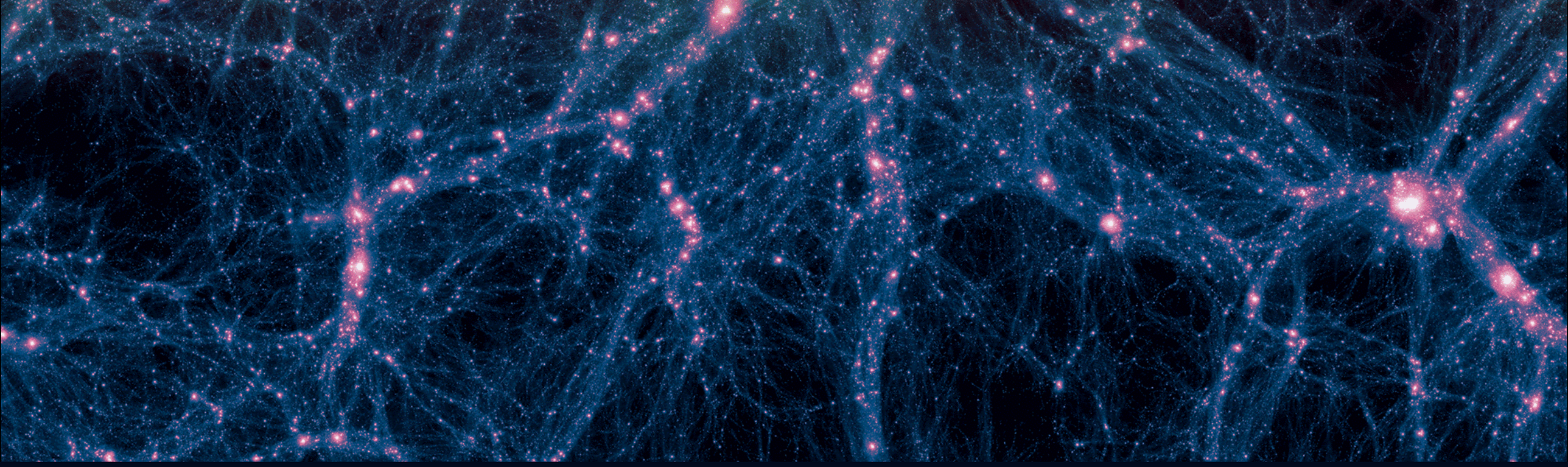
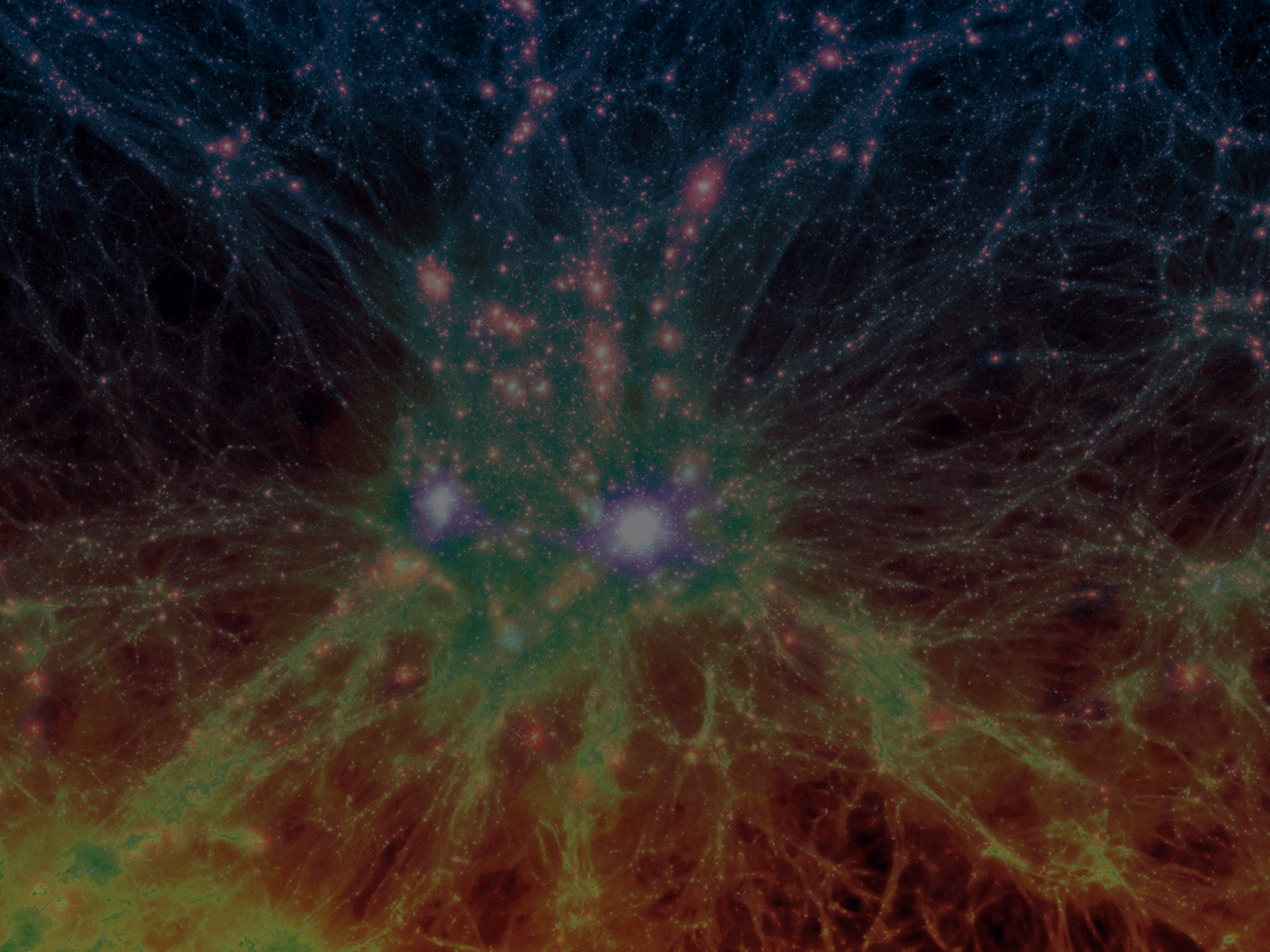


Probing dark matter with deep learning

Dr David Harvey, DARKSKIES SERI Funded ERC Starting Grant

EPFL



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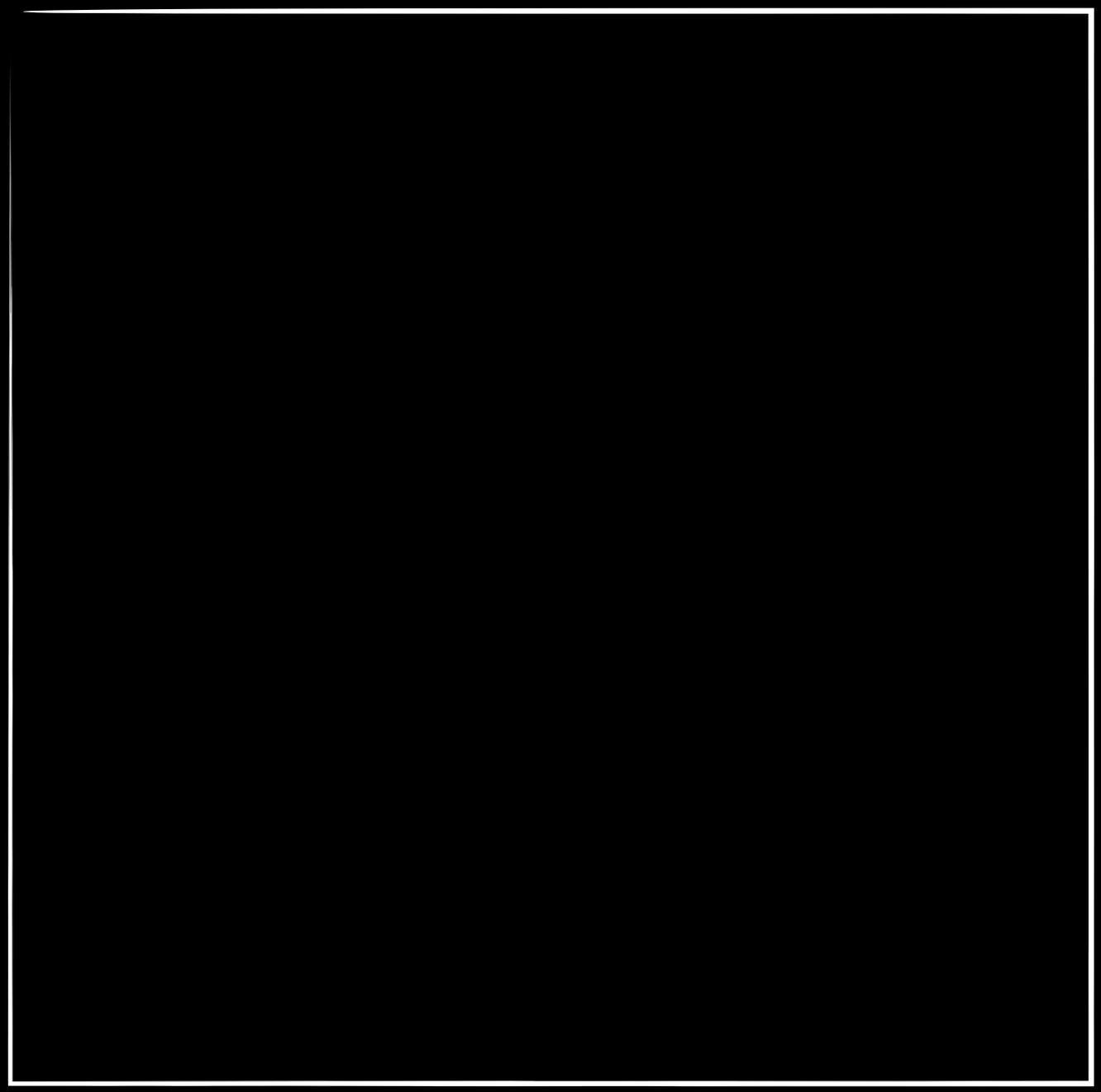
THAT WITH SUFFICIENT DATA CAN BE ROBUSTLY MEASURED

