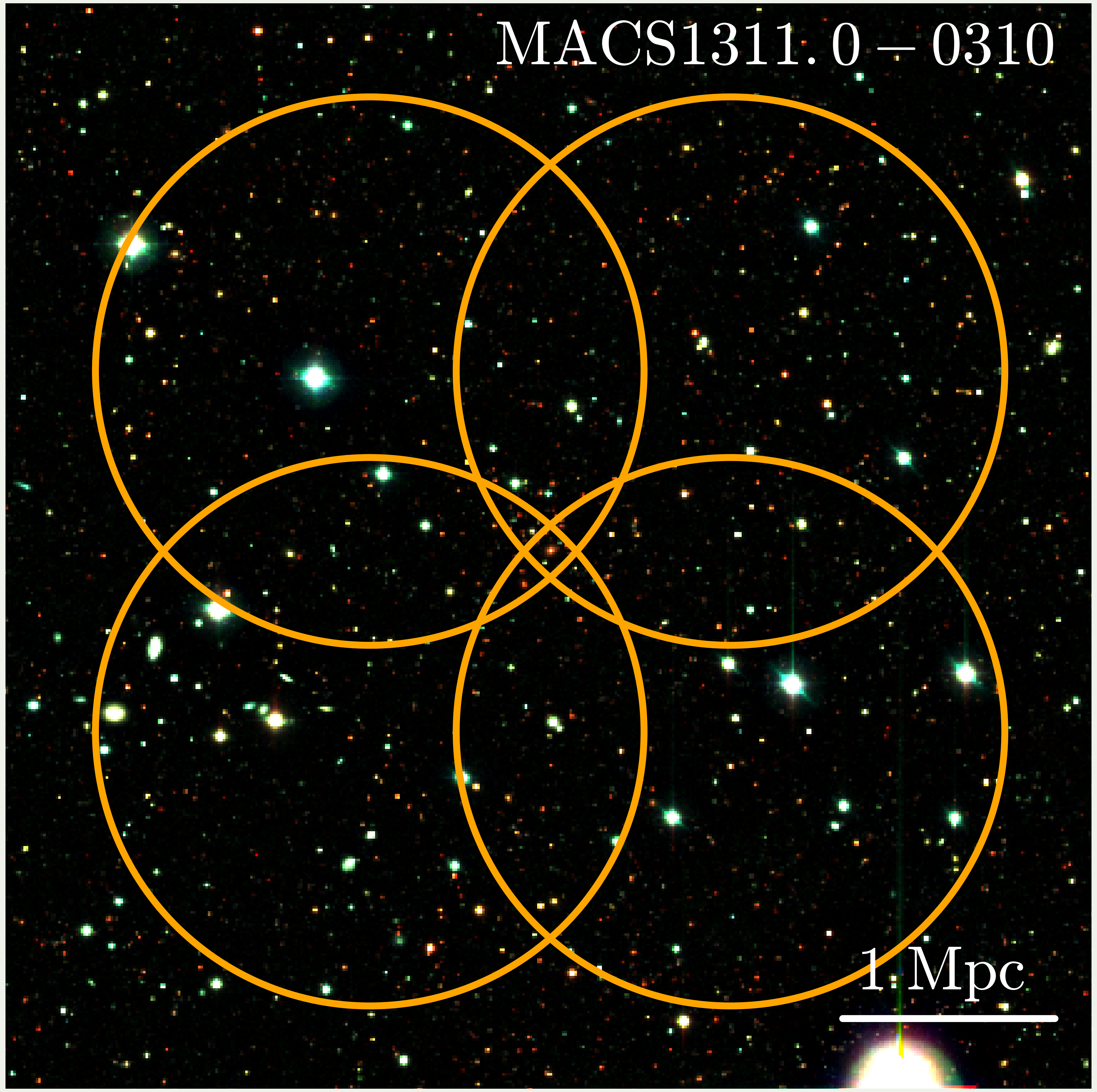
K-CLASH: Disc strangulation and ram-pressure stripping in cluster galaxies at 0.3 < z < 0.6

Dr. Sam Vaughan
University of Sydney

Alfred Tiley, Roger L. Davies, John Stott,
Laura Prichard & the K-CLASH team

K-CLASH- Observing CLASH cluster members with KMOS



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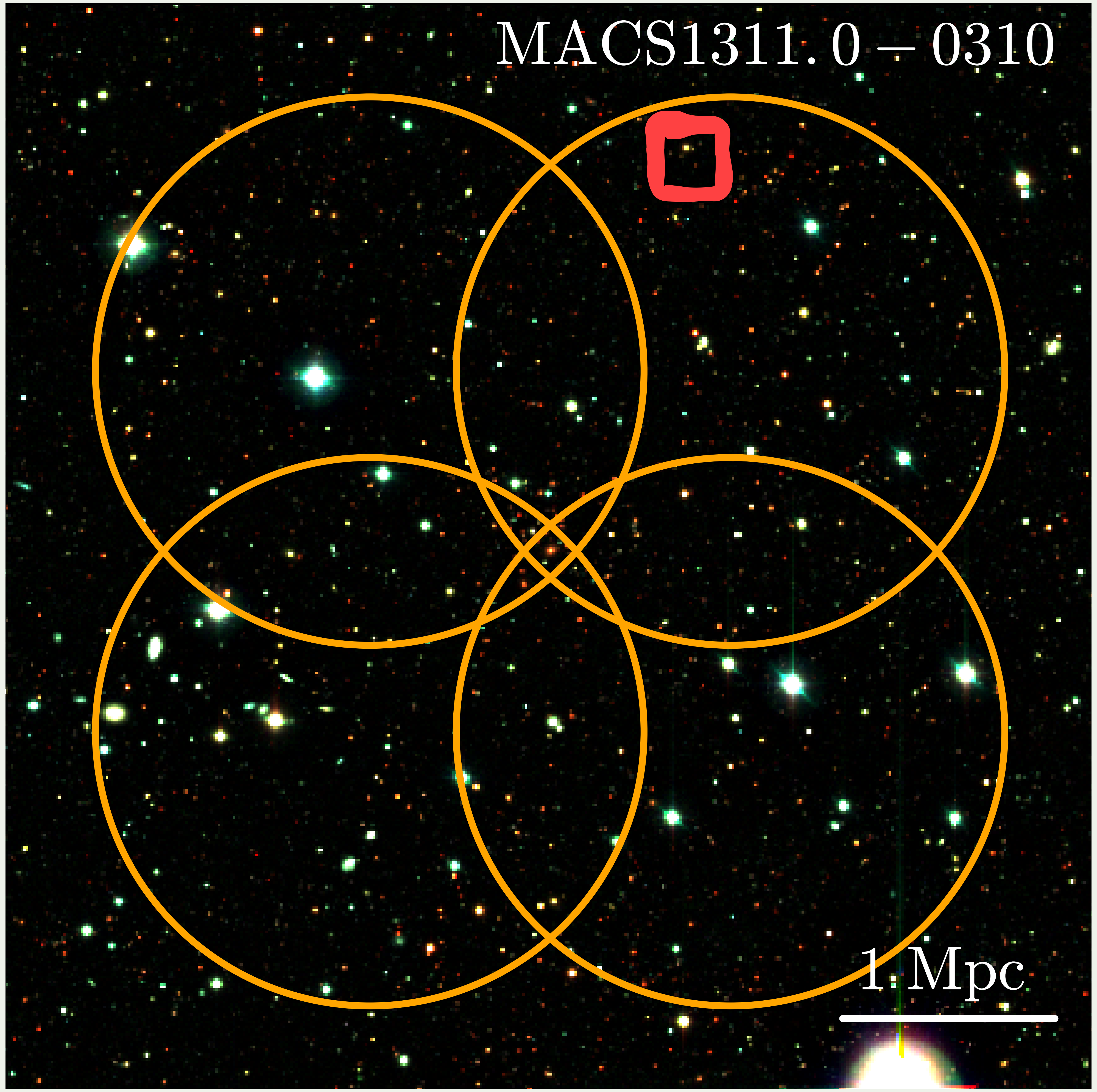

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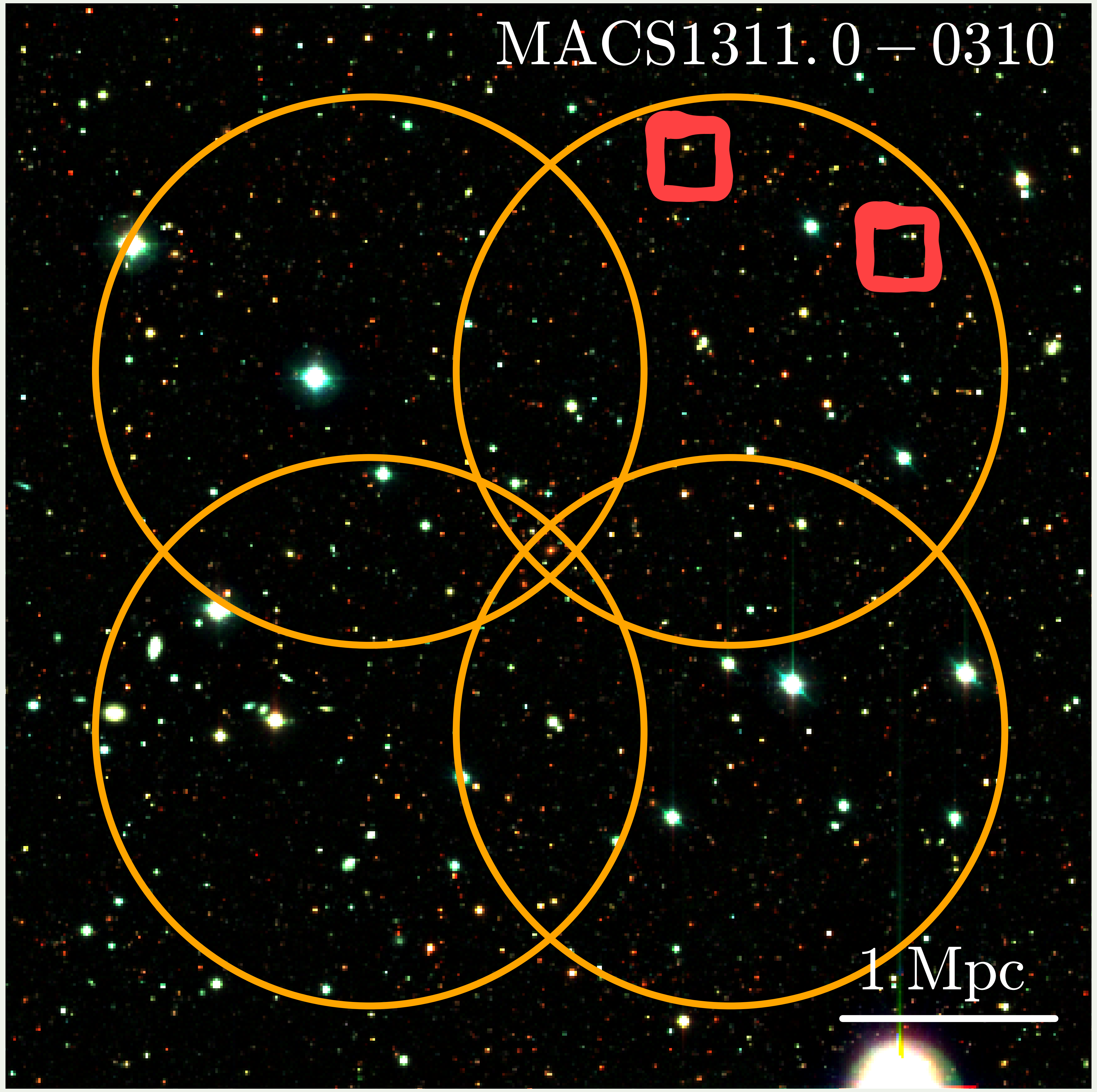

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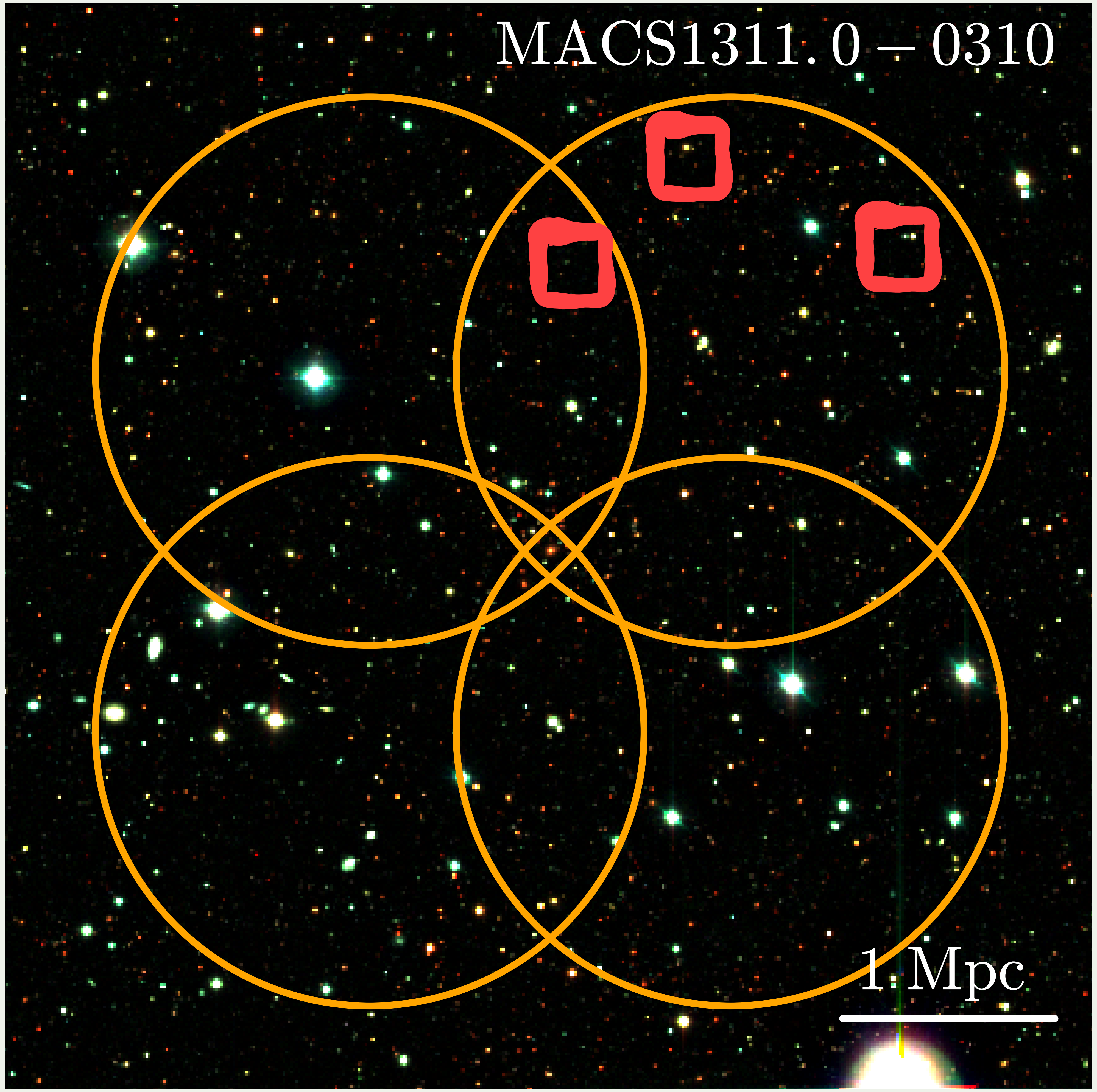

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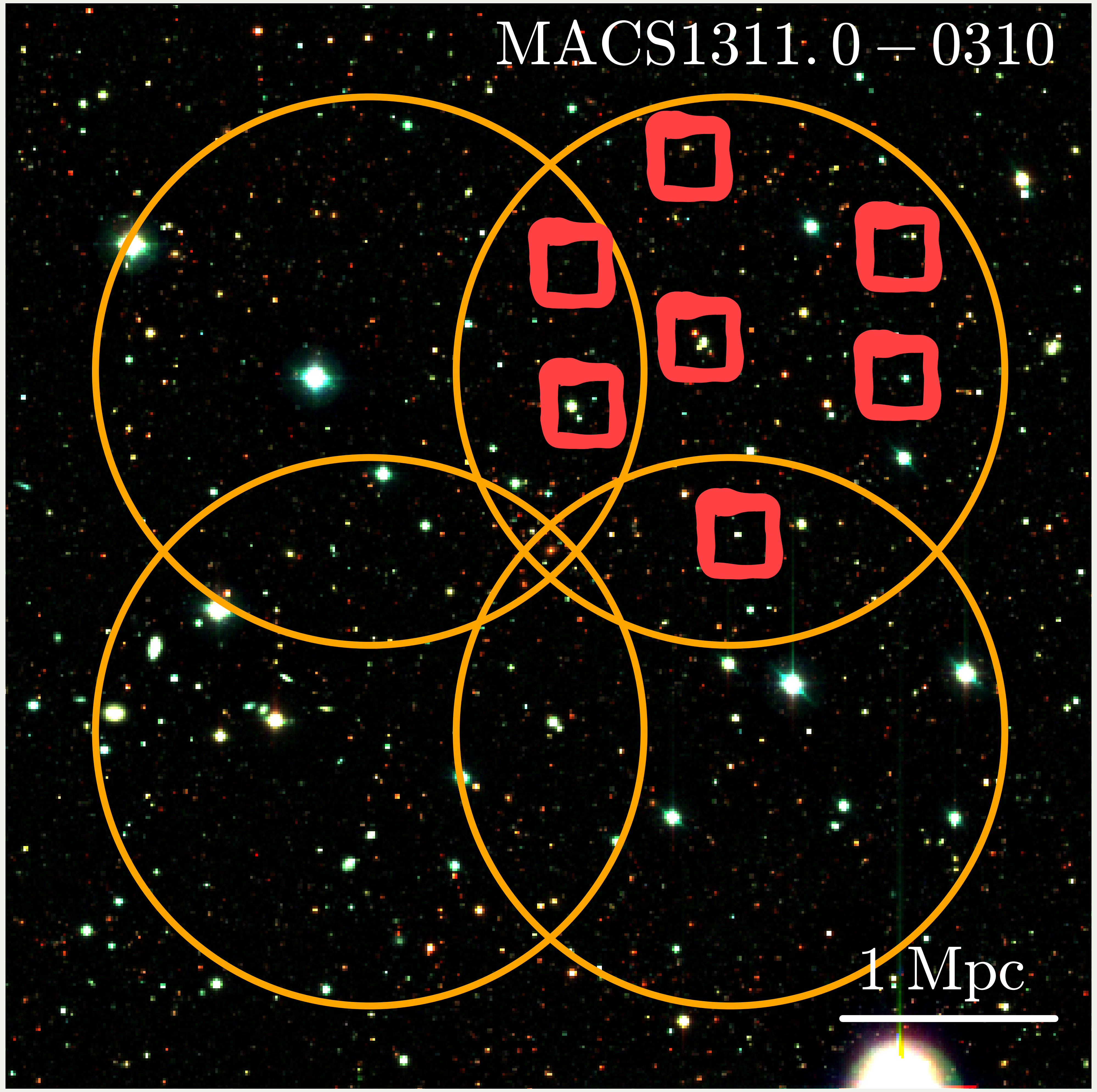

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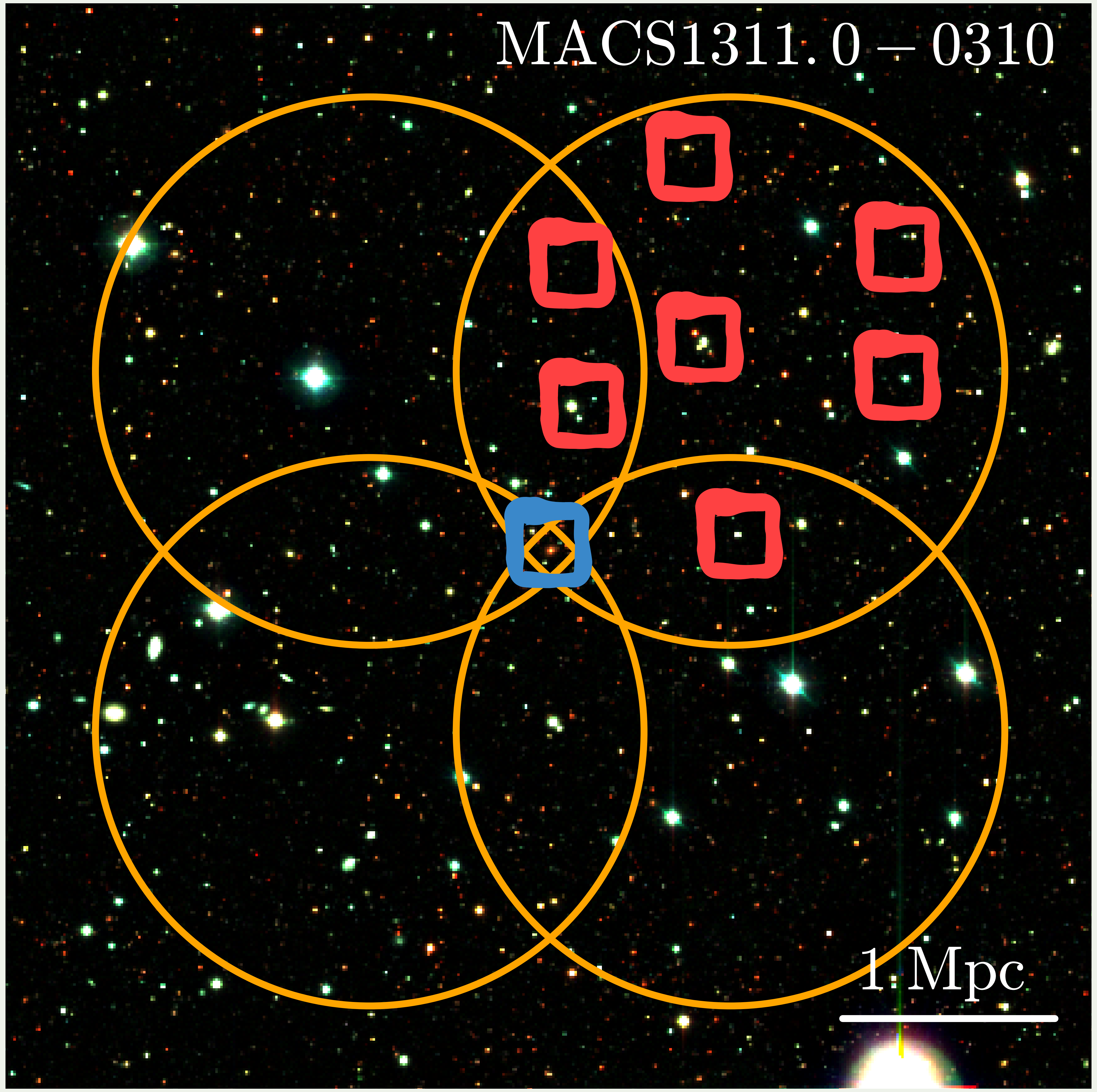

