Inferring Supernova dust with Neural Networks

Zoe Ansari – May 2021

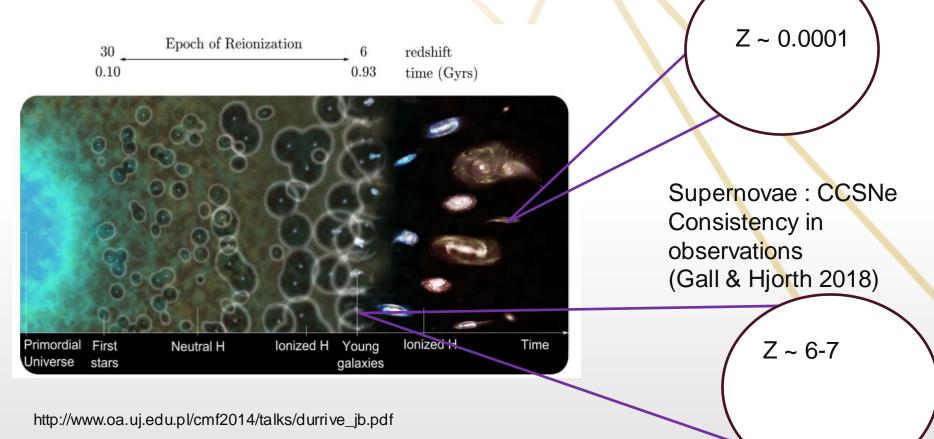


Applied Machine Learning 2021

- · What is cosmic dust
- Why Machine Learning?
- . Mixture Density Network
- . Uncertainty
- . Recursive feature elimination

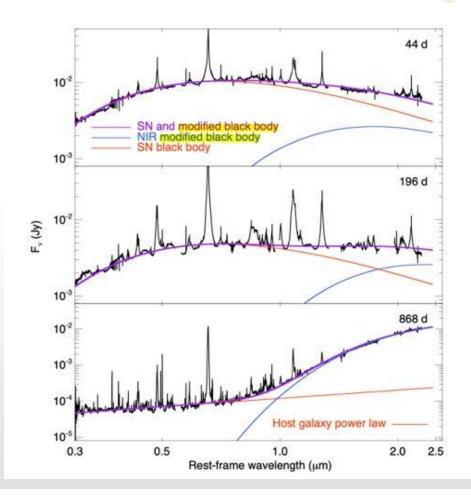


# Why should we keep an eye on dust



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# Challenges in inferring dust from observations



What we detect - spectra

#### Fitting to models

1.Assumptions on set of parameters that are dependent on each other 2.Coverage issue

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Dust mass Dust temp. Dust species

## Inferring dust from observations with Machine

Fittir no nodels 1.Ass np. so set of parameters that are de nden each other 1.Infer dust properties without 2.Coverage parameters assumptions + uncertanity on estimation 2. Find the most effective wavelength range for inferring dust properties

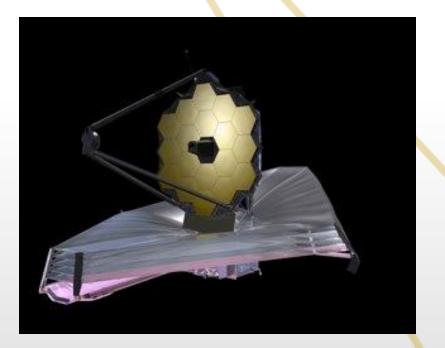
Collecting observations with various combination of dust properties

