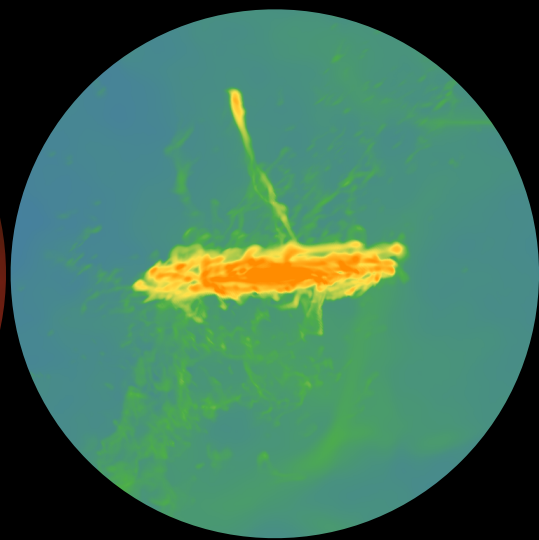
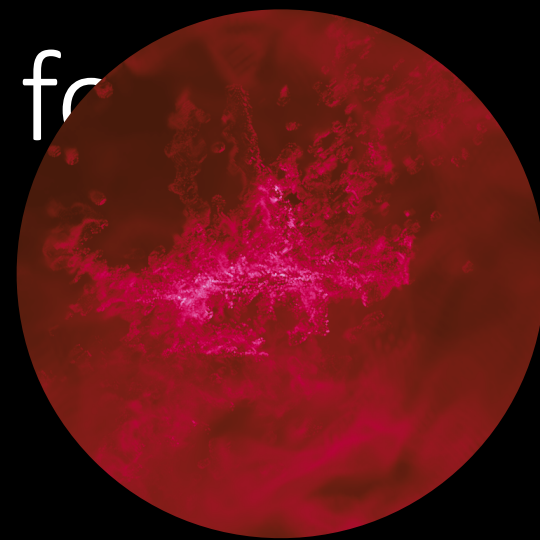


Galactic Feedback Affects Predictions for CGM Emission

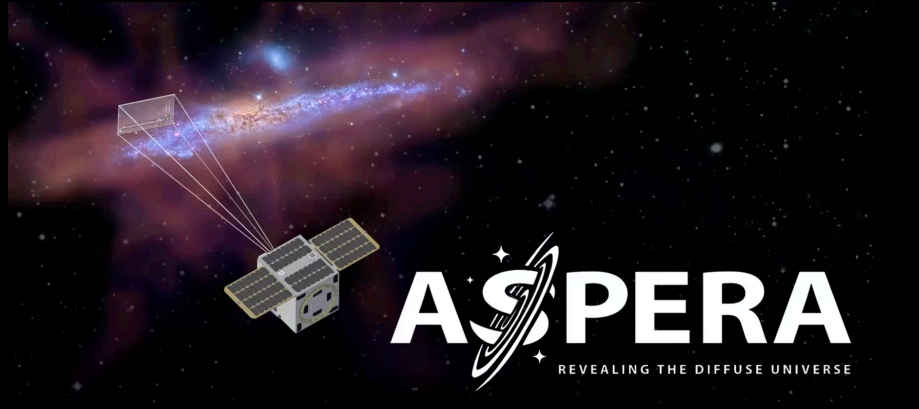
Cassi Lochhaas



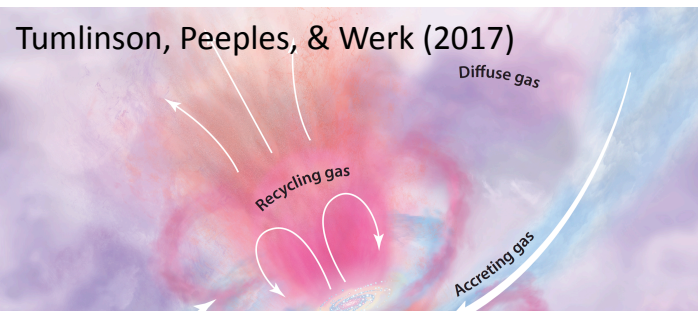
CENTER FOR **ASTROPHYSICS**
HARVARD & SMITHSONIAN



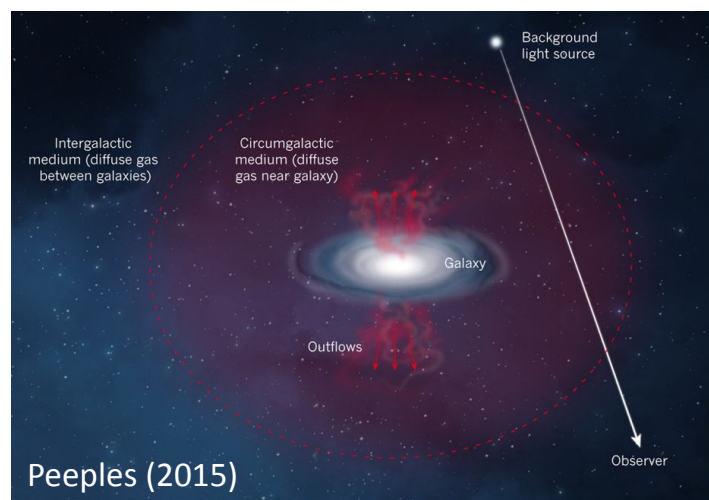
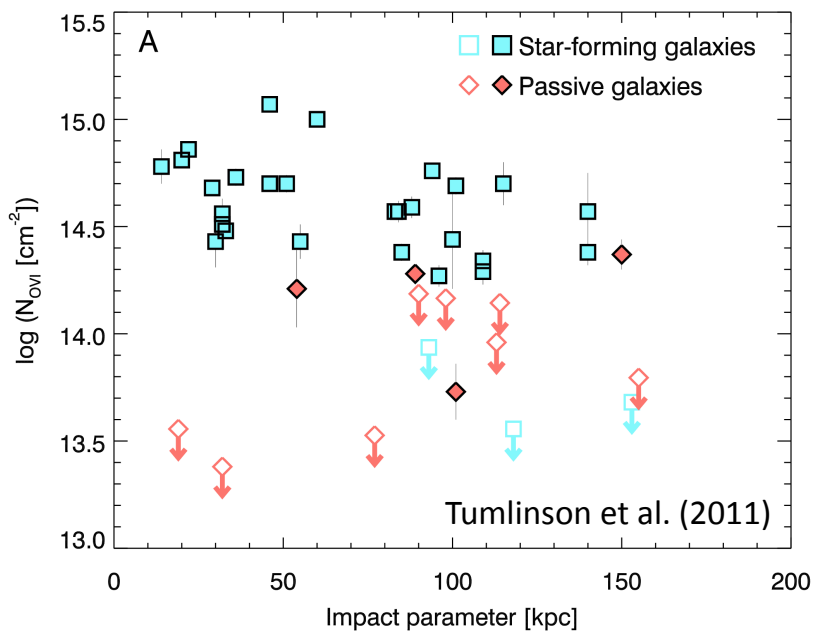
F I G G I E
Figuring Out Gas & Galaxies In Enzo



