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# Synchrotron Emission from Dark Matter: Constraints from Galaxy Clusters

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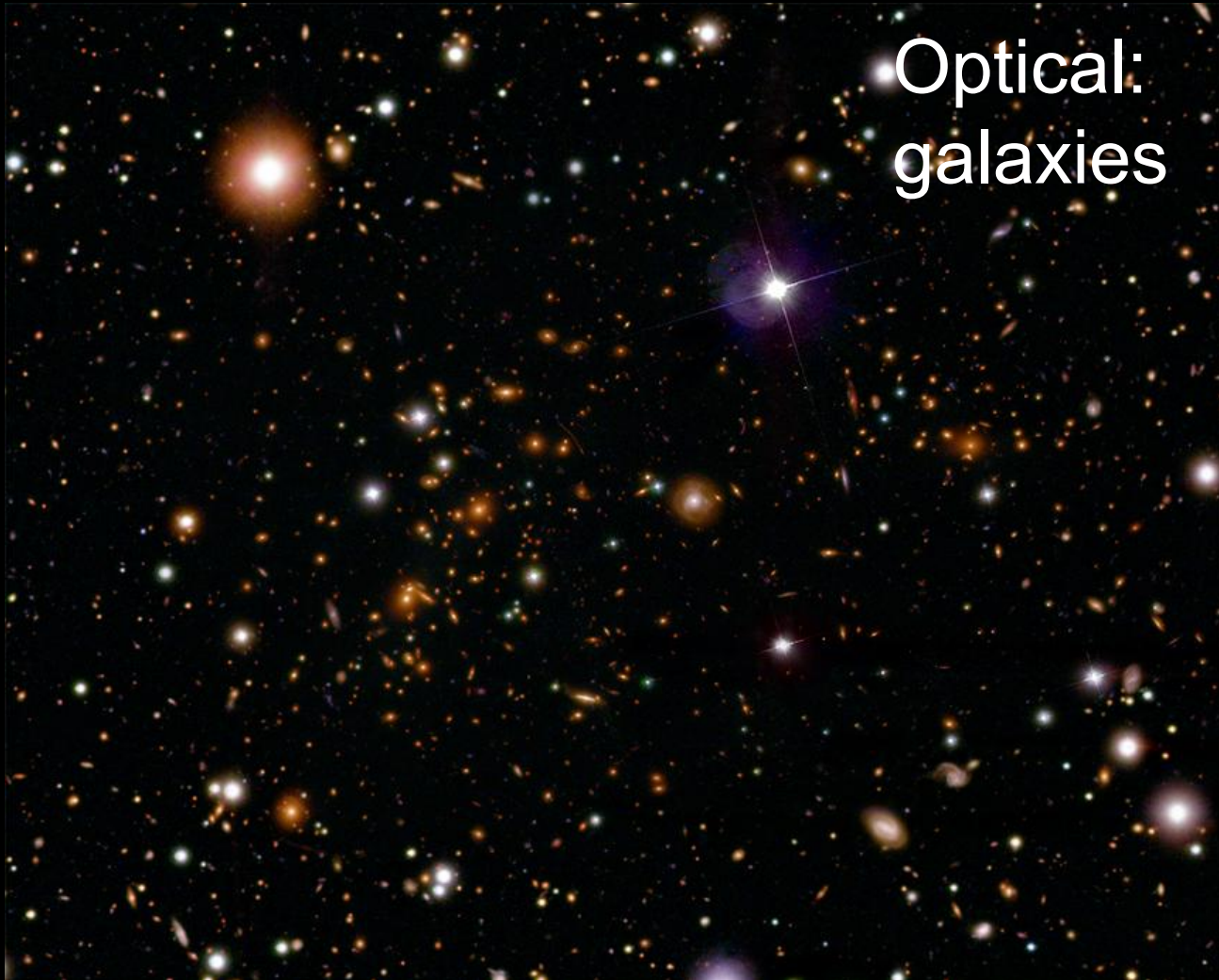
**Emma Storm**

with: Alex McDaniel, Tesla Jeltema, Stefano Profumo (UCSC)

**Diffuse Synchrotron Emission in Clusters -  
What's Next? | 27 October 2017**

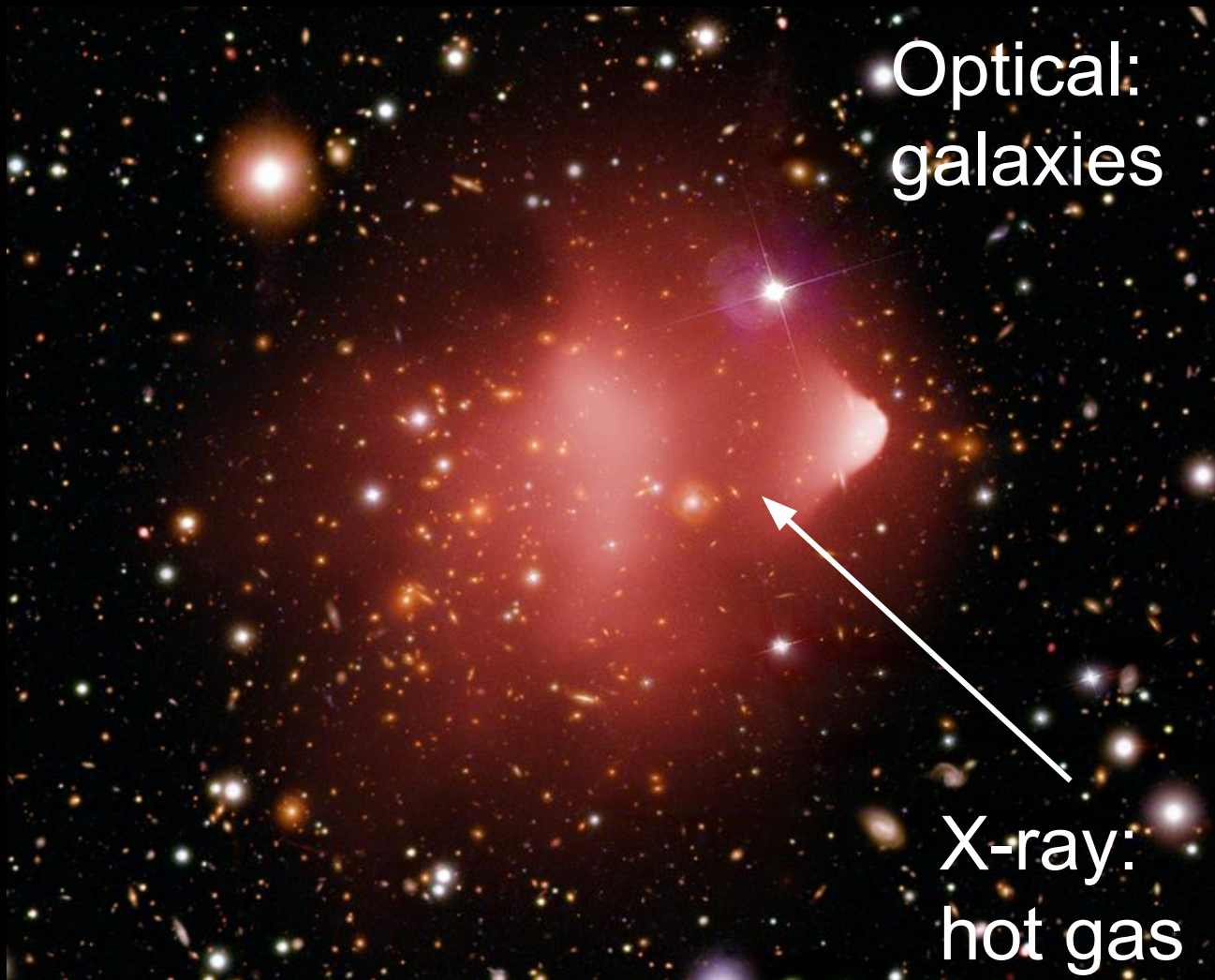
# Galaxy Cluster Components

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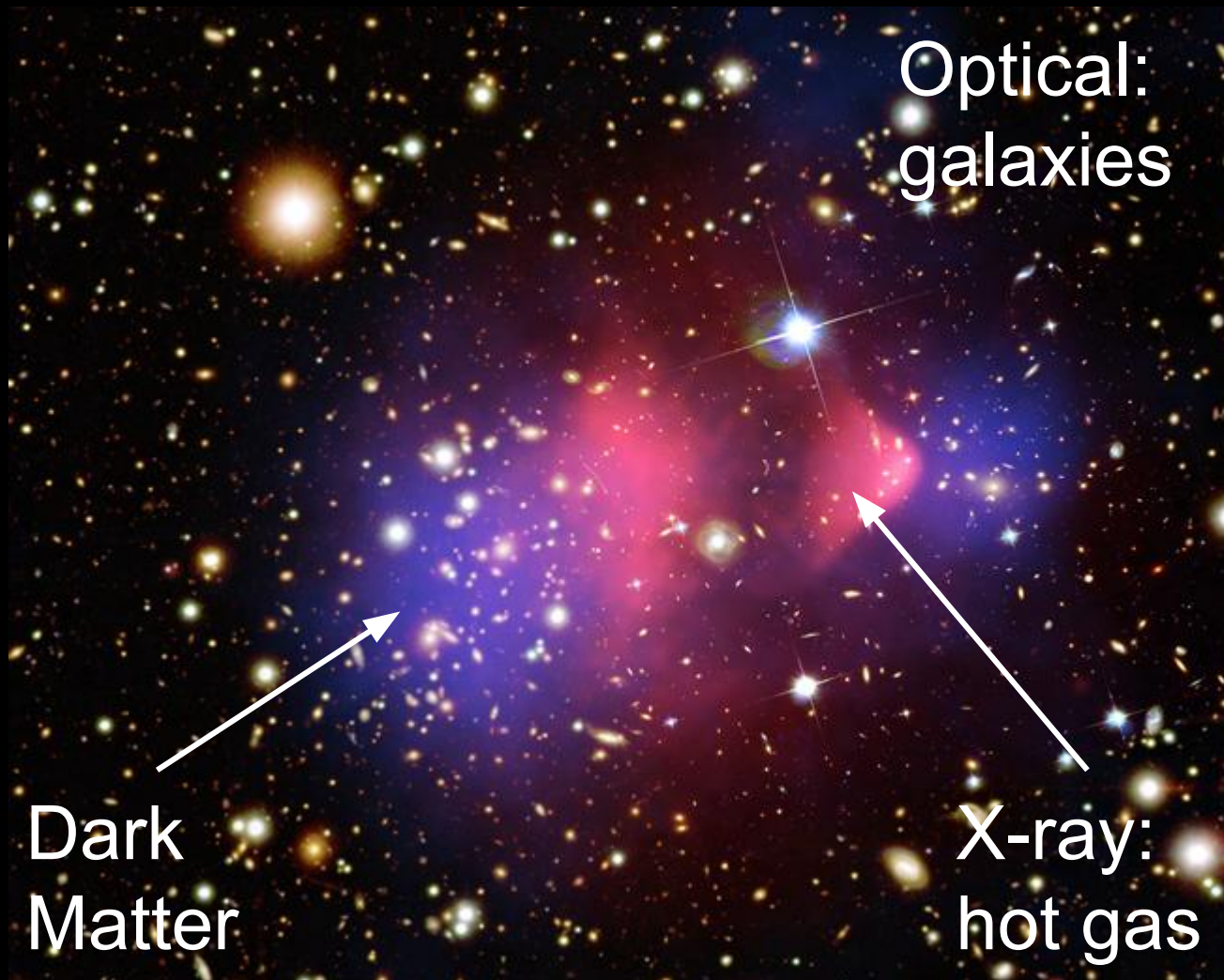
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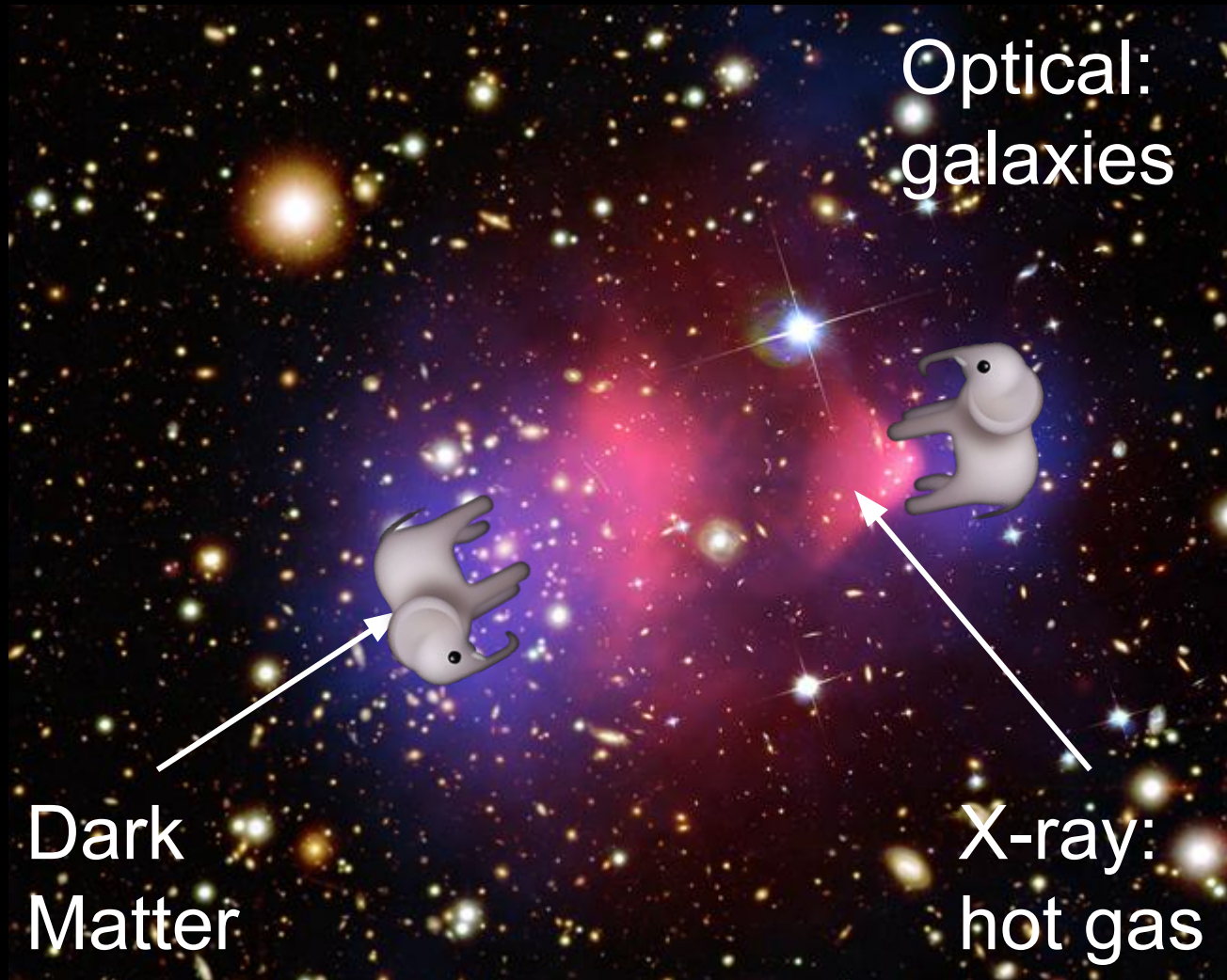
# Galaxy Cluster Components