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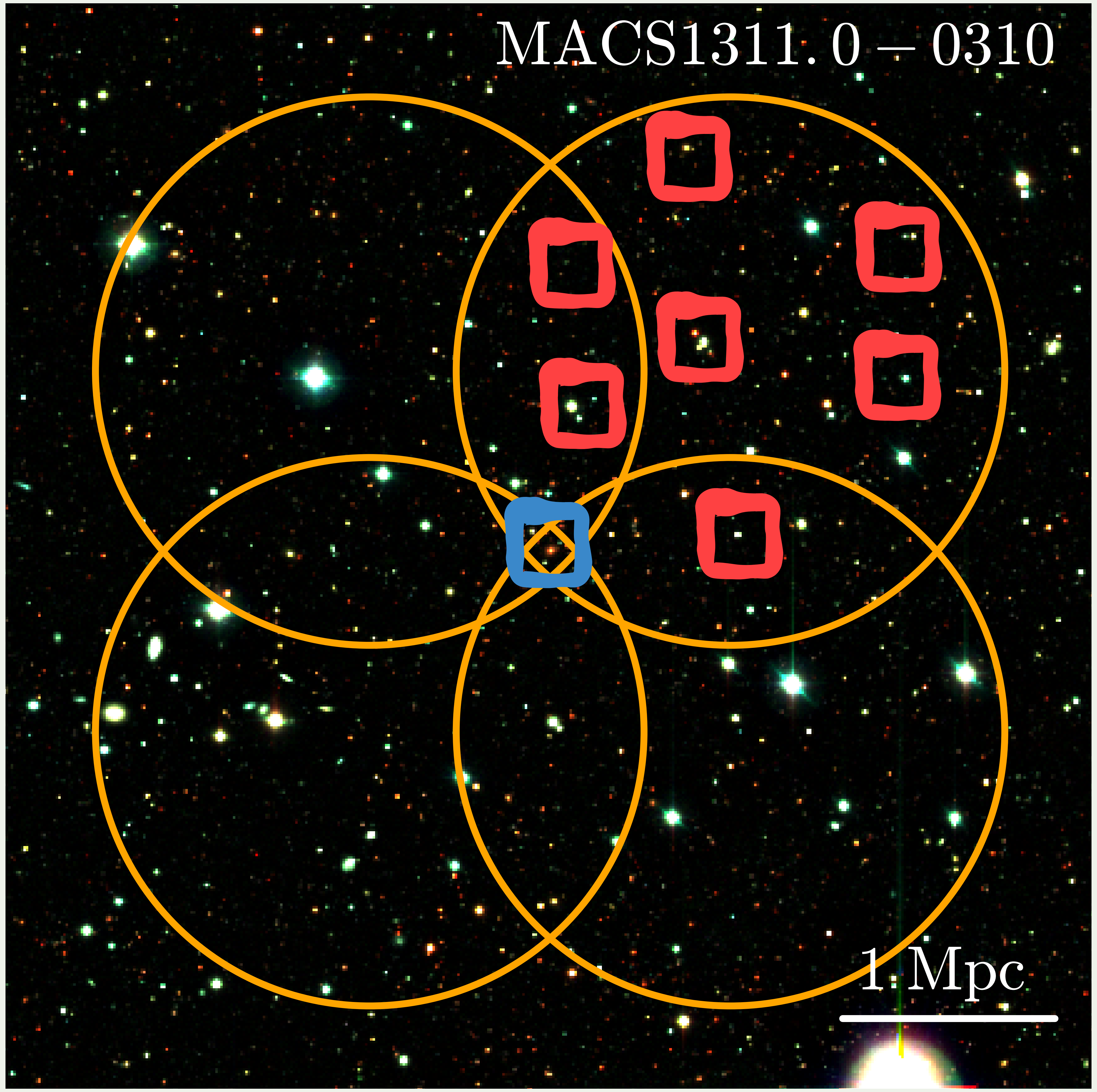

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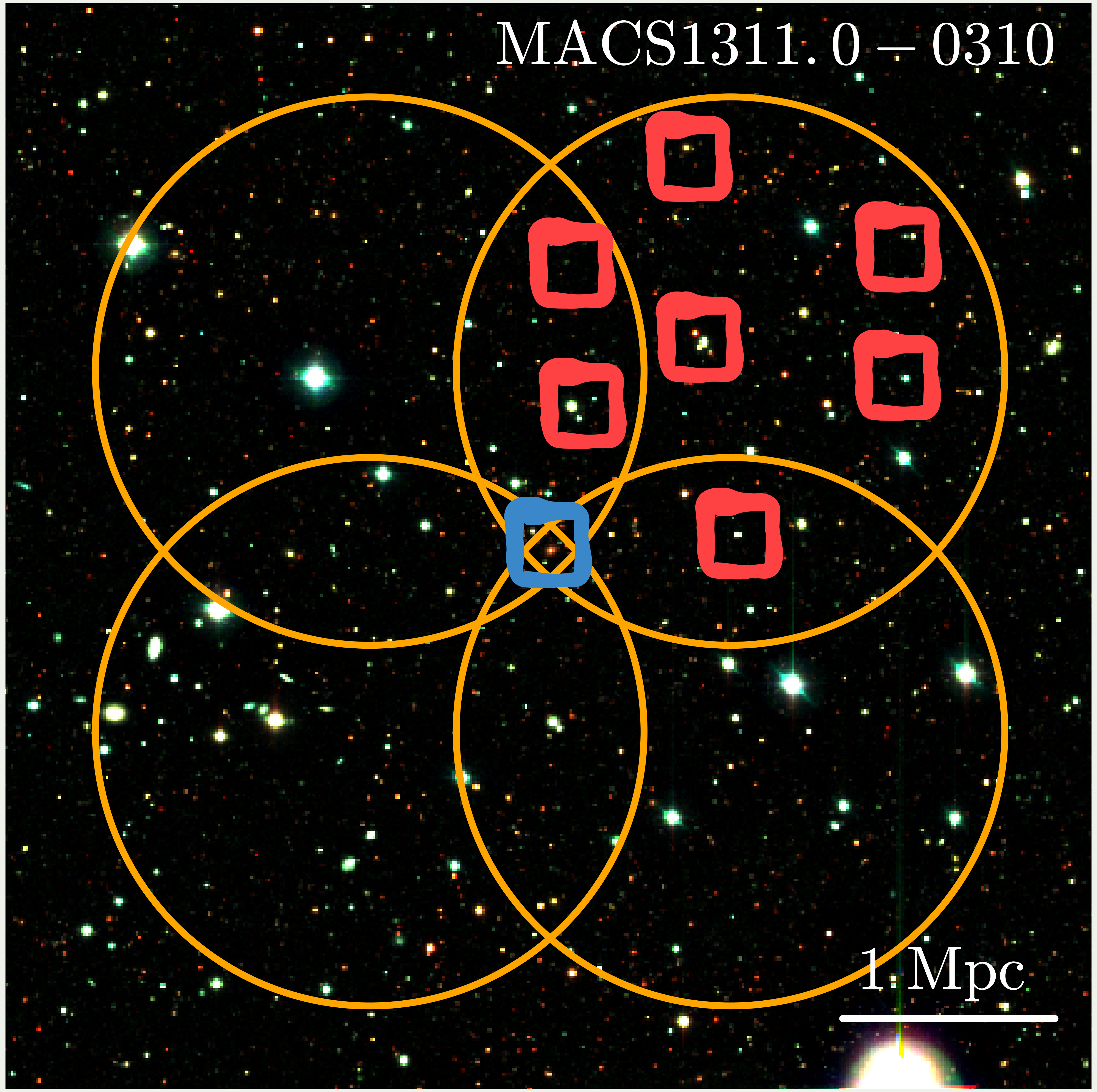

Key Points:

- Use **KMOS** to observe galaxies in 4 CLASH fields at **z=0.313, 0.352, 0.494 & 0.589**

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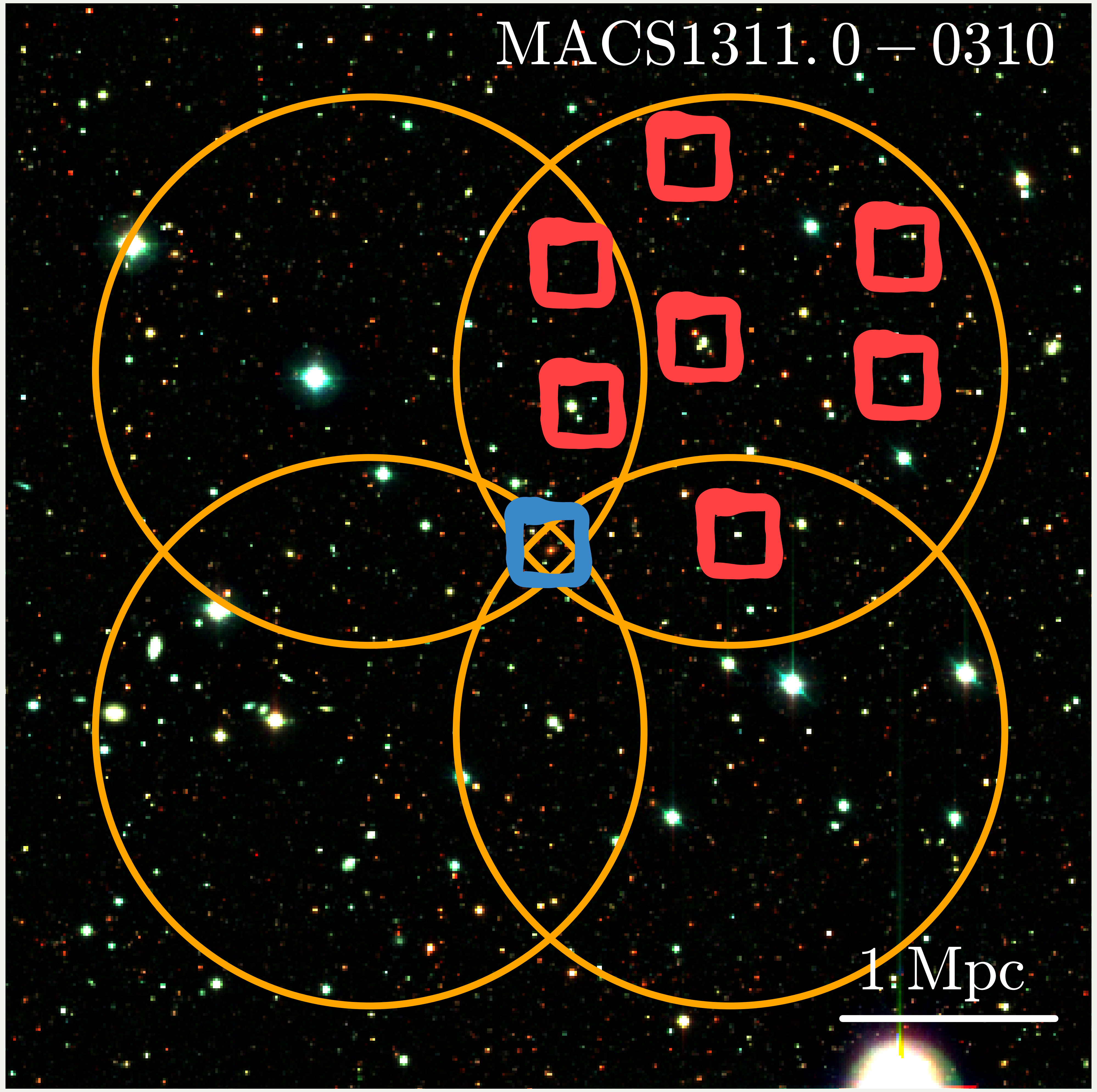

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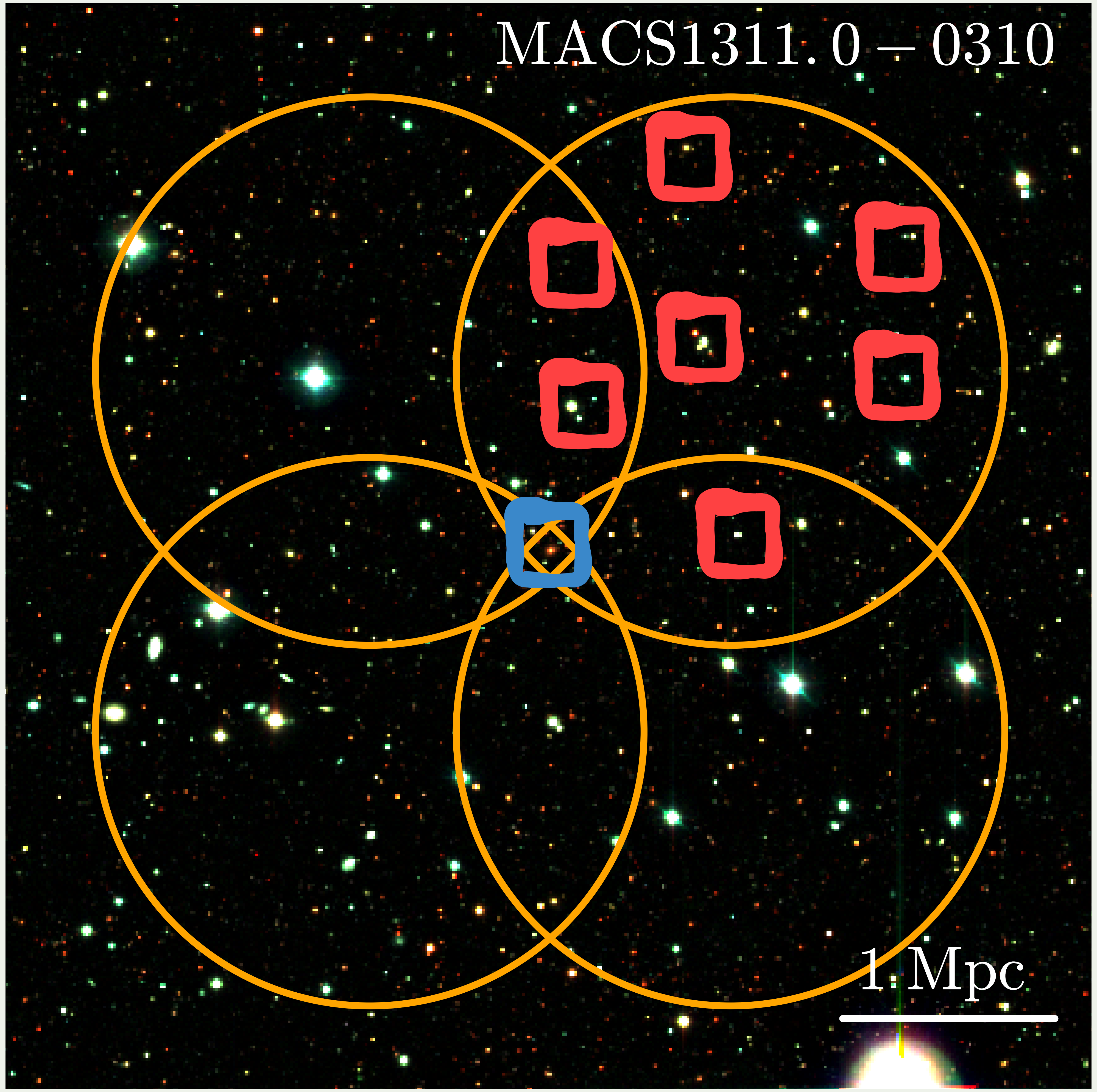

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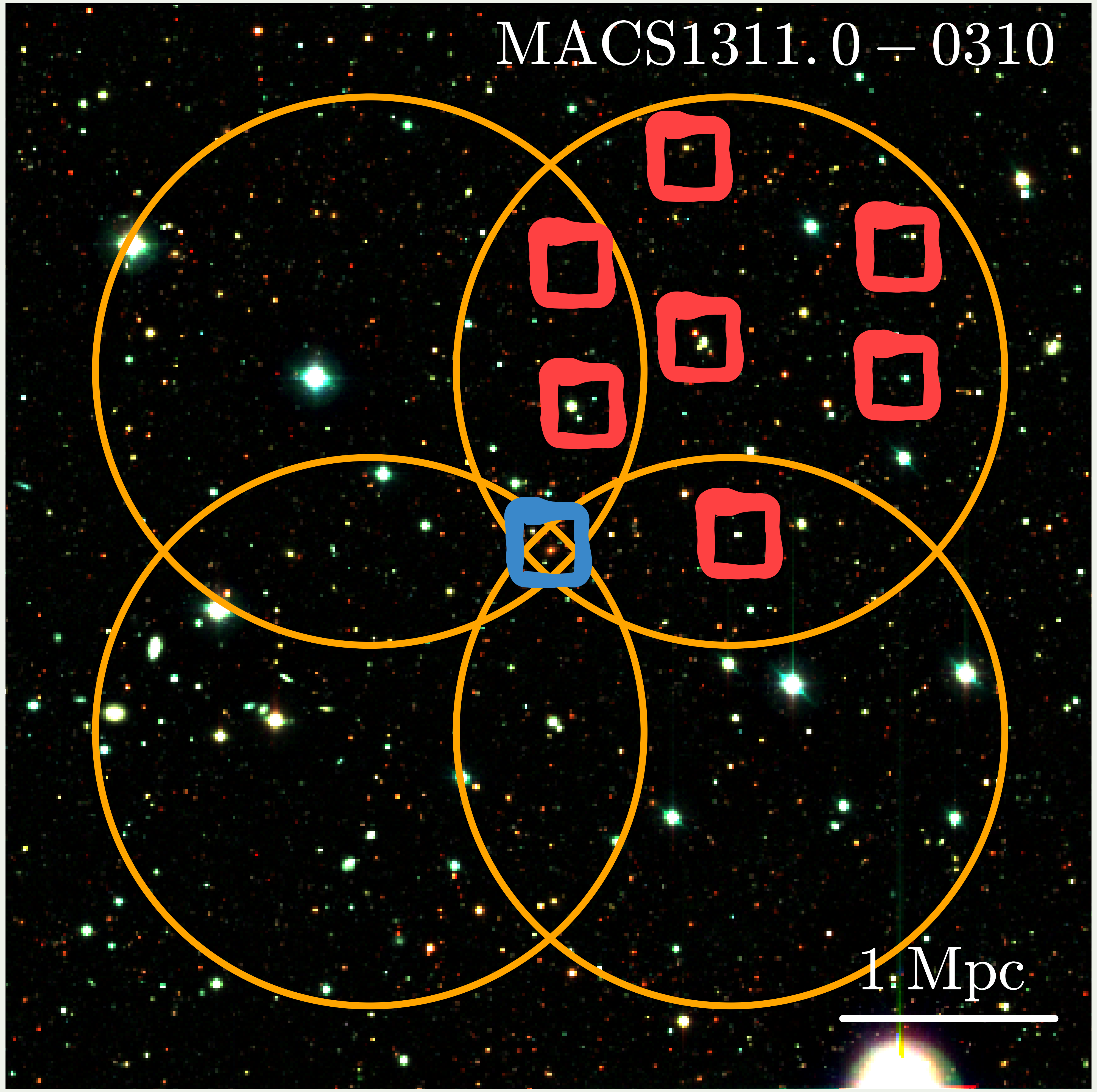

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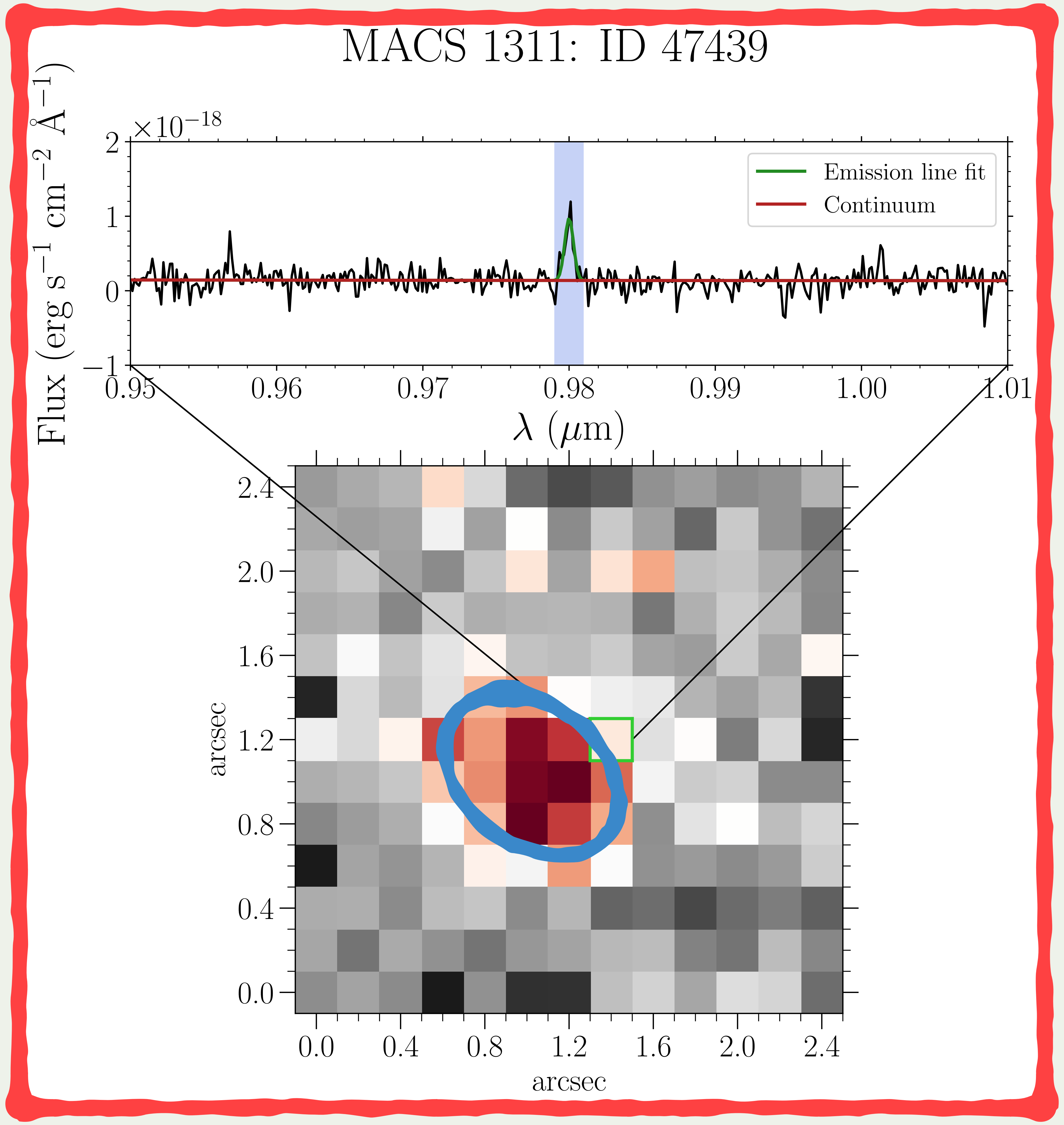
- See **Tiley, SPV et al (2020)-** arxiv: 2005.12471