Statistics are fundamentally limited

WE START BY BUILDING A MODEL OF DARK MATTER



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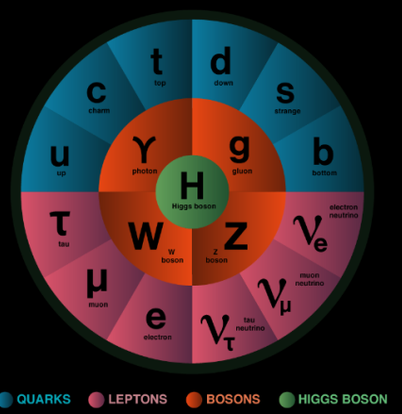

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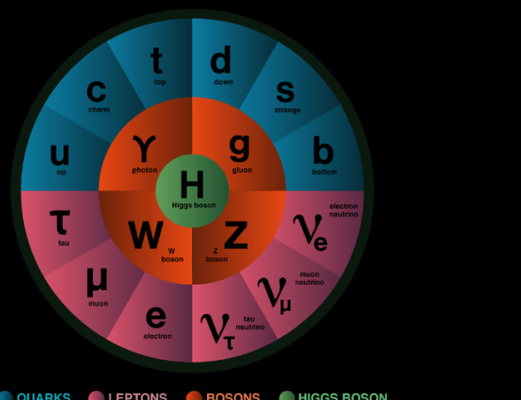

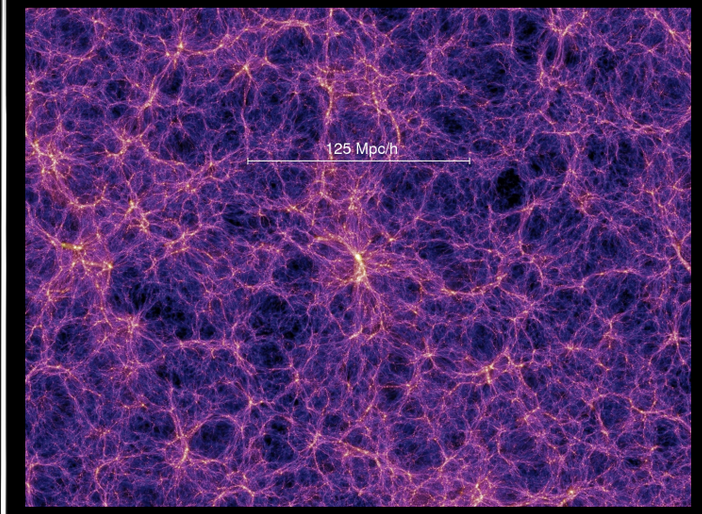

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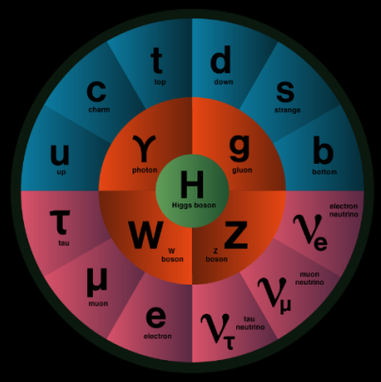

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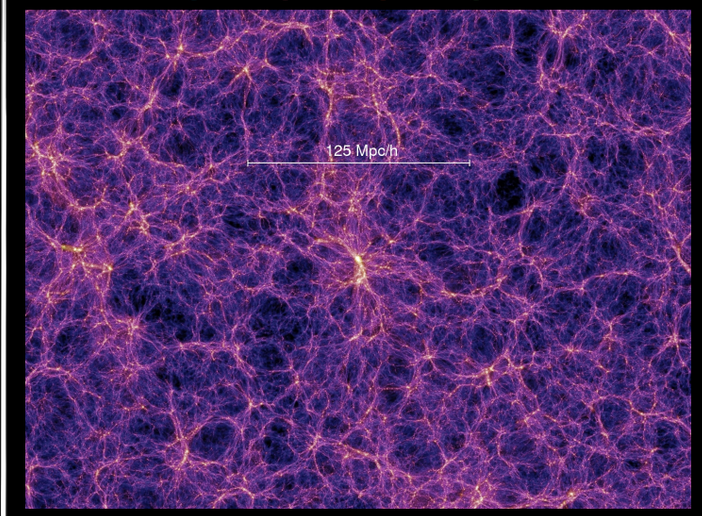
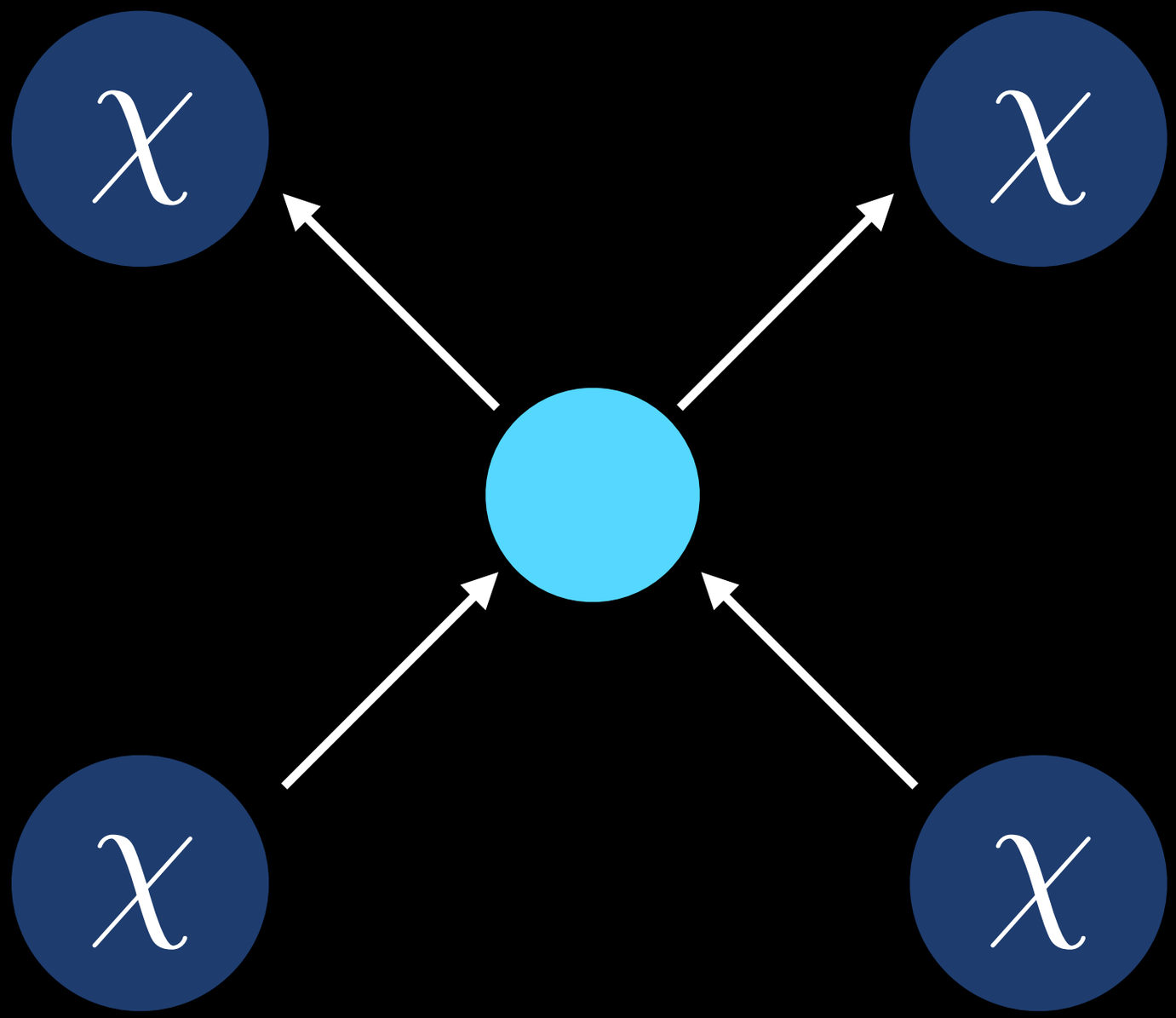


