



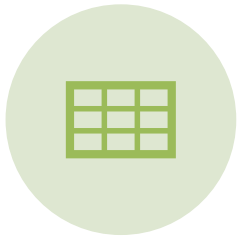
# Hierarchical Data Cubes

*With uncertainties*

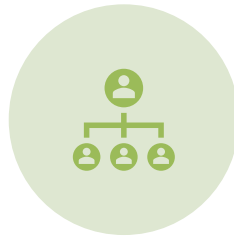
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# Agenda



CONSTRUCTING  
DATA CUBES



HIERARCHICAL  
CUBES WITH  
UNCERTAINTIES

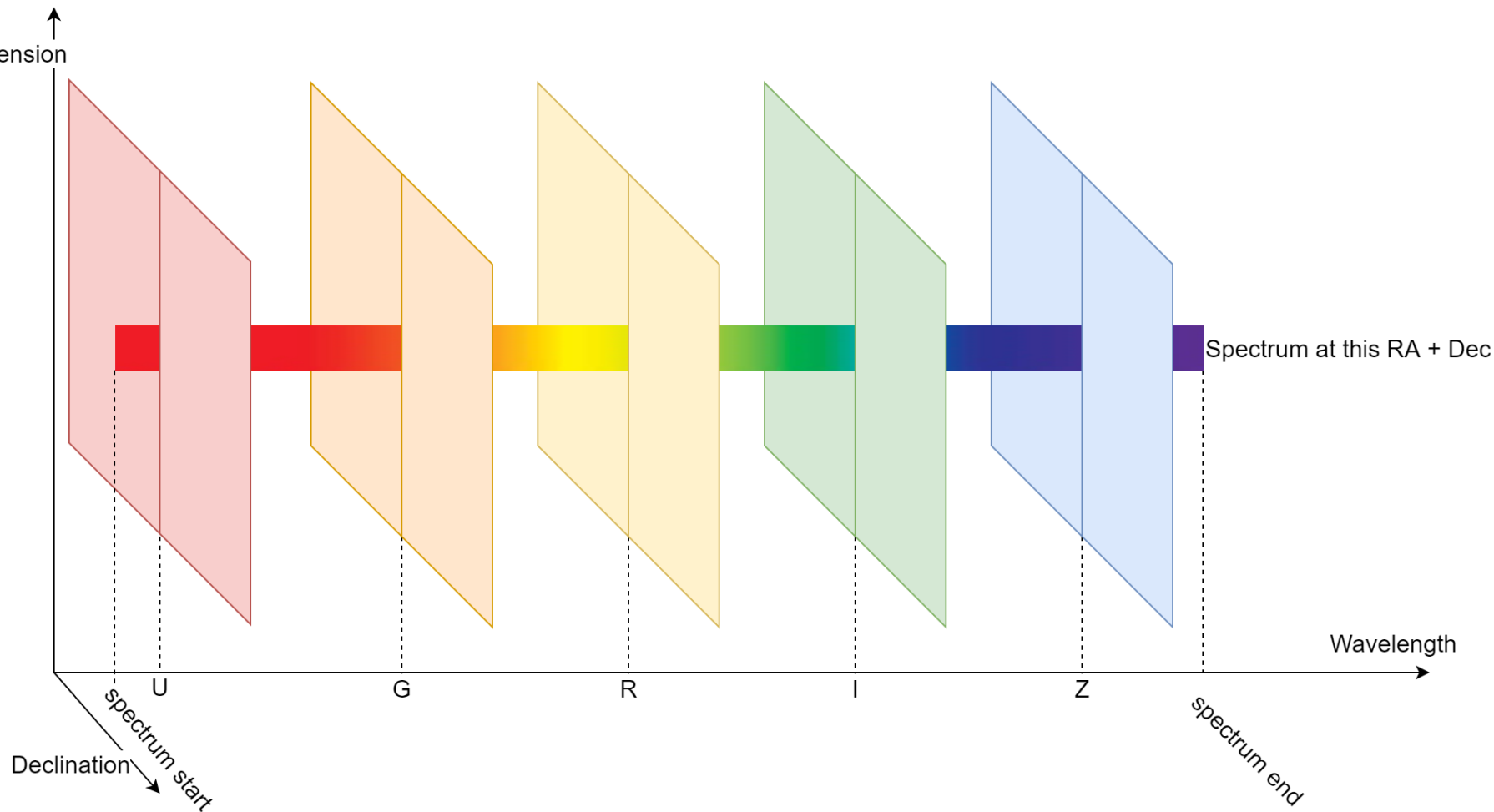


USING PROBABILITY  
DISTRIBUTIONS FOR  
QUERY



APPLICATION –  