We find cluster galaxies have smaller $r_e(H\alpha)/r_e(R\text{-band})$ sizes



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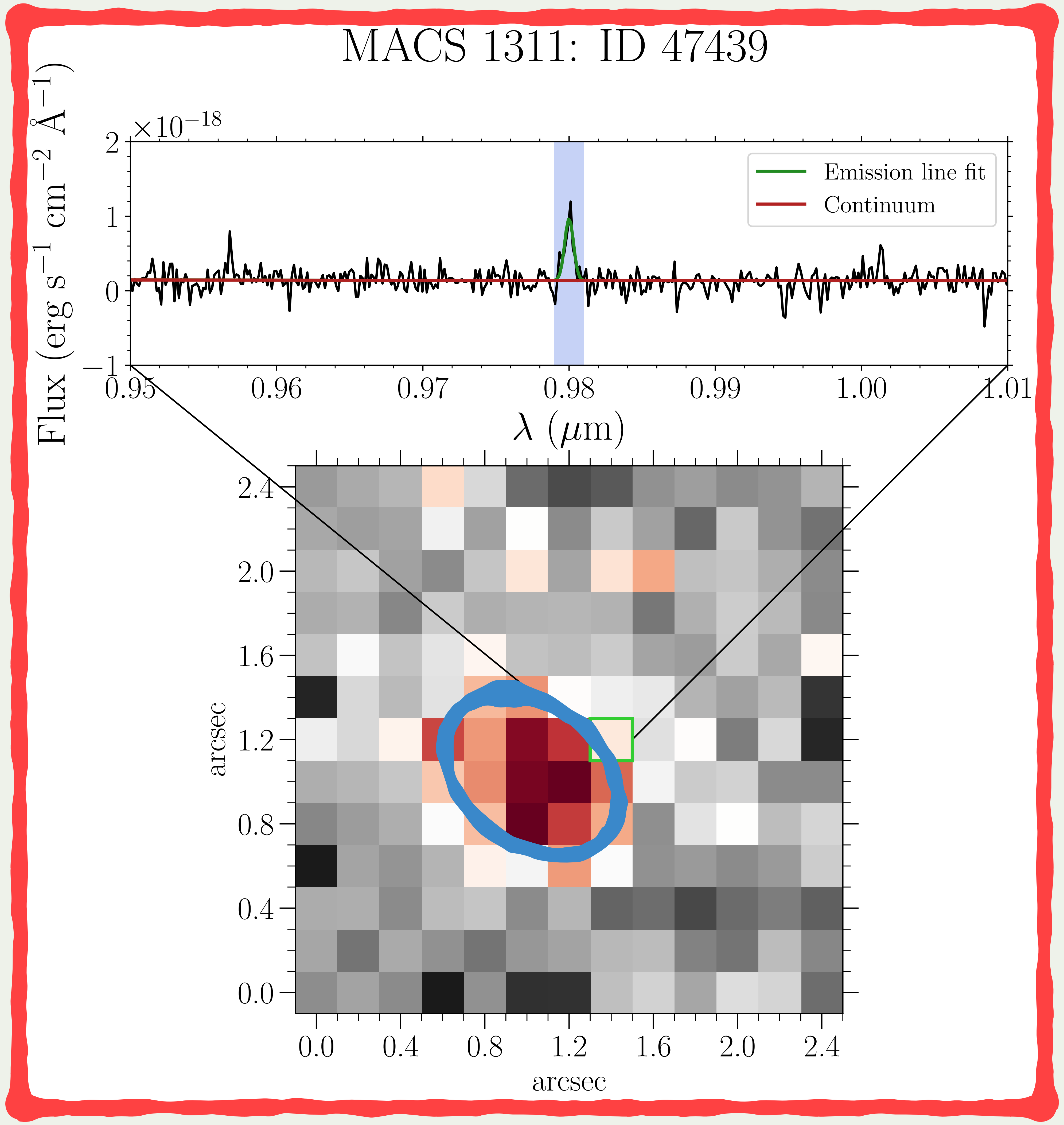

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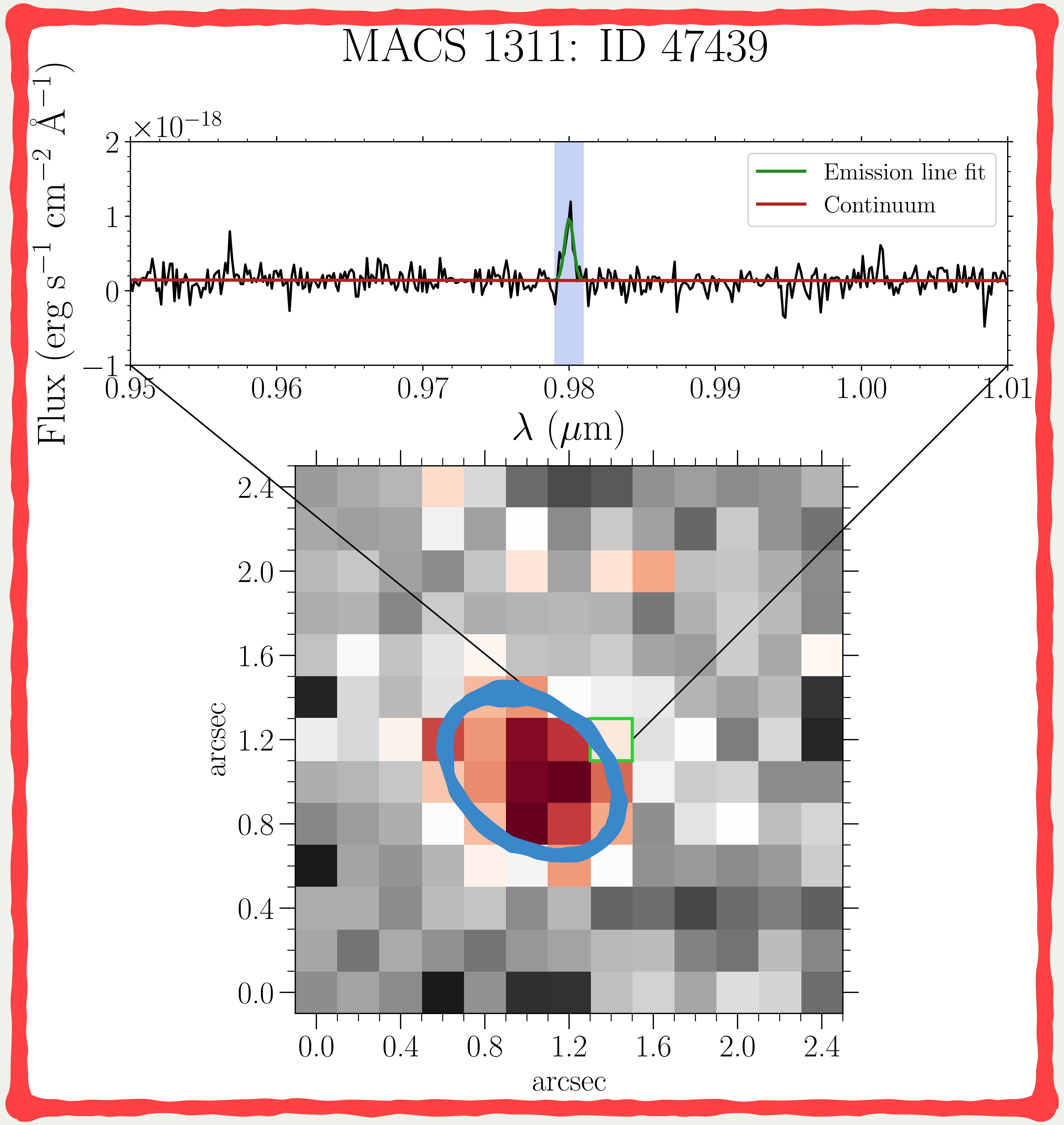

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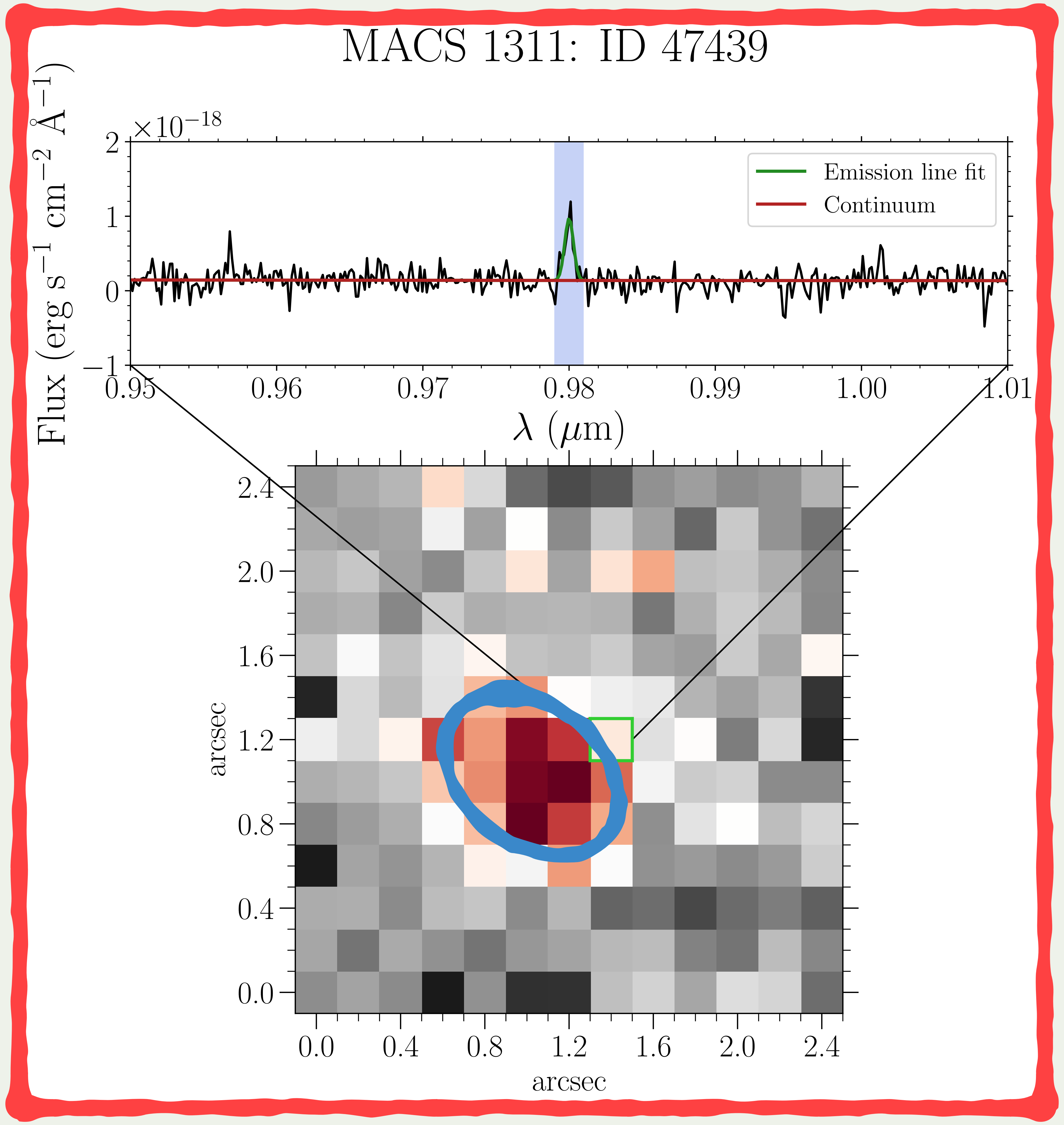
- Difference = −0.26 ± 0.12. The **98%** confidence interval **excludes 0**



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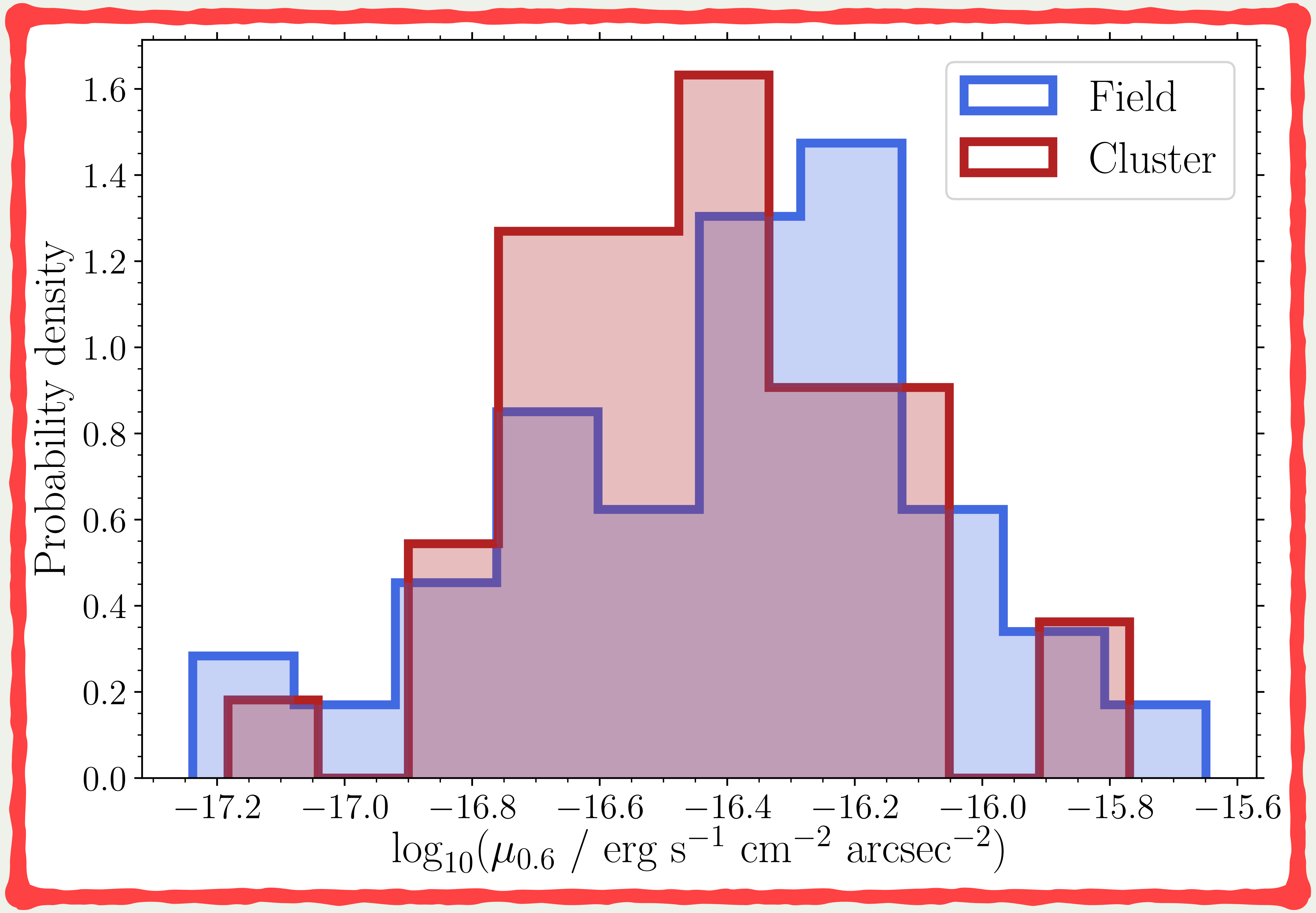

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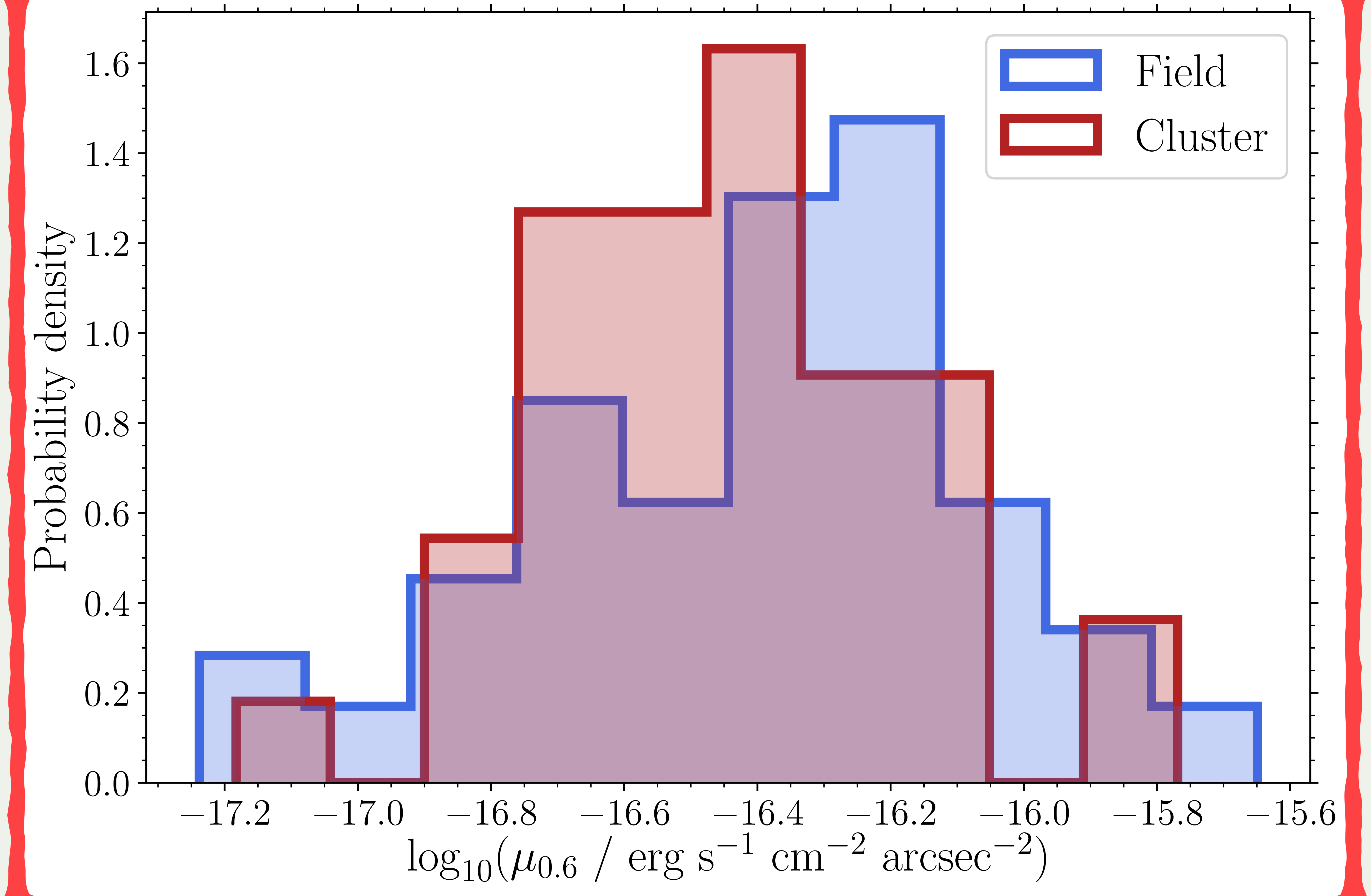