Observing the Circumgalactic Medium



CGM is home to gas flows into and out of galaxies and is crucially important for regulating or promoting galaxy evolution

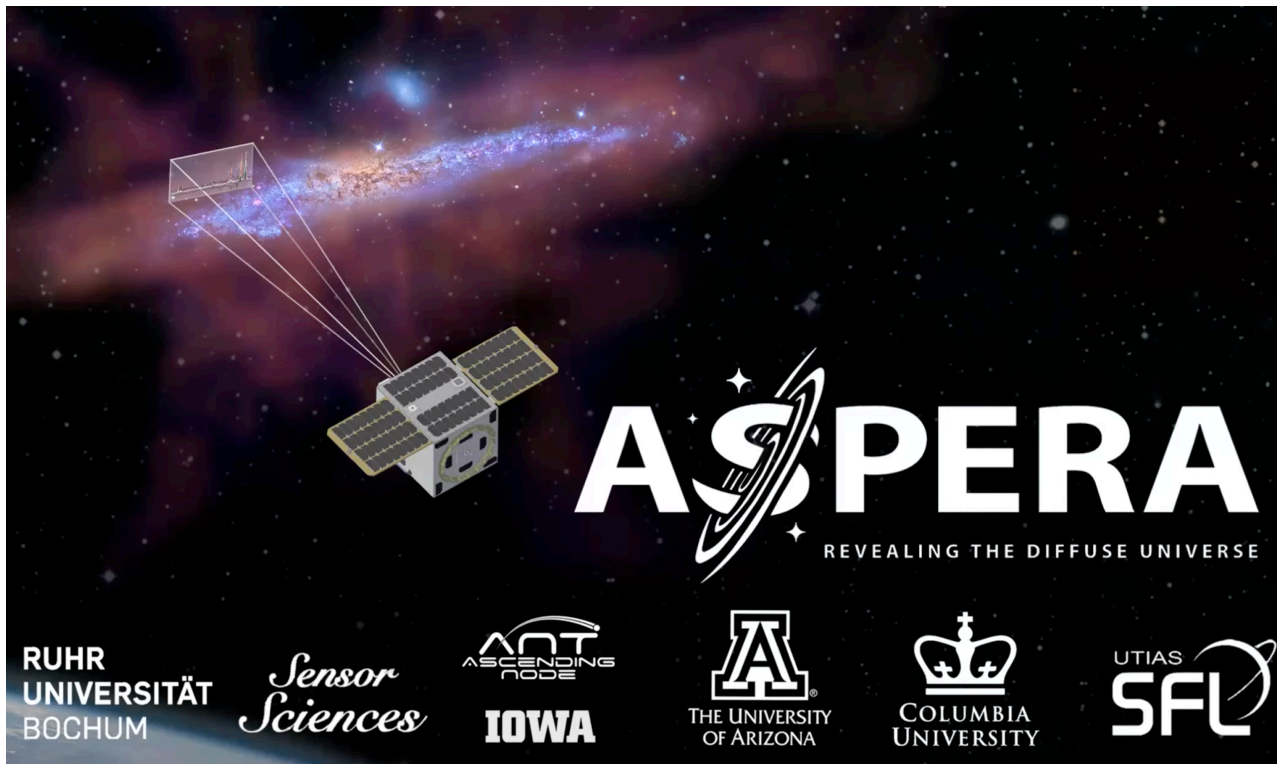


Historically, the CGM is observed in absorption toward background quasars

Absorption studies find significant column densities of O VI in the CGM of most Milky Way-like galaxies

What gas does O VI trace? Hot? Cold? Inflows? Outflows?

Observing the Circumgalactic Medium



PI: Carlos Vargas

NASA Pioneer SmallSat mission slated to launch in 2025

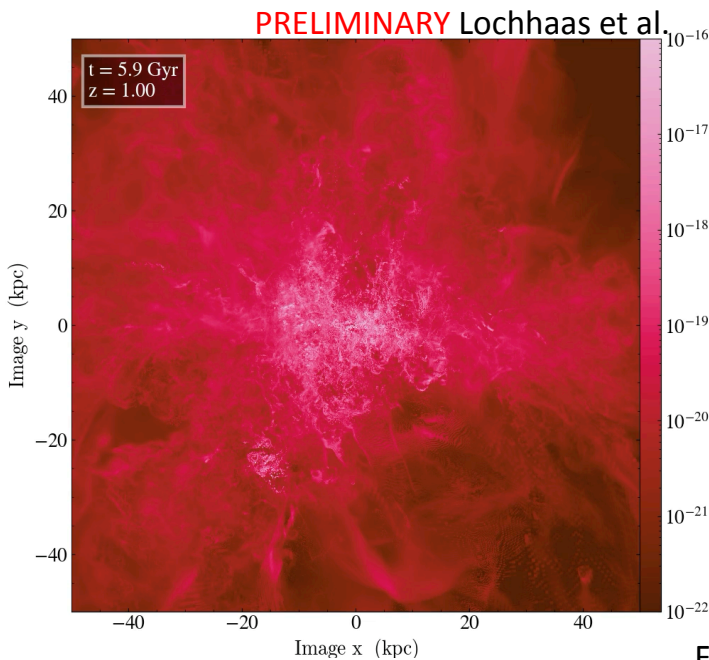
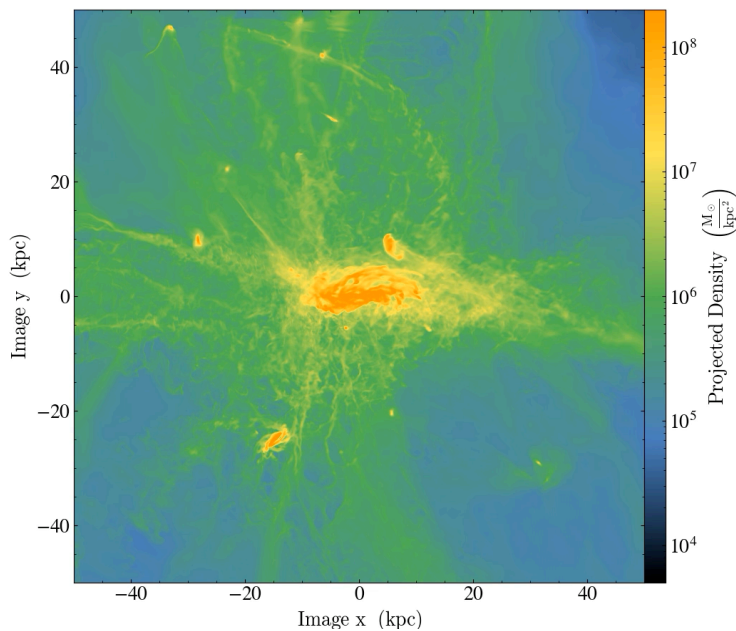
Design goal:

High-sensitivity, wide-field, FUV spectrograph covering 1030-1040 angstroms, inspired by FUSE

Science goal:

Detect and **spatially map** O VI **emission** off the plane of edge-on galaxies

Predicting O VI Emission



Cosmological simulations that zoom-in on a handful of MW-mass galaxies

CGM is forced to have high resolution

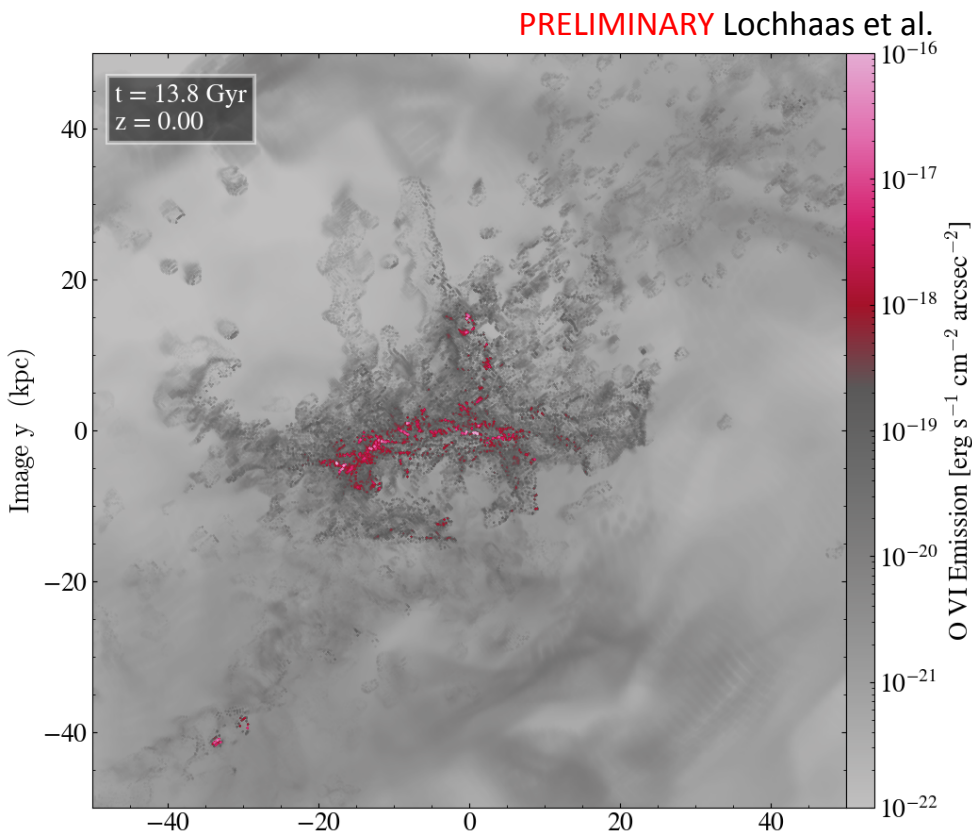
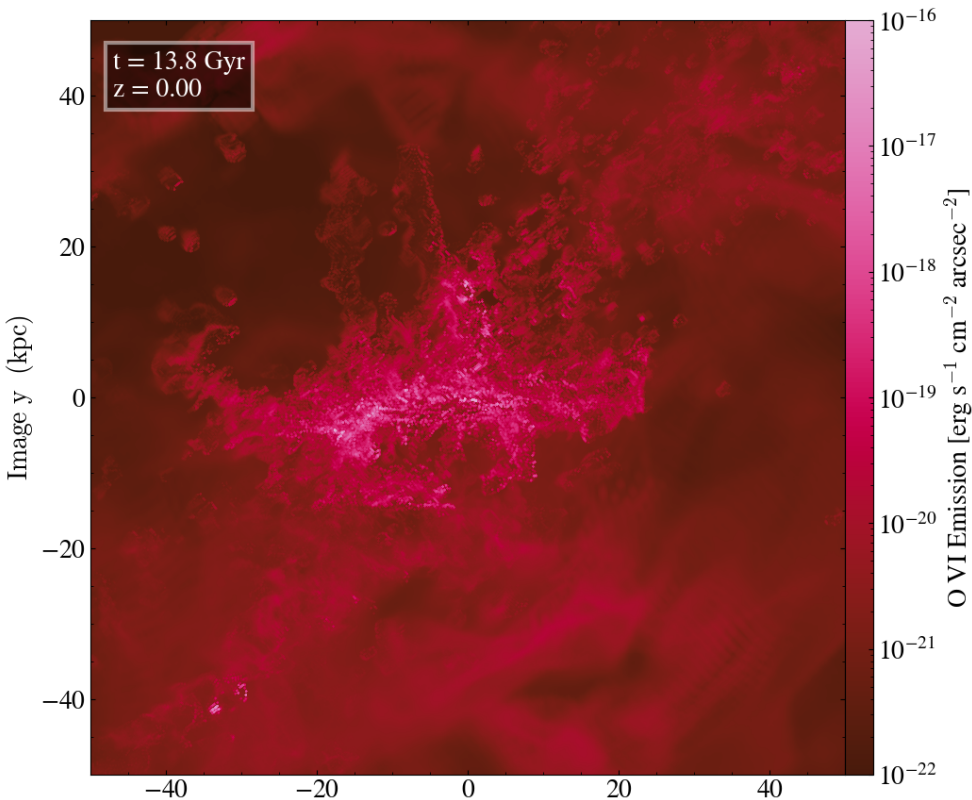
O VI emissivity calculated from density and temperature of gas (CLOUDY tables)

Assumptions: ionization equilibrium, no time evolution of ionization

FOGGIE papers:

- I. Peebles et al. (2019) ApJ 873, 129
- II. Corlies et al. (2020) ApJ 896, 2
- III. Zheng et al. (2020) ApJ 896, 143
- IV. Simons et al. (2020) ApJ 905, 167
- V. Lochhaas et al. (2021) ApJ 922, 121
- VI. Lochhaas et al. (2023) ApJ 948, 43
- VII. Wright et al. (2023), arXiv: 2309.10039