YOUR OPINION

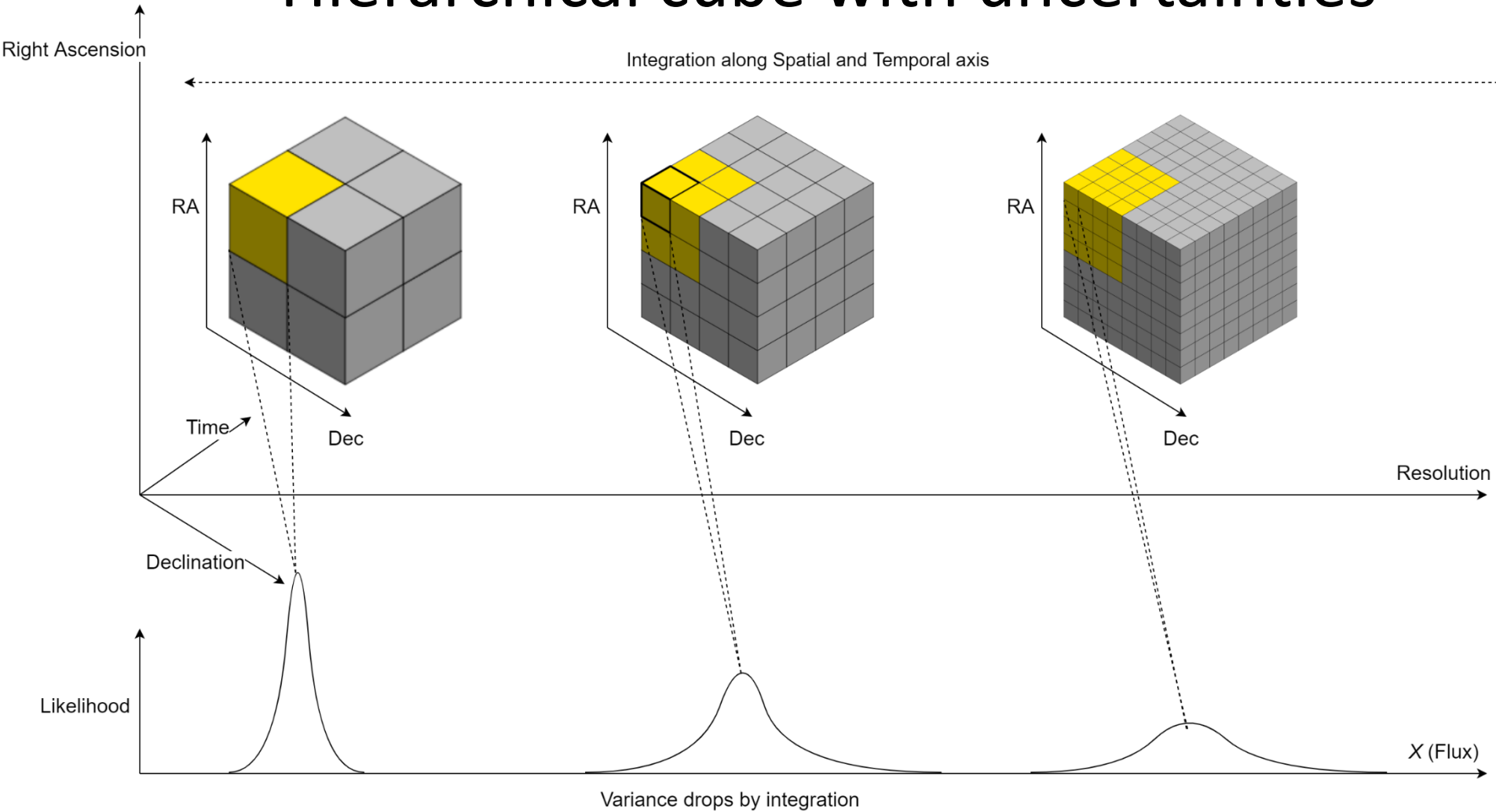
# Construction of cube



# Challenges

- Combining images and spectra from
  - Same data provider
  - Different data providers (next level)
- We construct data cube from SDSS images and spectra
  - We add Filter curves from Spanish VO to cover also filters U + Z with spectral measurements
  - We add uncertainties from the data