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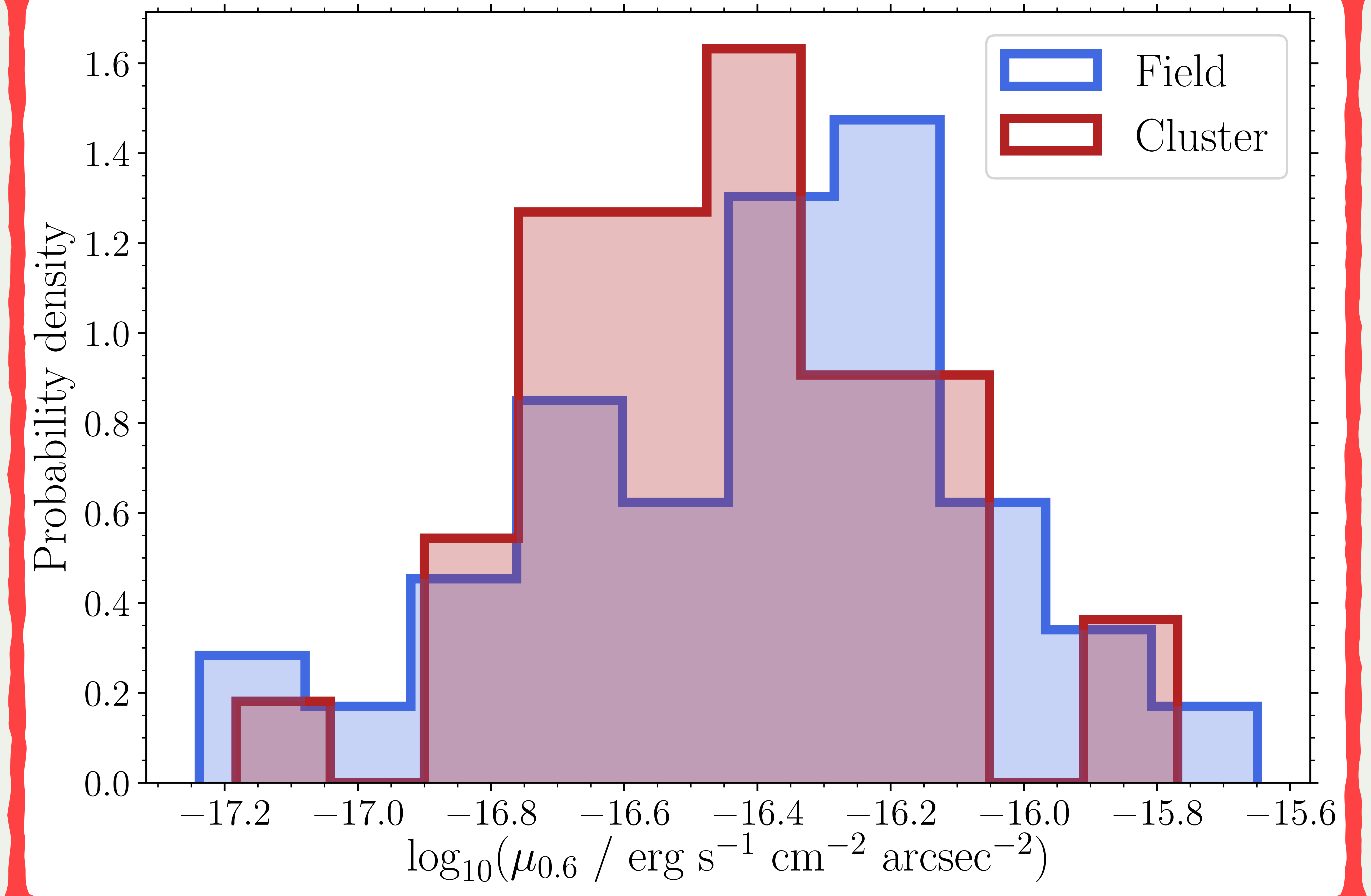
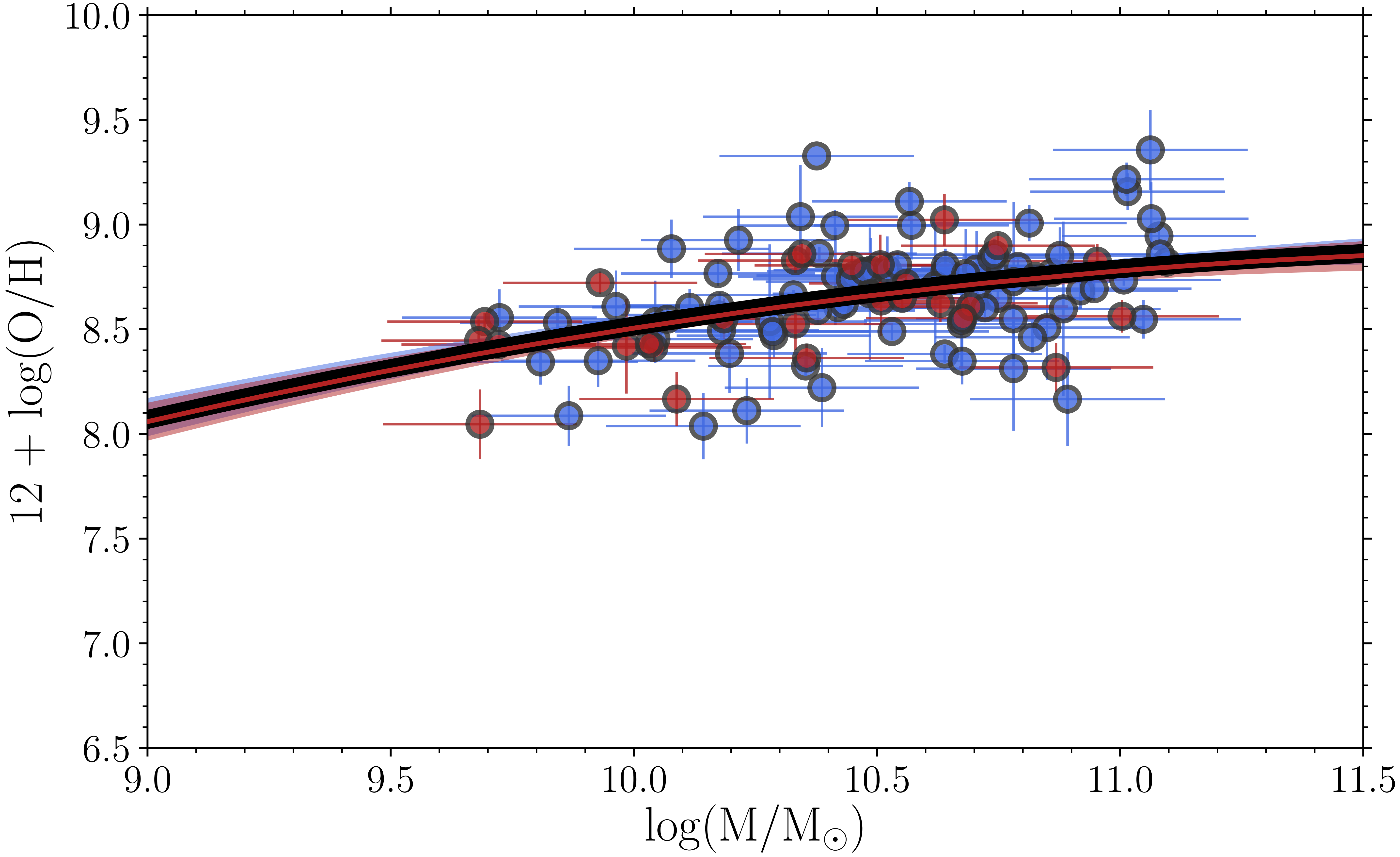


- We measure the average **Hα surface-brightness** in an aperture of diameter 0.6 arcseconds centred on the peak flux
- The average central SB in the **cluster sample** is **marginally smaller** than in the field sample by 0.06 dex

Whilst the mass-metallicity relations are indistinguishable...



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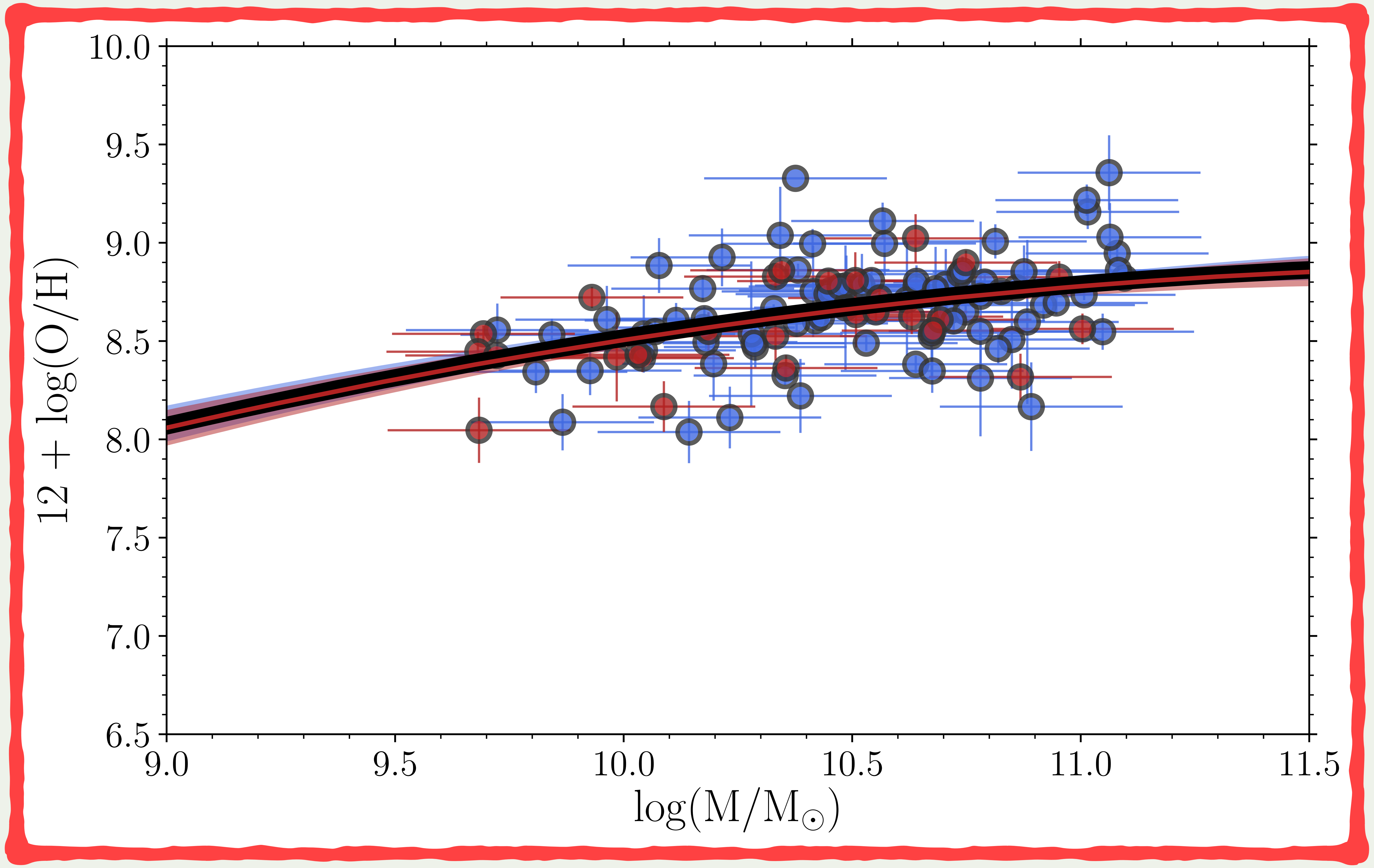

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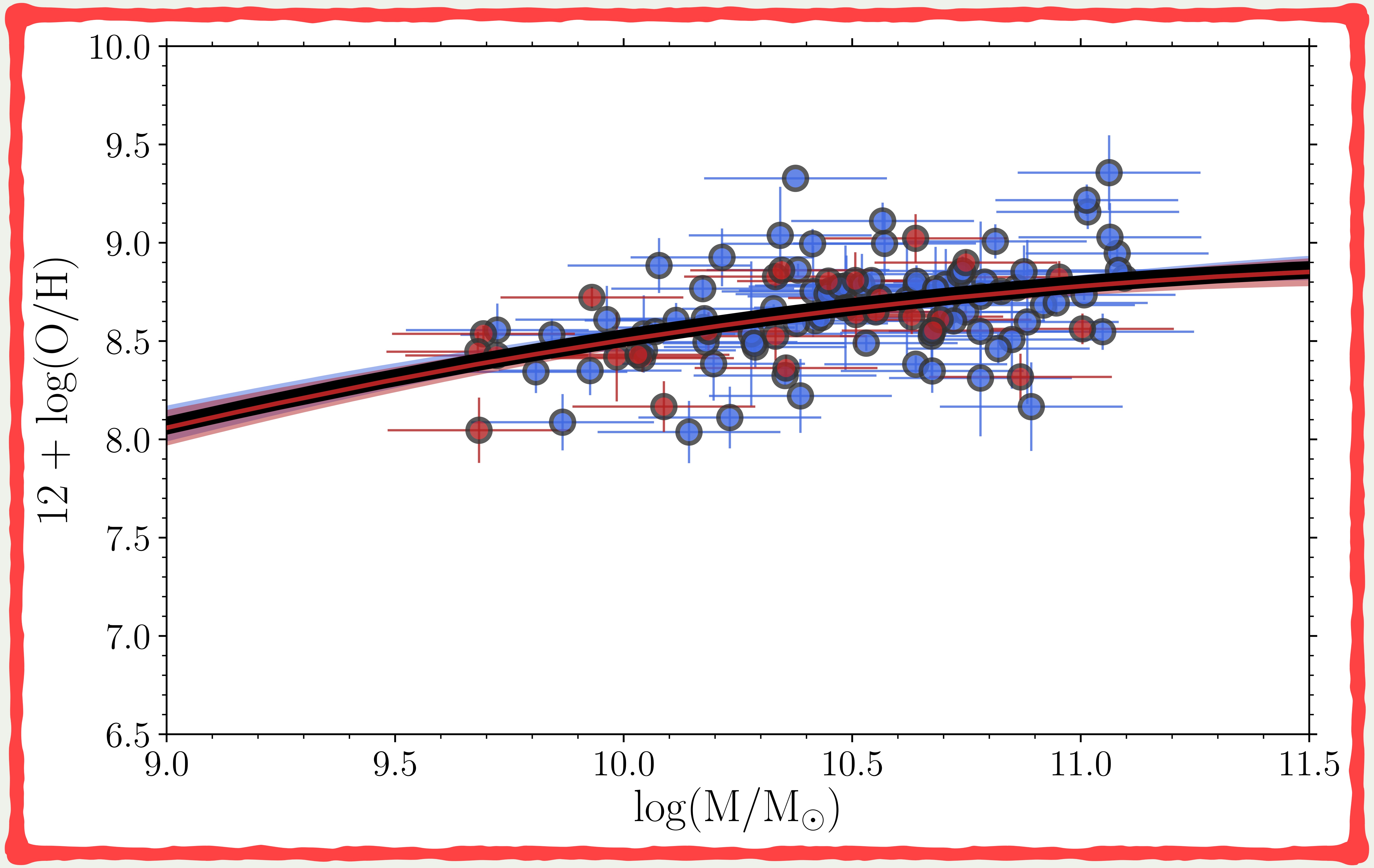

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- Get **gas-phase metallicity** from [NII]/Hα ratio
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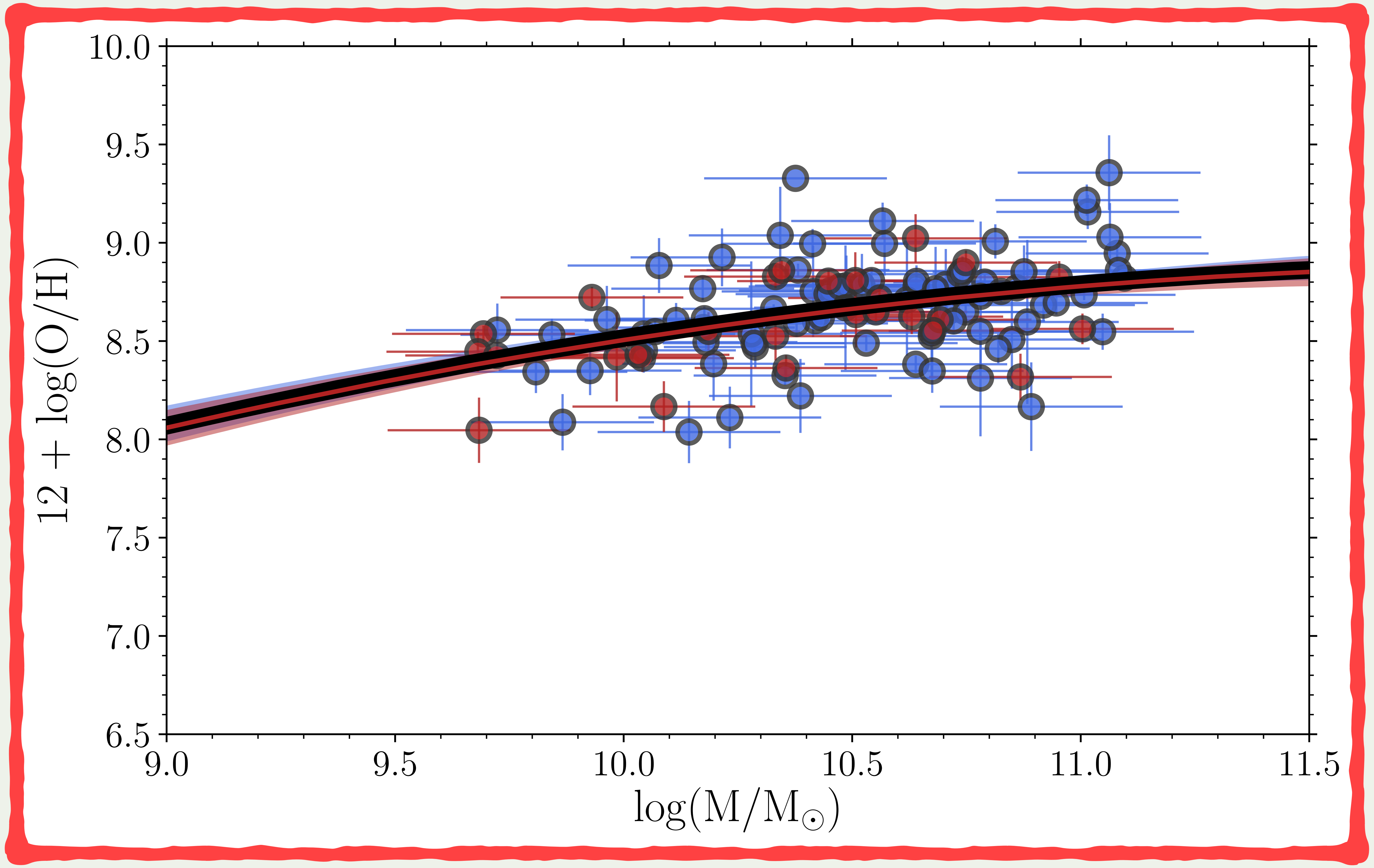
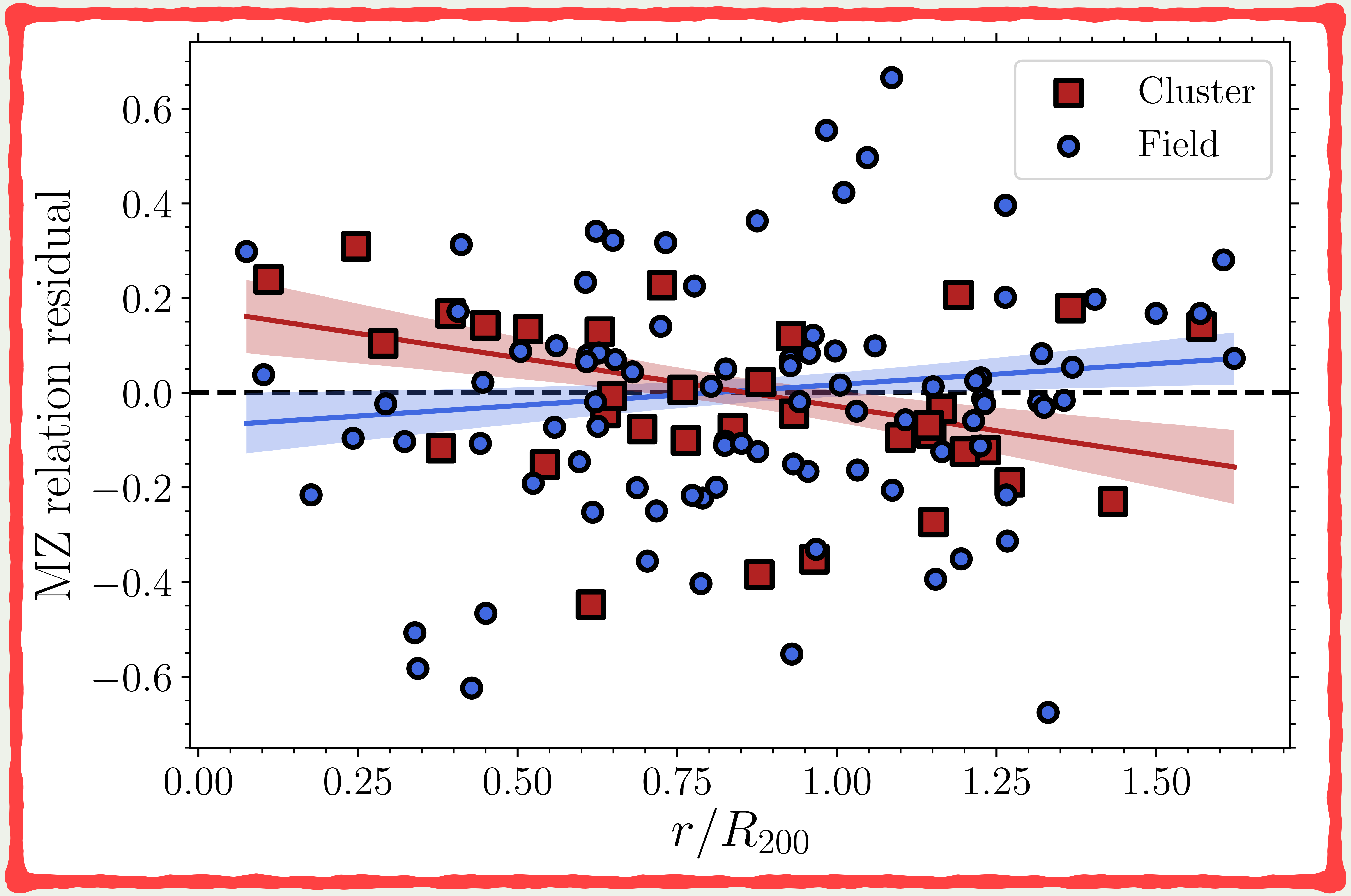
- The mass-metallicity relations are **indistinguishable** for our cluster and field samples



...we see a correlation between M-Z **residual** and cluster-centric distance



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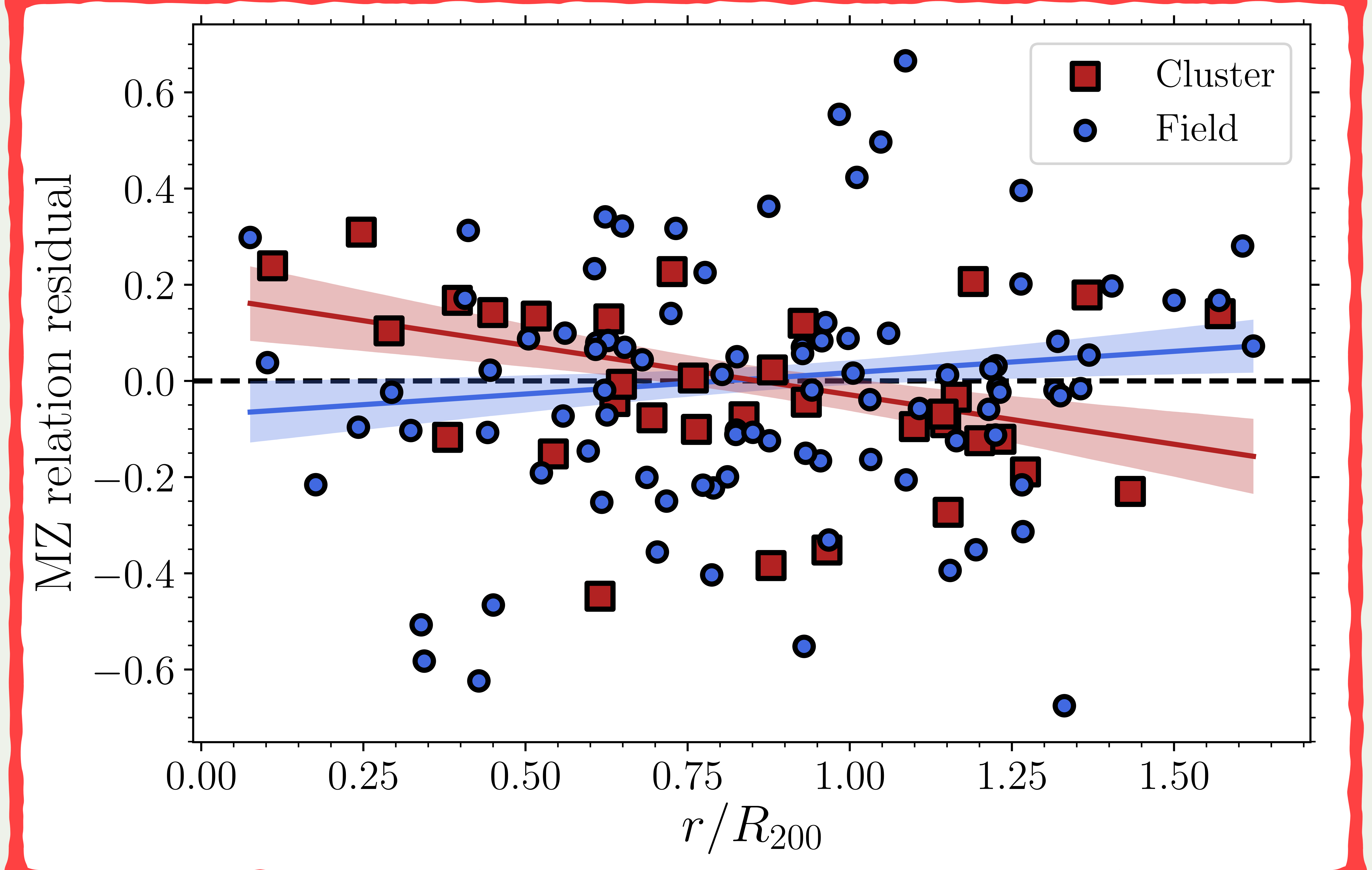

