Machine Learning
Dark Matter Halo Formation

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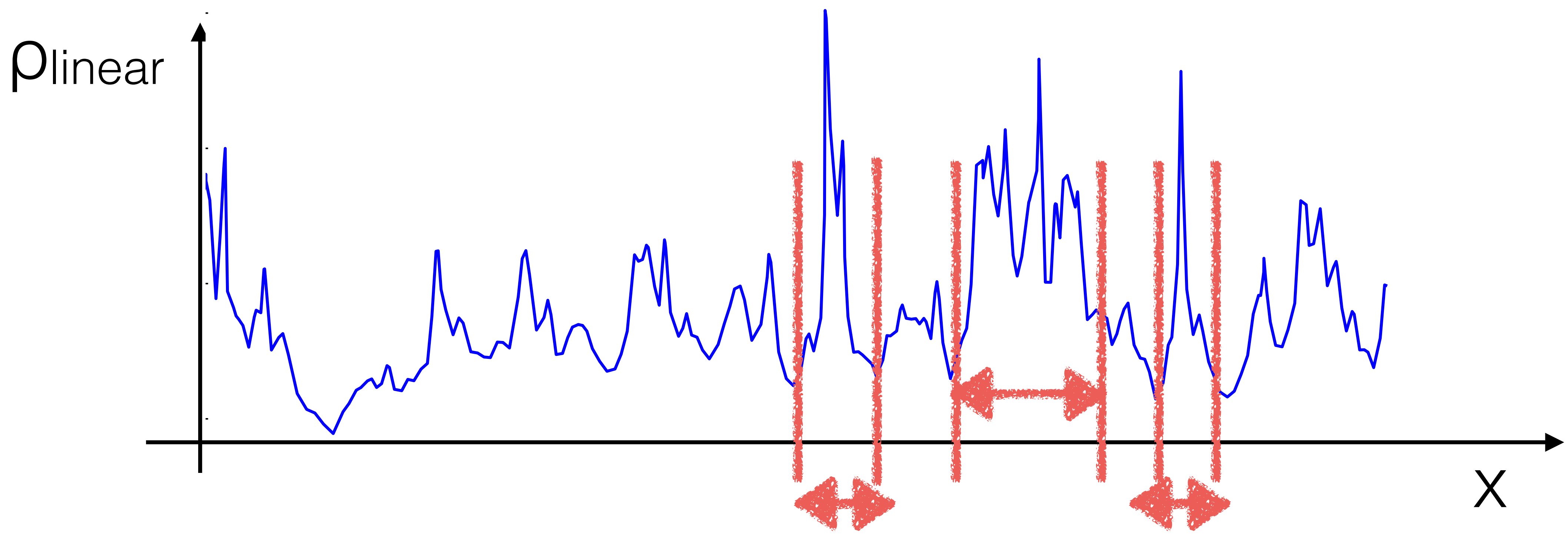
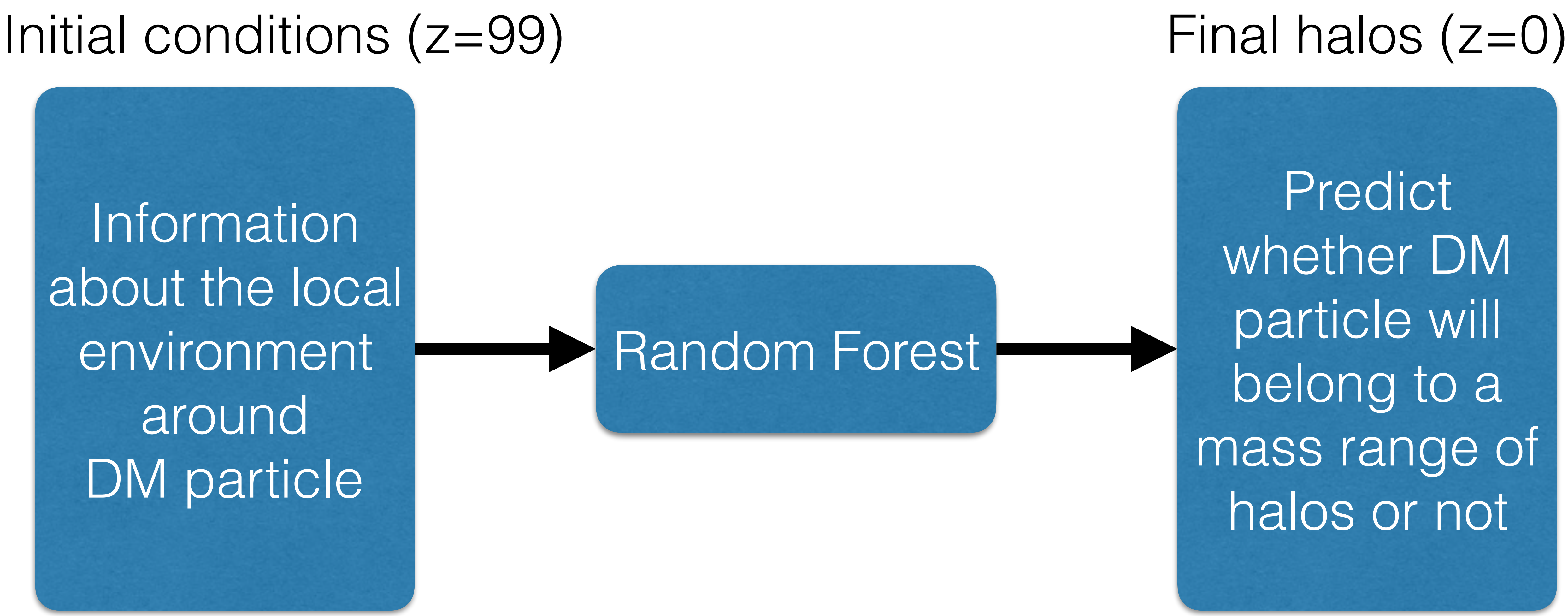
A machine learning approach