ASTRONOMICAL OBSERVATIONS HAVE A UNIQUE VIEW POINT ON THE SELF-INTERACTION



THE CLASSICAL WAY OF MEASURING THE SELF-INTERACTION

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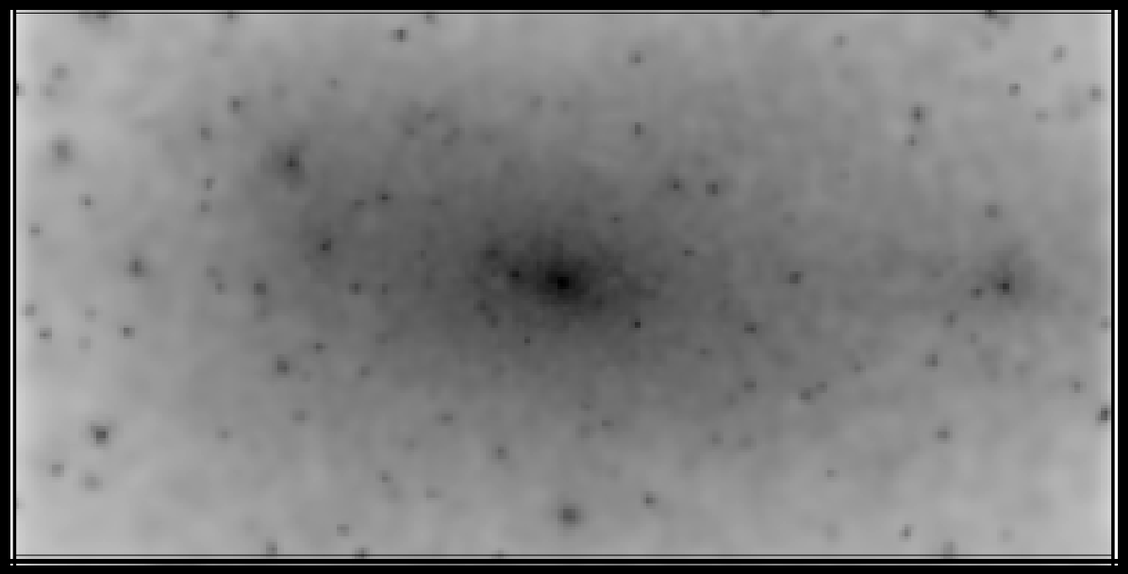

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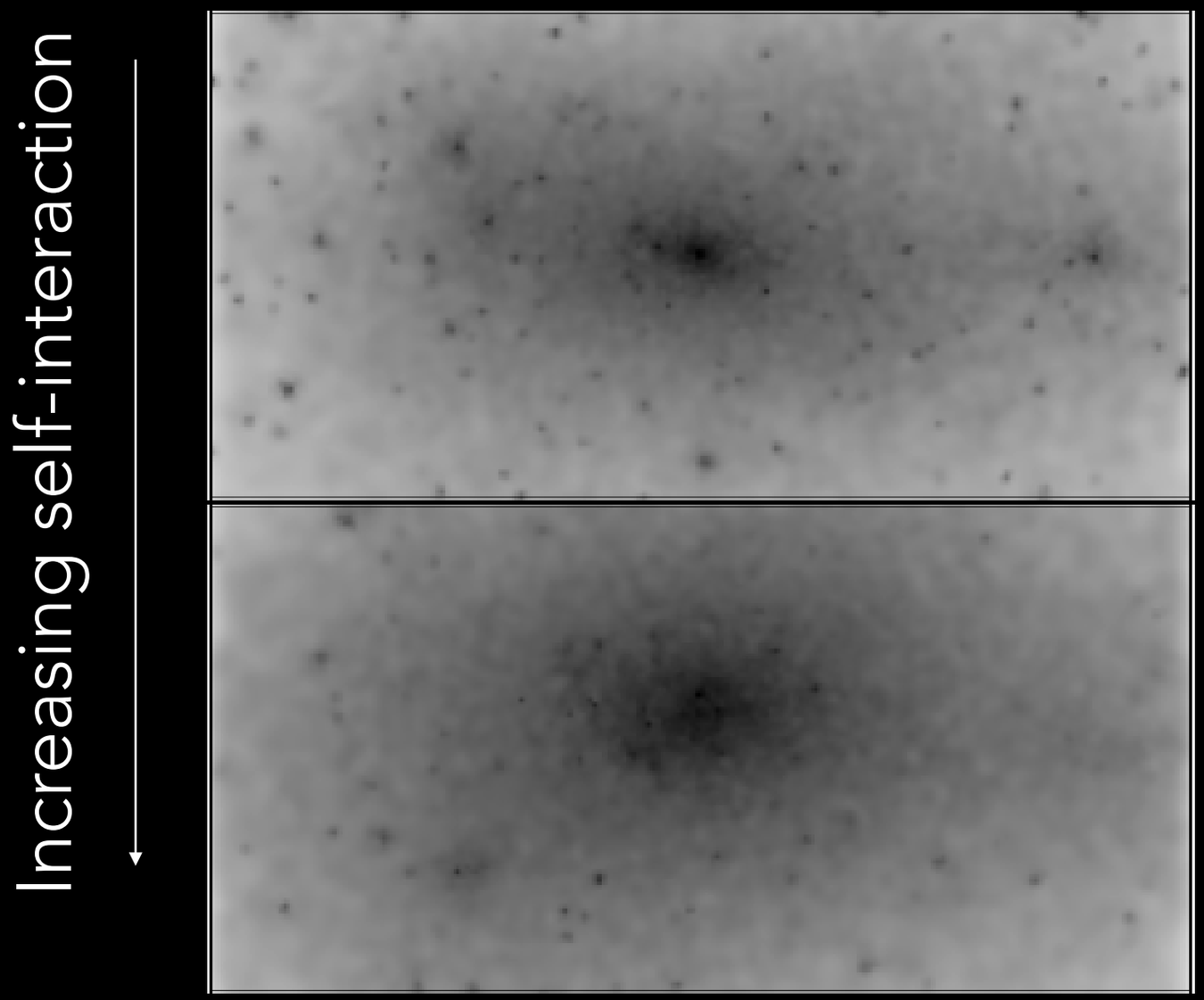