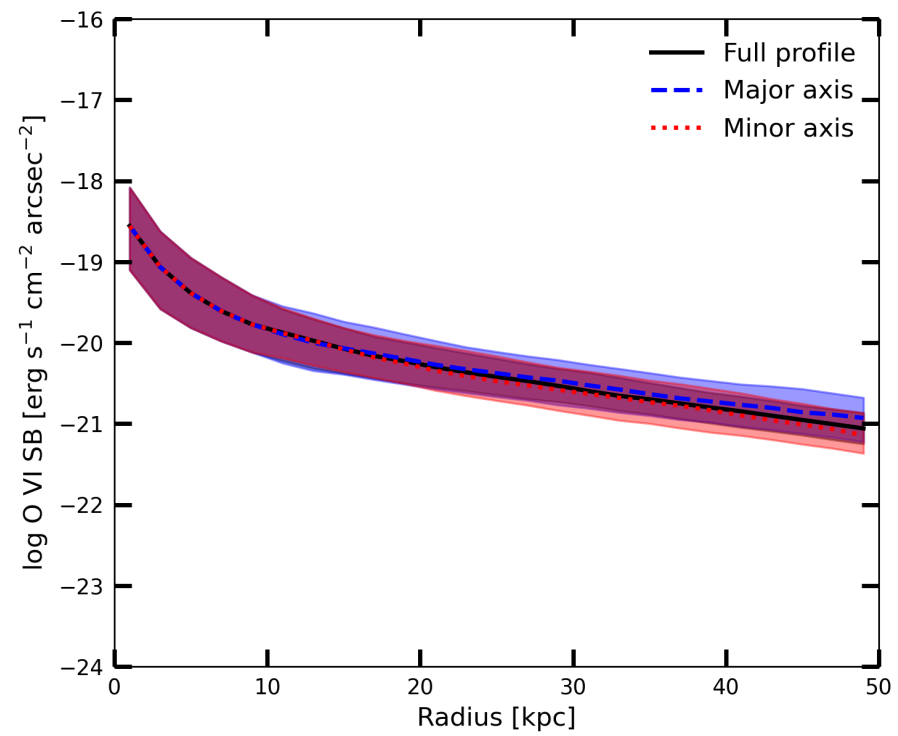
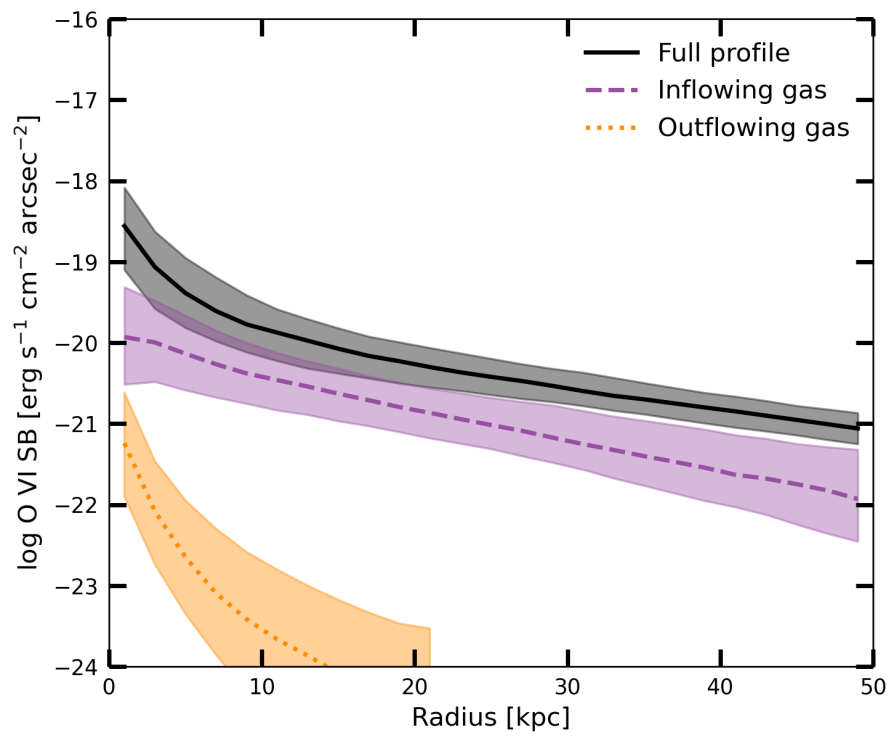
Mapping O VI Emission



At low redshift, brightest emission and only emission above detection limit is close to galaxy disk
Morphology is very clumpy — expected because emission scales with n^2

Where is O VI Emitting Gas?

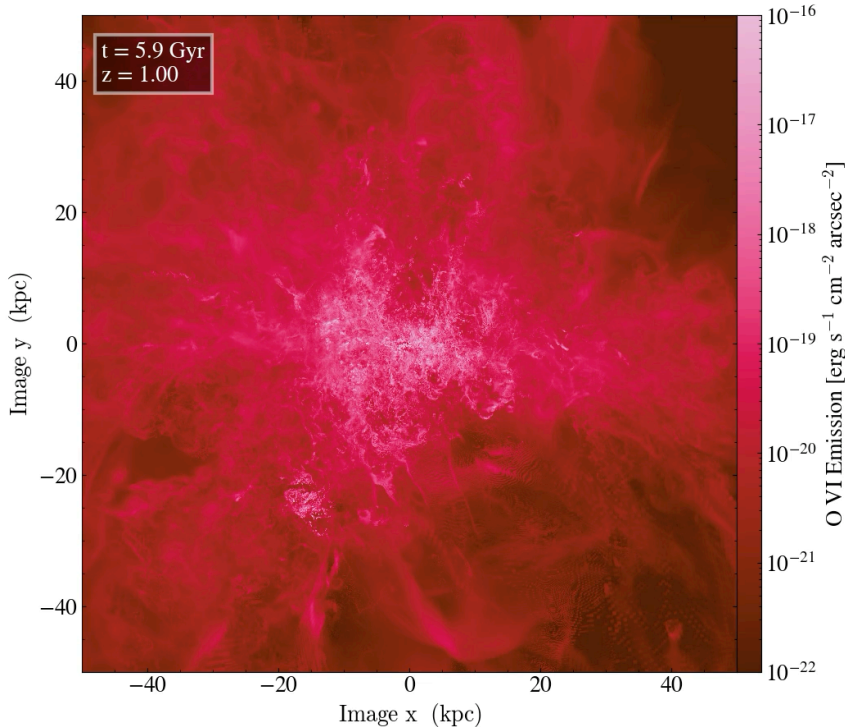
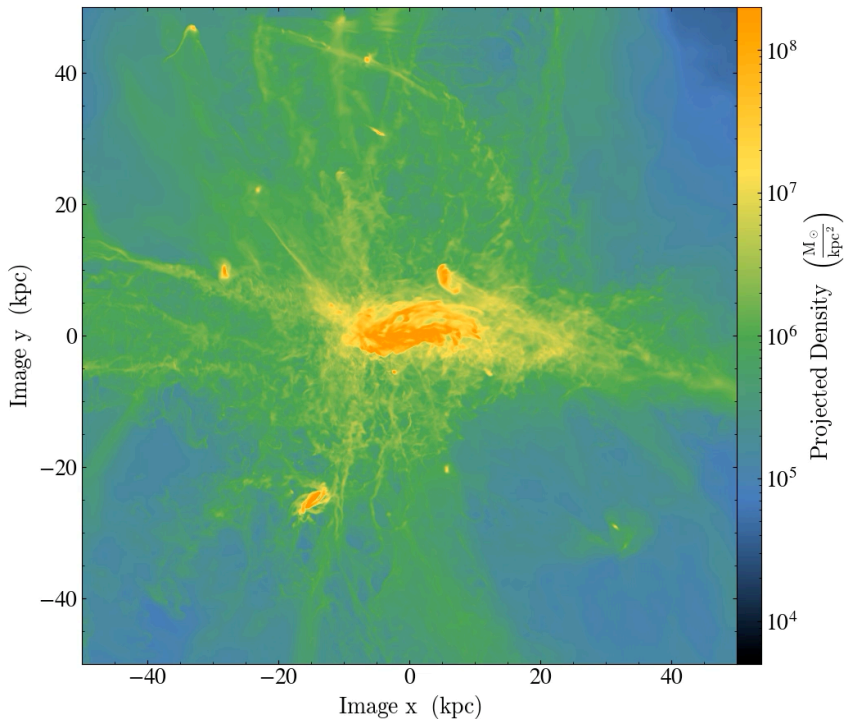
PRELIMINARY Lochhaas et al.



