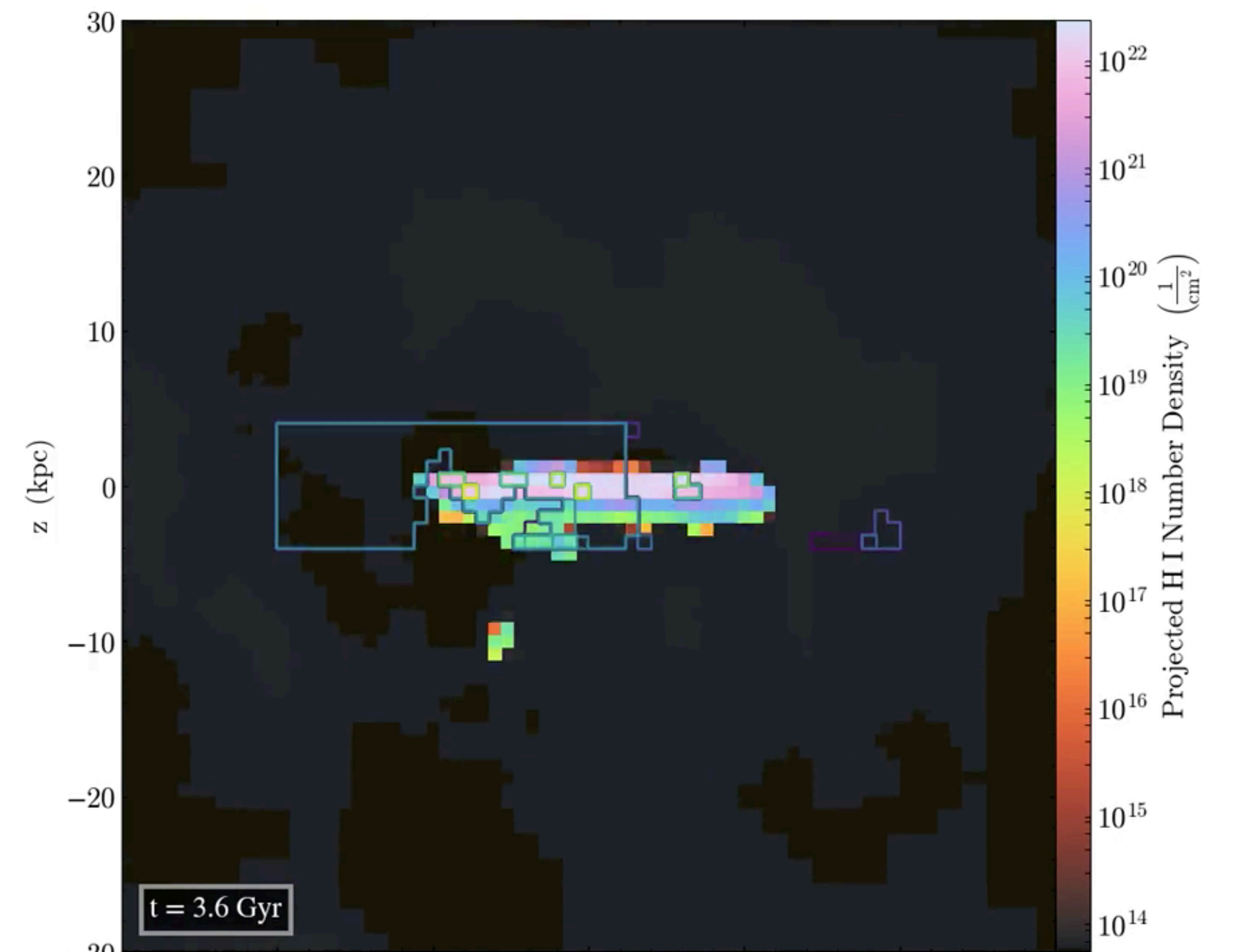
WORK IN
PROGRESS



^^Austin Gilbert

Members of the
MSU Galaxies Group

David Crowe >>



THANKS!

QUESTIONS?