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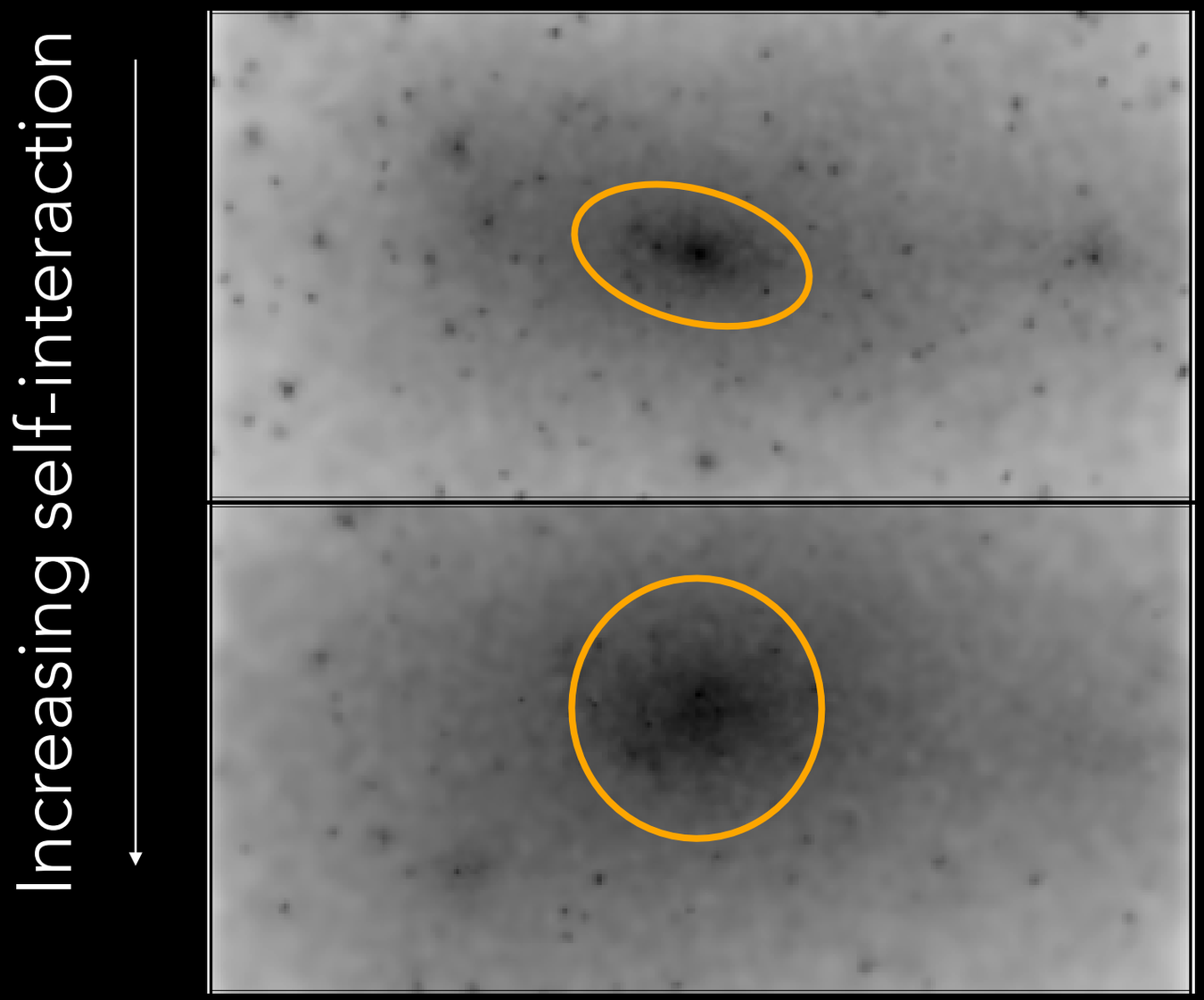
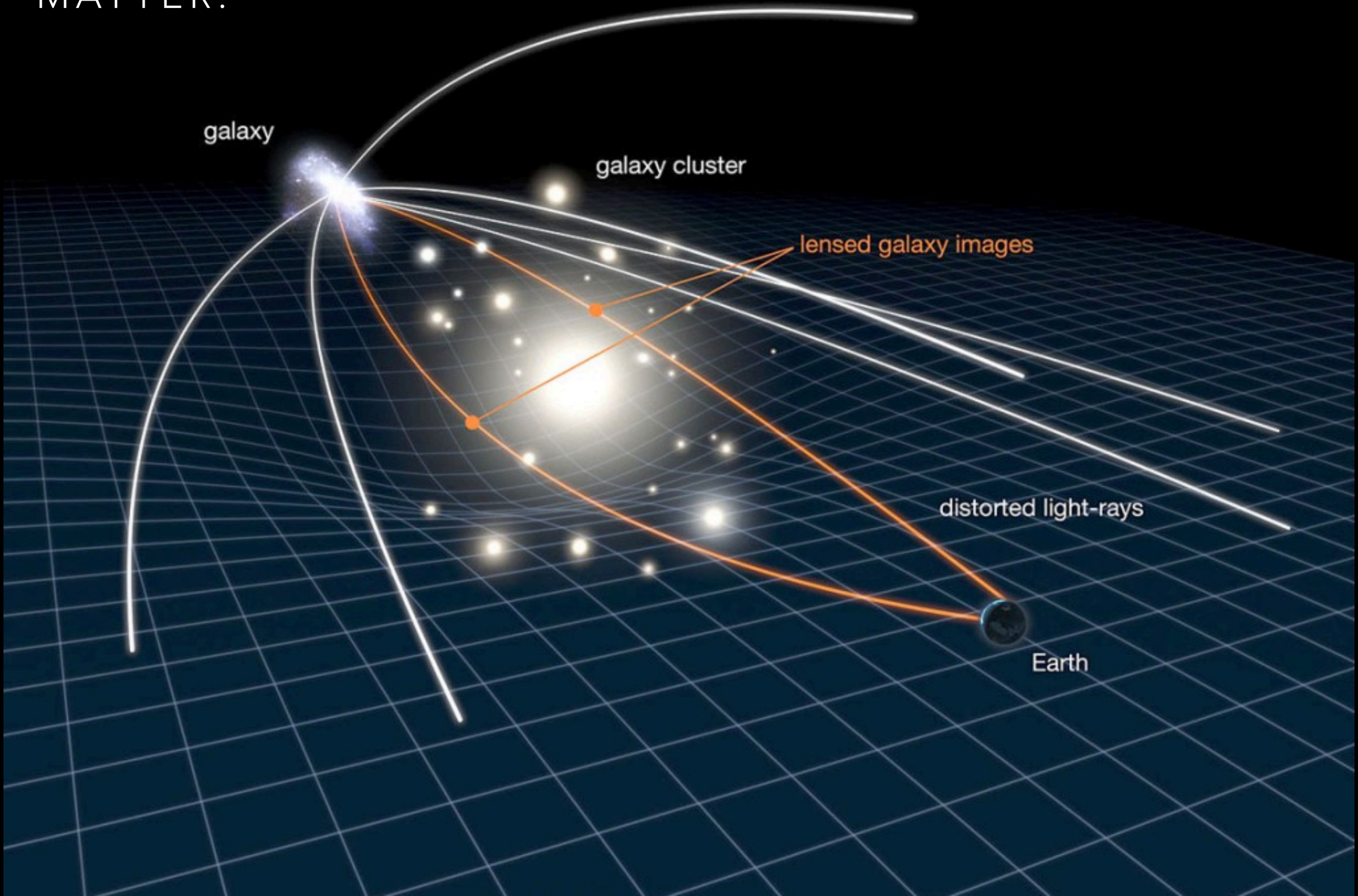
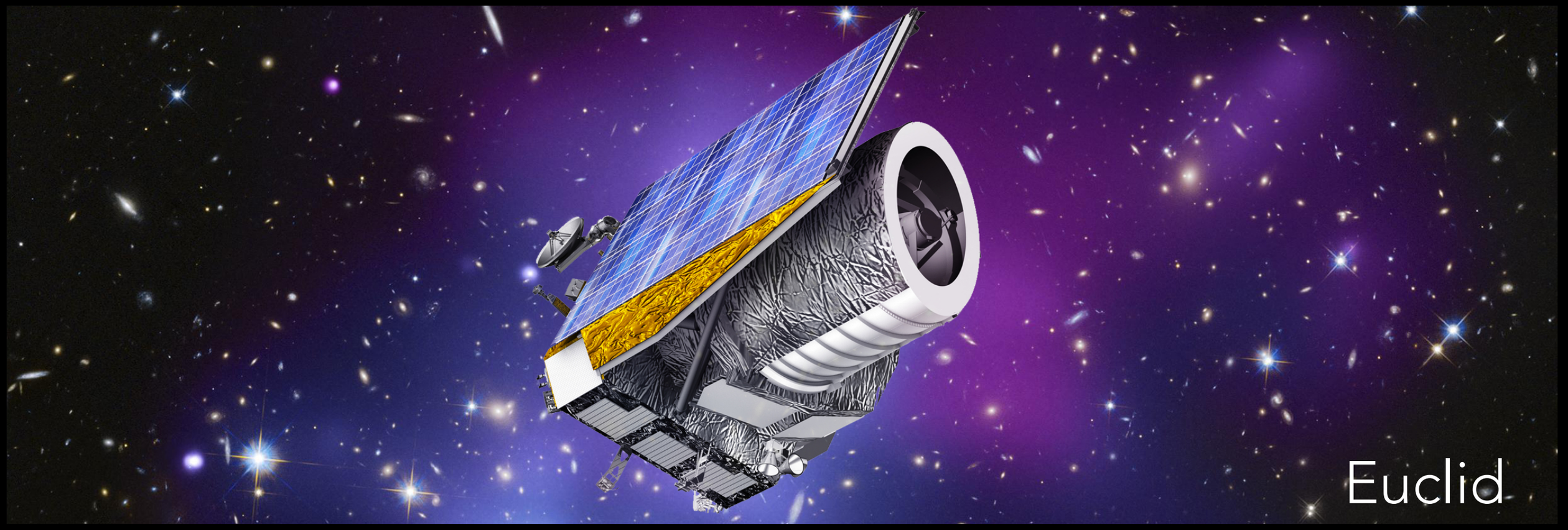


COMPARE THIS MODEL TO OBSERVATIONS

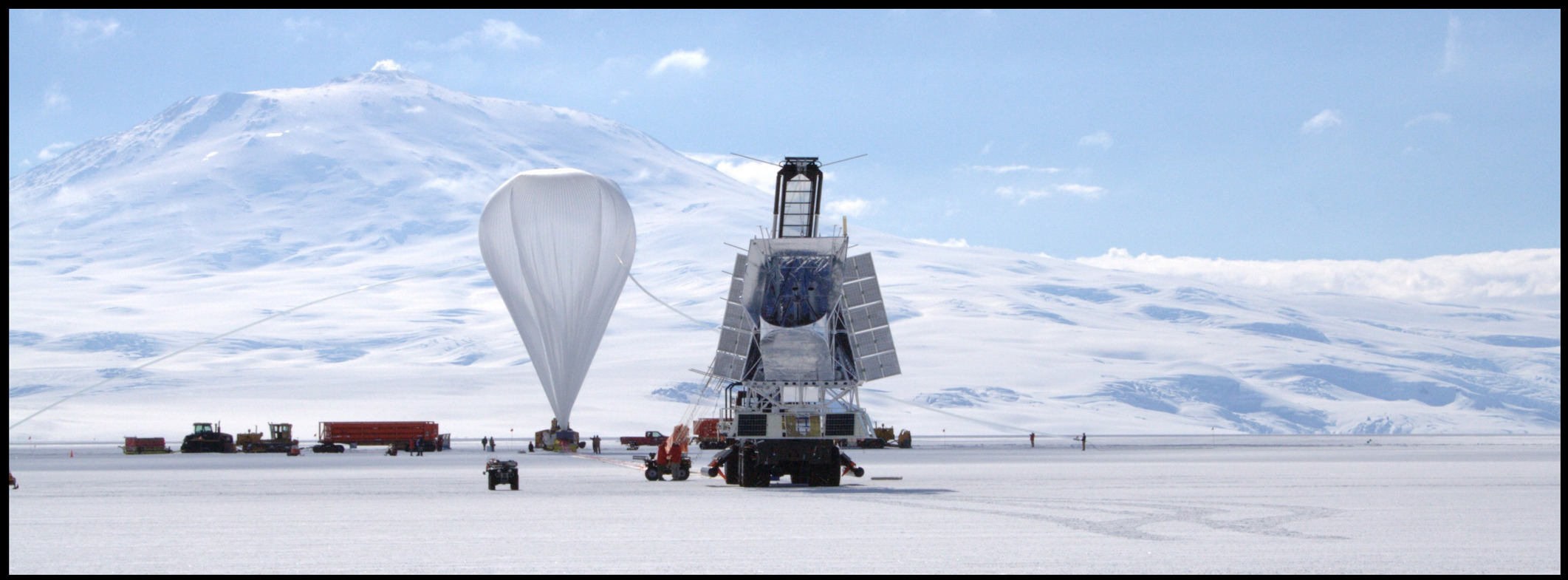
GRAVITATIONAL LENSING HELPS US TRACE THE DARK MATTER.