Inflowing gas dominates O VI brightness, BUT inflowing gas is not along major axis!
O VI brightness is dominated by clumpy gas, so this may indicate clumpy inflow has a different morphology than expected from classical galaxy accretion theories

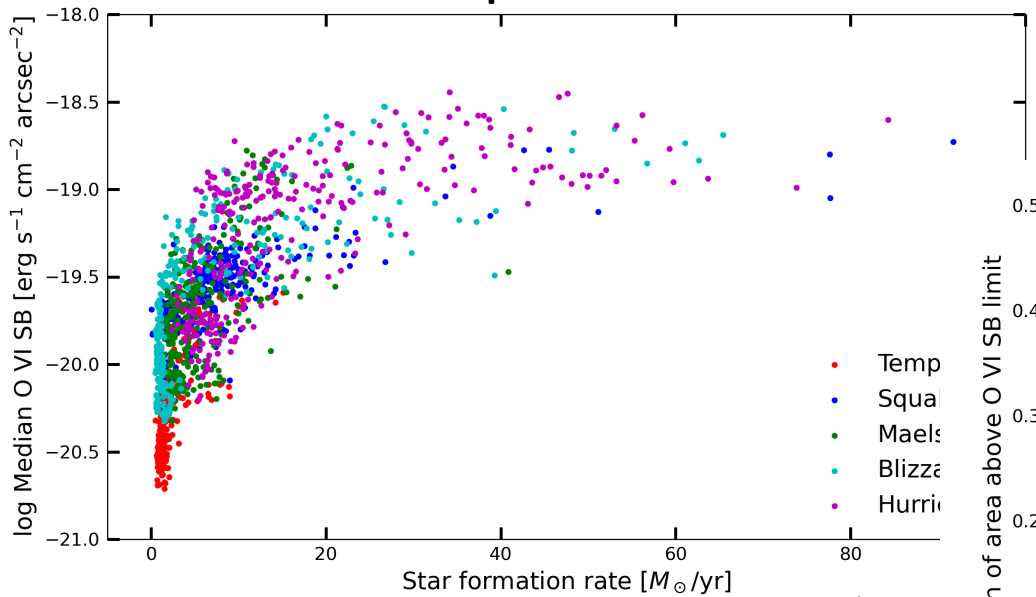
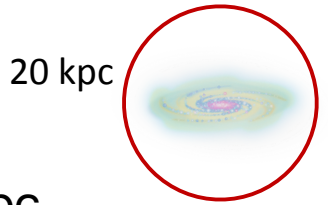
Where is O VI Emitting Gas?

PRELIMINARY Lochhaas et al.



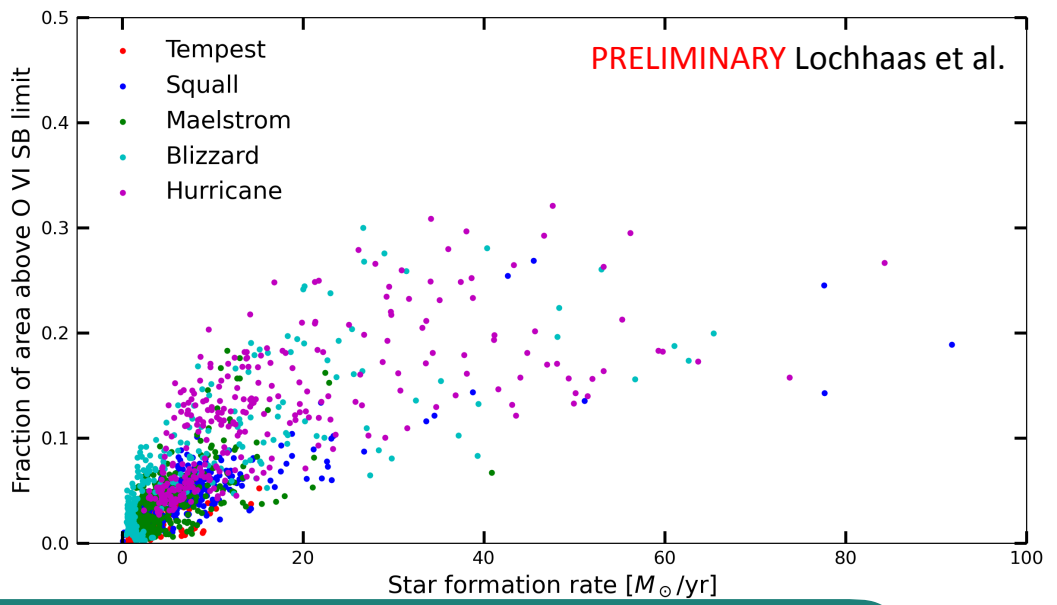
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Does O VI Depend on SFR?



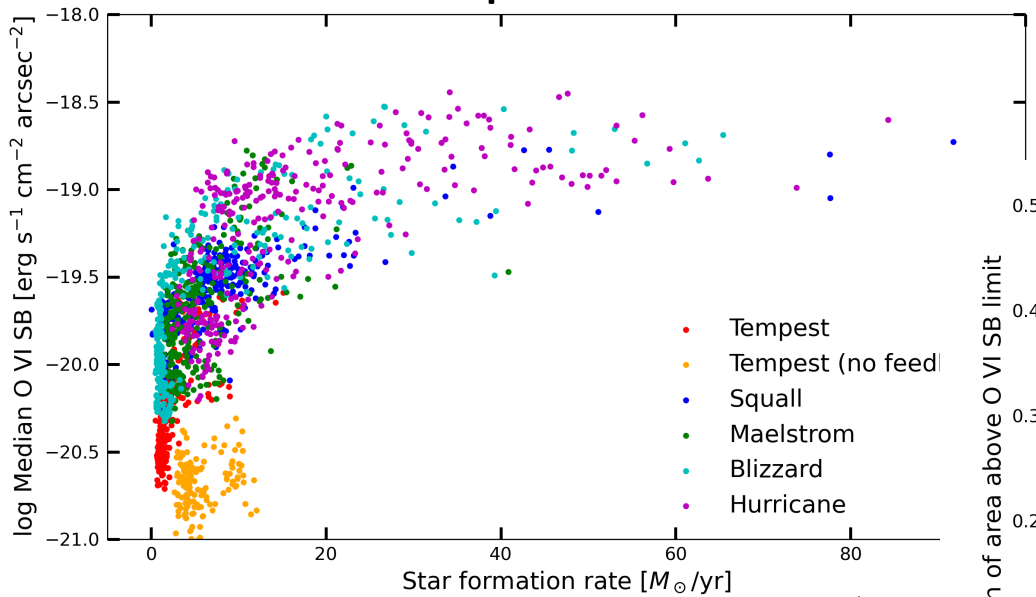
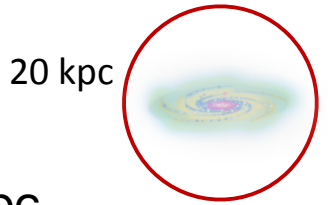
Median O VI surface brightness within 20 kpc radius of the galaxy center