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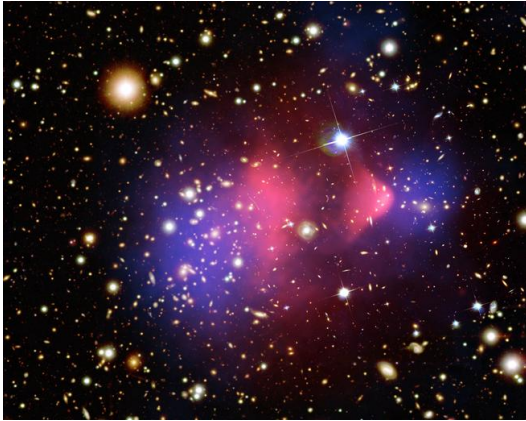
# Galaxy Cluster Components

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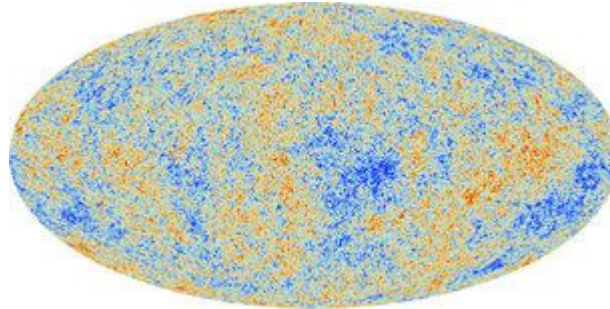


# Dark Matter

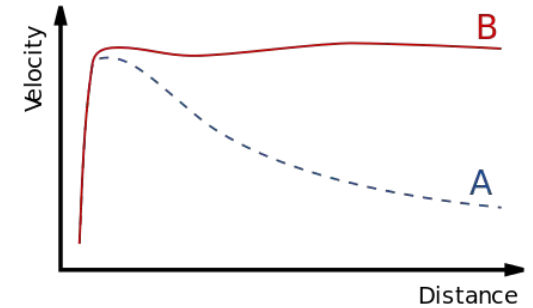
DM is not baryonic



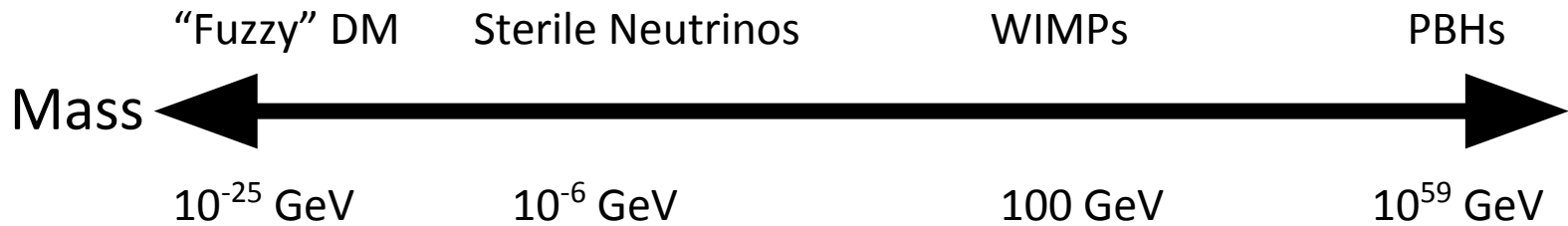
DM is 85% of matter



DM halo size  $\gg$   
visible galaxy size



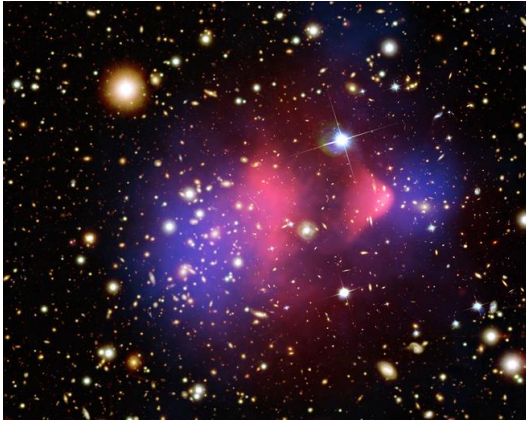
Extremely Incomplete + Biased:



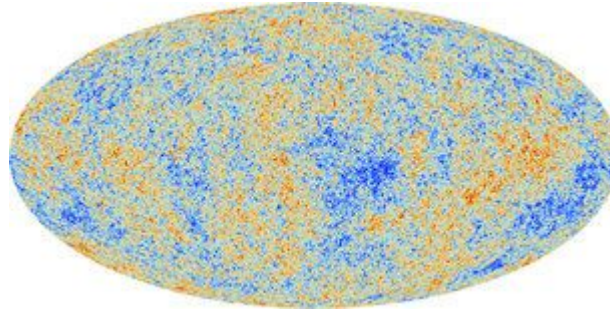


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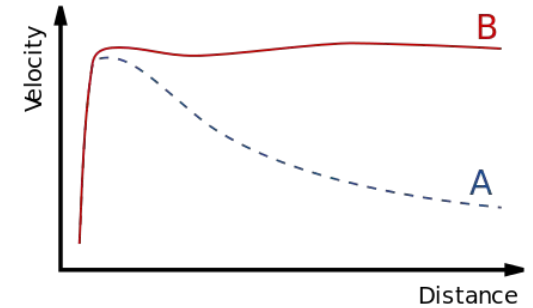
DM is not baryonic



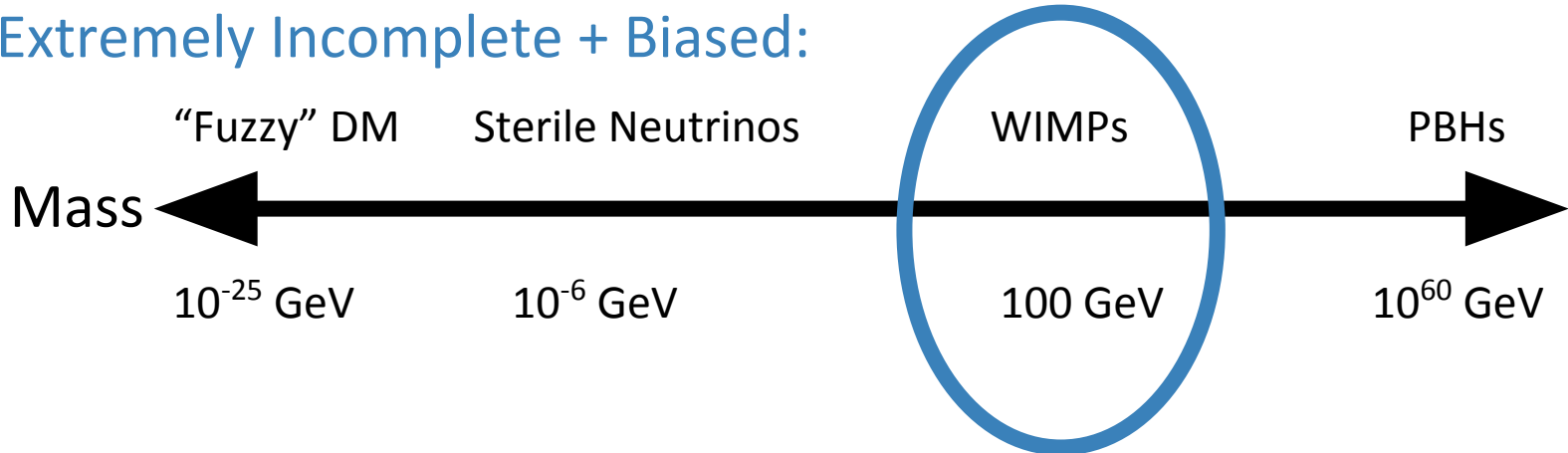
DM is 85% of matter



DM halo size  $\gg$  visible galaxy size

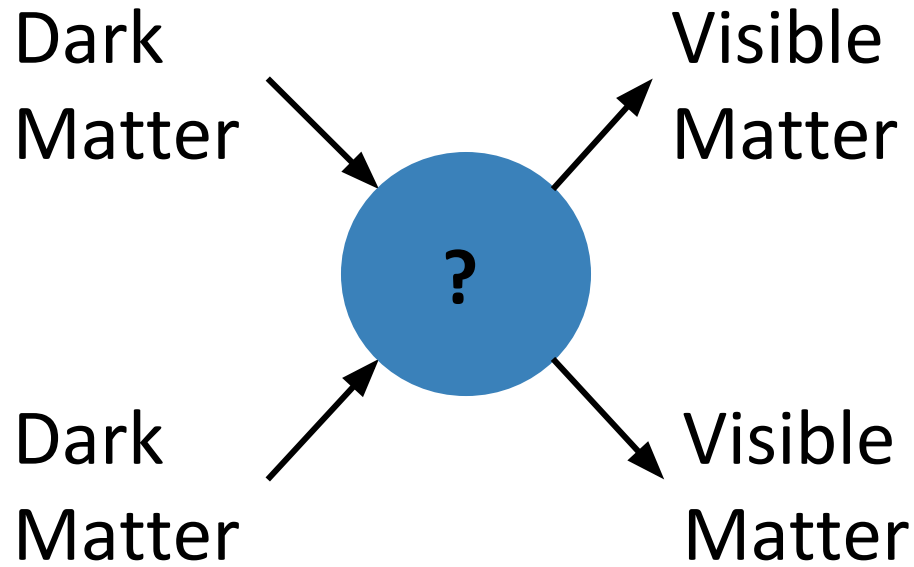


Extremely Incomplete + Biased:



# Dark Matter Candidate: WIMPs

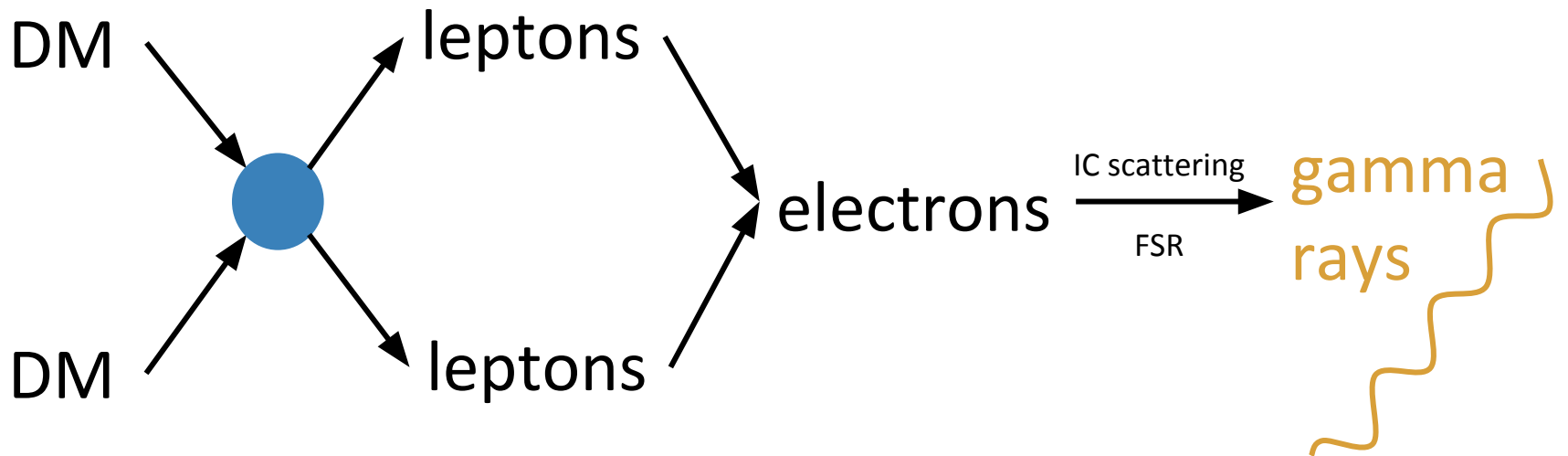
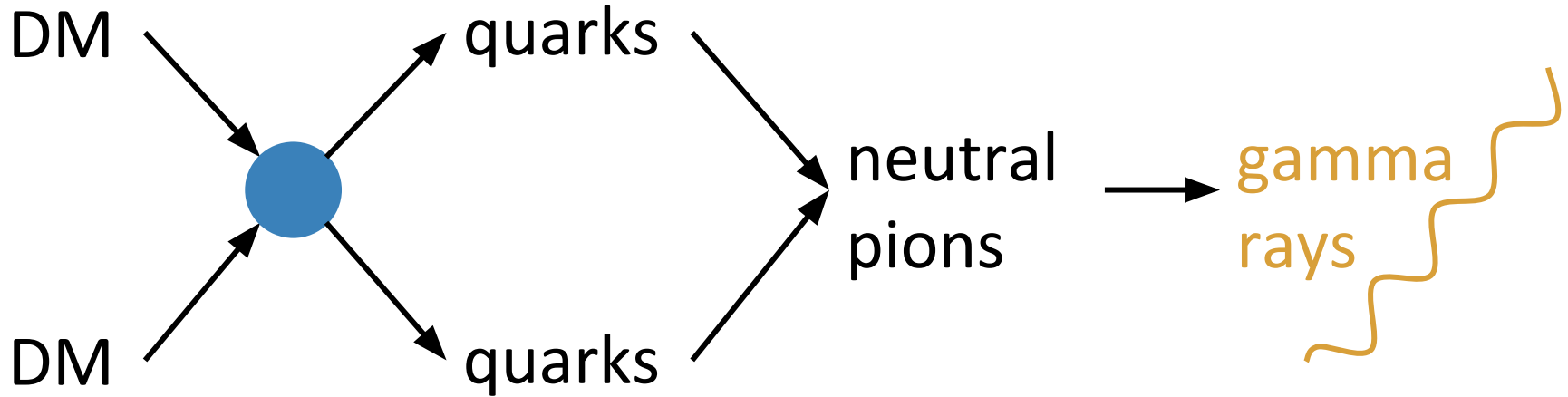
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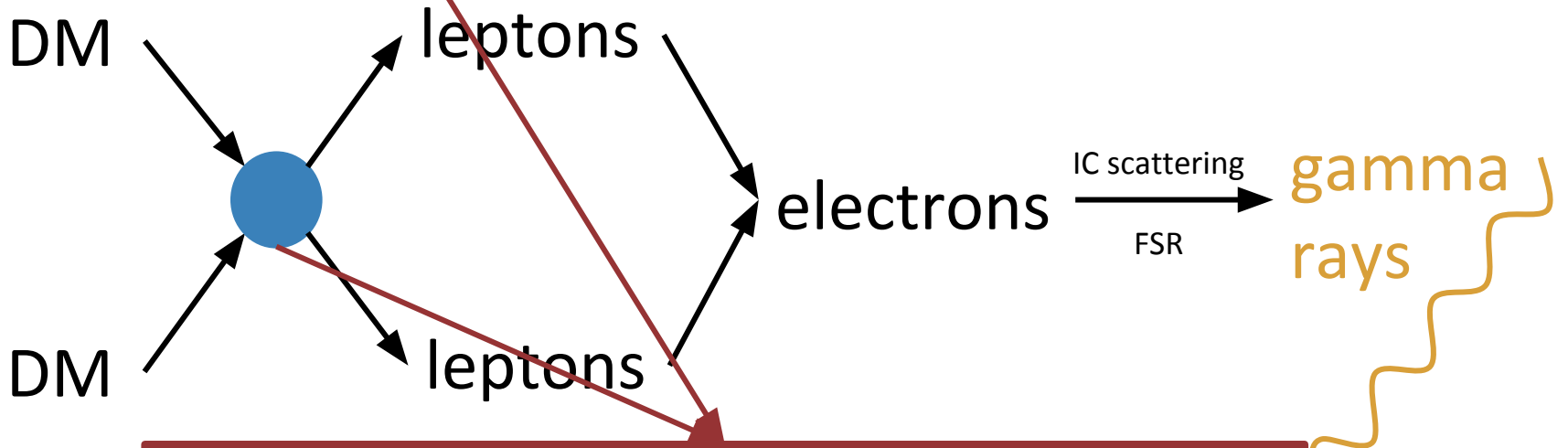
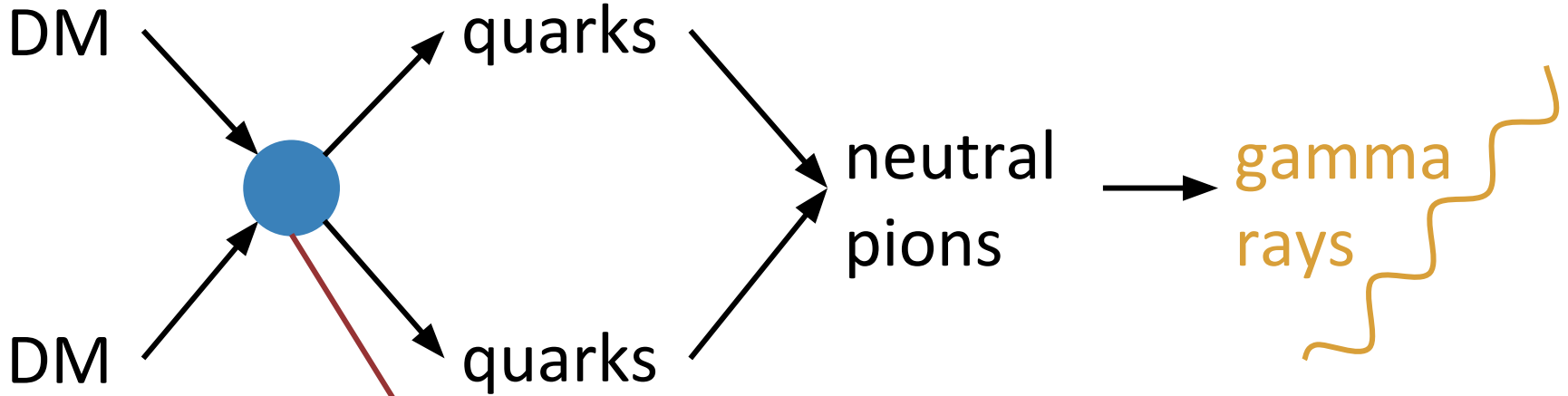


# Gamma Rays from DM Annihilation

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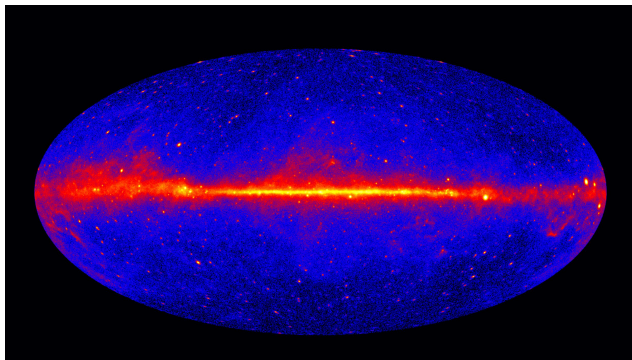
# Gamma Rays from DM Annihilation



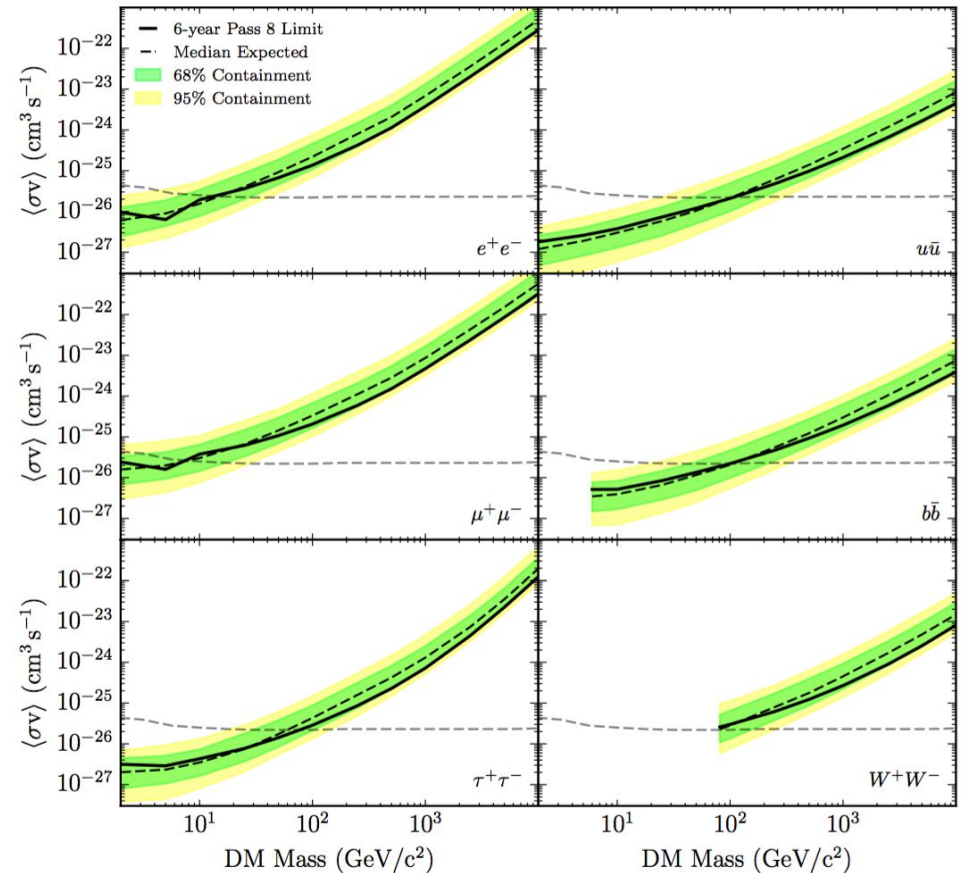
annihilation cross section:  $\langle \sigma v \rangle$