NEXT FIVE YEARS MANY TELESCOPES WILL COME ONLINE.



SUPER BIT



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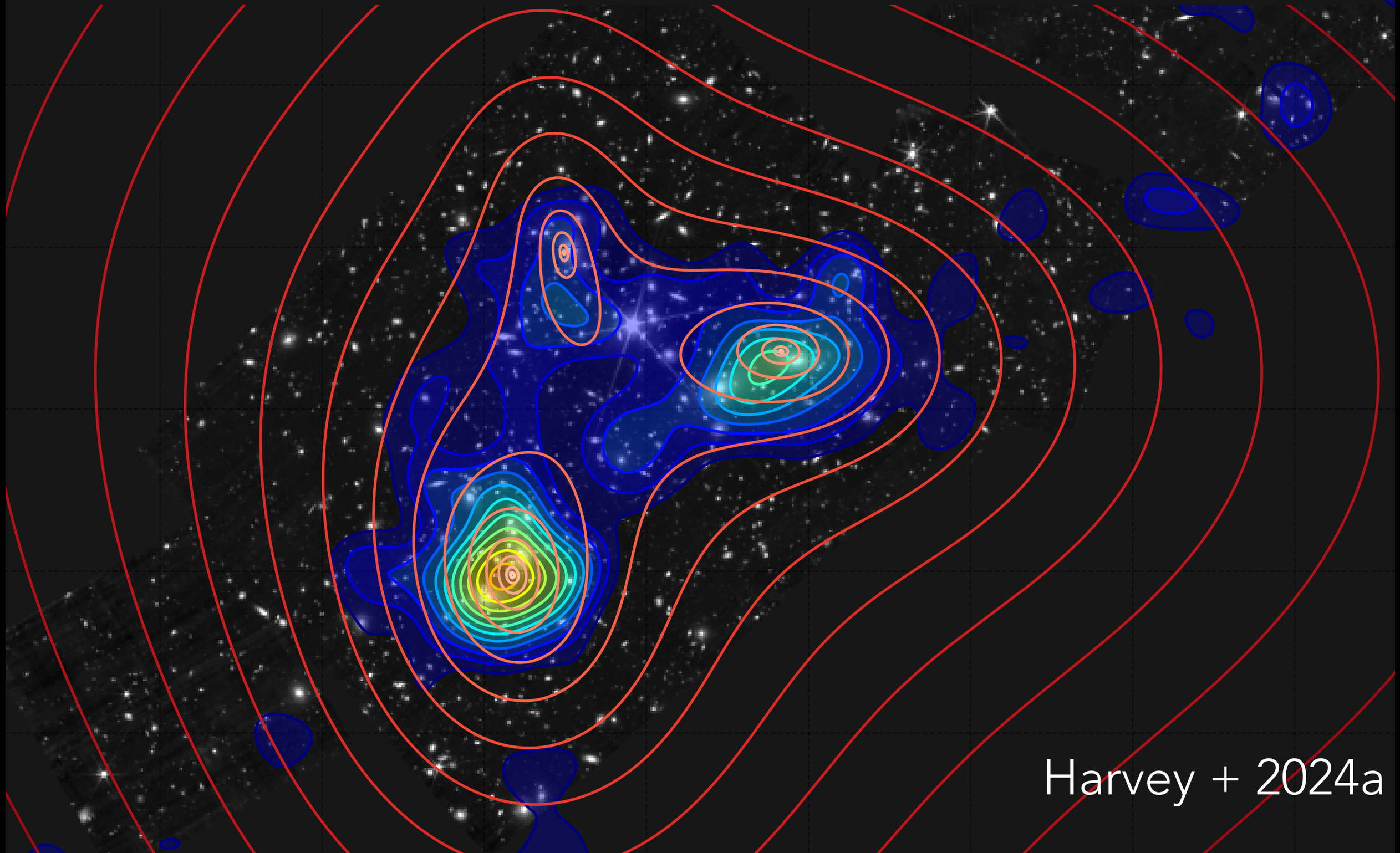
BUT INFORMATION CAN BE
LOST IN SIMPLIFICATION.



DEEP NETS CAN HELP US AGNOSTICALLY PROBE DARK MATTER WHILST SPEEDING UP THE PROCESS

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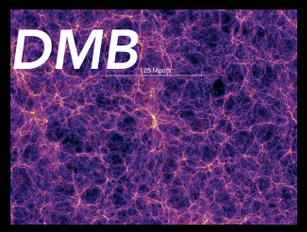

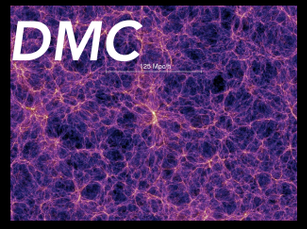

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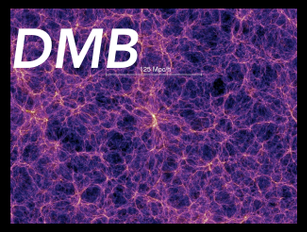

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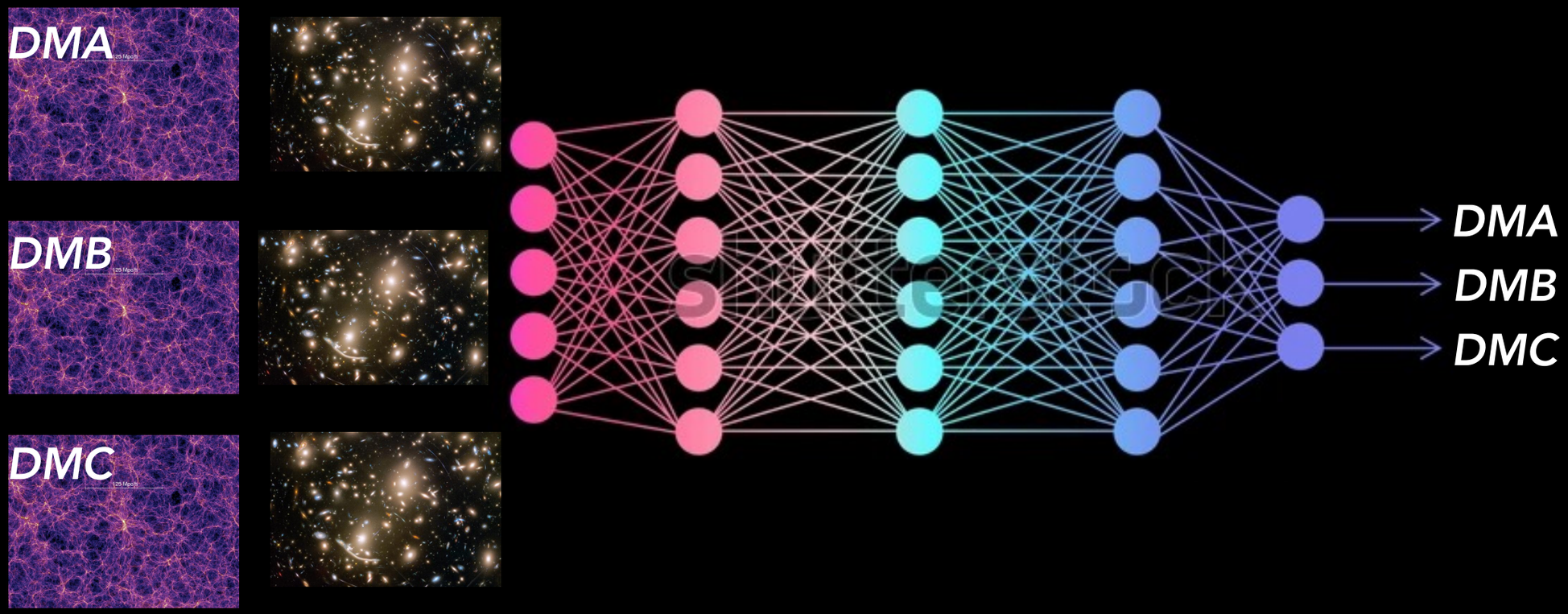

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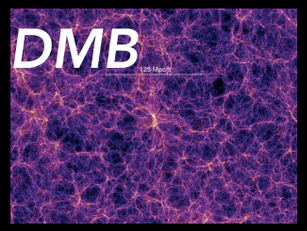

