Escape of ionizing radiation from high redshift dwarf galaxies: role of AGN feedback

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Introduction

Small galaxies are responsible for most of the ionizing budget for the Reionization. SN feedback is a necessary condition to create paths through which ionizing radiation can escape into the IGM.
Using high-resolution cosmological simulation with radiative hydrodynamics, we investigate the possibility that accreting SMBH in early dwarf galaxies may provide additional feedback and enhance the leakage of ionizing radiation.

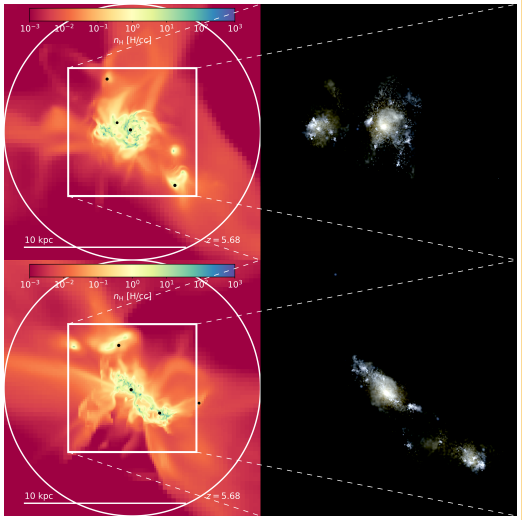
Methods: Ramses-RT

We use the RHD version of the Ramses AMR code (Rosdahl et al, 2013).

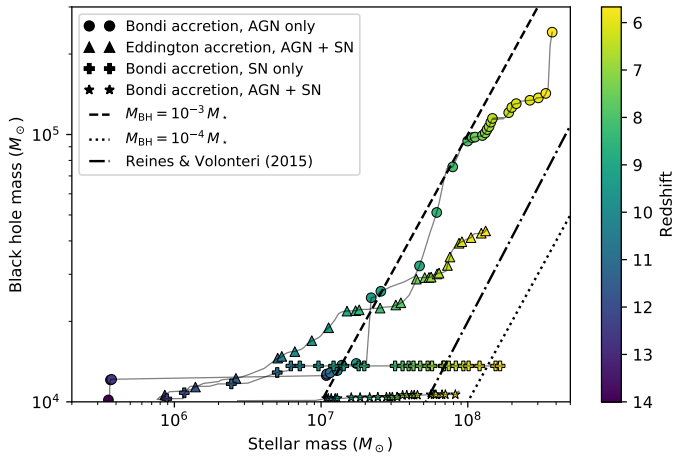
- High resolution
  - Dark matter: $m_{\rm DM} \simeq 10^4$ M$_\odot$
  - Gas: $\Delta x \simeq 10$ pc
  - Stars: $m_\star \simeq 2000$ M$_\odot$
- Recent subgrid models
  - Gravoturbulent star formation (Devriendt+, in prep.)
  - Resolved mechanical feedback (Kimm & Cen, 2014)
  - BH growth: Bondi rate capped at the Eddington limit
  - Dual mode AGN feedback
- Ionizing radiation propagated in 3 bins (HI, HeI, HeII)
- H + He thermochemistry

Structure of the galaxy

- We follow a $M_{\rm h} \simeq 5 \times 10^9\, M_\odot$ halo until the universe was 1 Gyr old
- The galaxy reaches a stellar mass of $M_\star \simeq 10^8\, M_\odot$ by $z \sim 6$
- Gas in the ISM is very turbulent because of the strong SN feedback
- We perform a set of simulations, varying the physics:
  - AGN + SN, Bondi rate accretion
  - AGN only, Bondi rate accretion
  - SN only, Bondi rate accretion
  - AGN + SN, Eddington rate accretion
  - No BH, but SN feedback

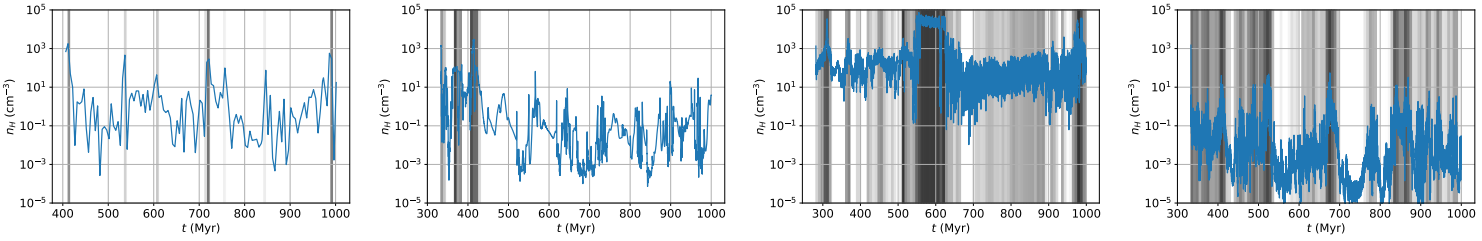


SN feedback quenches BH growth in low mass galaxies



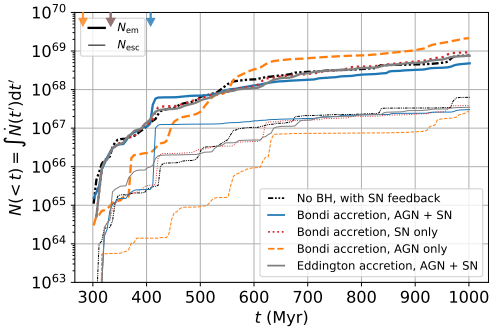
- Simulations with SN feedback show almost no BH growth
- Even when accreting maximally, supernovæ stir the ISM too much for BH growth
- BH can grow very efficiently without SN feedback
- AGN feedback has very little effect on BH growth in low mass galaxies

Density around the BH



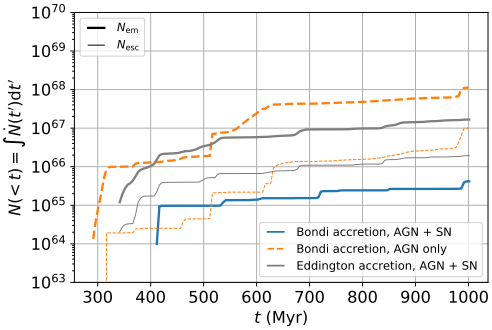
(a) AGN + SN, Bondi accretion (b) SN only, Bondi accretion (c) AGN only, Bondi accretion (d) AGN + SN, Eddington accretion

Ionizing radiation from stellar populations



- Simulations without SN feedback produce more radiation, but with a lower $f_{\rm esc}$
- AGN feedback has no effect on ionizing starlight

Ionizing radiation from the BH



- Accretion on BH release much less radiation than massive stars
- SN feedback is still the main driver of $f_{\rm esc}$

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