Fraction of area within 20 kpc radius with a surface brightness above Aspera detection limit



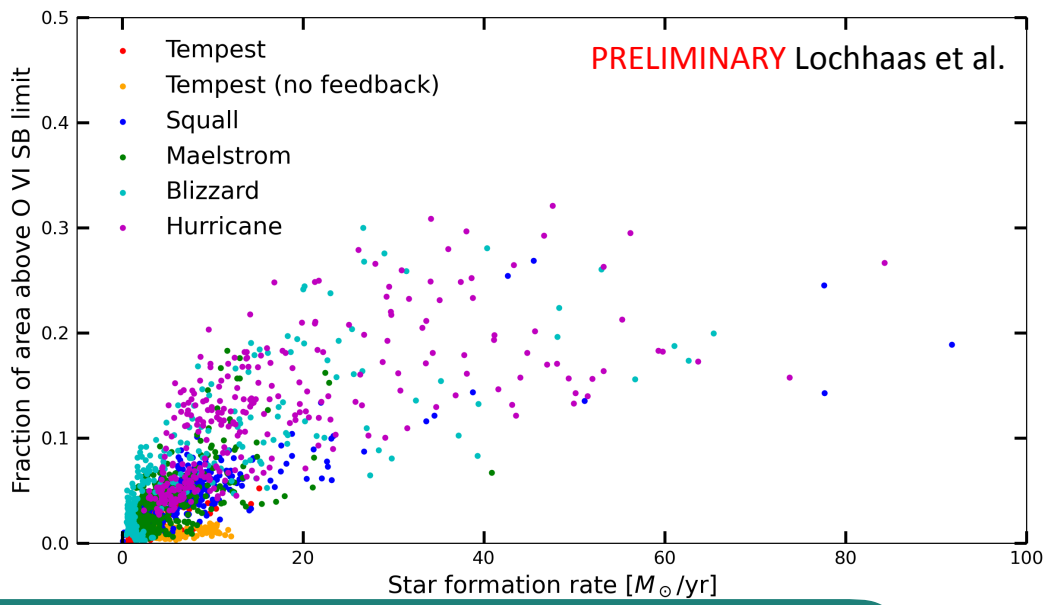
Brighter and more widespread O VI emission when SFR is larger... but O VI emission is dominated by inflows!

Does O VI Depend on SFR?



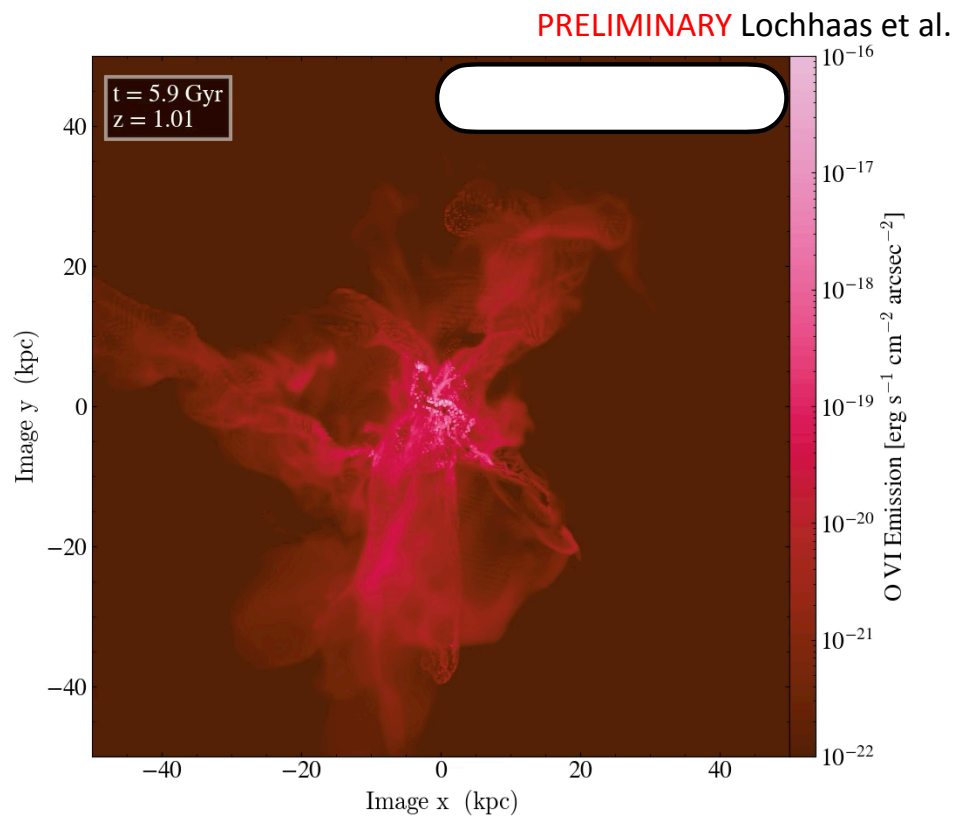
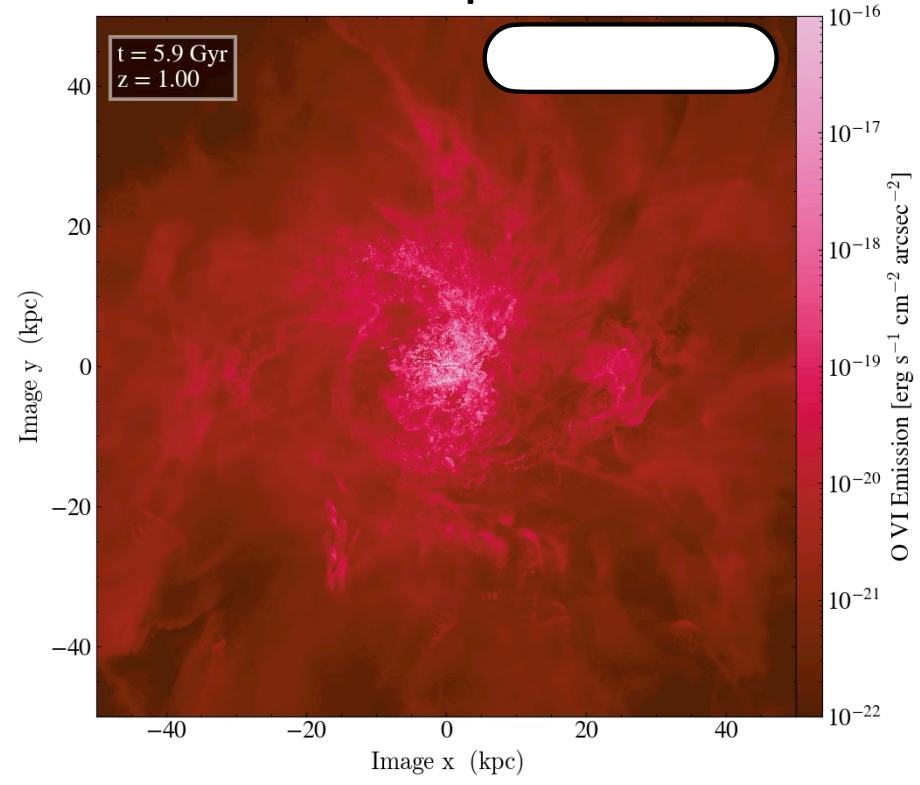
Median O VI surface brightness within 20 kpc radius of the galaxy center