# Gamma Rays from DM Annihilation

Fermi



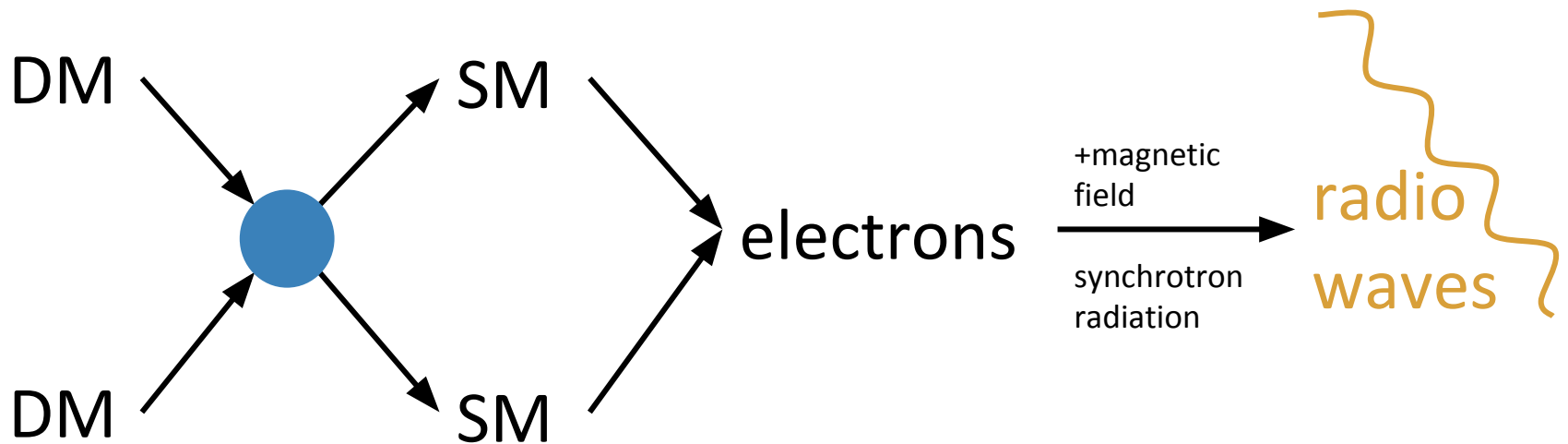
Nondetection of dwarfs:  
best limits



Ackermann+2015, PRL 231301

# Radio Emission from DM Annihilation

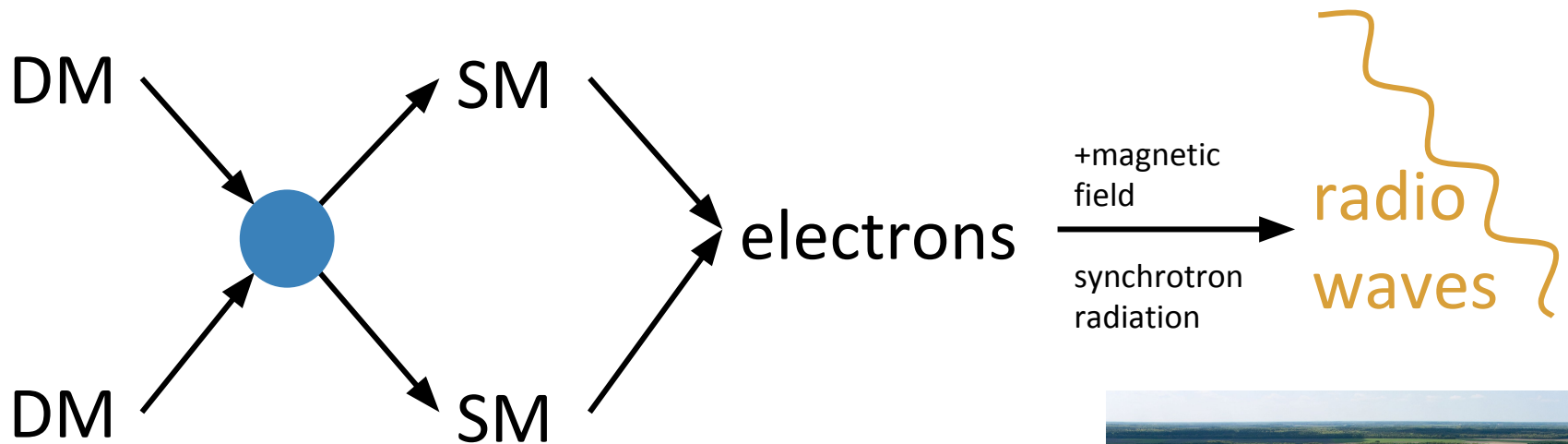
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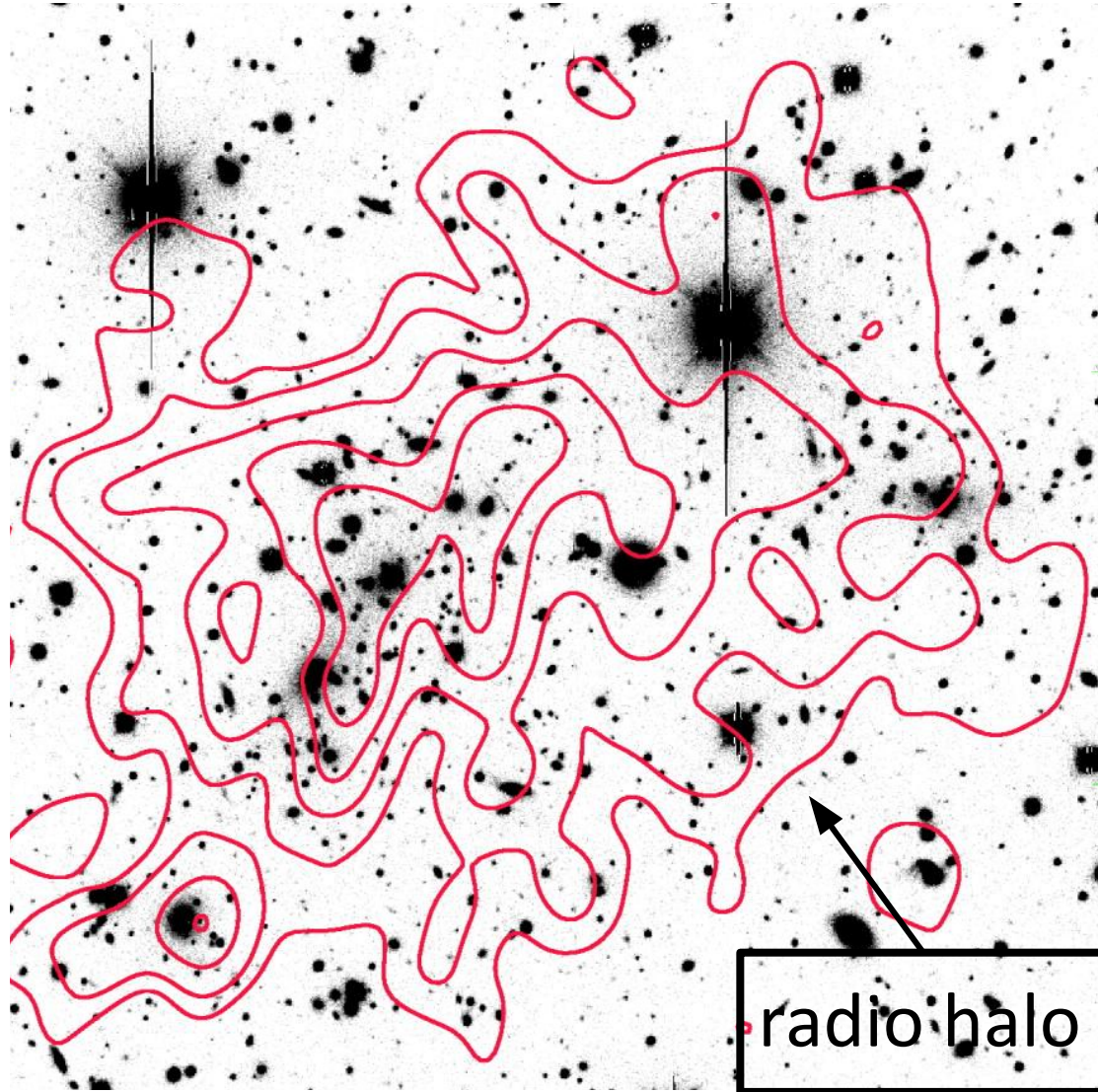
# Radio Emission from DM Annihilation

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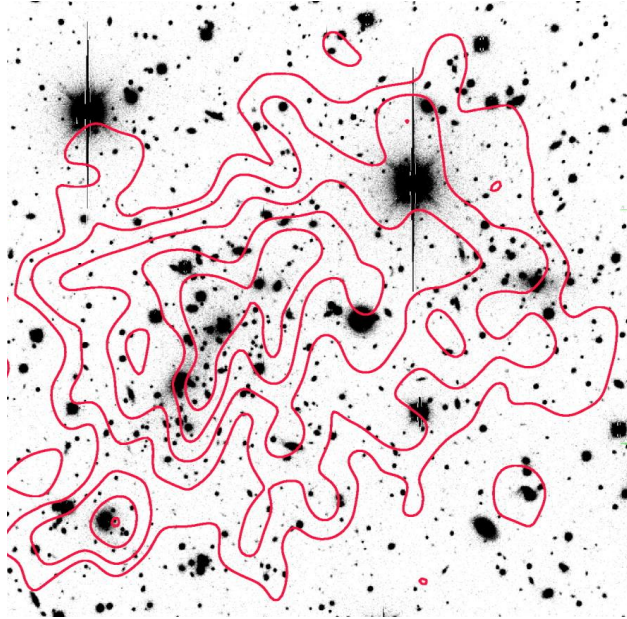
# Radio Emission in Galaxy Clusters

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# Radio Emission in Galaxy Clusters

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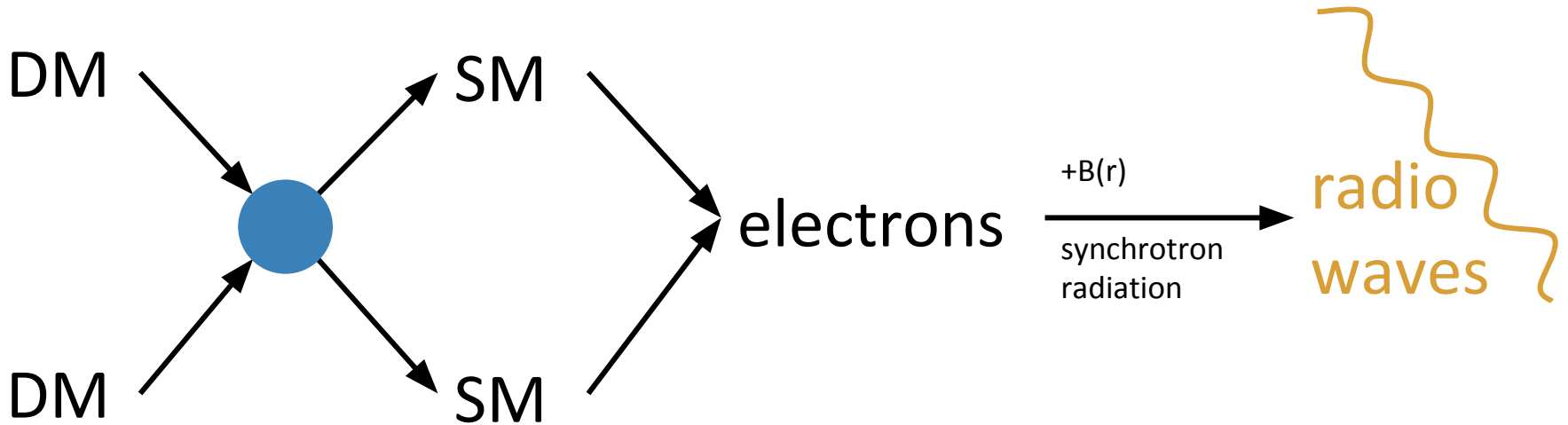
GeV electrons and  
 $\mu\text{G}$  magnetic fields