What we observe - spectra

Training an algorithm with the collected data

### Collect the data

James Webb Space Telescope

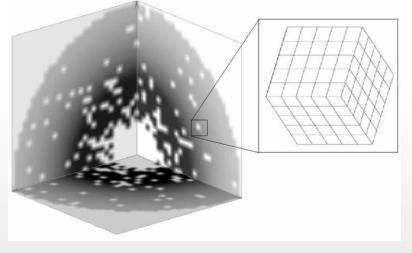




## Collect the data

#### Simulations

### MOCASSIN



3D representative of supernova ejecta model

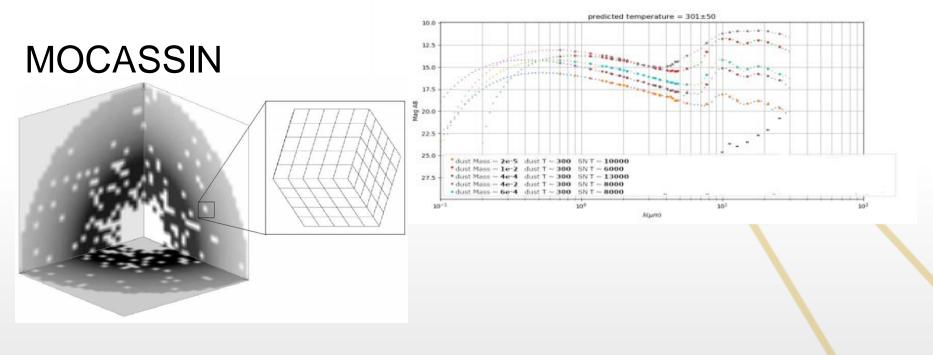
James Webb Space Telescope



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## Collect the data

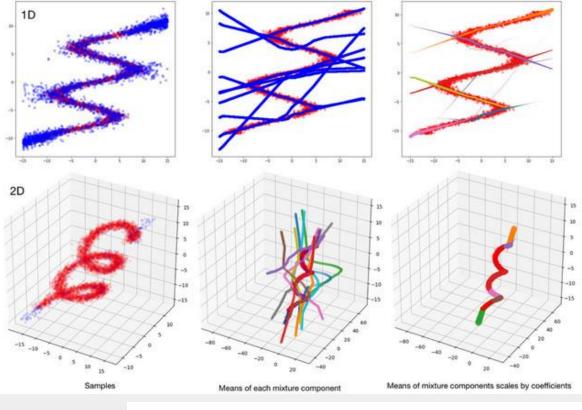
#### Simulations



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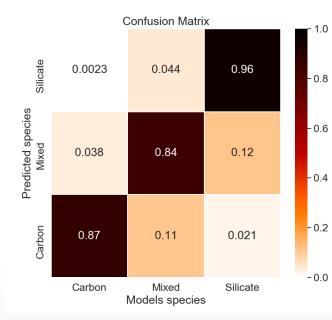
3D representative of supernova ejecta model

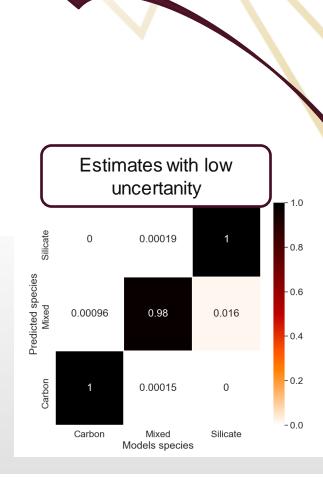
## **Mixture Density Network**



$$E(\boldsymbol{w}) = -\sum_{n=1}^{N} \ln \left\{ \sum_{k=1}^{K} \pi_k(\boldsymbol{x}_n, \boldsymbol{w}) \mathrm{N}(\mathrm{t} \mid \mu_k(\boldsymbol{x}_n, \boldsymbol{w}), \sigma_k^2(\boldsymbol{x}_n, \boldsymbol{w})) 
ight\}$$

https://github.com/cpmpercussion/kerasmdn-layer りくやく





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## **Recursive feature elimination**



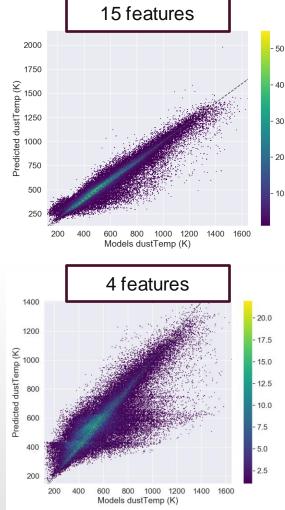
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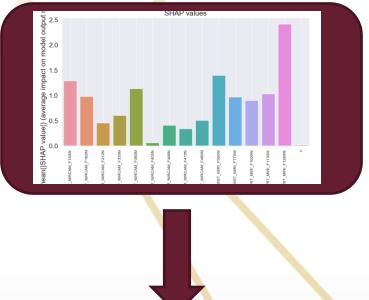
## **Recursive feature elimination**

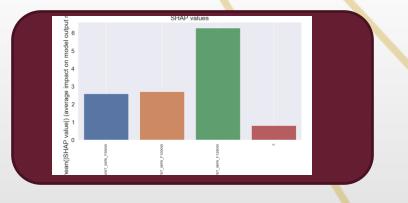


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## Recursive feature elimination







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