Train a machine learning algorithm to learn cosmological structure formation from N-body simulations.



Aim: *gain insights into the physics driving halo formation*

Supervised classification



Which aspects of early-Universe density field contain relevant information to predict dark matter halo formation?

Training the machine learning algorithm

1. *Machine learning input:*

   Given a sphere of mass scale M_i centred on particle p, calculate:

   1. Density contrast
      (motivated by extended Press-Schechter theory)

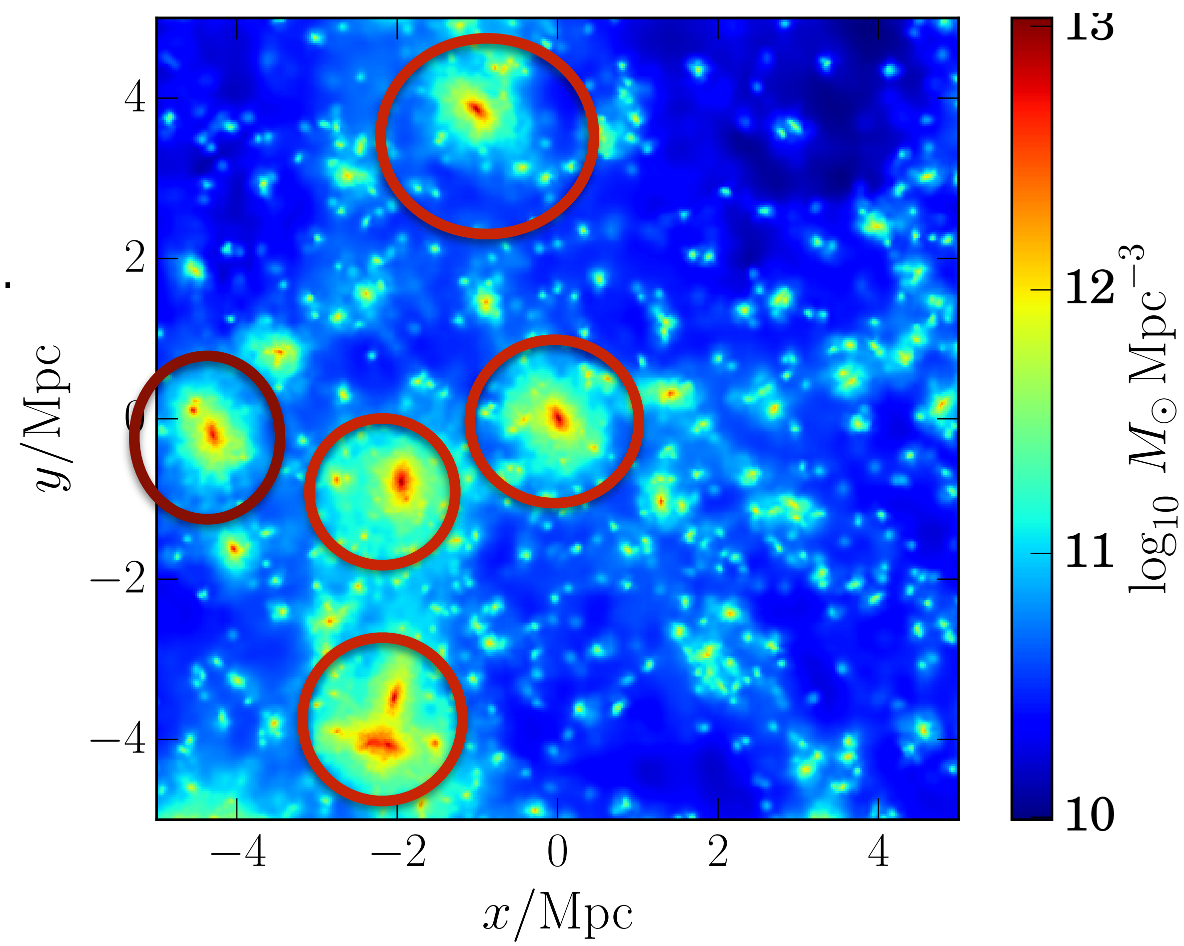
   2. Tidal shear tensor
      (motivated by Sheth-Tormen theory)