**However:**

Nondetections provide clean  
sources to constrain DM

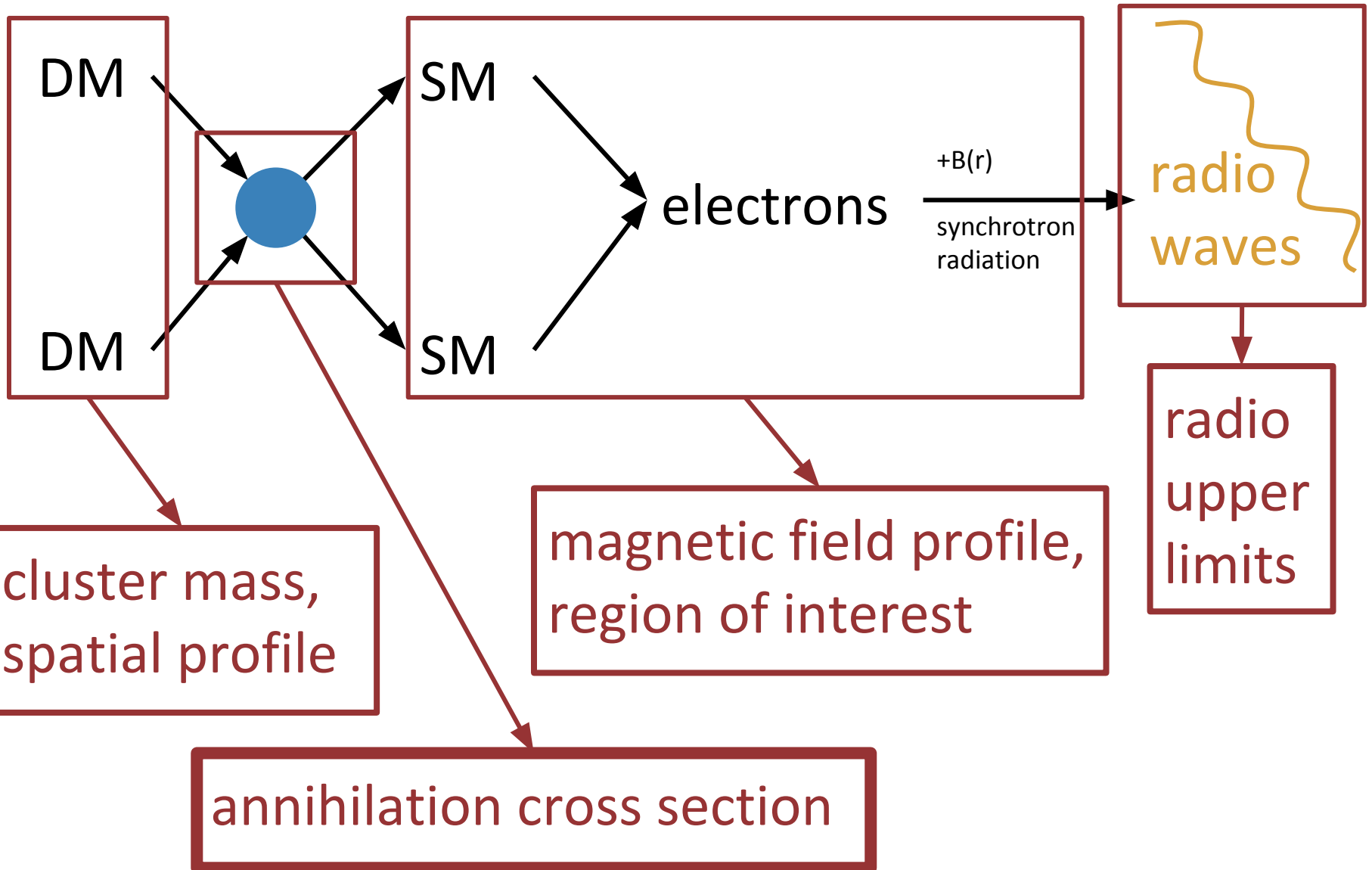
# Constraining Dark Matter with Radio

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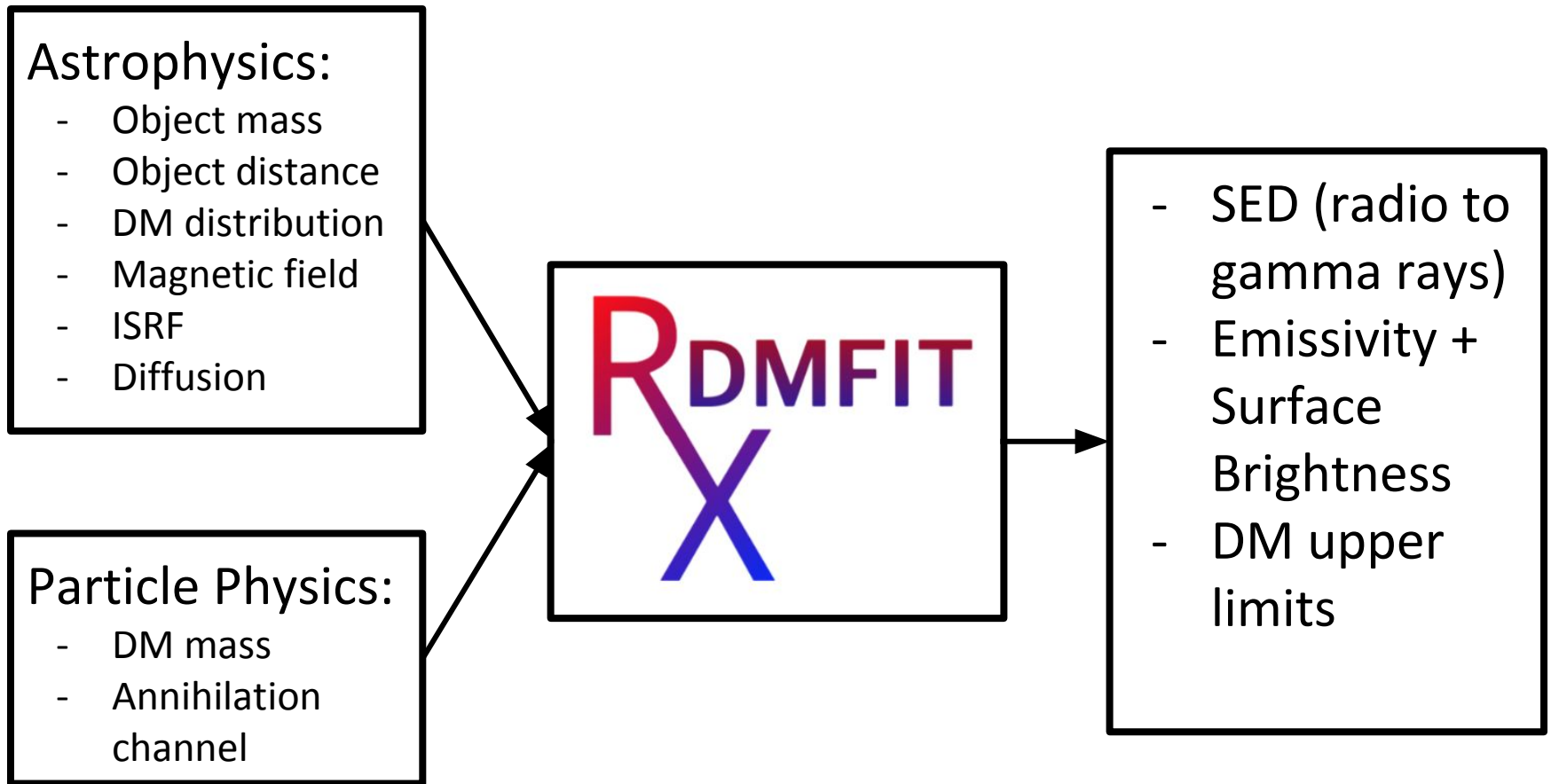


# Constraining Dark Matter with Radio



# RX-DMFIT

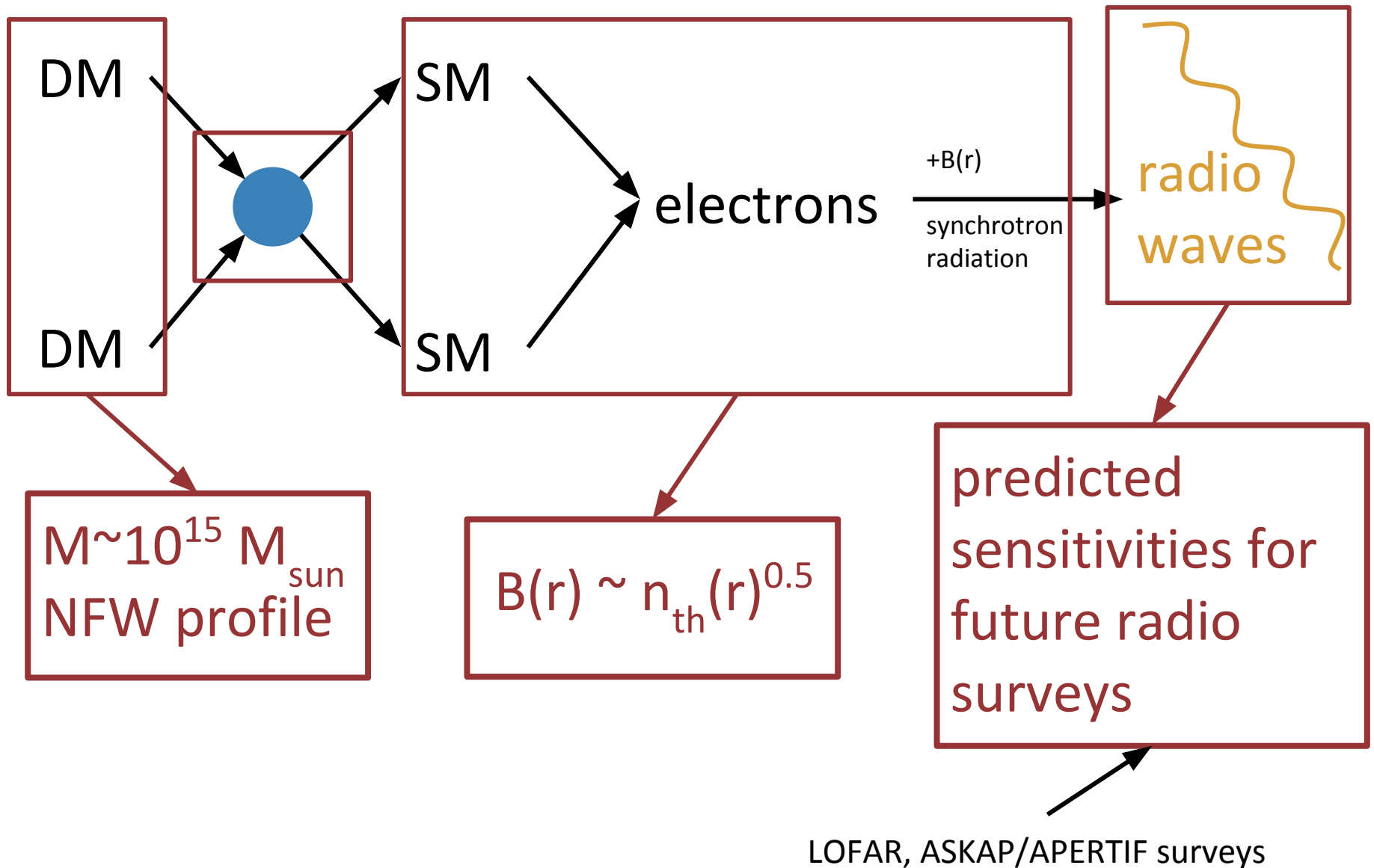
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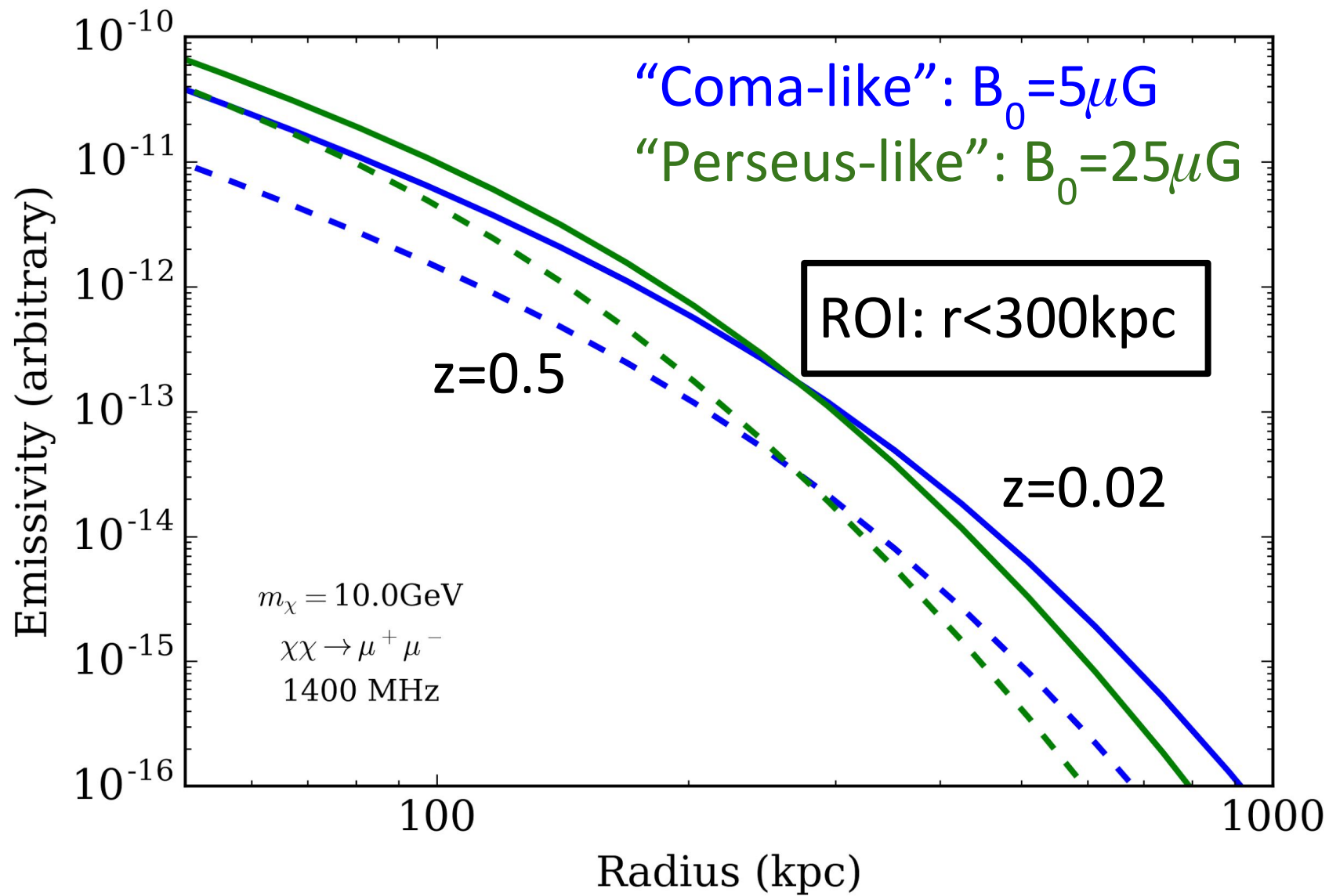
McDaniel+ JCAP09 (2017) 027M