Fraction of area within 20 kpc radius with a surface brightness above Aspera detection limit



Could it be tracing inflowing fuel for star formation?
 Turning off feedback eliminates O VI emission. Perhaps tracing interface between

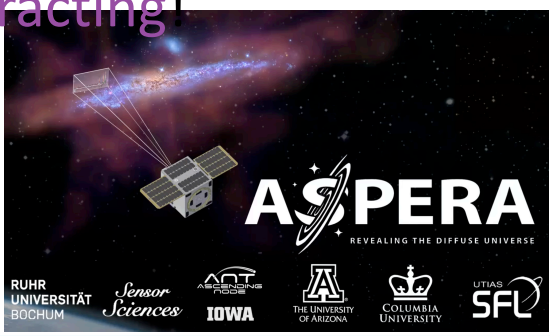
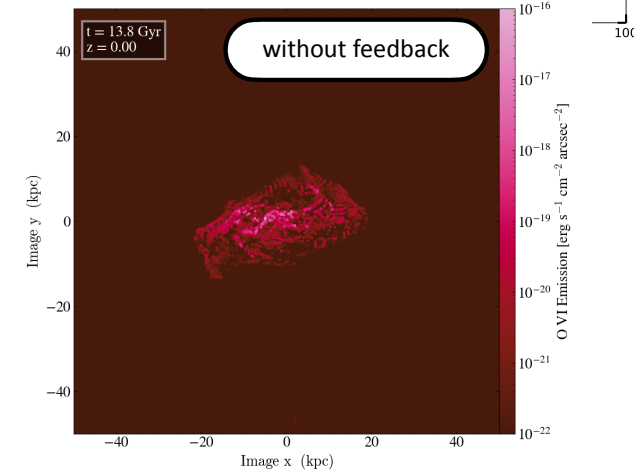
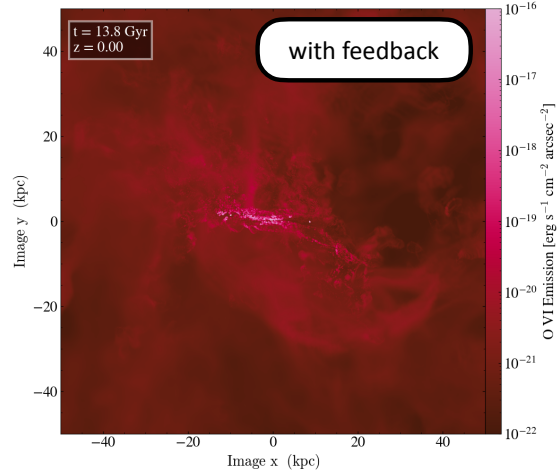
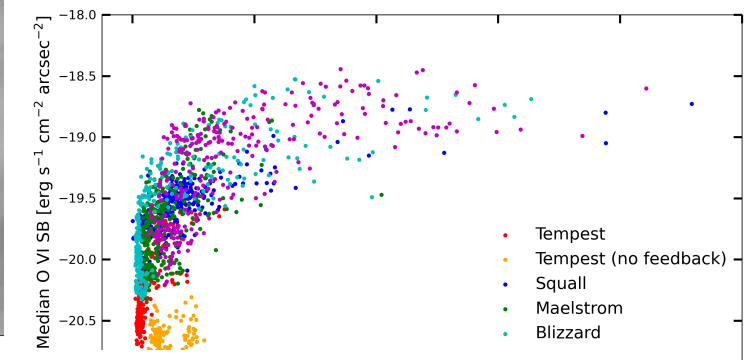
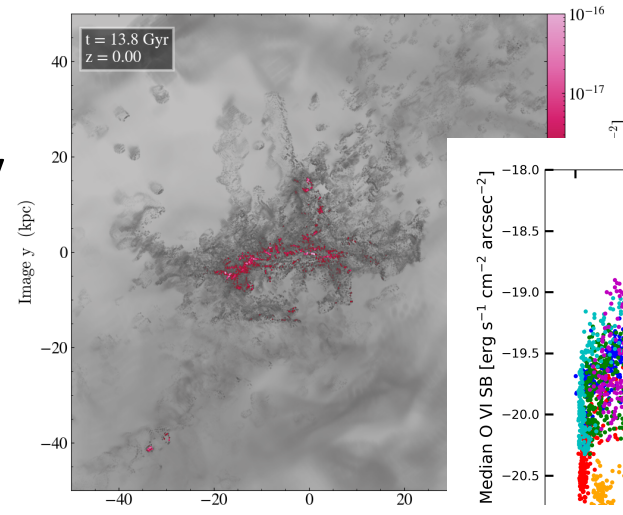
Does O VI Depend on SFR?



Could it be tracing inflowing fuel for star formation?
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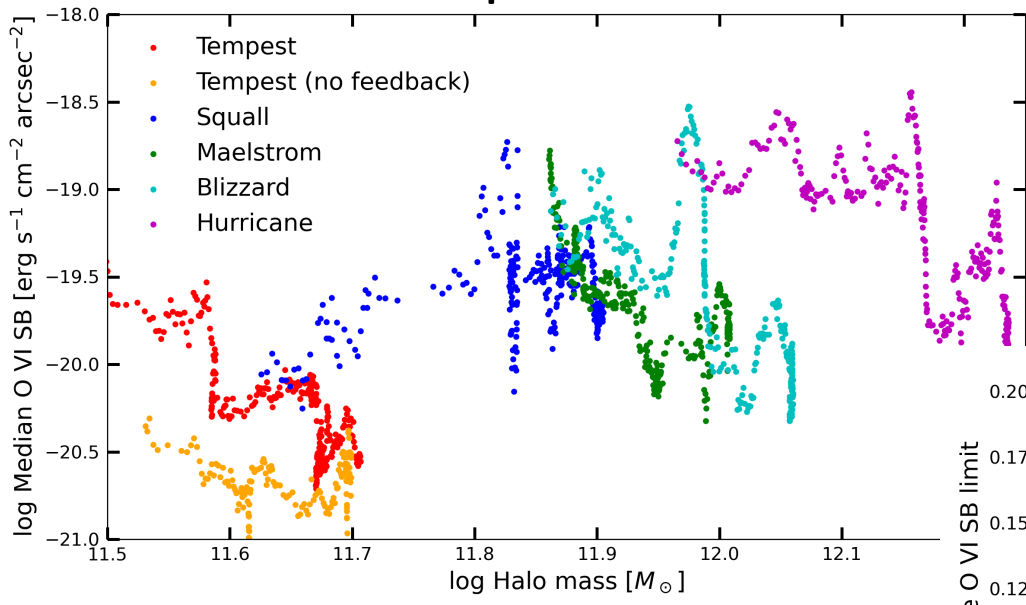
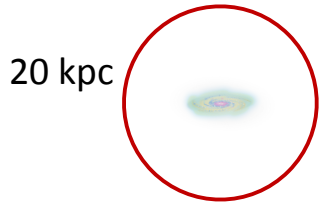
So what does this mean for Aspera?