   Do the same procedure for 50 mass scales.

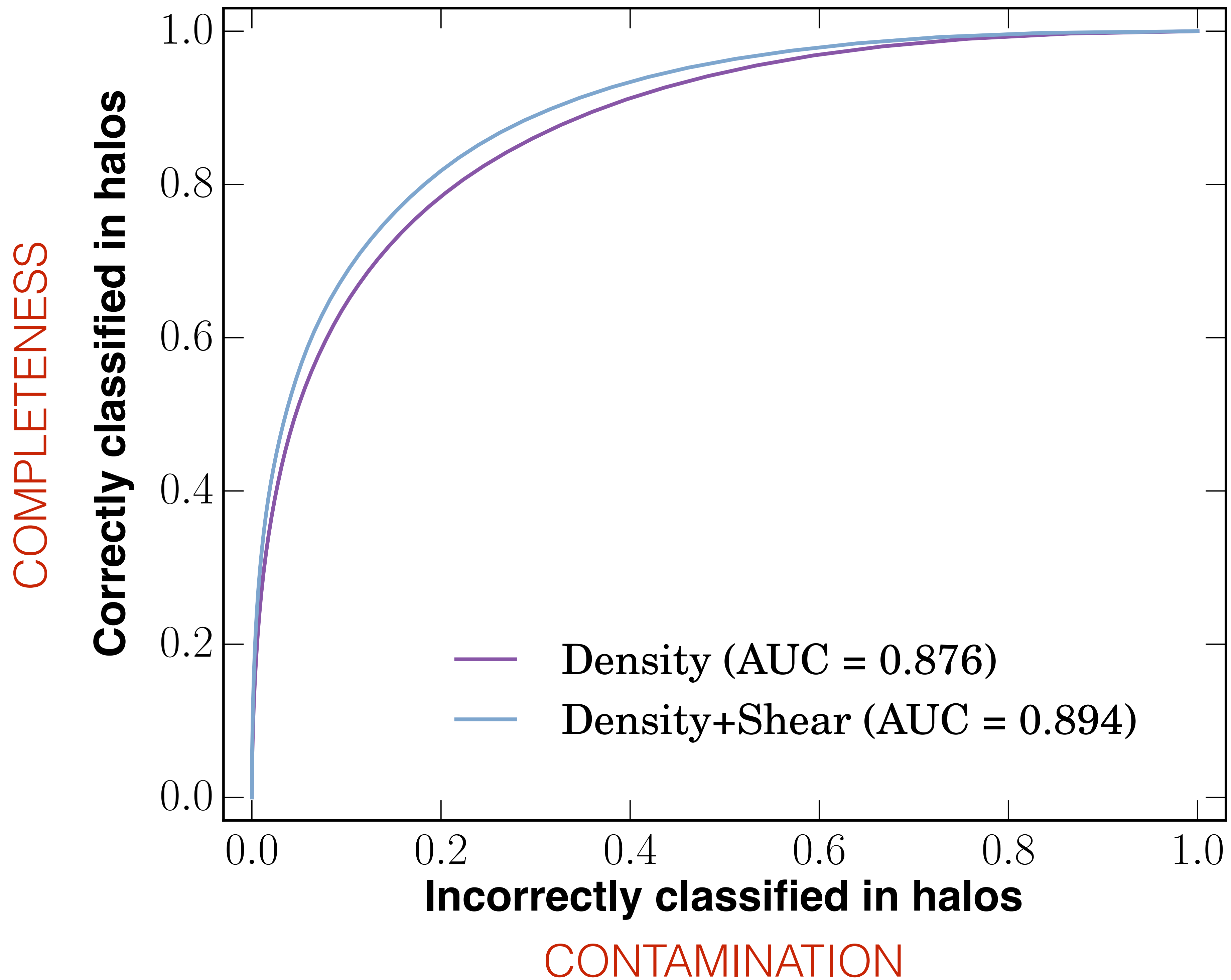
2. *Machine learning output:*

   1. **IN** halos of mass, $10^{12}\,M_{\odot} < M < 10^{14}\,M_{\odot}$

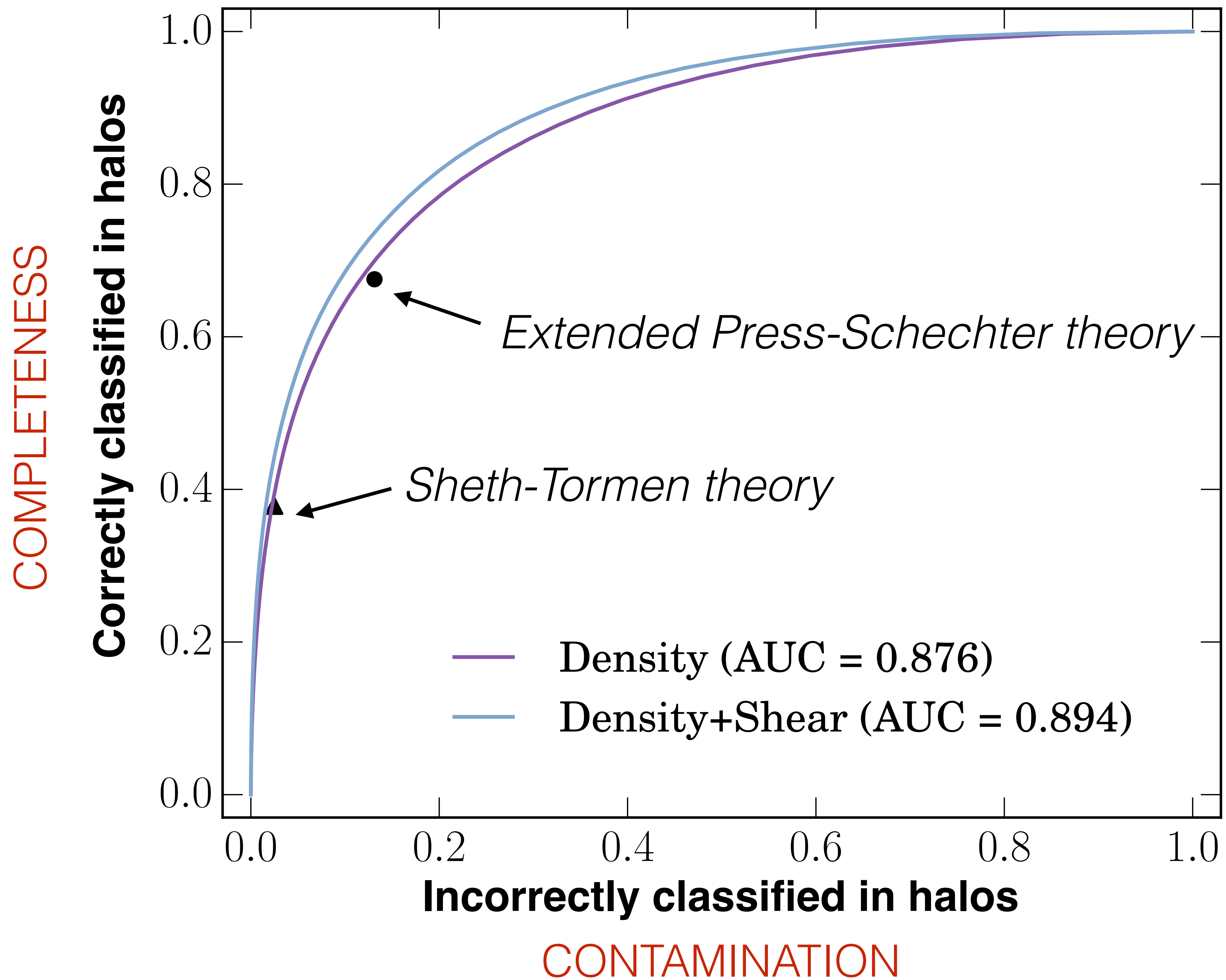
   2. **OUT**, otherwise.



ML predictions: adding the shear shows little improvement



Machine learning vs analytic frameworks



For more information see

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