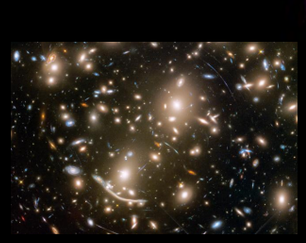

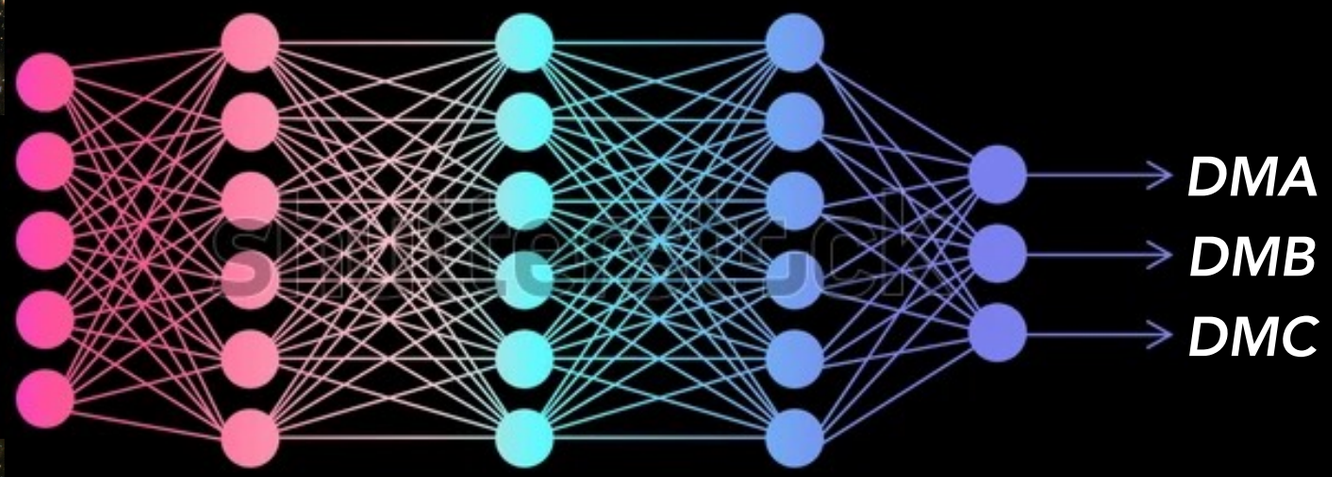

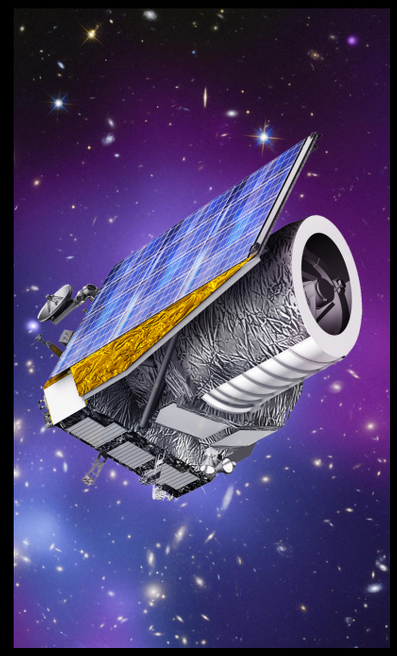

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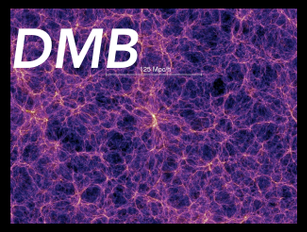
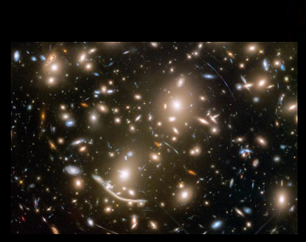
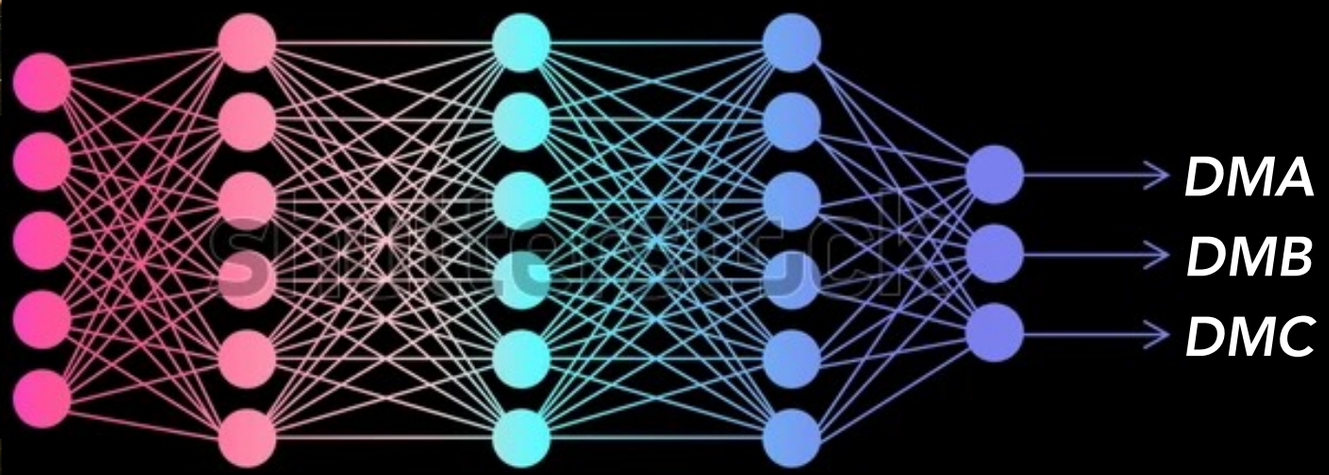
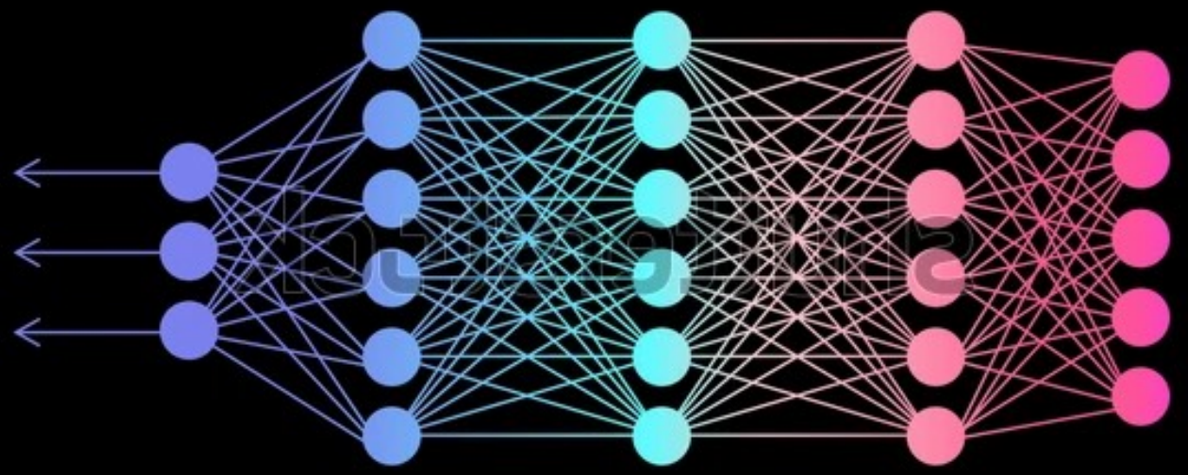
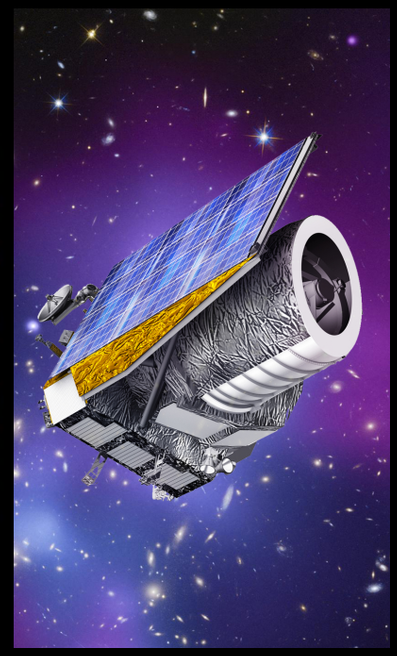