- ...but there's a correlation between the **residuals around the M-Z relation** and **projected distance from the cluster centre**

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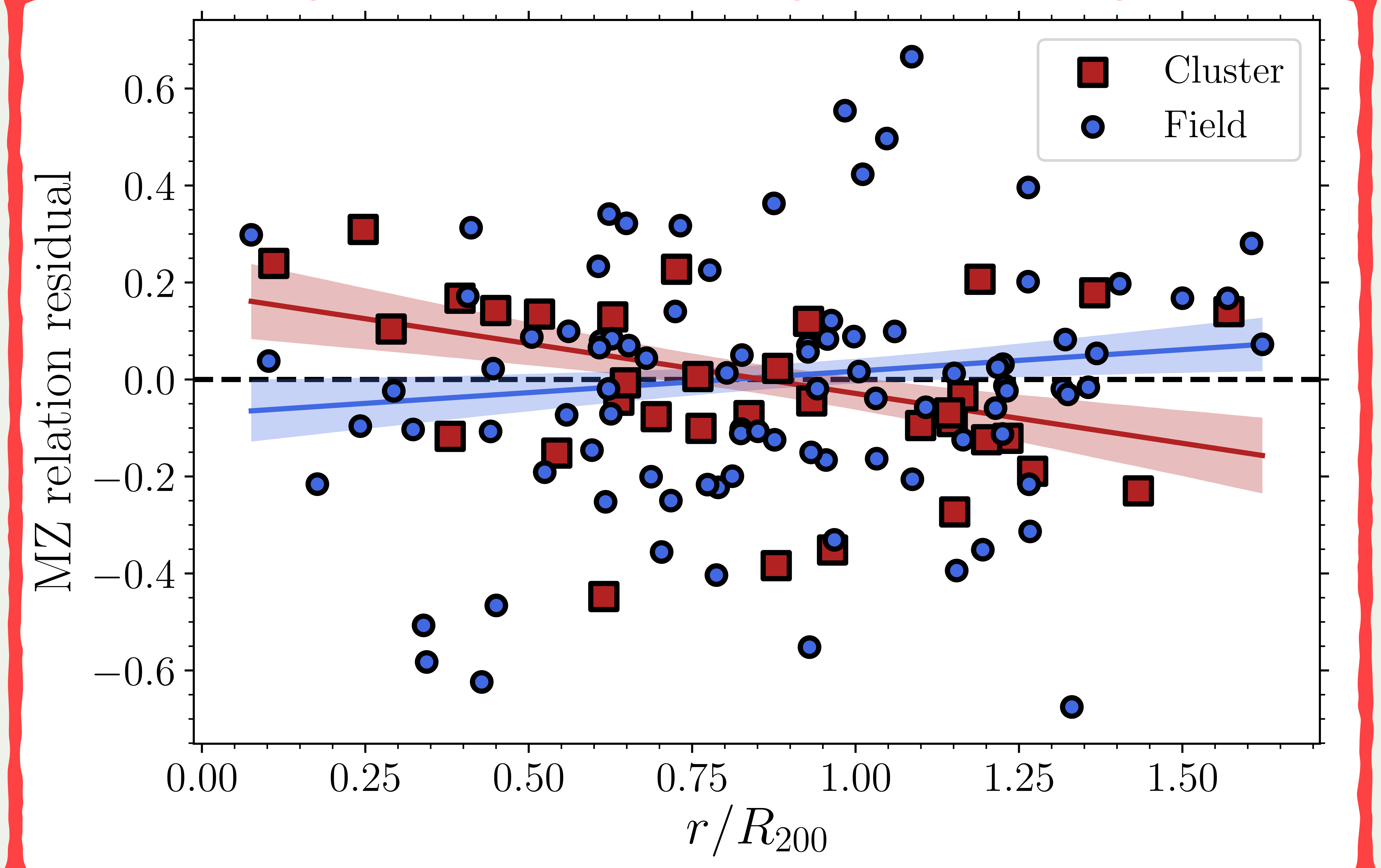

- ...but there's a correlation between the **residuals around the M-Z relation** and **projected distance from the cluster centre**
- Galaxies closer to the cluster centre have **higher metallicities** than **predicted by the M-Z relation**

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Three pieces of evidence

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- We find that, on average, galaxies in our cluster sample have smaller **Hα sizes in comparison to their stellar size** than the field sample

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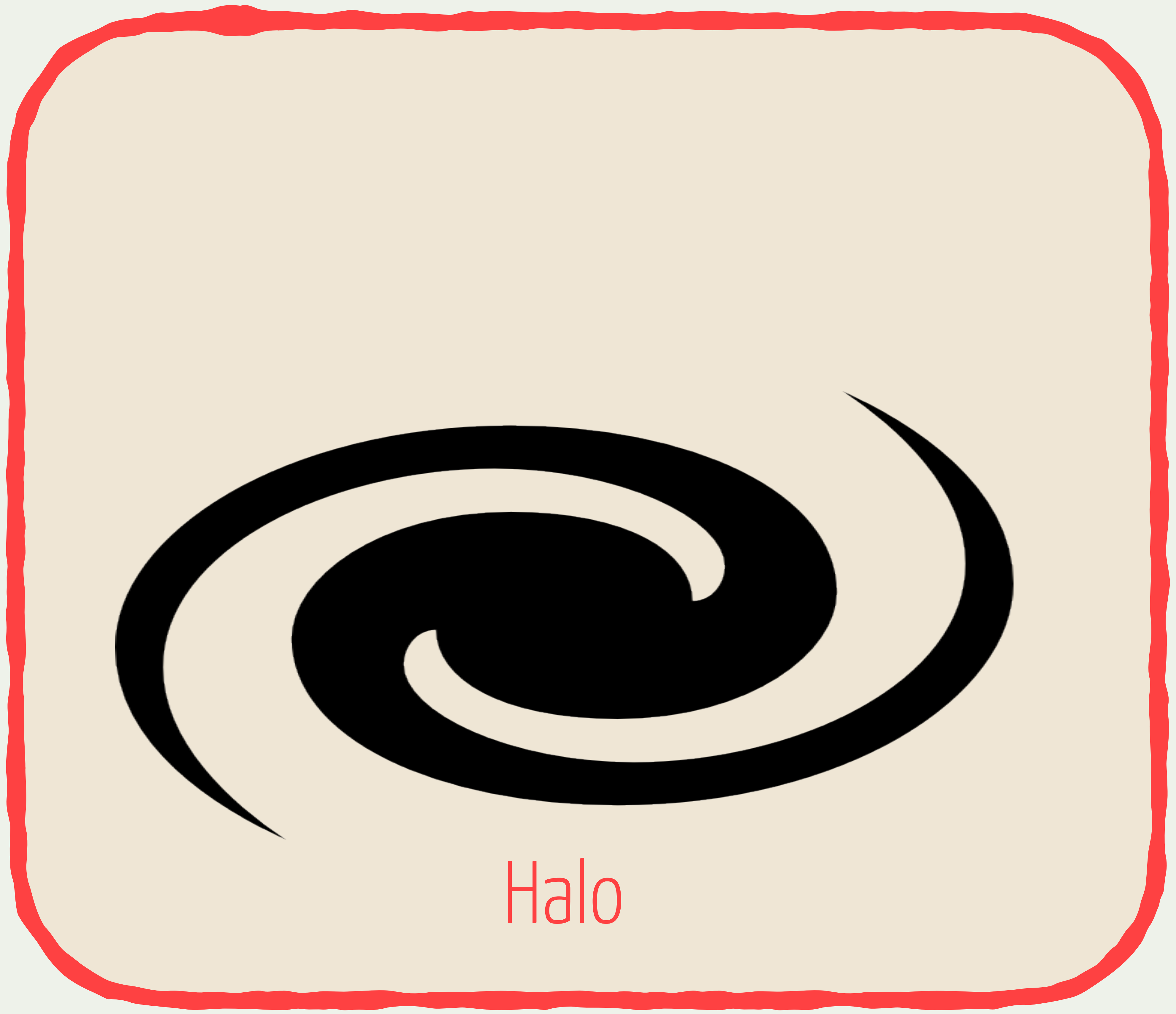
- We find that, on average, galaxies in our cluster sample have **marginally fainter central surface brightnesses** than the field sample
- For the cluster sample, galaxies **closer to the cluster centre** are **more metal-enriched** than you'd expect for their mass

Chemical evolution models: "bathtub"



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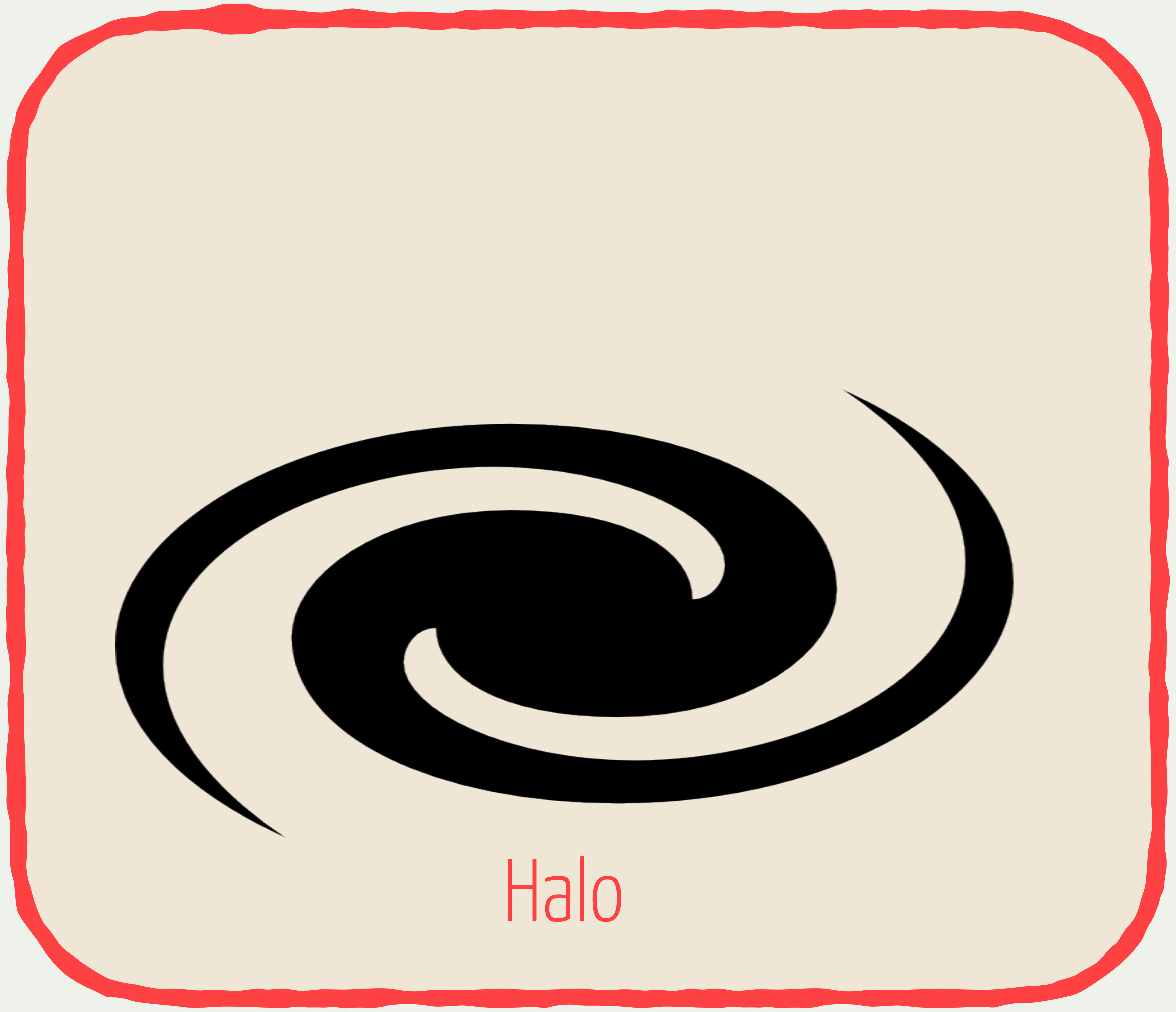

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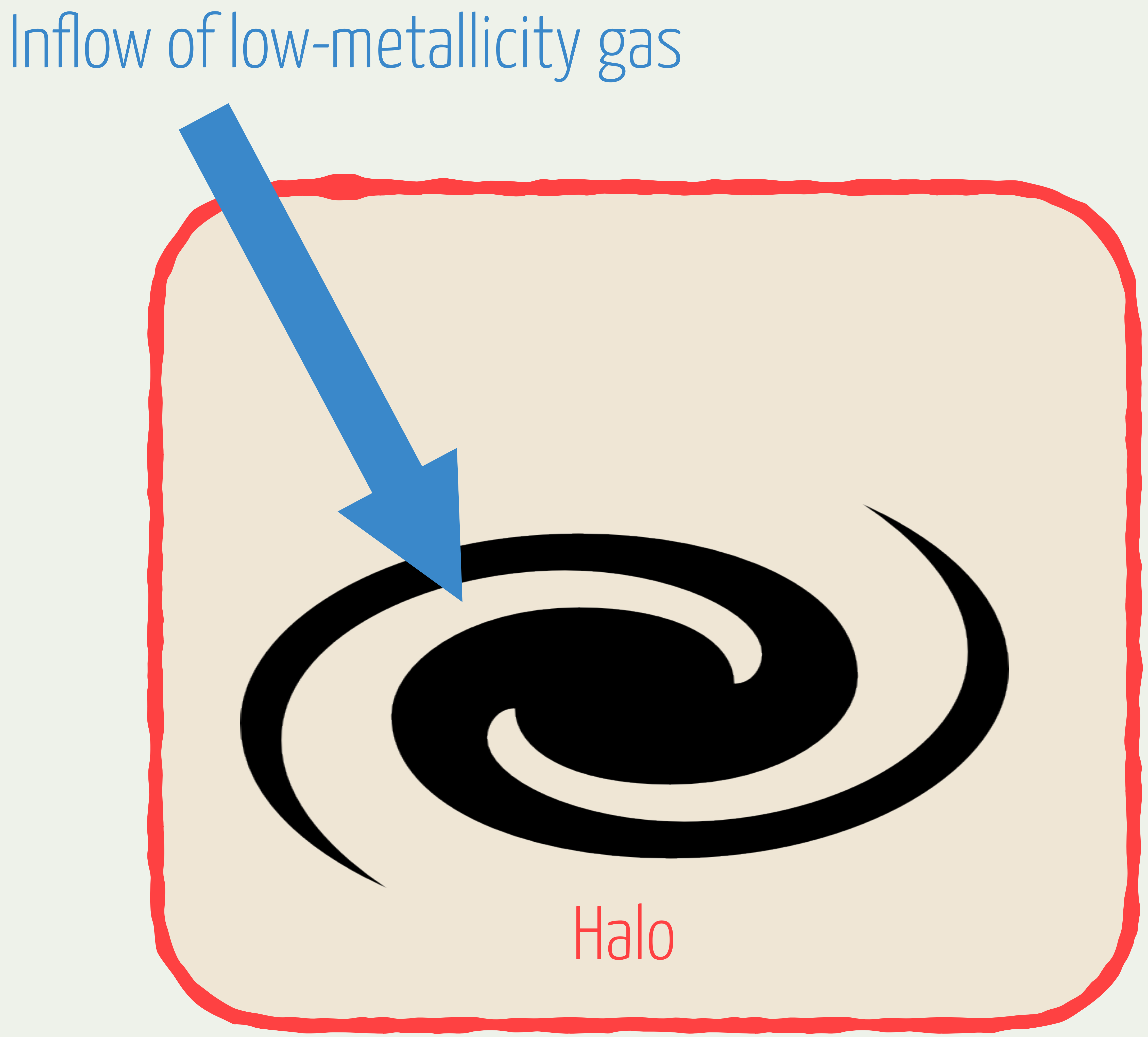

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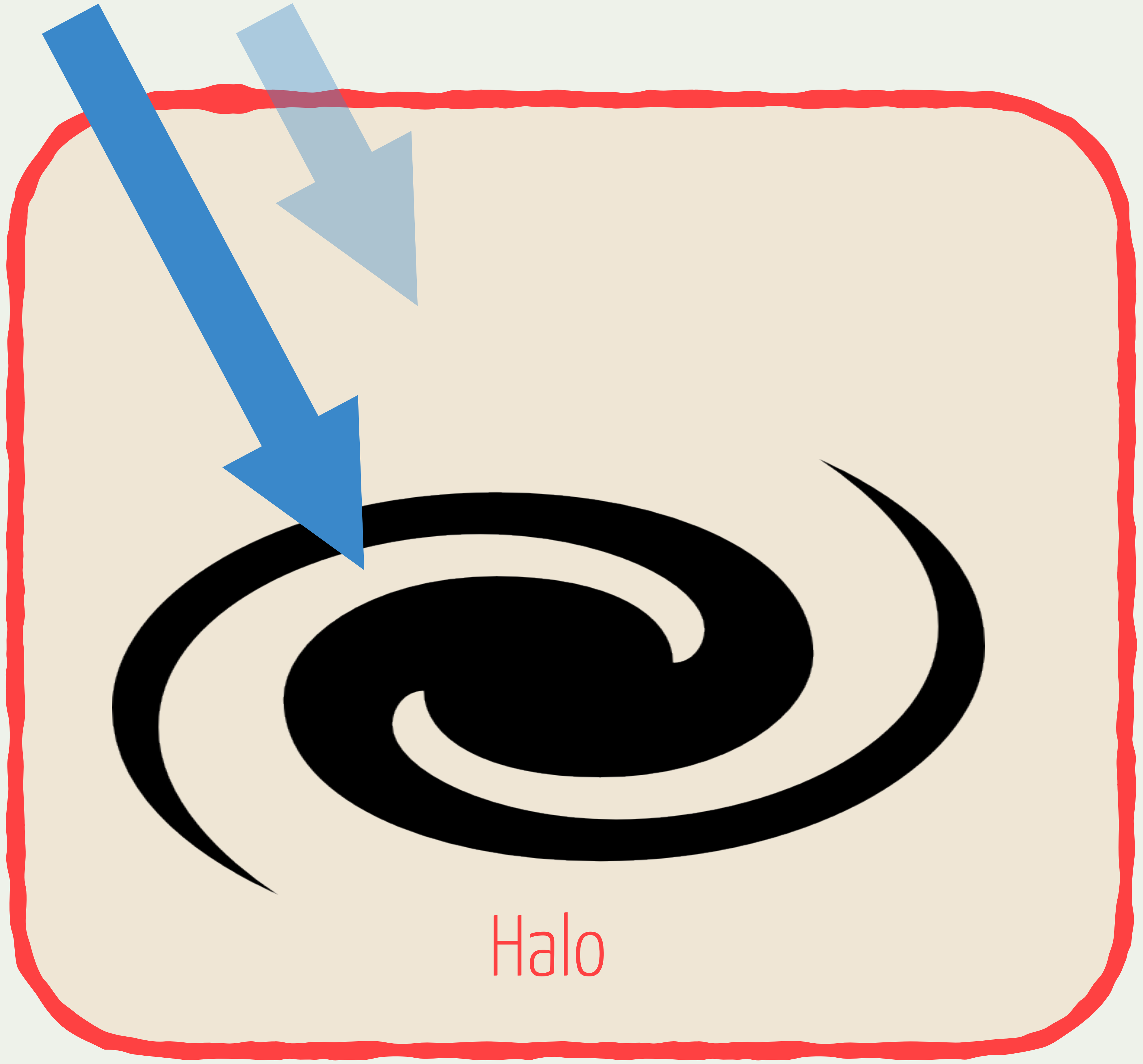

