



Jet Propulsion Laboratory
California Institute of Technology

A Radio Scream at Cosmic Dawn

**Modeling Radio Loud Black Holes and
the 21 cm signal**



The Scream - Edvard Munch

Aaron Ewall-Wice, NPP Fellow
[arXiv:1803.01805](https://arxiv.org/abs/1803.01805)
AEW+2018 in prep.

Radio Loud Black Holes at $z > 10$?

No?

- Radio loud sources may be suppressed due to inverse Compton losses (Saxena+ 2017). This may be circumvented by higher magnetic field densities.

Yes?

- Very radio loud sources observed at $z \sim 6$ (Bañados+2018) and radio-loudness fraction may be similar to today (Bañados+2015)
- Unexplained radio-background detected by ARCADE-2 (Fixsen+2011)
[See Raul's Talk](#)
- Unusual EDGES feature (Bowman+2018) might be explained by a radio background (Feng+ 2018, Ewall-Wice+2018)

Goal: A simple model describing the impact of radio loud black holes on the 21cm Cosmic Dawn Signal

Model Ingredients

1) BH Emissivity: $\epsilon(\nu) \propto \frac{\dot{\rho}_\bullet}{\tau_{acc}}$

2) BH Density:

$$\frac{d\text{mass}}{dt} = \text{New Seeds} + \text{Accretion} - \text{Feedback}$$

$$\dot{\rho}_\bullet = f \cdot \dot{\rho}_{coll} + \frac{\dot{\rho}_\bullet}{\tau_{acc}} - f \cdot \dot{\rho}_{coll}(t - \tau_{fb}) e^{\tau_{fb}/\tau_{acc}}$$

Can easily be added to existing Semi-numerical recipes

Some Results

Coming to arXiv
In ~a week