<https://github.com/alex-mcdaniel/RX-DMFIT>

# Constraining Dark Matter with Radio

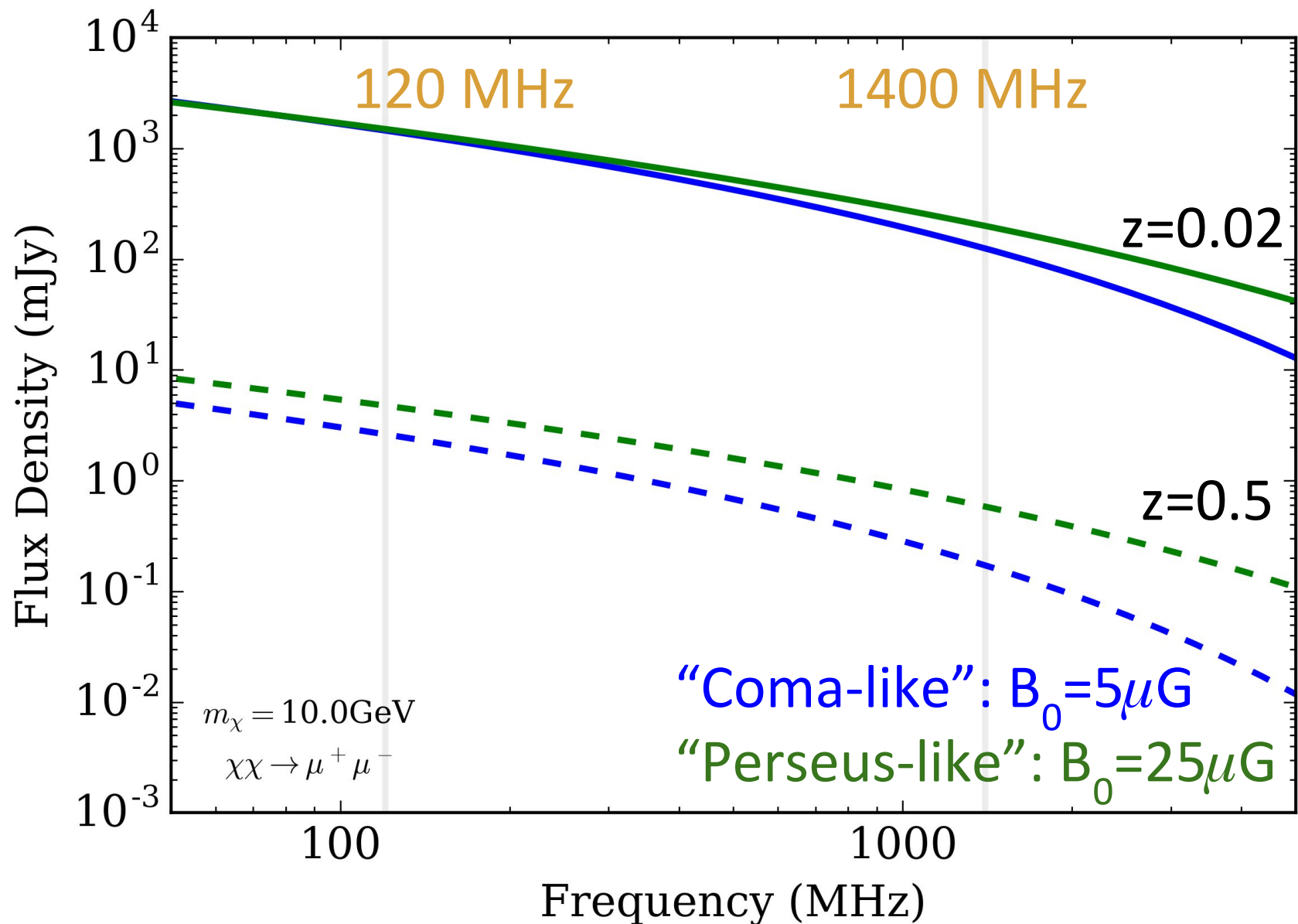


# Dark Matter Signal from Synchrotron

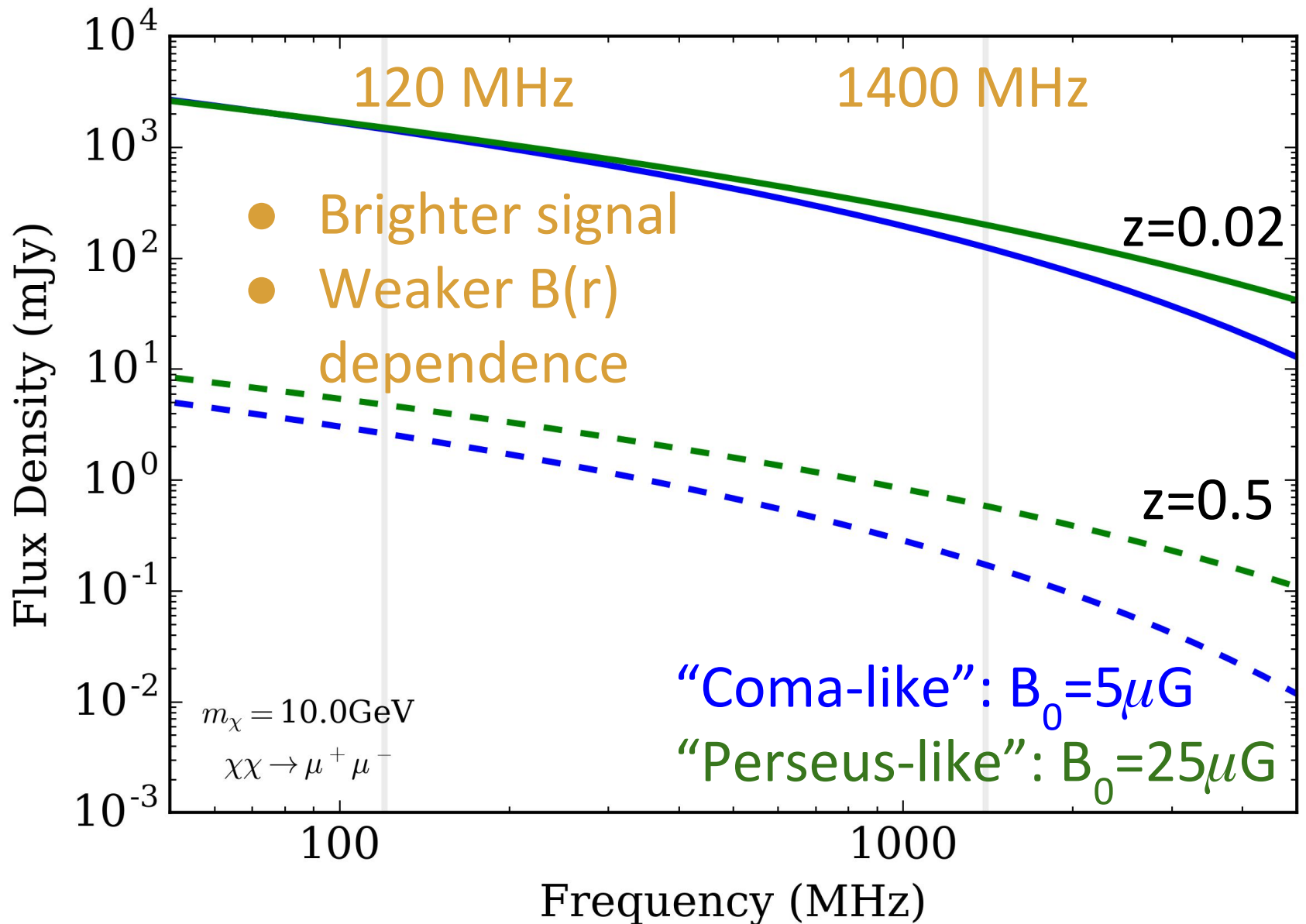




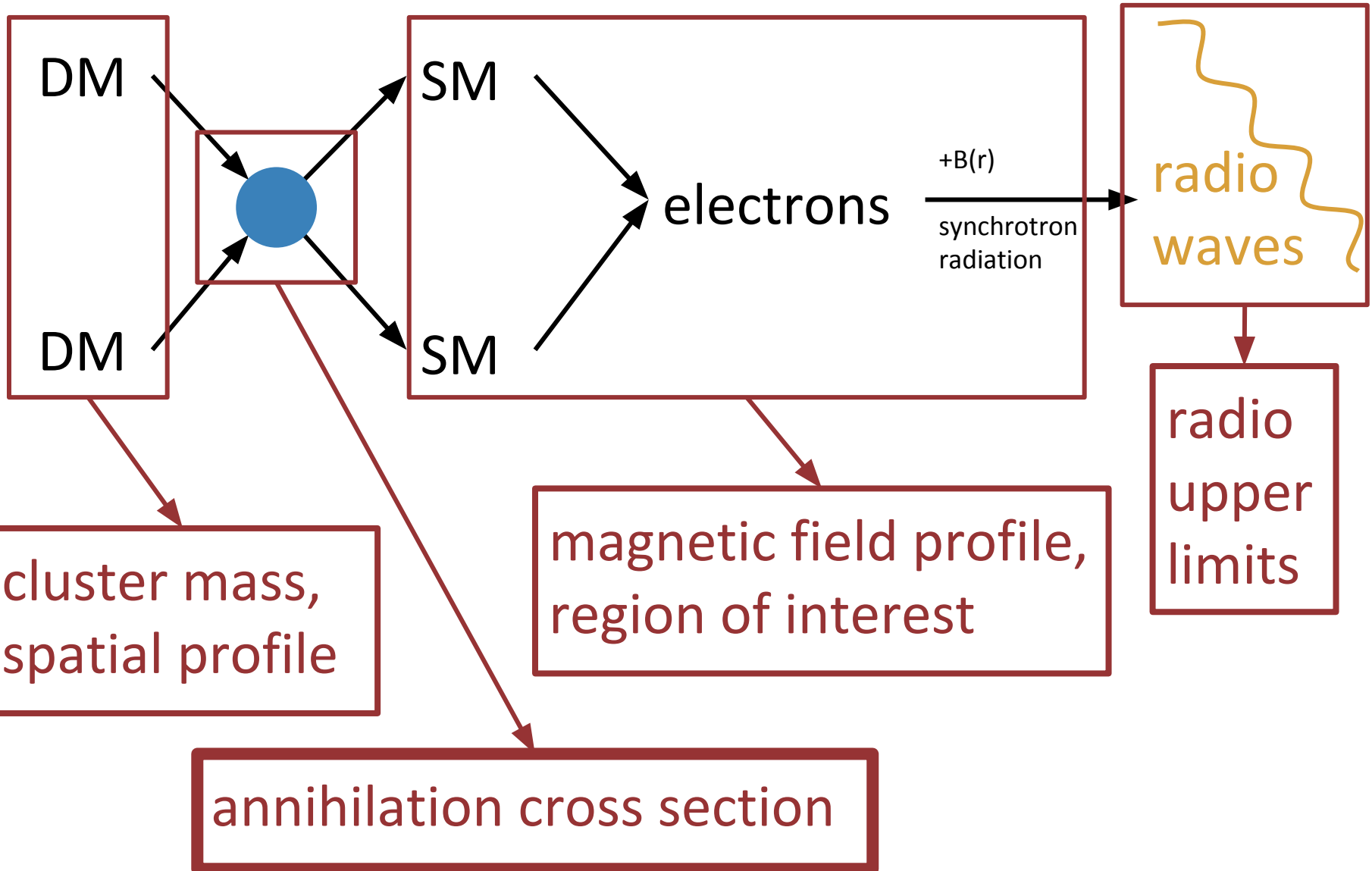
# Dark Matter Signal from Synchrotron



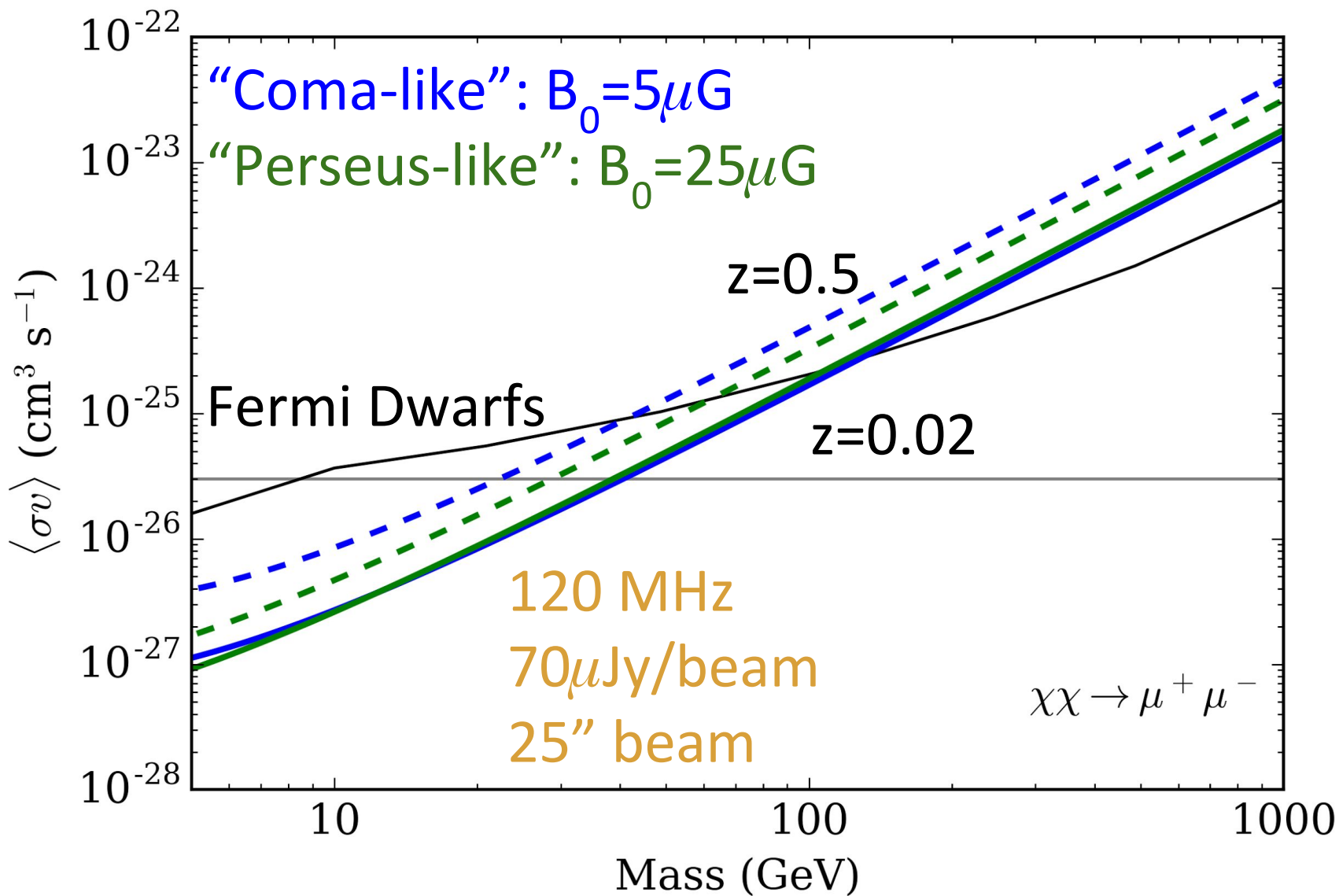