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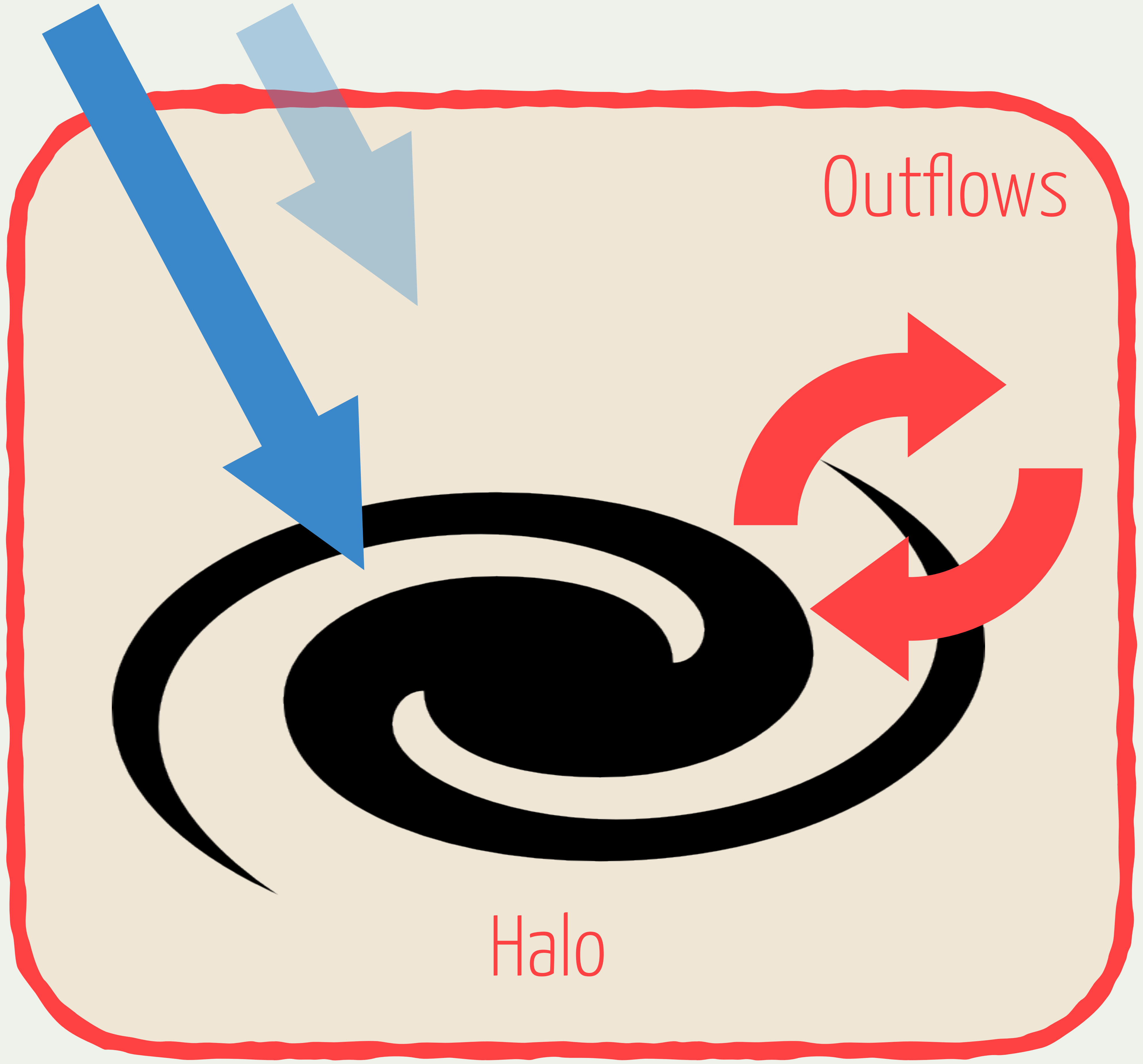

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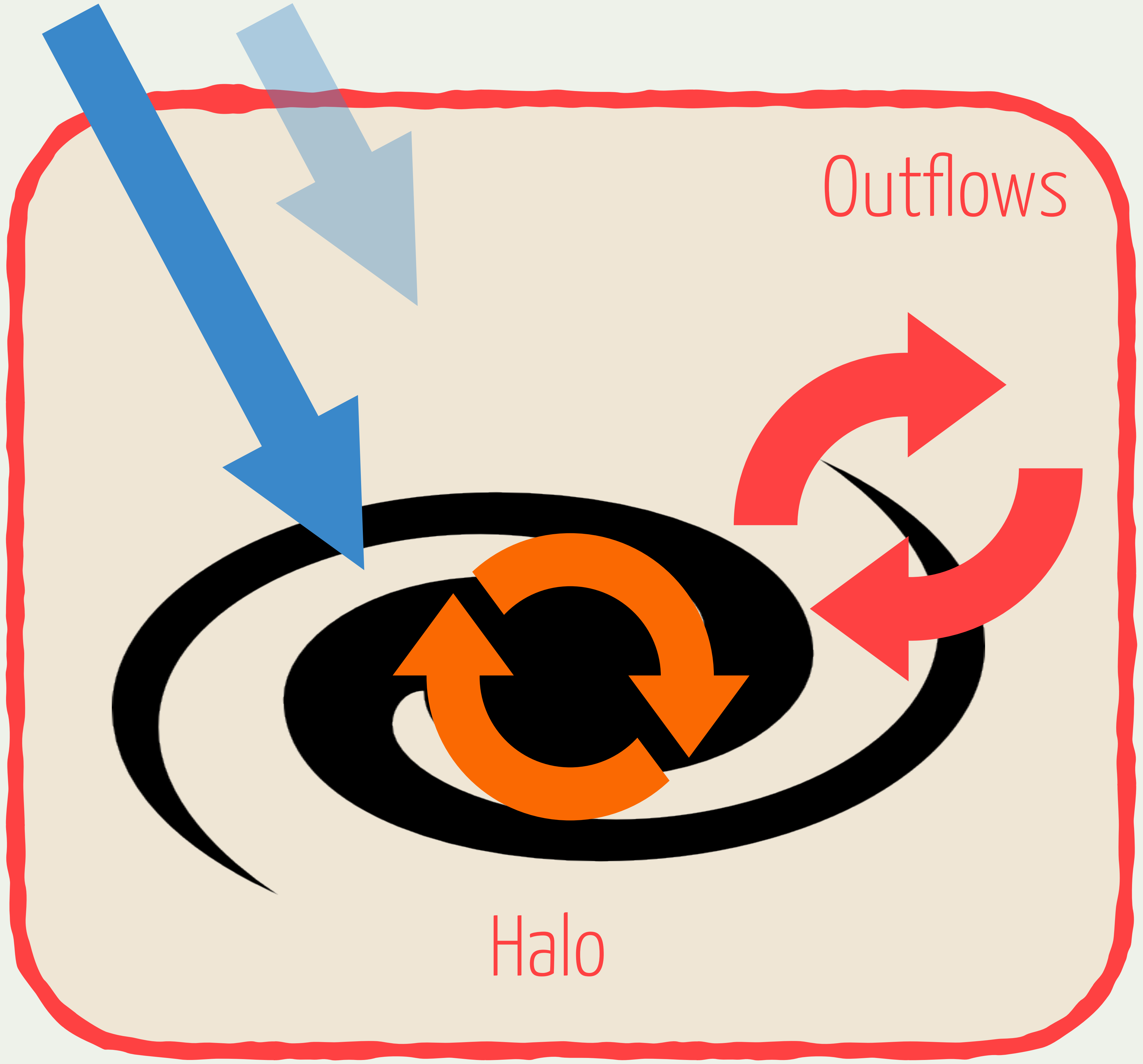

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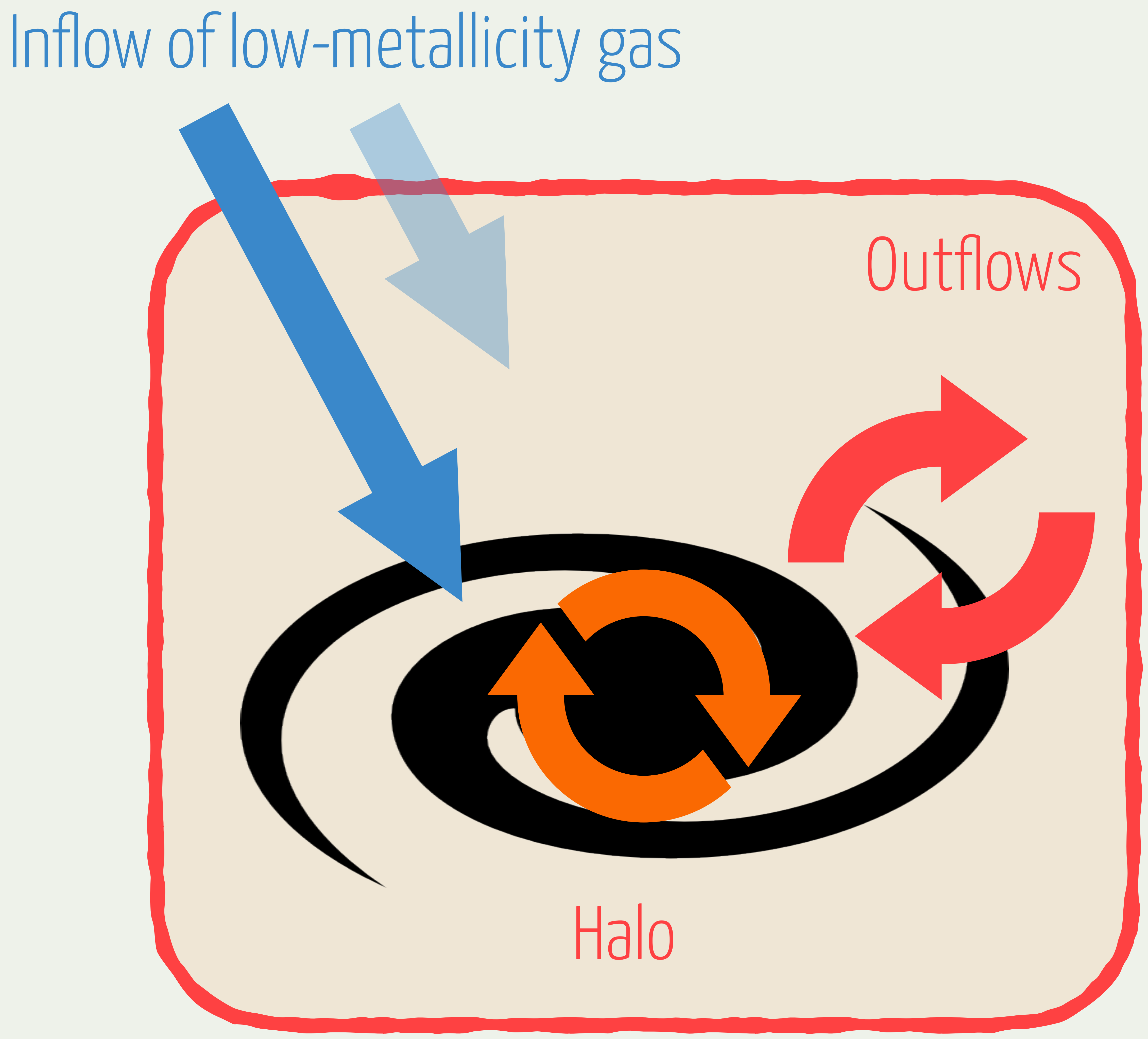

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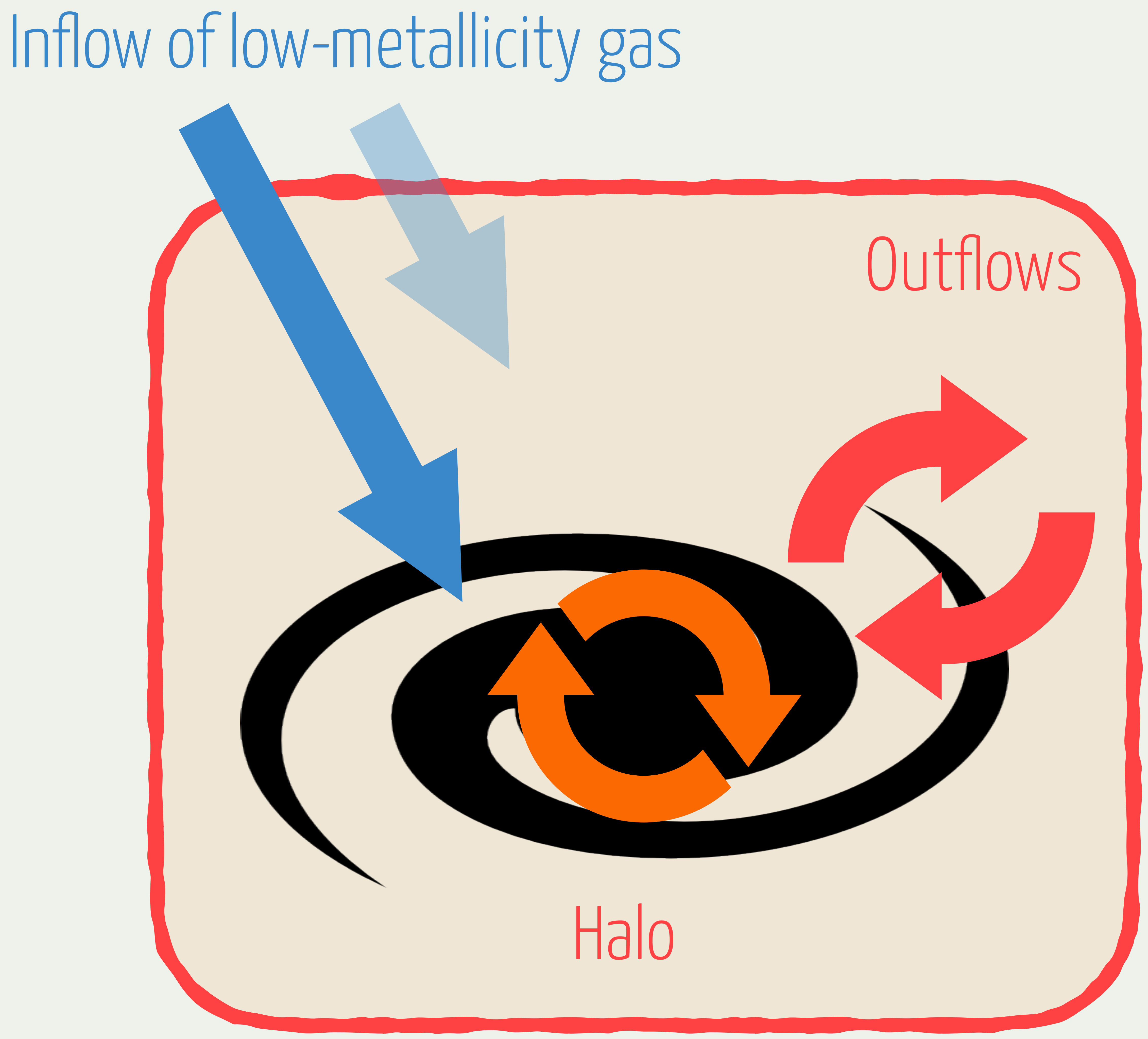

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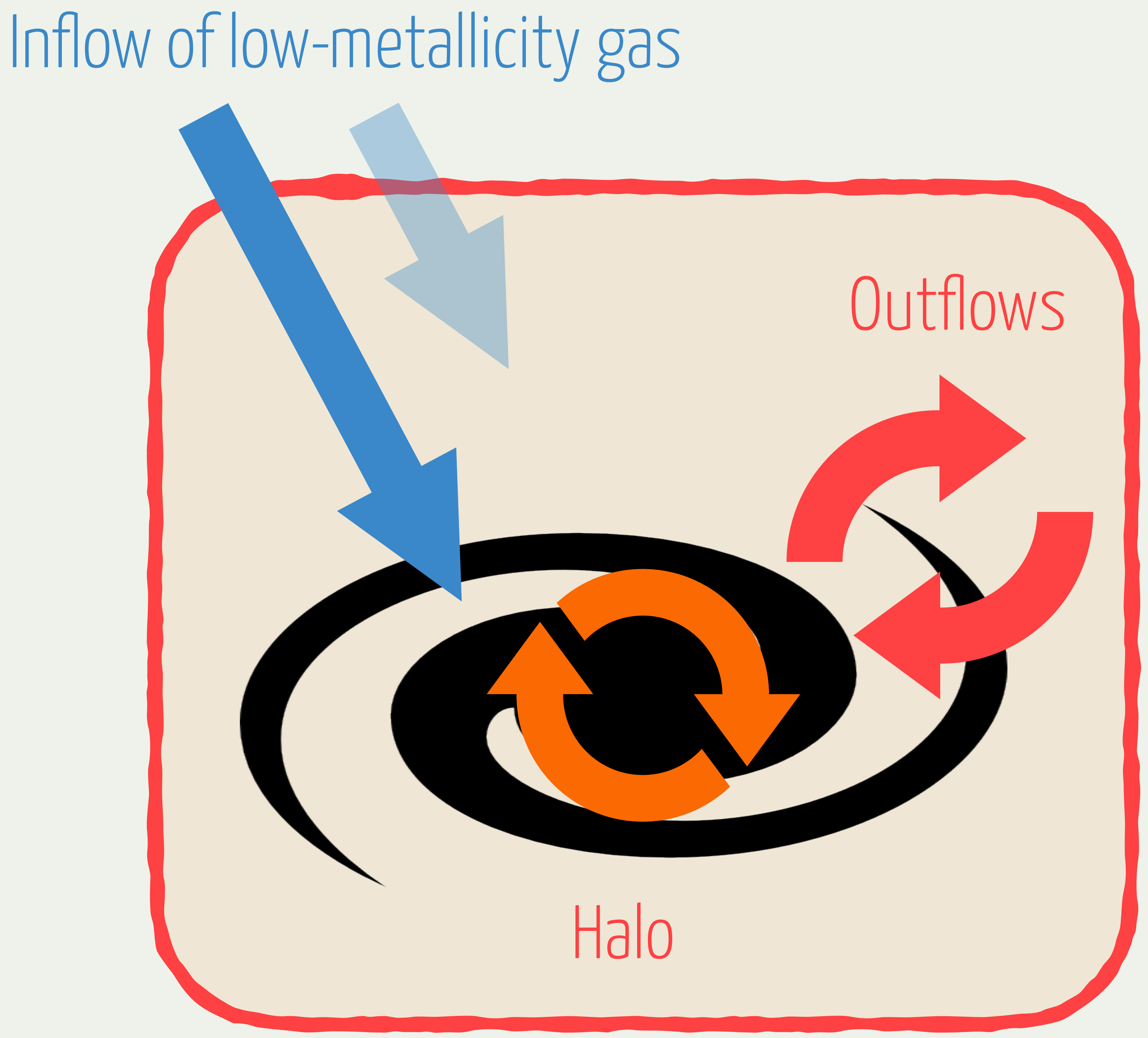
Chemical evolution models: closed box



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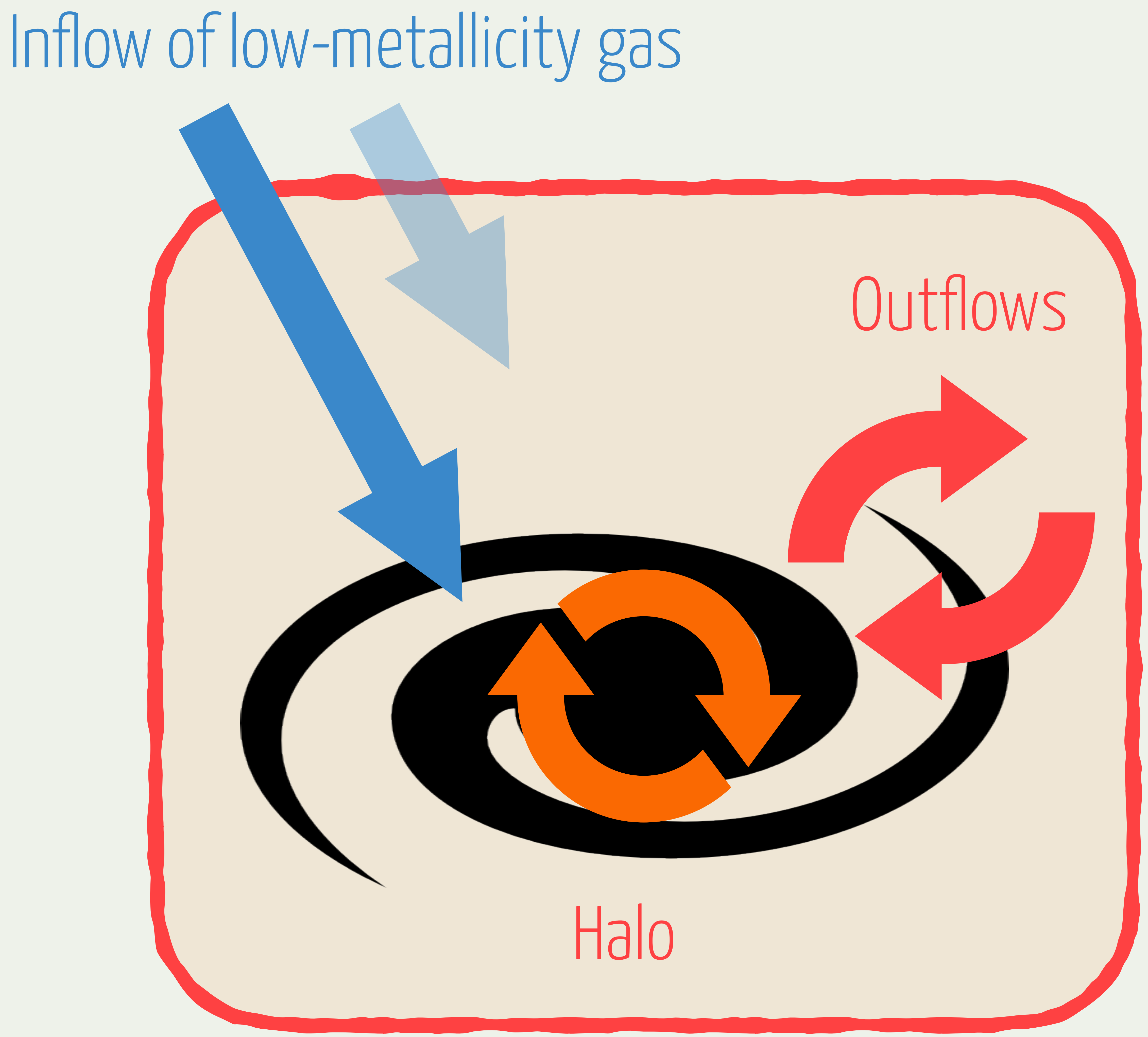