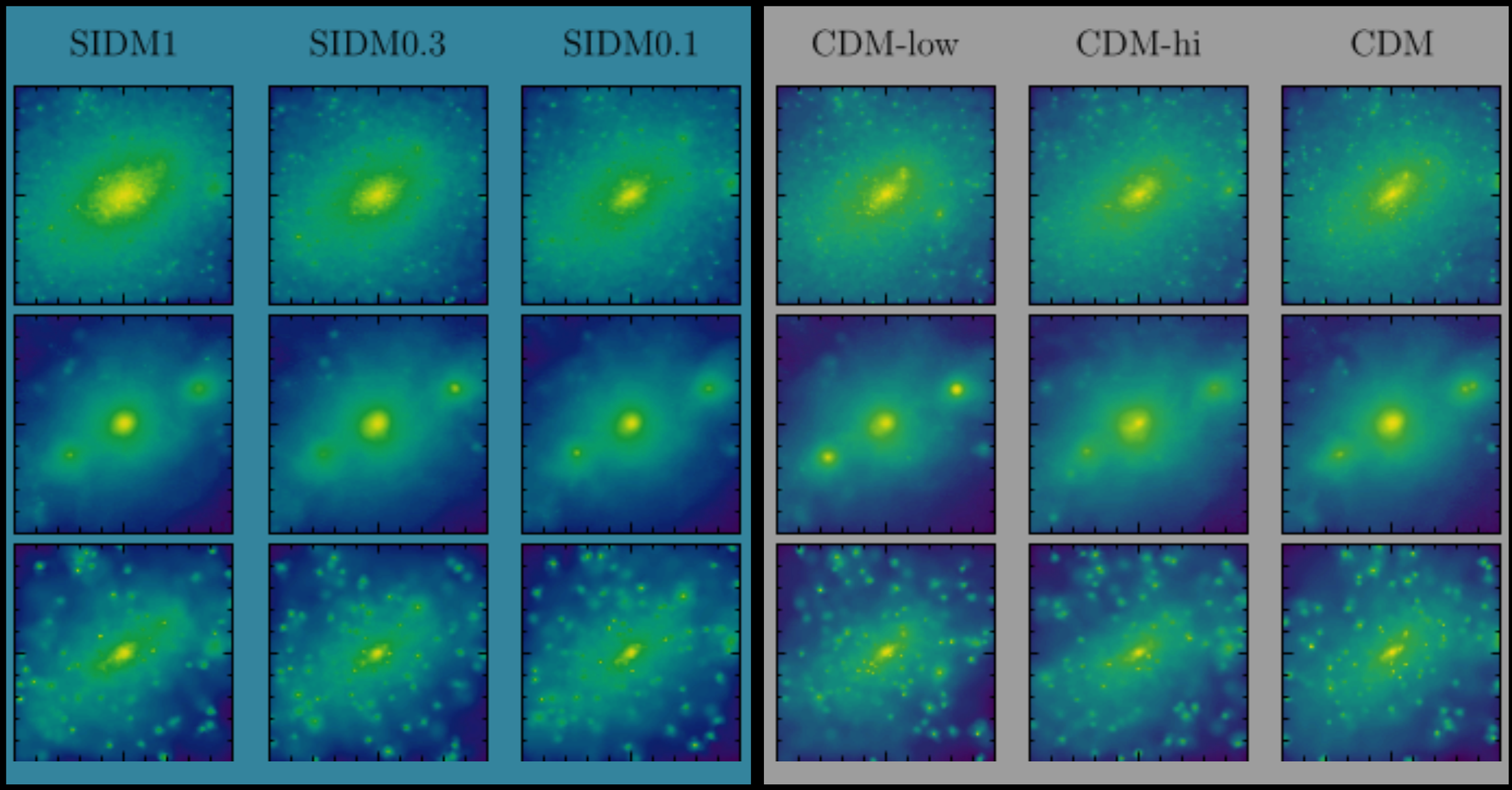






SIMULATING OUR TRAINING SET - BAHAMAS - SIDM

Different values of AGN feedback



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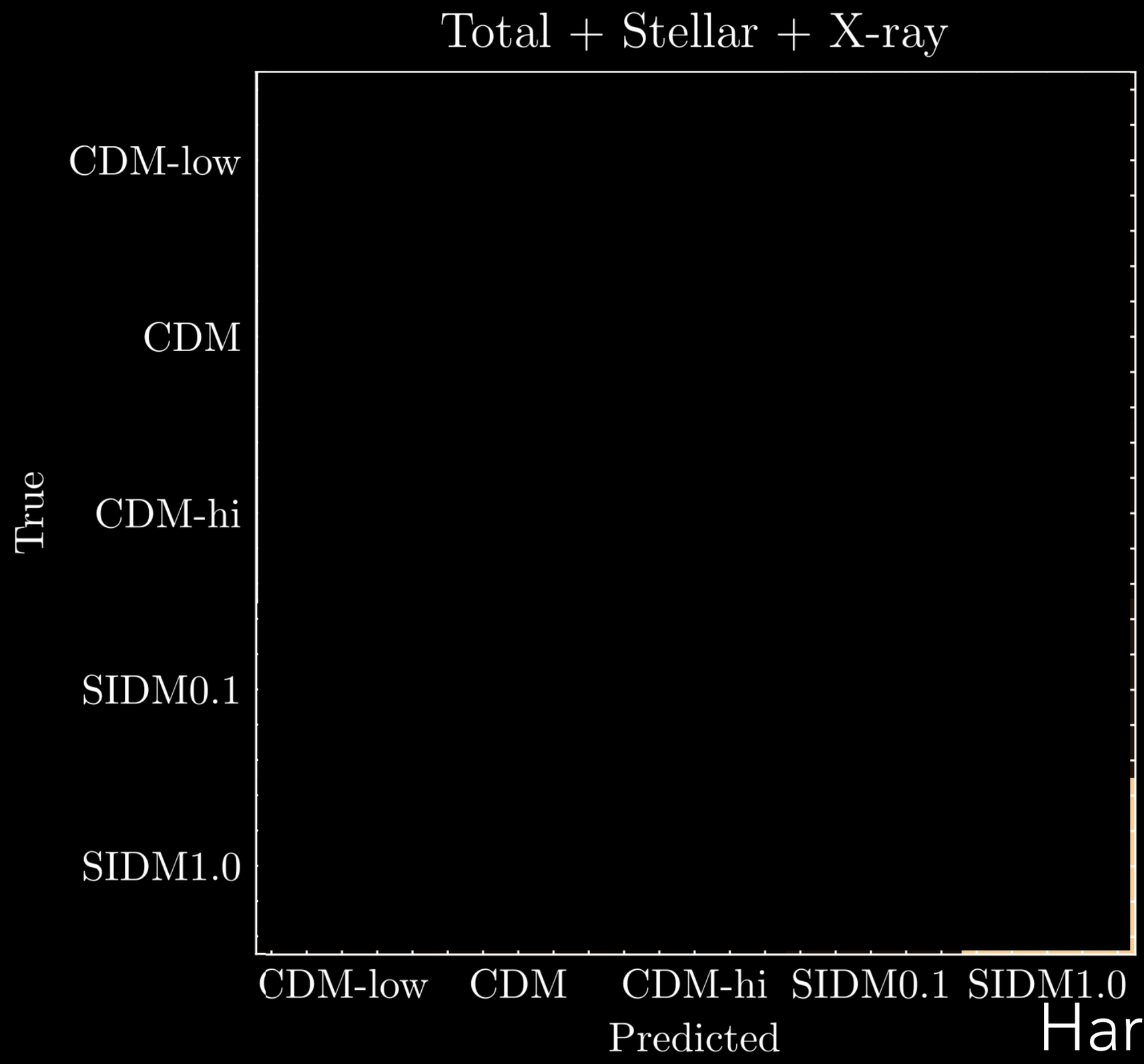
The network performs very well compared to standard measures.



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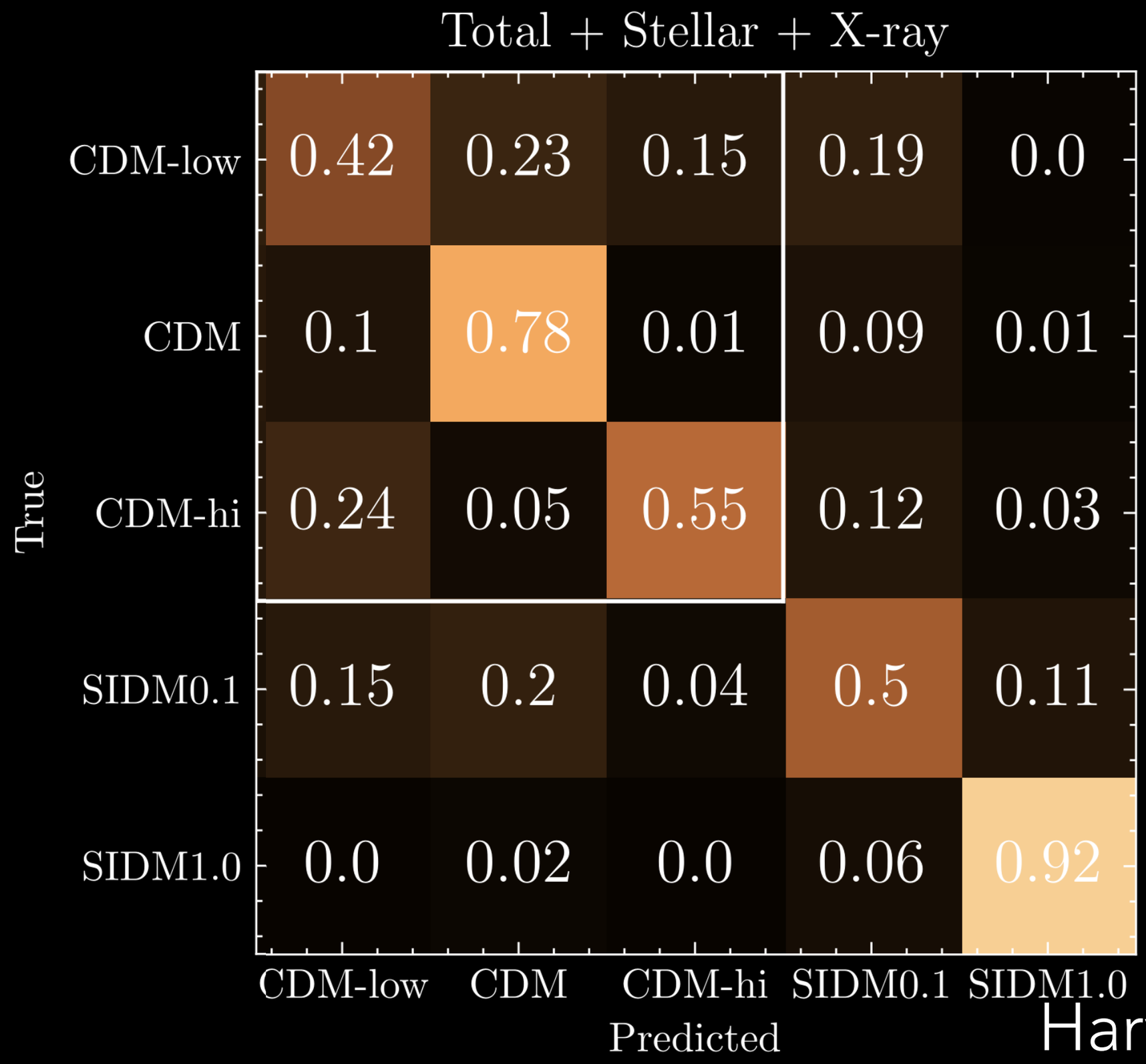