- Expect emission to be **close to galaxy** with clumpy morphology
- Target selection: more **highly star-forming galaxies** may have more O VI emission
- Mapping O VI may show us where **outflows and inflows are interacting!**



Extra slides

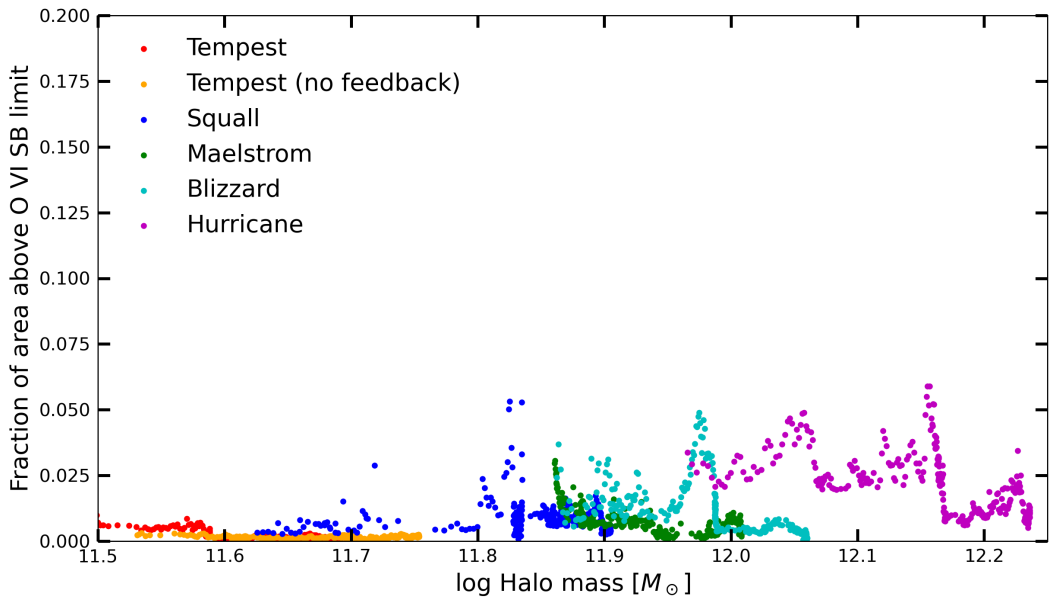
Does O VI Depend on Mh?



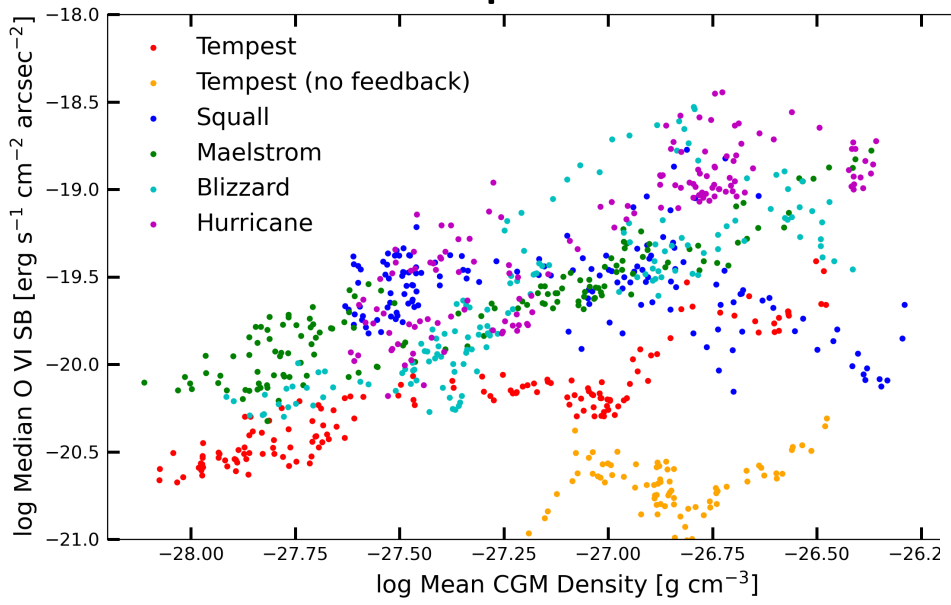
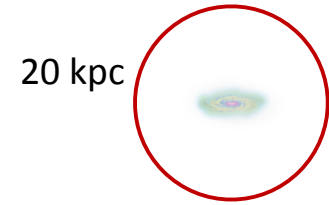
Median O VI surface brightness within 20 kpc radius of the galaxy center

PRELIMINARY Lochhaas et al.

Fraction of area within 20 kpc radius with a surface brightness above Aspera detection limit



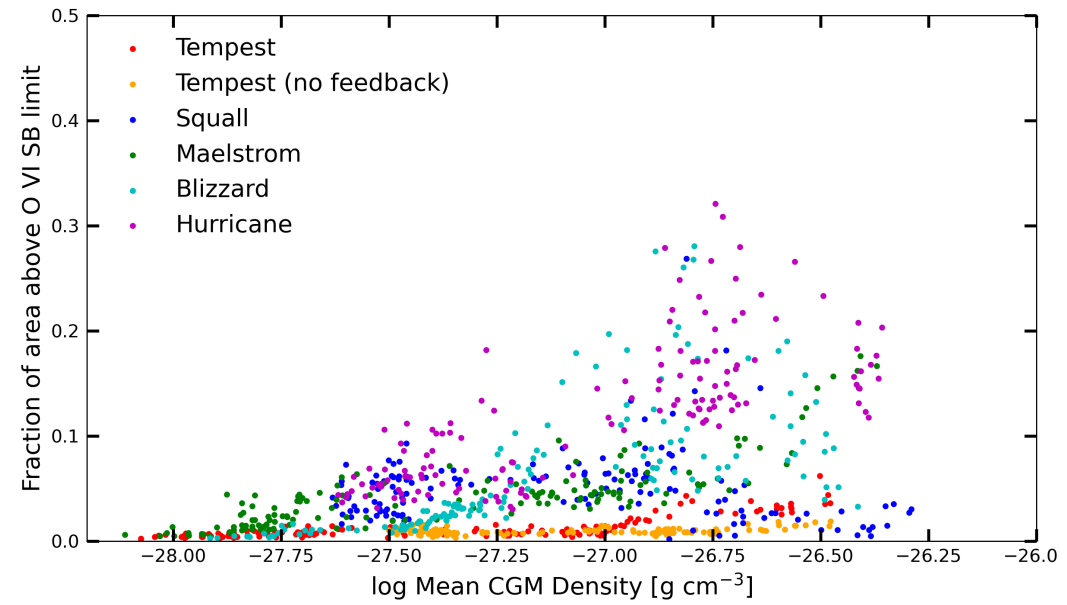
Does O VI Depend on CGM density?



← Median O VI surface brightness within 20 kpc radius of the galaxy center

PRELIMINARY Lochhaas et al.

Fraction of area within 20 kpc radius with a surface brightness above Aspera detection limit →



Does O VI Depend on Redshift?