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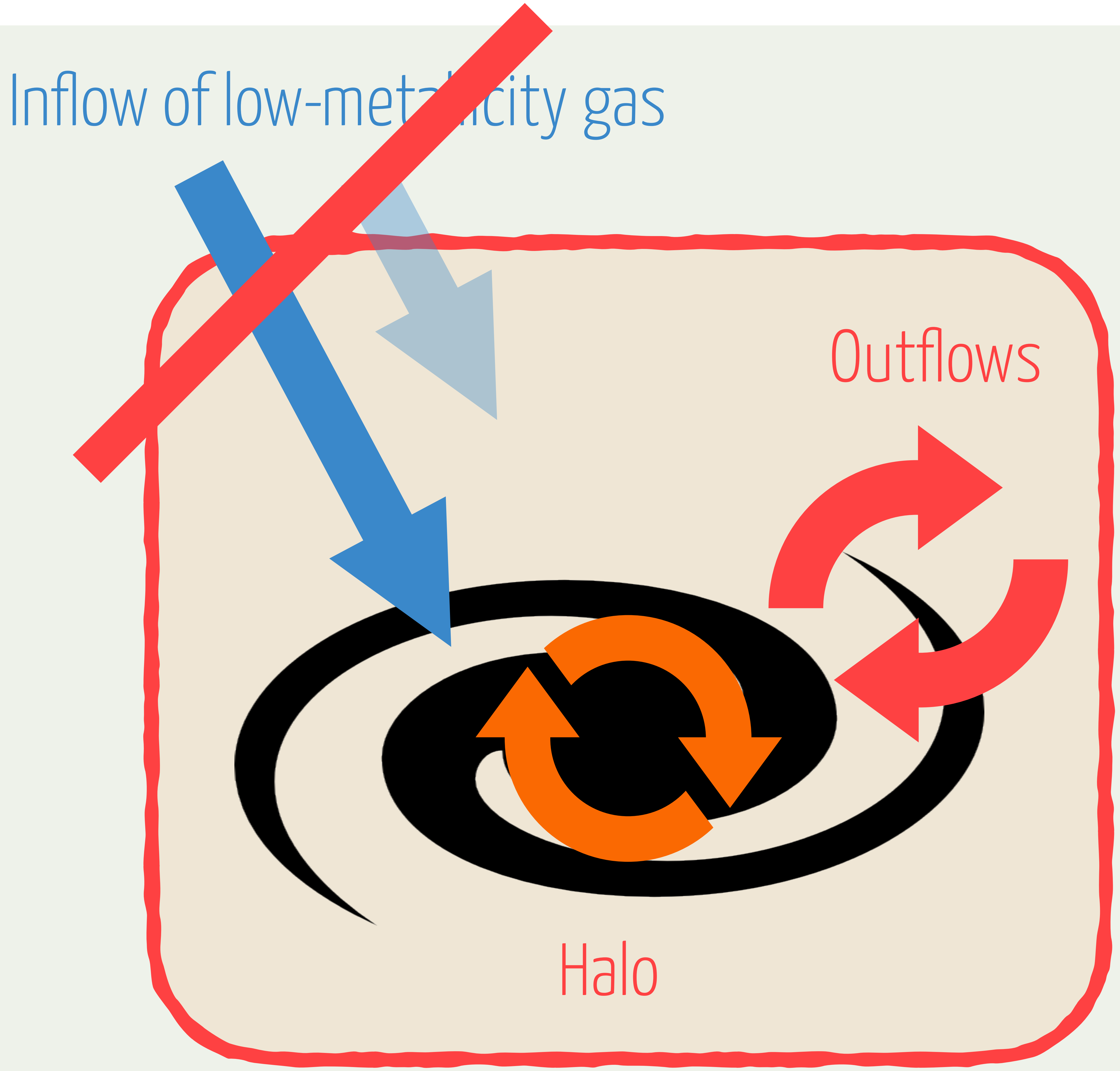

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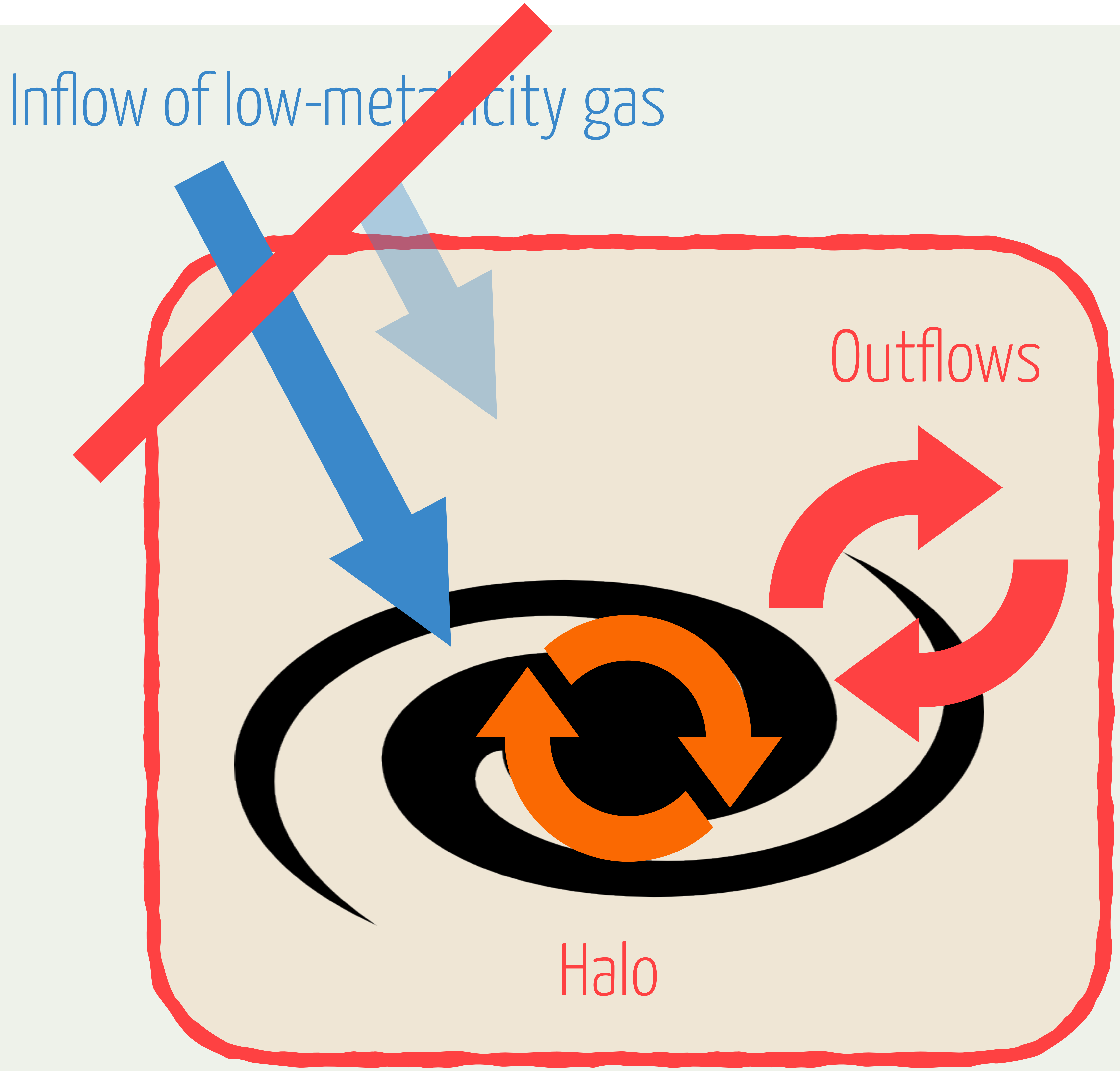

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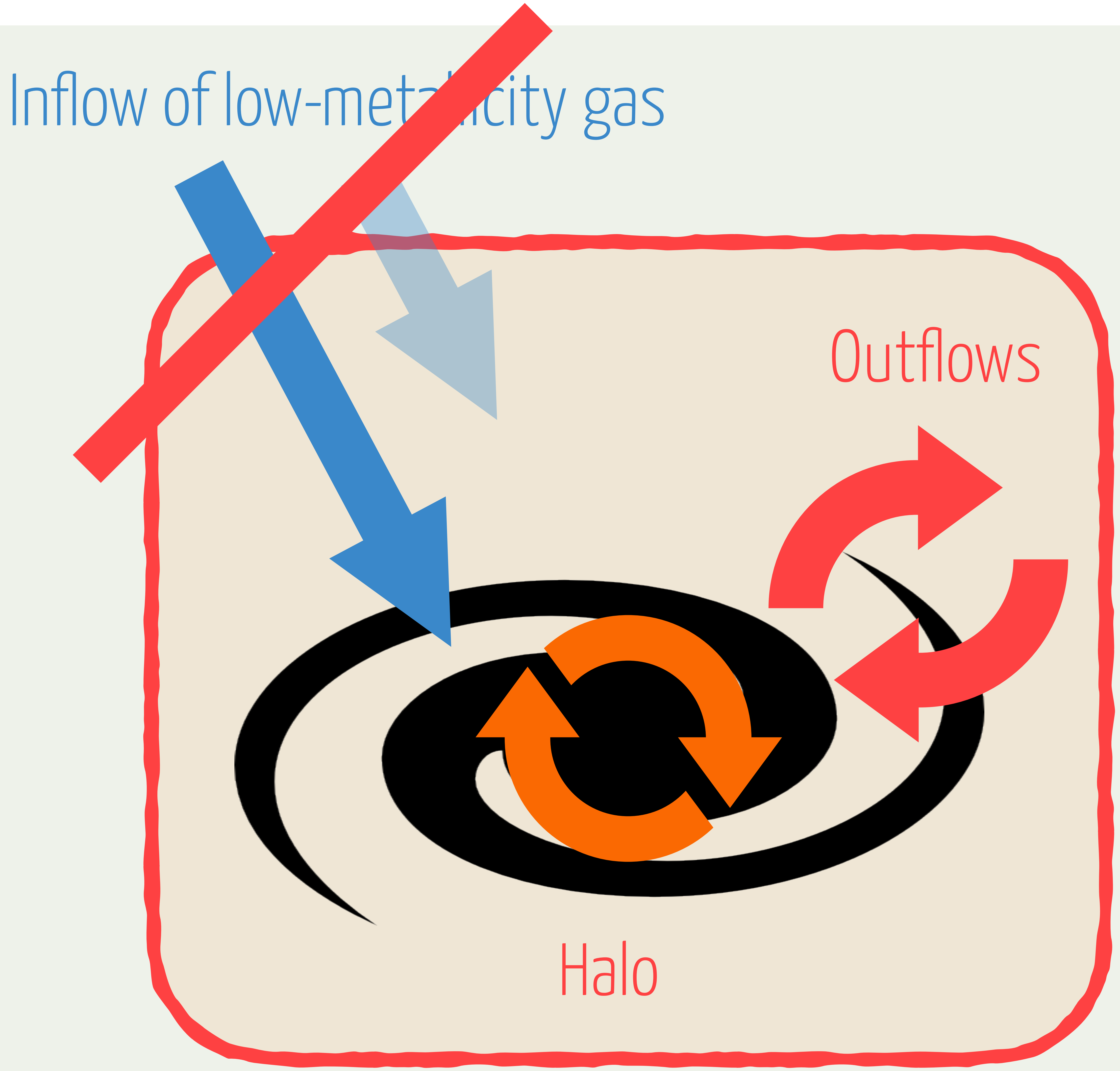

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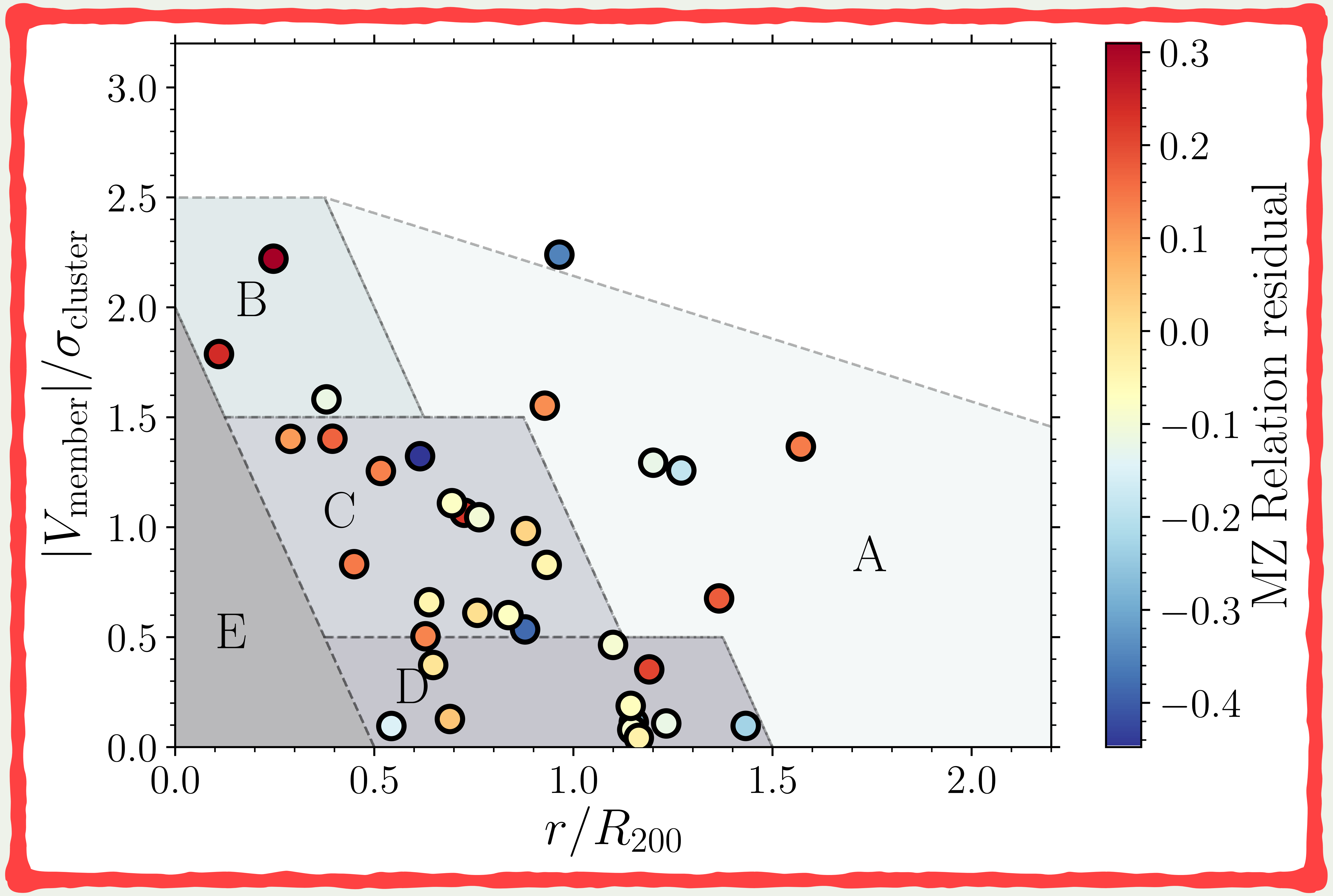

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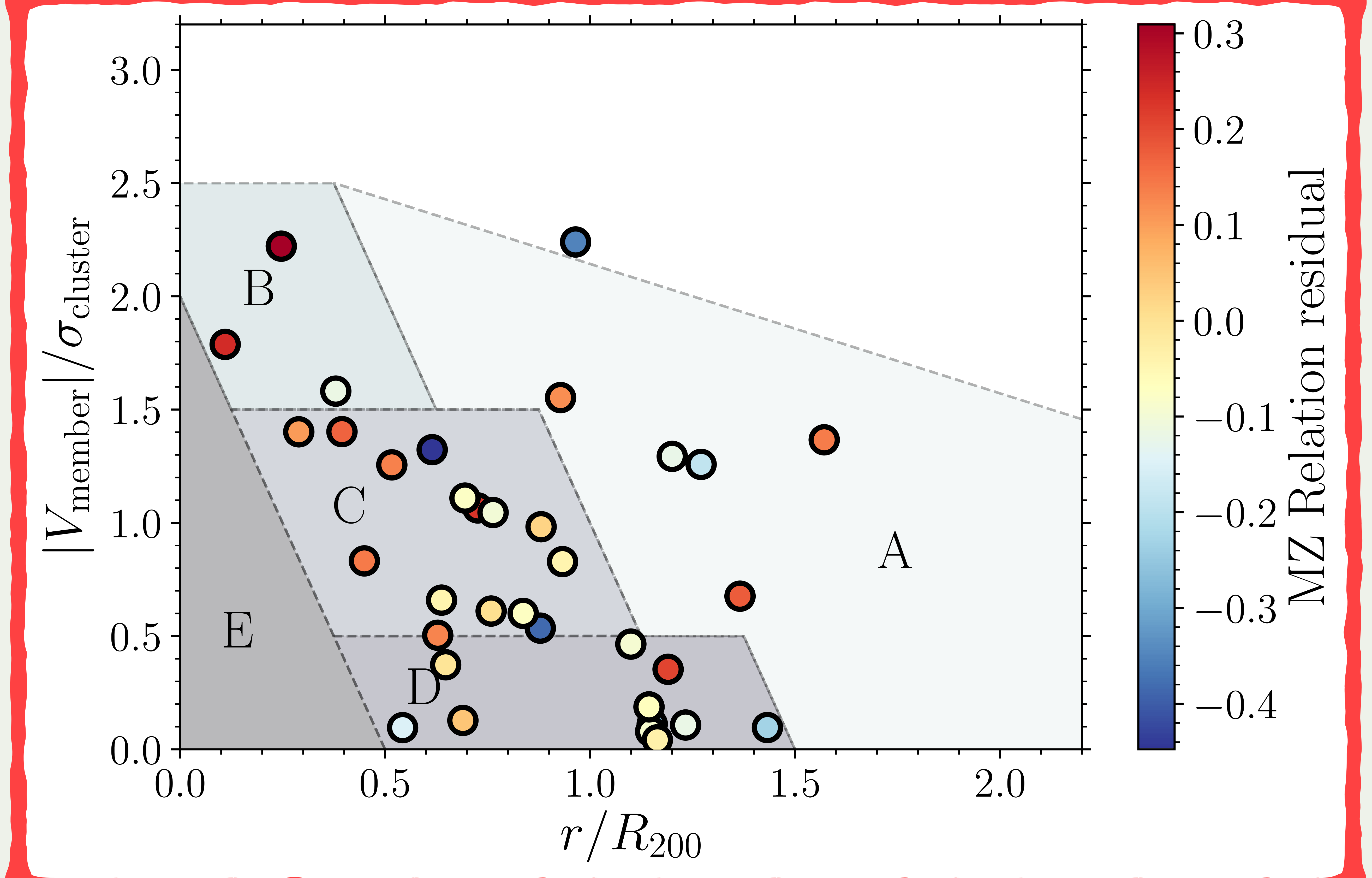
- Using **cluster phase-space diagrams** and simulations from **Rhee et al. 2017**, we estimate most of our cluster galaxies entered the cluster between 1-5 Gyrs ago



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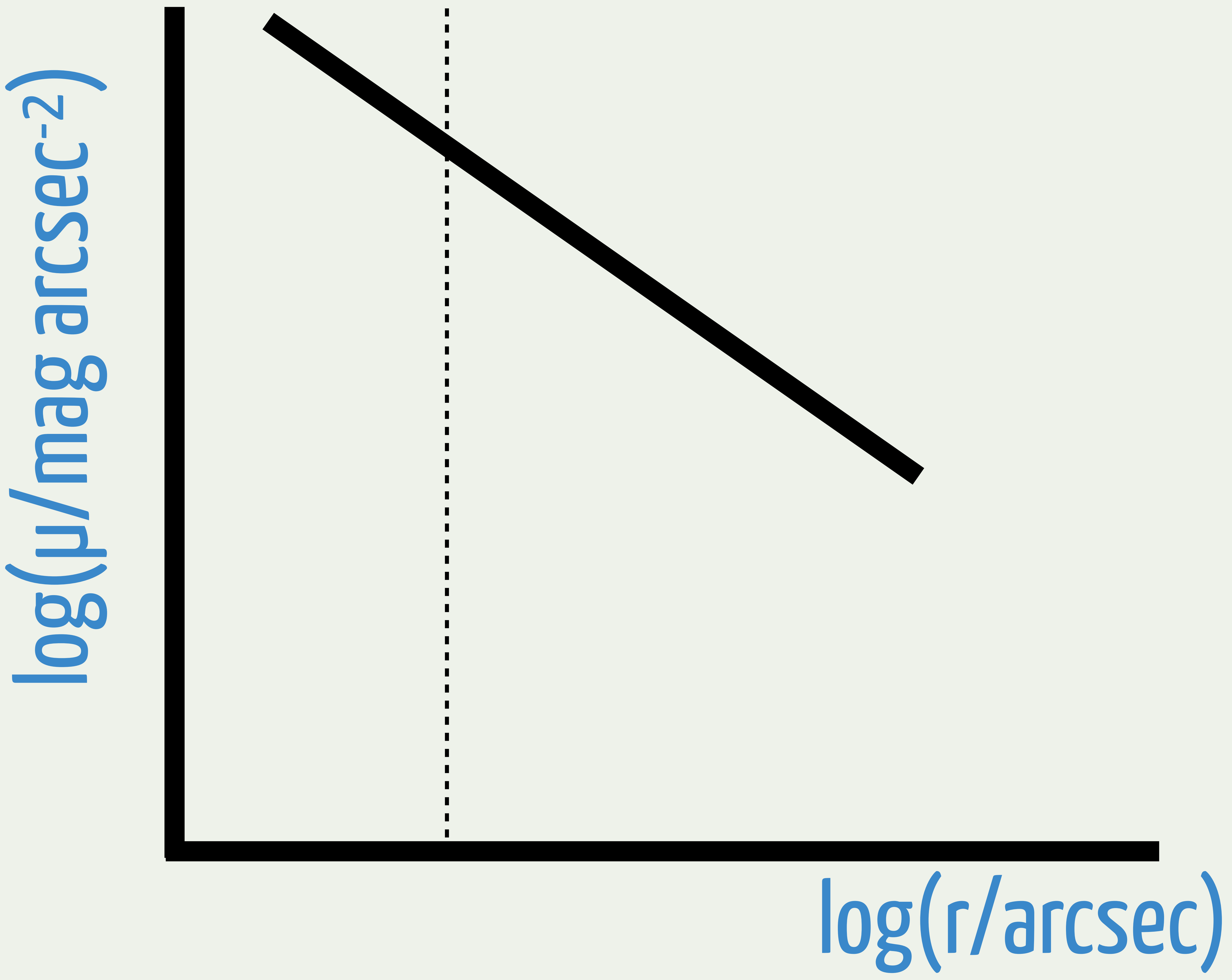