# Dark Matter Signal from Synchrotron



# Constraining Dark Matter with Radio

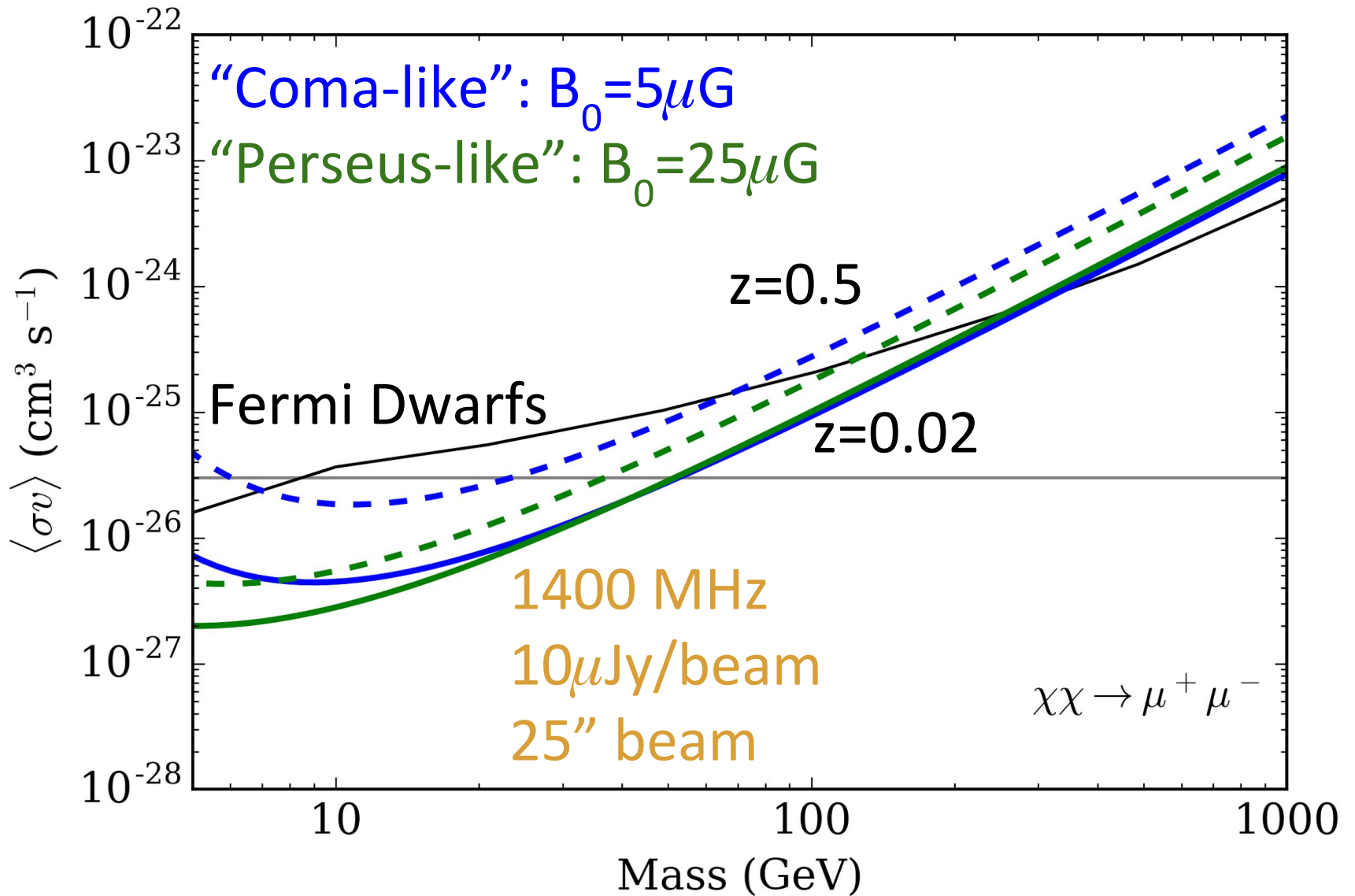


# Dark Matter Limits from Clusters

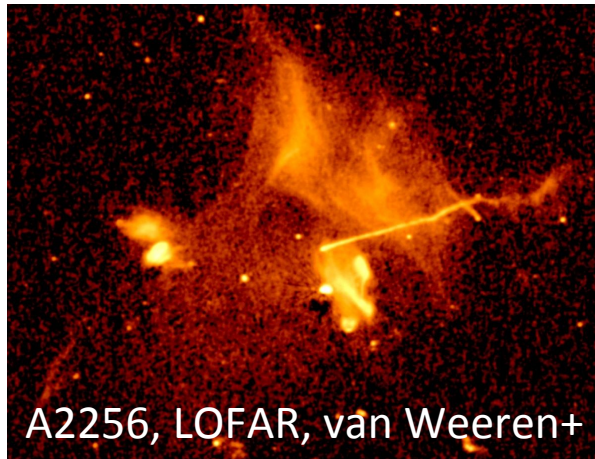




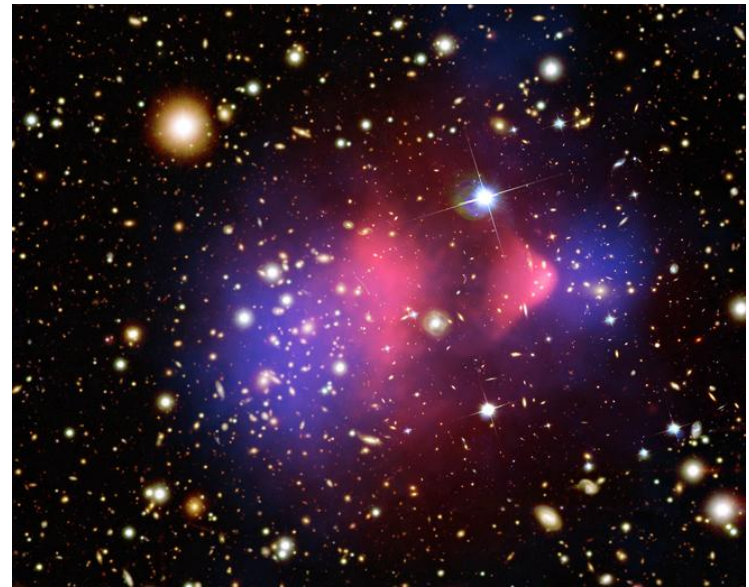
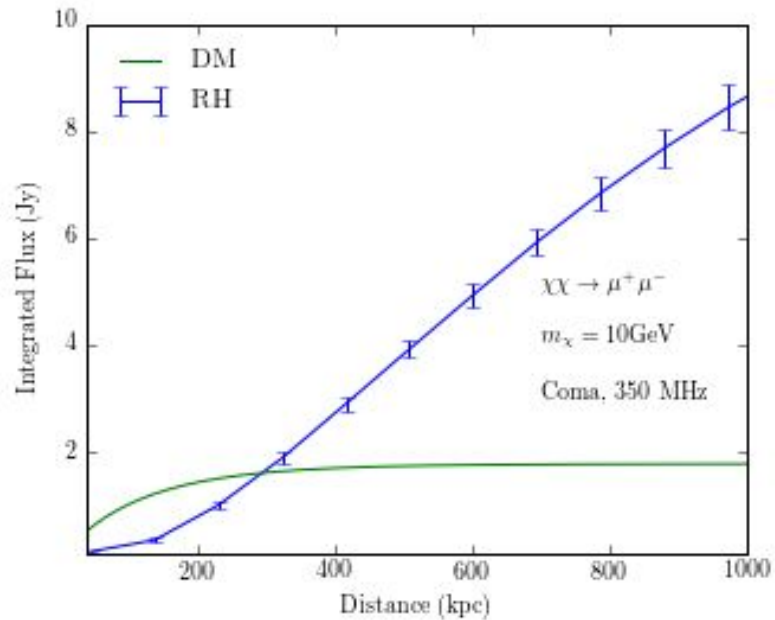
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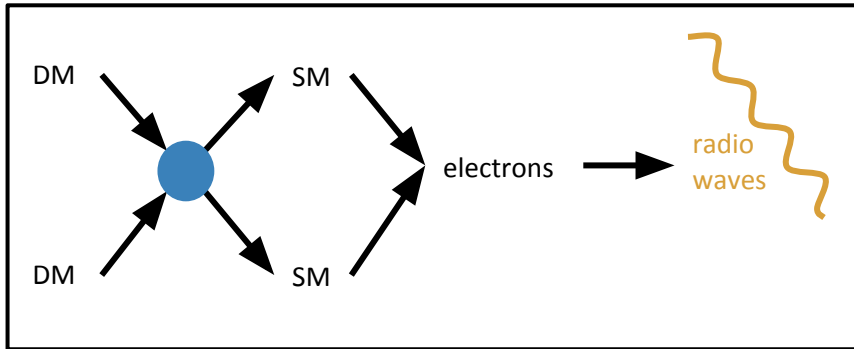
# Dark Matter Limits from Clusters