# Hierarchical cube with uncertainties



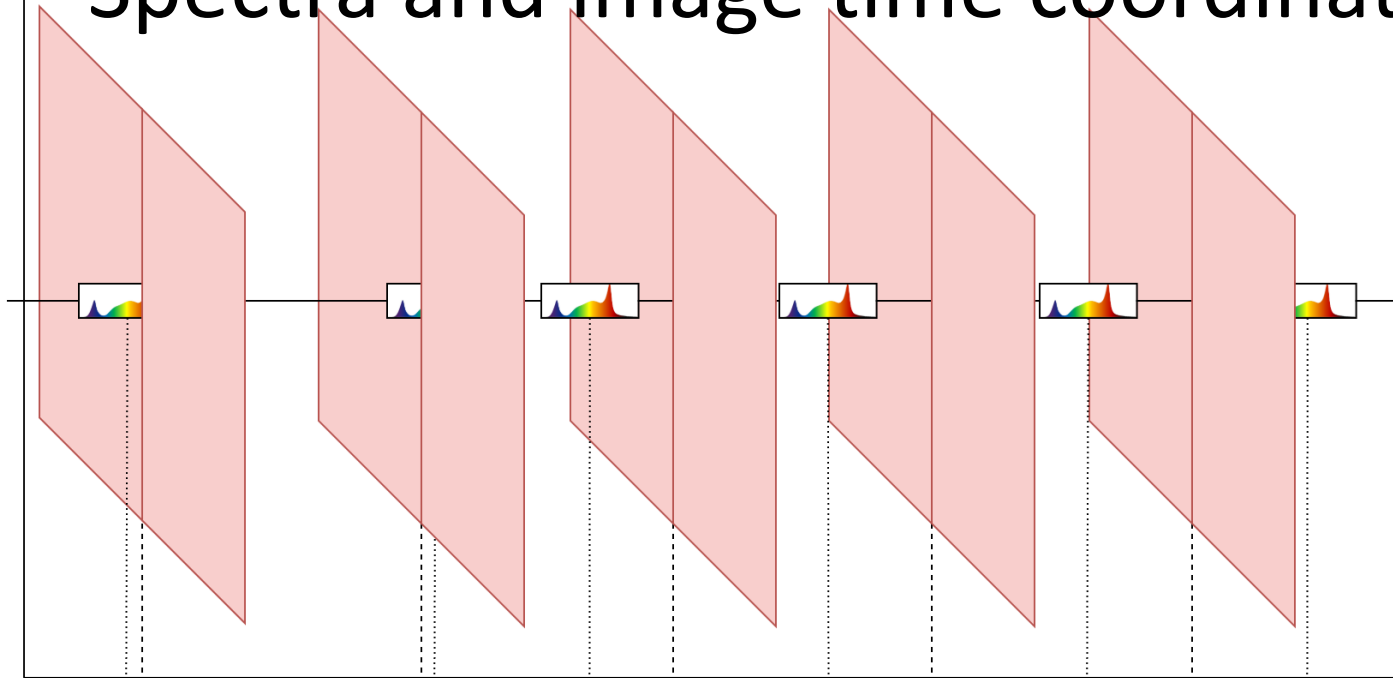
# Challenges

- Produce “HiPS-like” cube that will have uncertainty
- Being able to tell which data can be trusted
  - Much needed for ML algorithms as input
- Being able to tell on **lower resolutions** to reduce volume enough for more expensive ML algorithms
- Use persistent storage in the form of array DB (Rasdaman?)

# Spectra and image time coordinates

Right Ascension

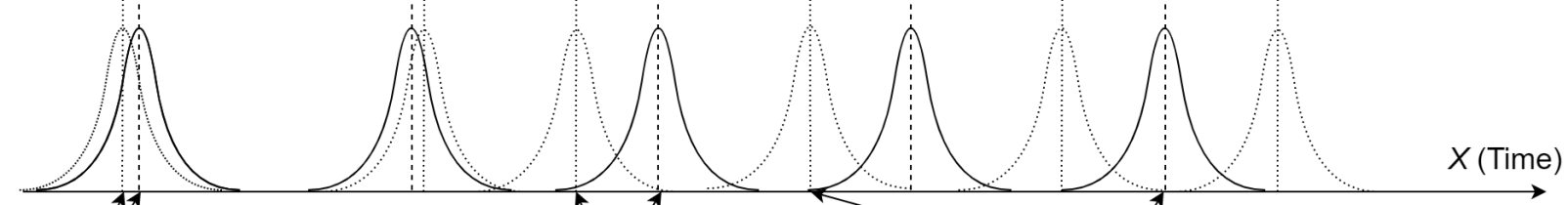
RA+DEC of:  
1. Image cutout  
2. Spectrum



Time coordinate

Spectrum observed Image observed Image observed Spectrum observed Spectrur observed Image observed Spectch observed Image observed Spectrum observed Image observed Spectrum observed Image observed Spectrum observed

Declination



X (Time)

97%

25%

1%

Spectrum relevance to image cutout

# Challenges

- Be able to tell uncertainty not only in measurement, but also:
  - Coordinates – spatial error in calibrating RA, DEC
  - Relevance – combining only with data that is “close enough” in spatial, time or spectral axis
- Physically changing objects (Quasar, BE stars, supernovas) have very small window of time where spectra are relevant



# Discussion - application

- Uncertainty maps in different resolutions
- PCA, t-SNE, UMAP interactively on both spectra + image cutouts interactively!
- Standardize Queries –
  - Give me data with beta, sigma smaller than...
  - Give me only high quality sources, etc.
- Your ideas?

# Thank you!

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