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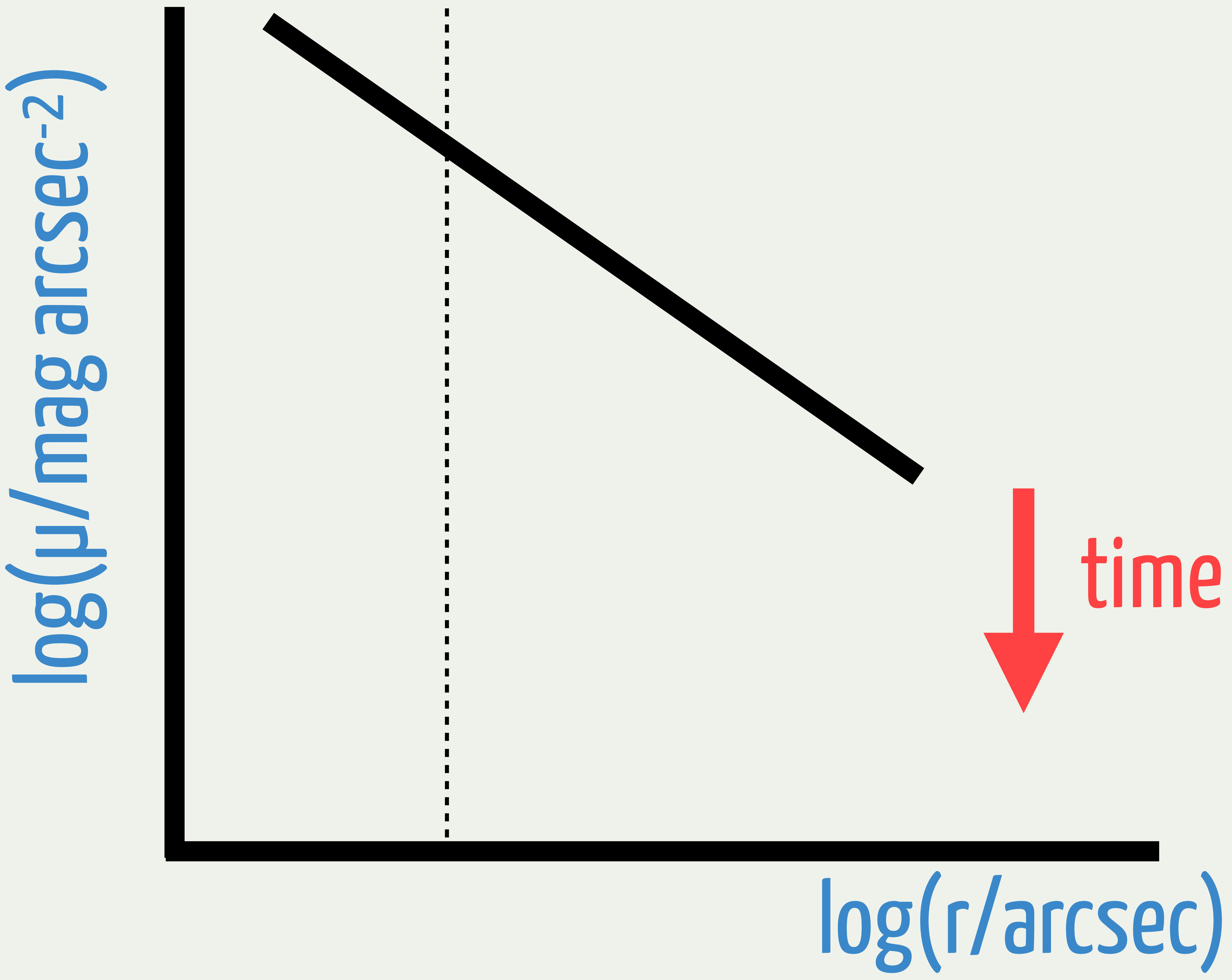

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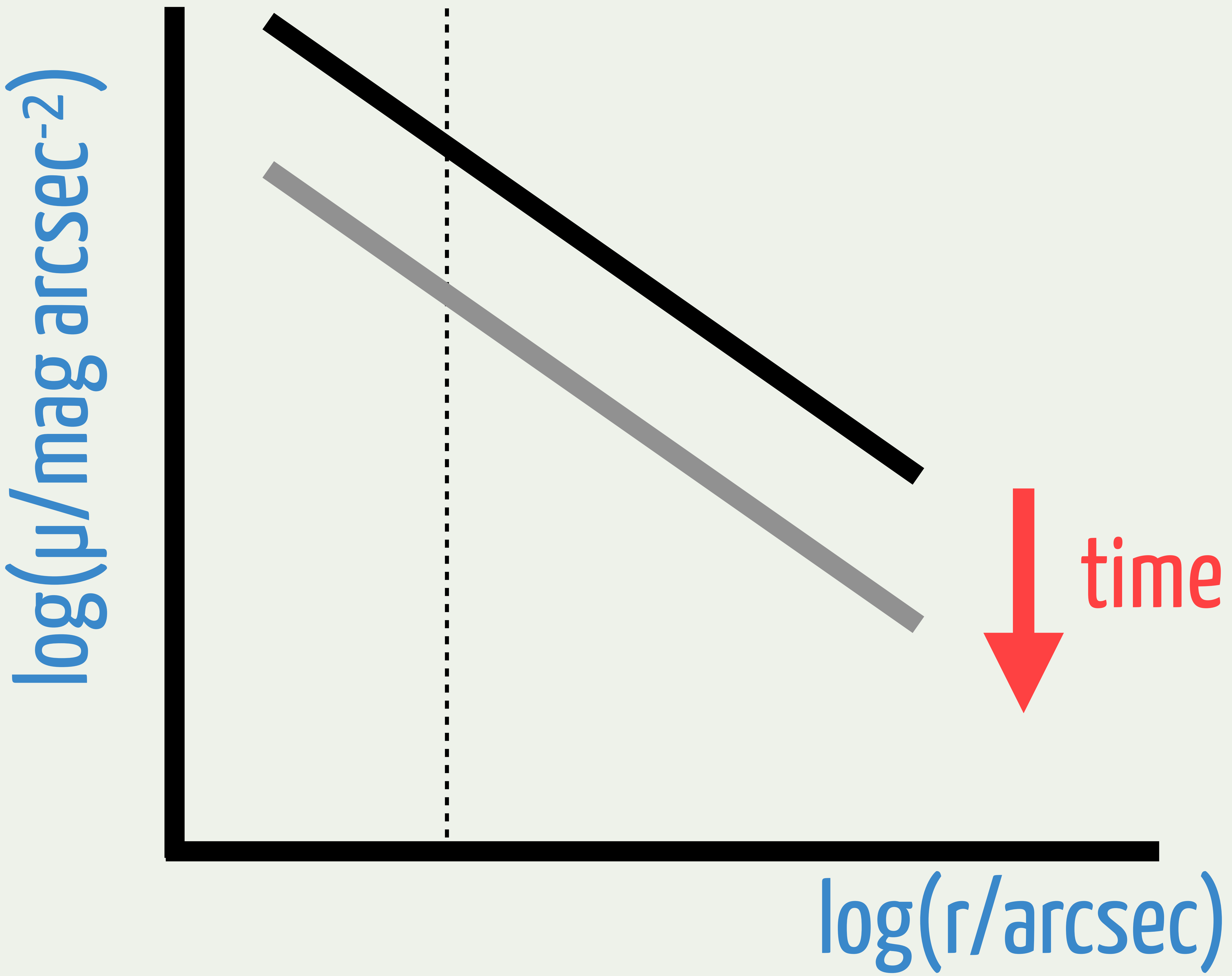

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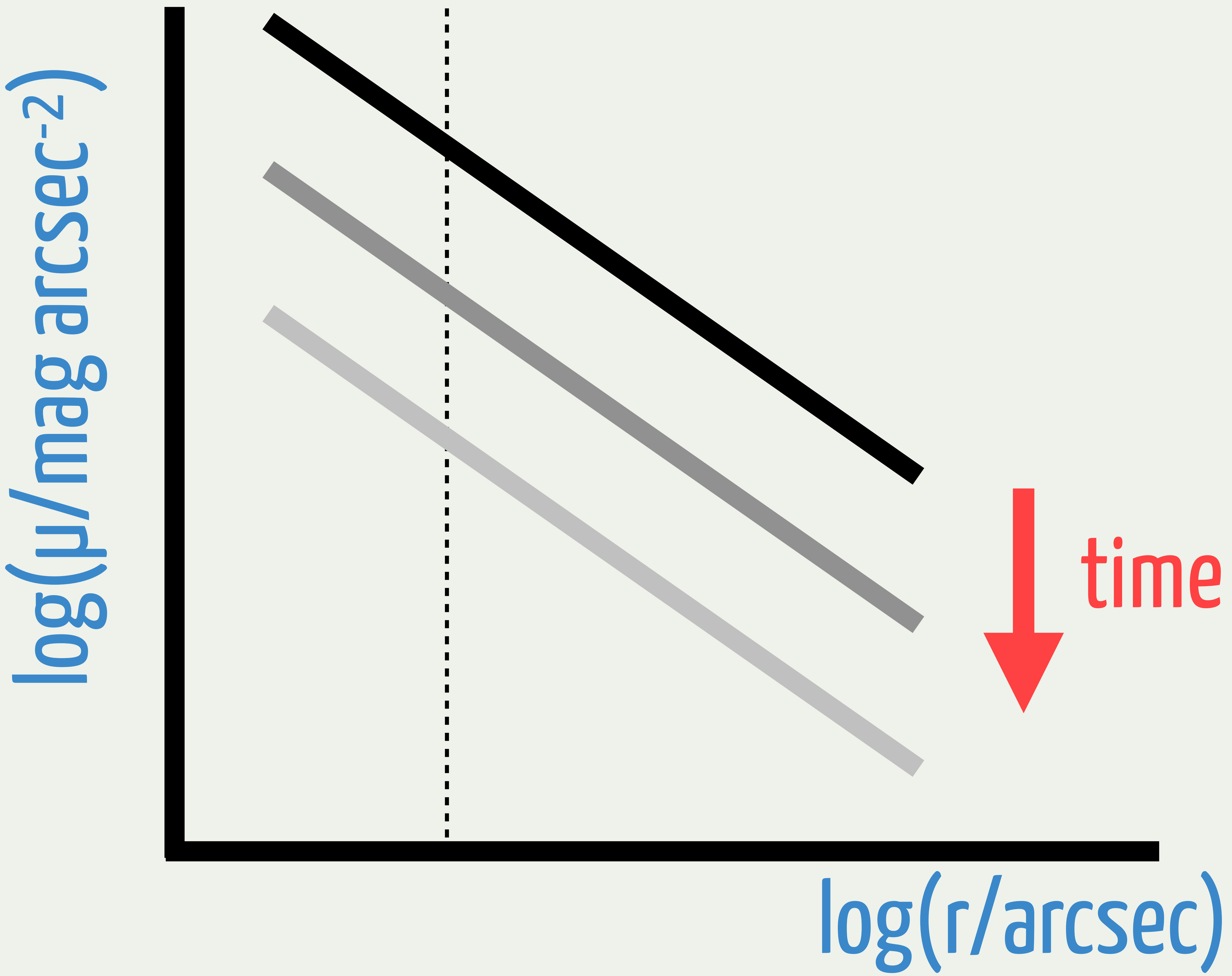

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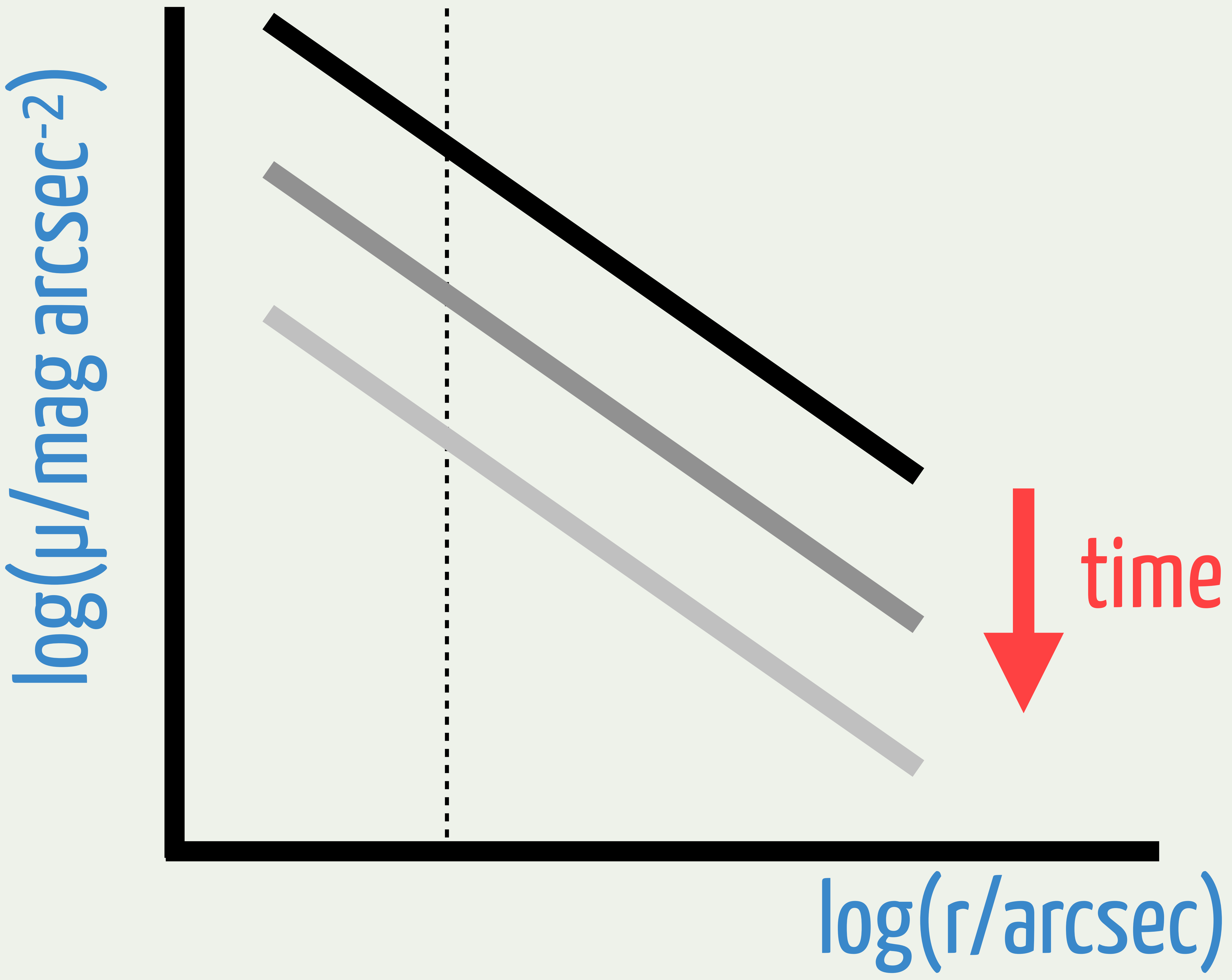
But we need ram pressure stripping on top of it



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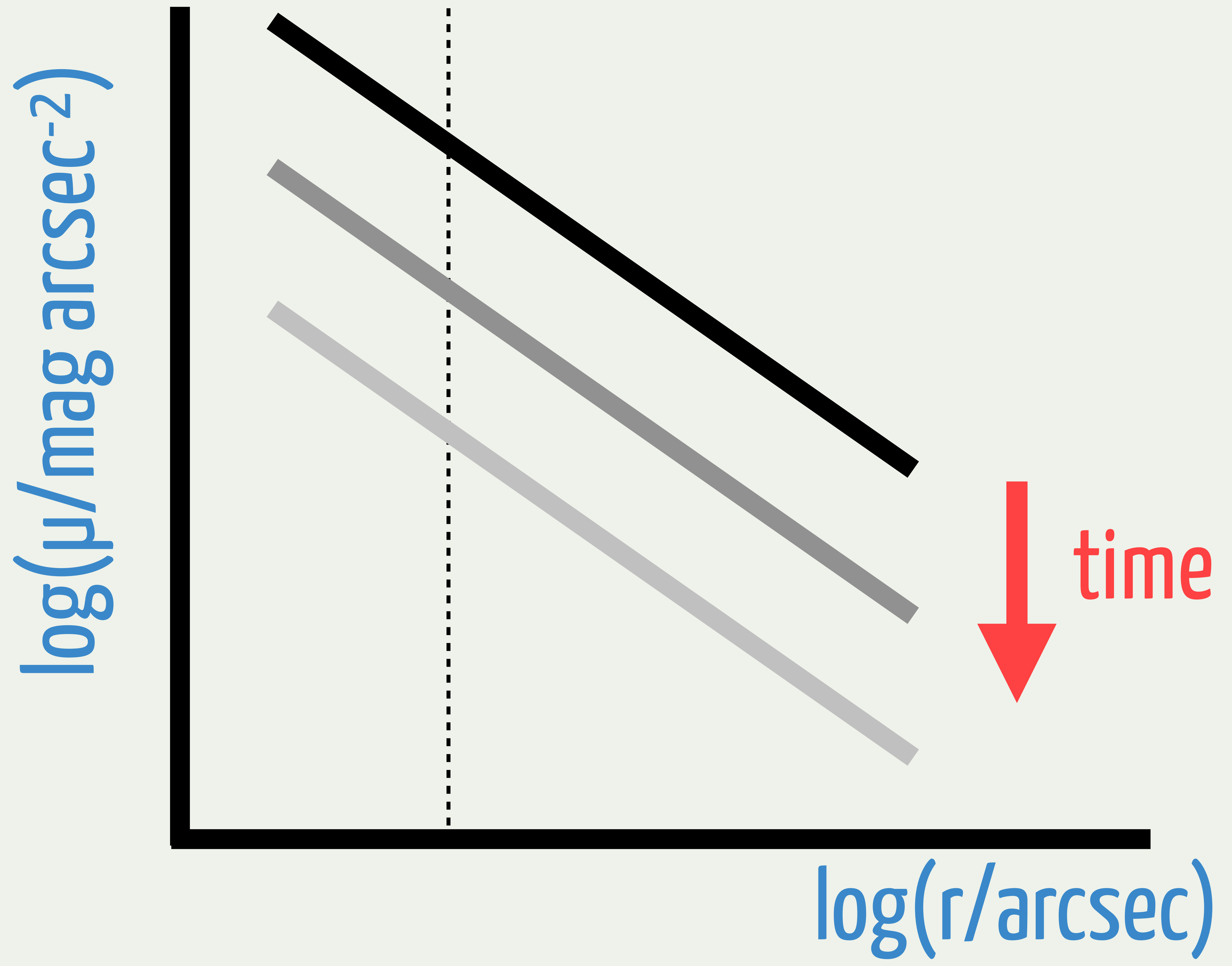

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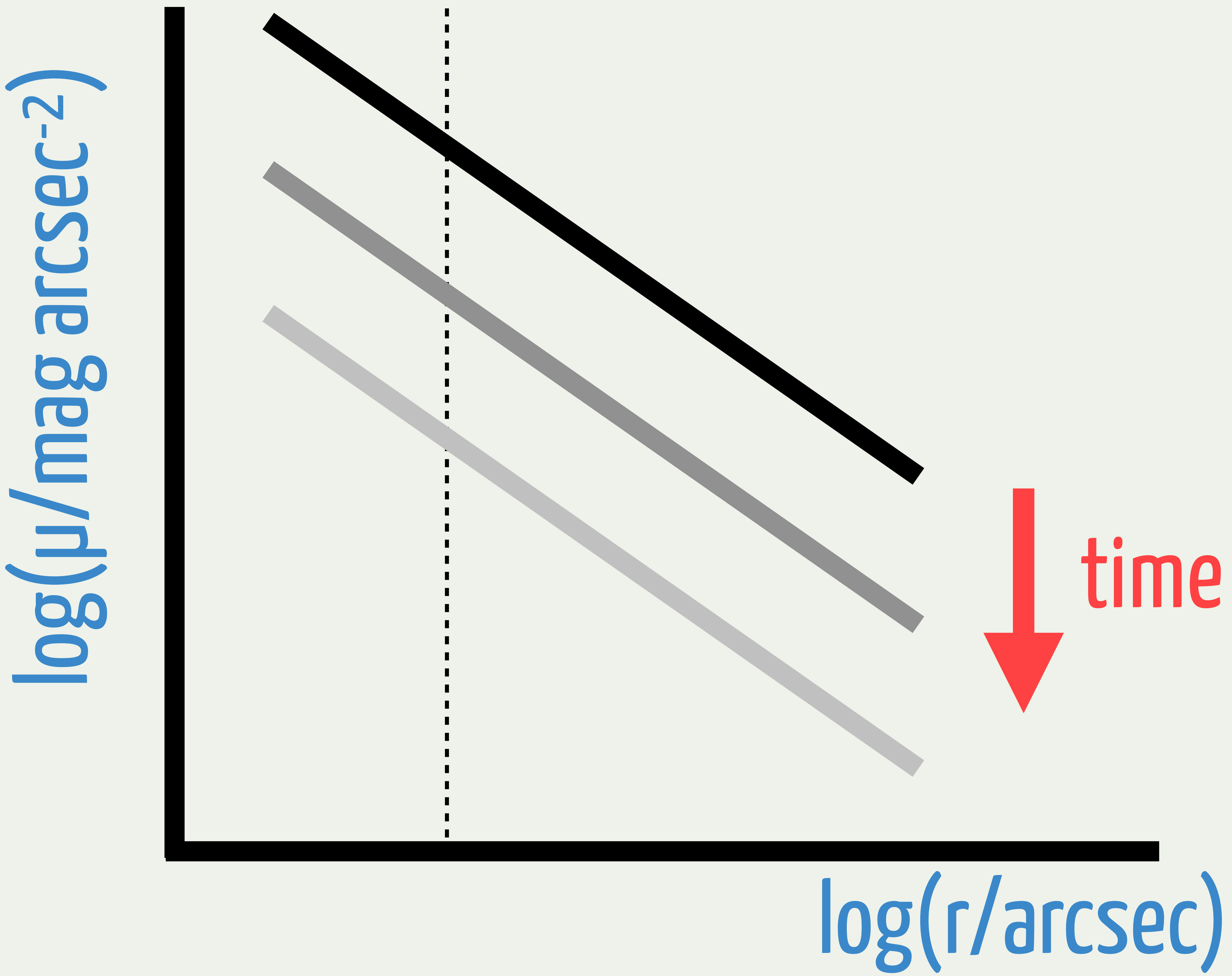
- But this **disc strangulation** on its own **wouldn't change** the **intrinsic Hα half-light radius** we measure. The most likely culprit to do that is **ram-pressure stripping** (e.g. see simulations by **Bekki 2014**)



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Conclusions

- **K-CLASH** has observed **galaxy cluster members** at $0.3<z<0.6$, as well as a **matched "field" sample**
- On average, the cluster galaxies have **smaller $r_e(H\alpha)/r_e$(R-band) ratios** & **fainter average Hα central surface brightnesses** than the field galaxies. Those with a projected distance **closer to the cluster centre** also have **higher metallicity** than predicted by the M-Z relation
- **Ram-pressure stripping** can account for these observations