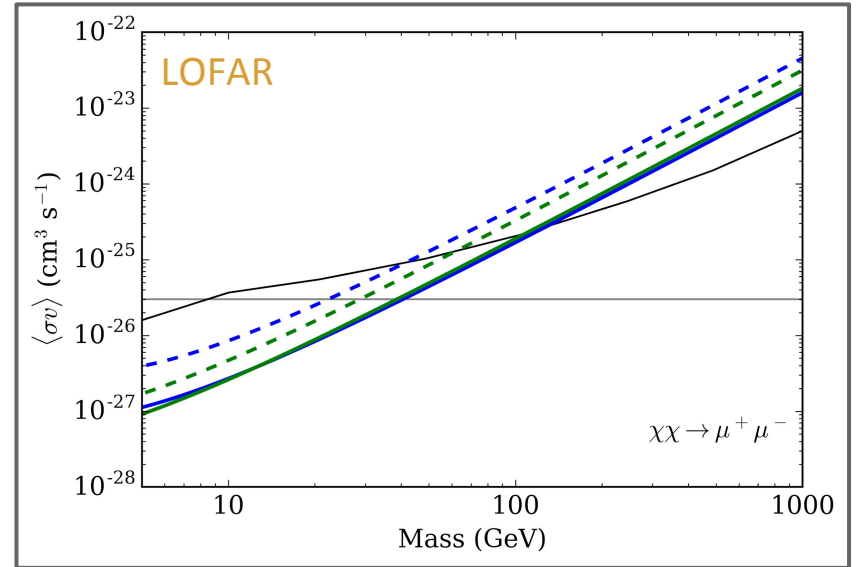
← Not dark matter



# Conclusions



- DM annihilation can produce synchrotron emission
- More astrophysics ingredients needed: RX-DMFIT

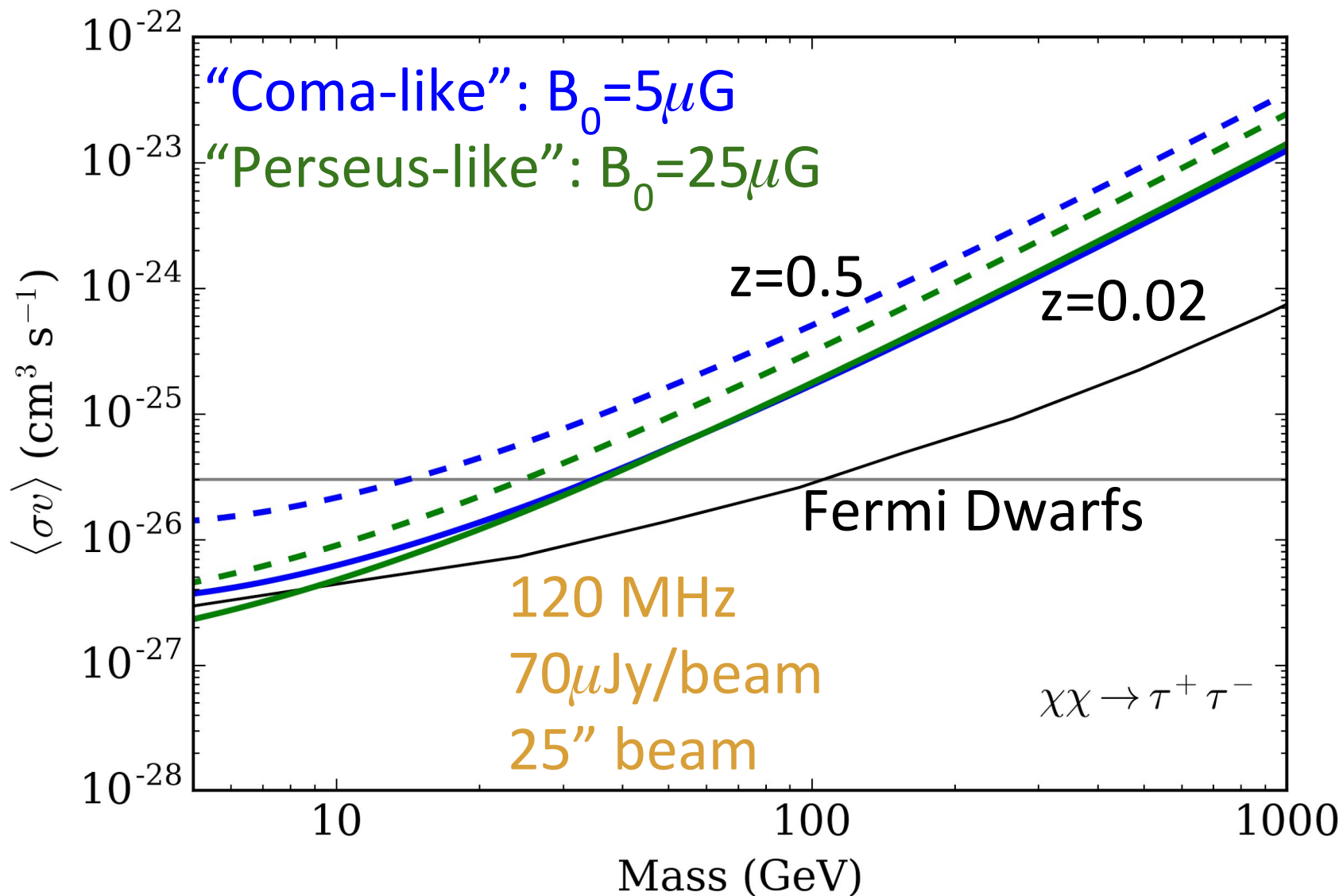


- Predicted constraints from nondetections of clusters very strong!
- Spatial structure can be a discriminator

# Backup Slides

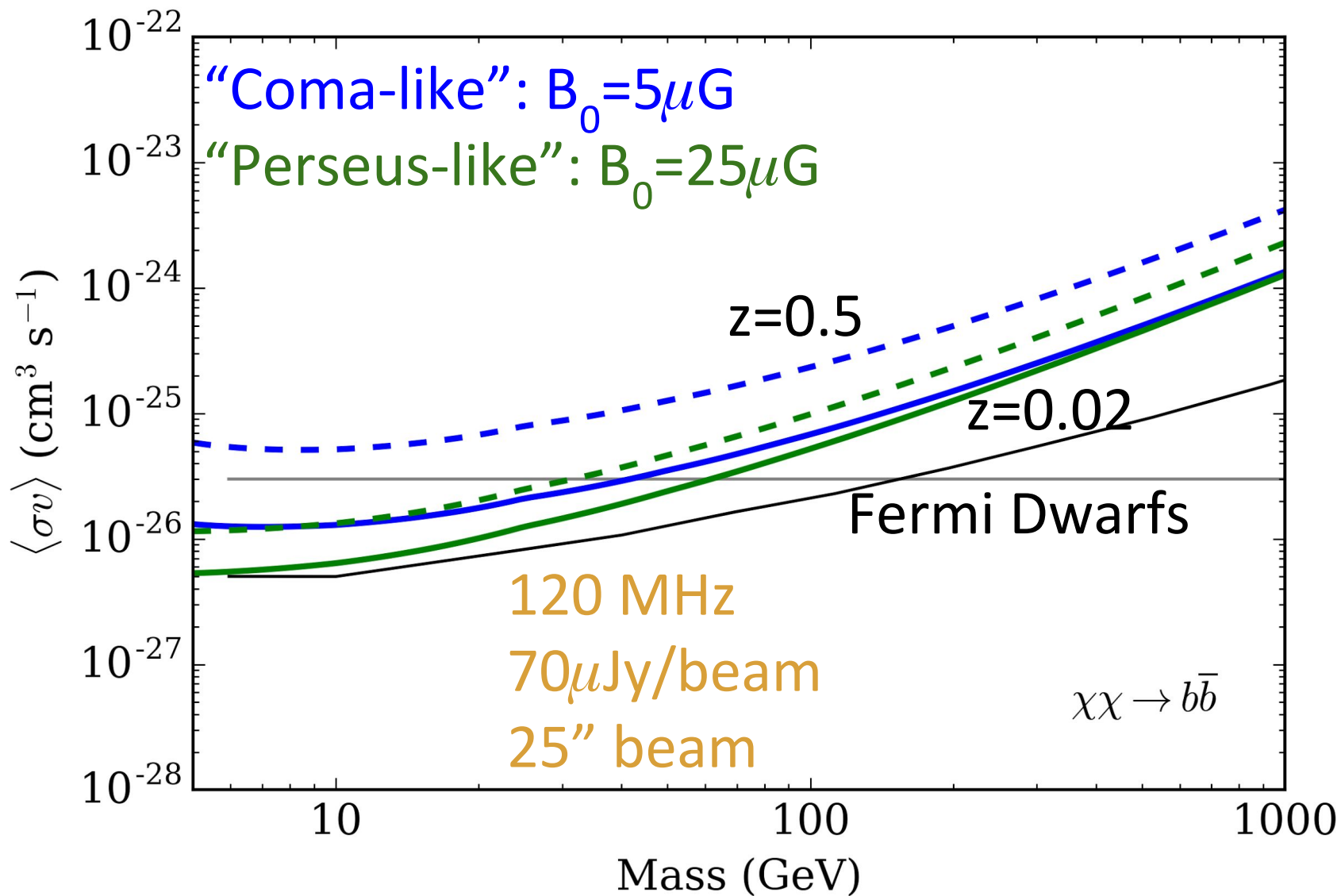
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# Dark Matter Limits from Clusters

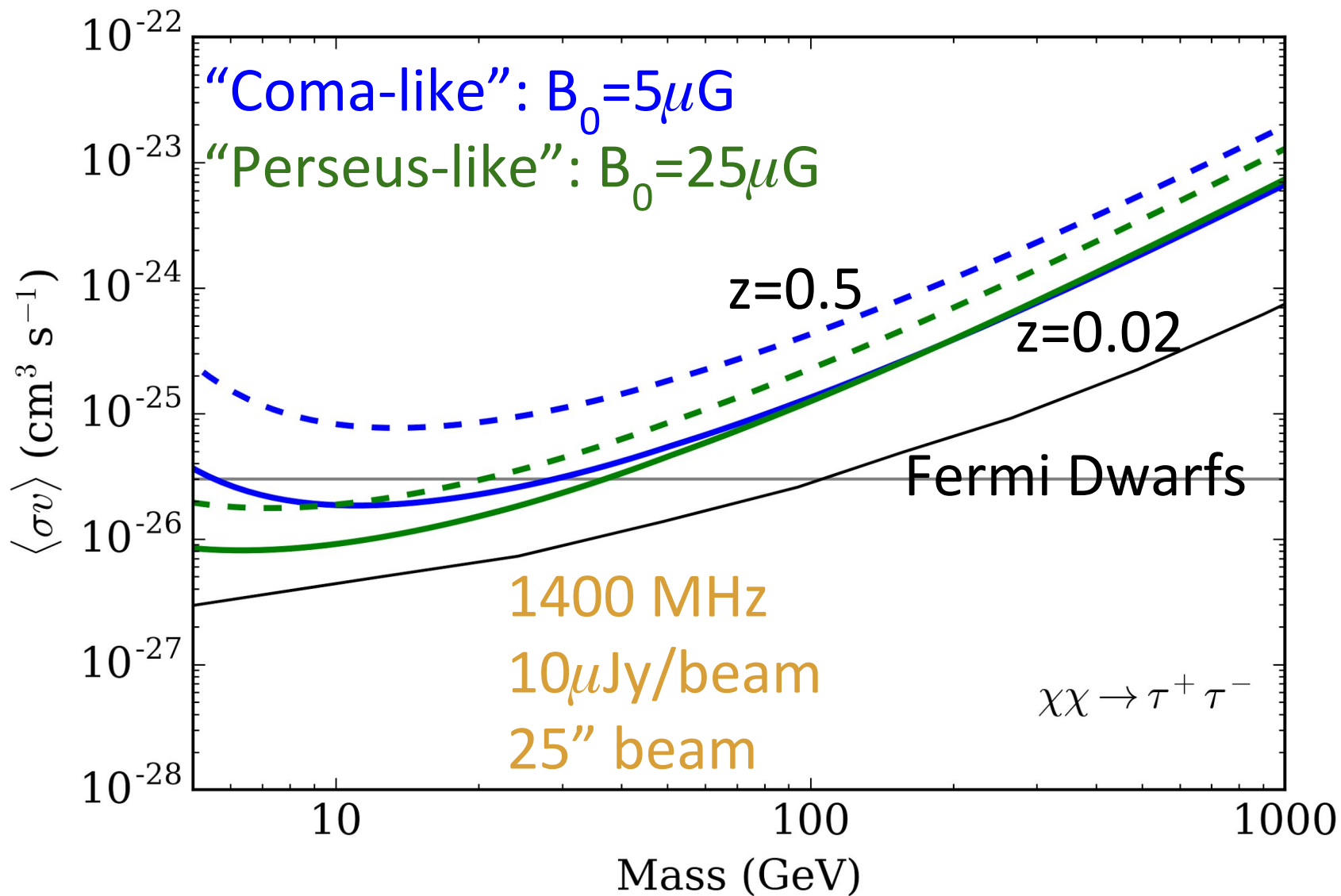




# Dark Matter Limits from Clusters



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# Dark Matter Limits from Clusters