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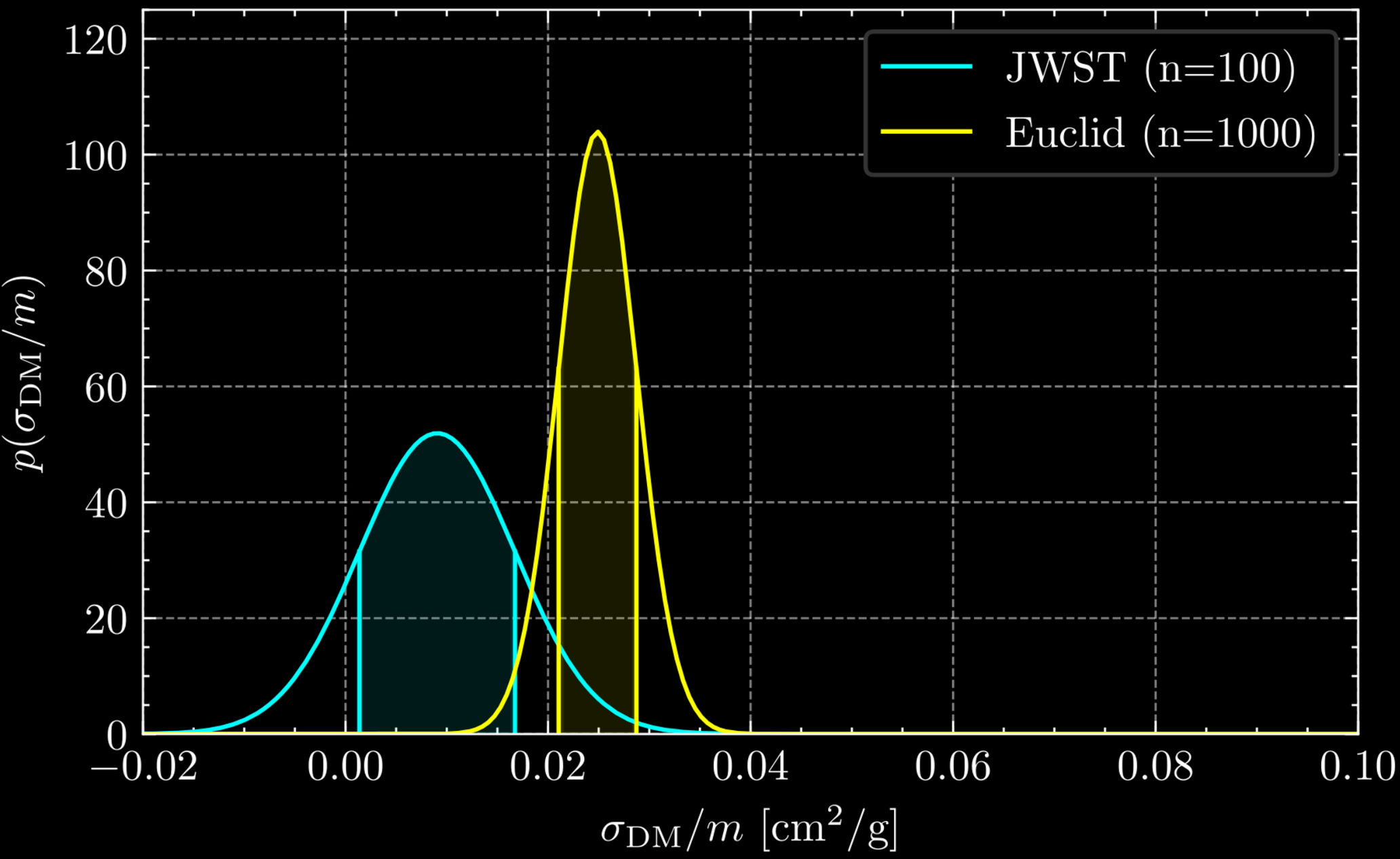
Predictions after forward modelling on upcoming telescopes



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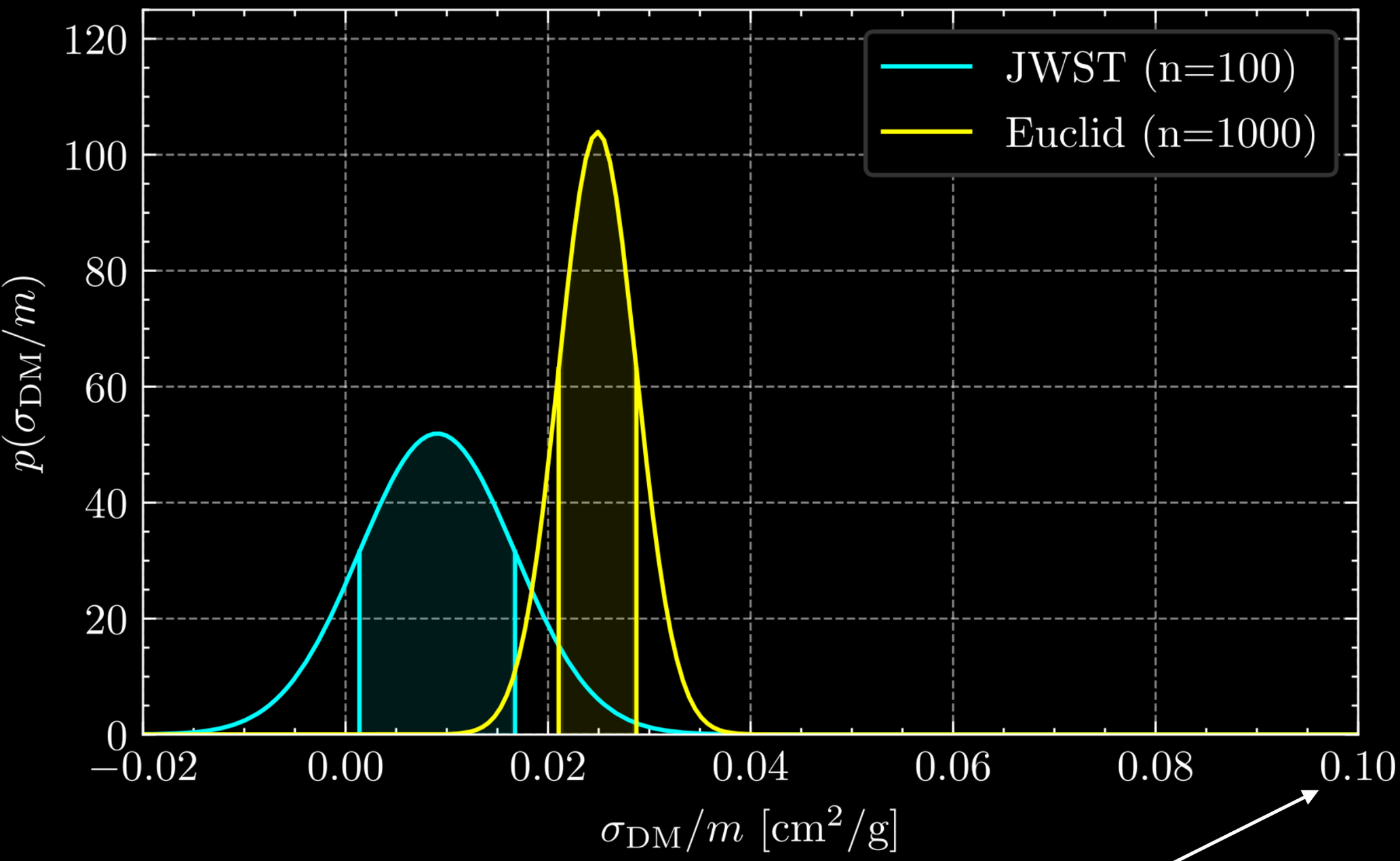

Limit with classic methods

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DEEP LEARNING PRESENTS A NOVEL WAY TO UNDERSTAND DARK MATTER THAT COULD BREAK THE CURRENT IMPASSE IN DARK MATTER RESEARCH

BUT WE MUST USE IT IN PARALLEL WITH PHYSICS INFORMED METHODS TO INSURE THAT WE PRODUCE ROBUST AND TRANSPARENT RESULTS.

david.harvey@epfl.ch