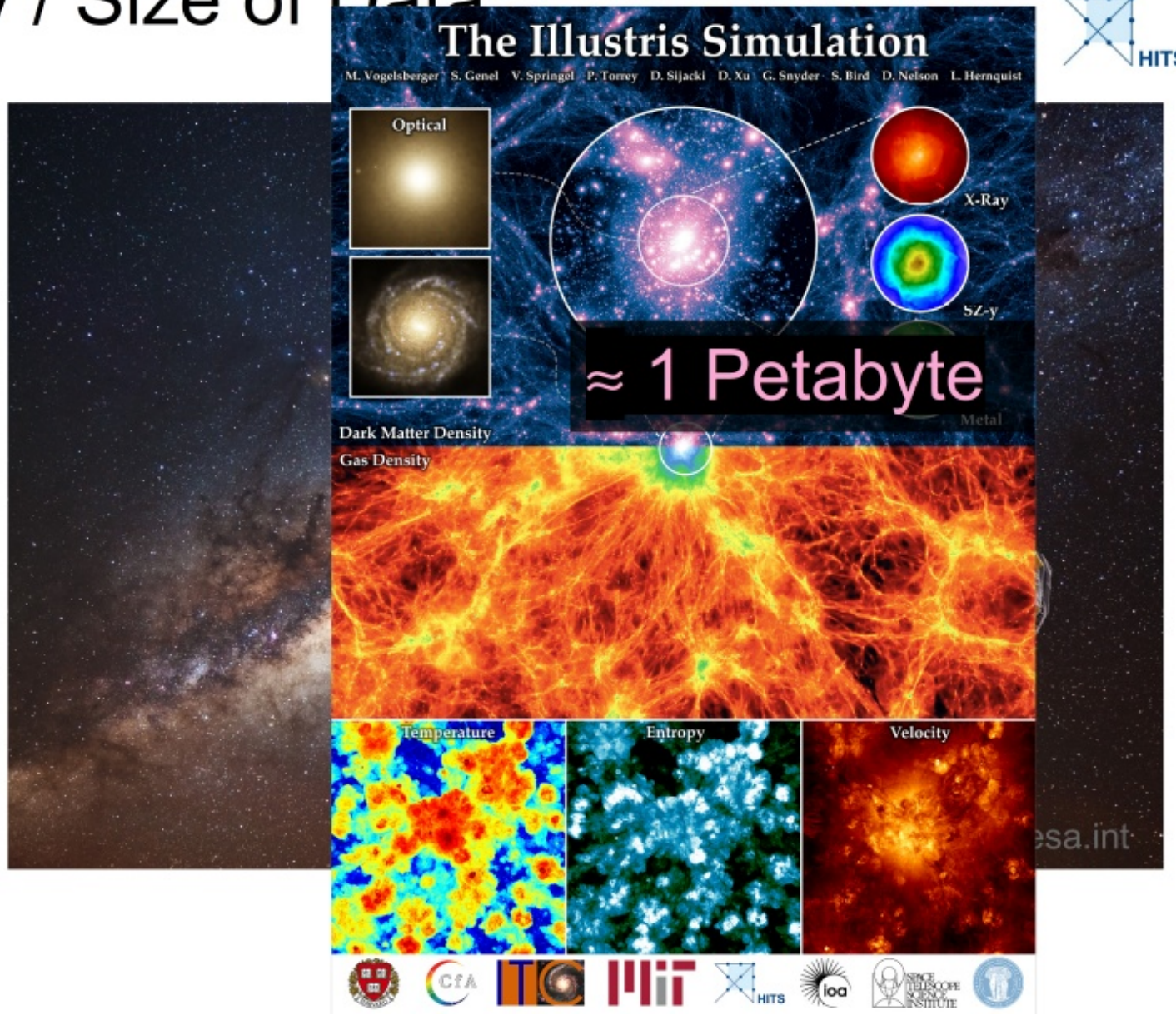
ML-based, explorative web-service

how to deal with complex morphologies

Complexity / Size of Data

Complexity / Size of Data



Complexity / Size of Data

Manual Visual Inspection

200.000 stellar spectra

- “Pickering’s Computers” → Annie Jump Cannon

Manual Visual Inspection

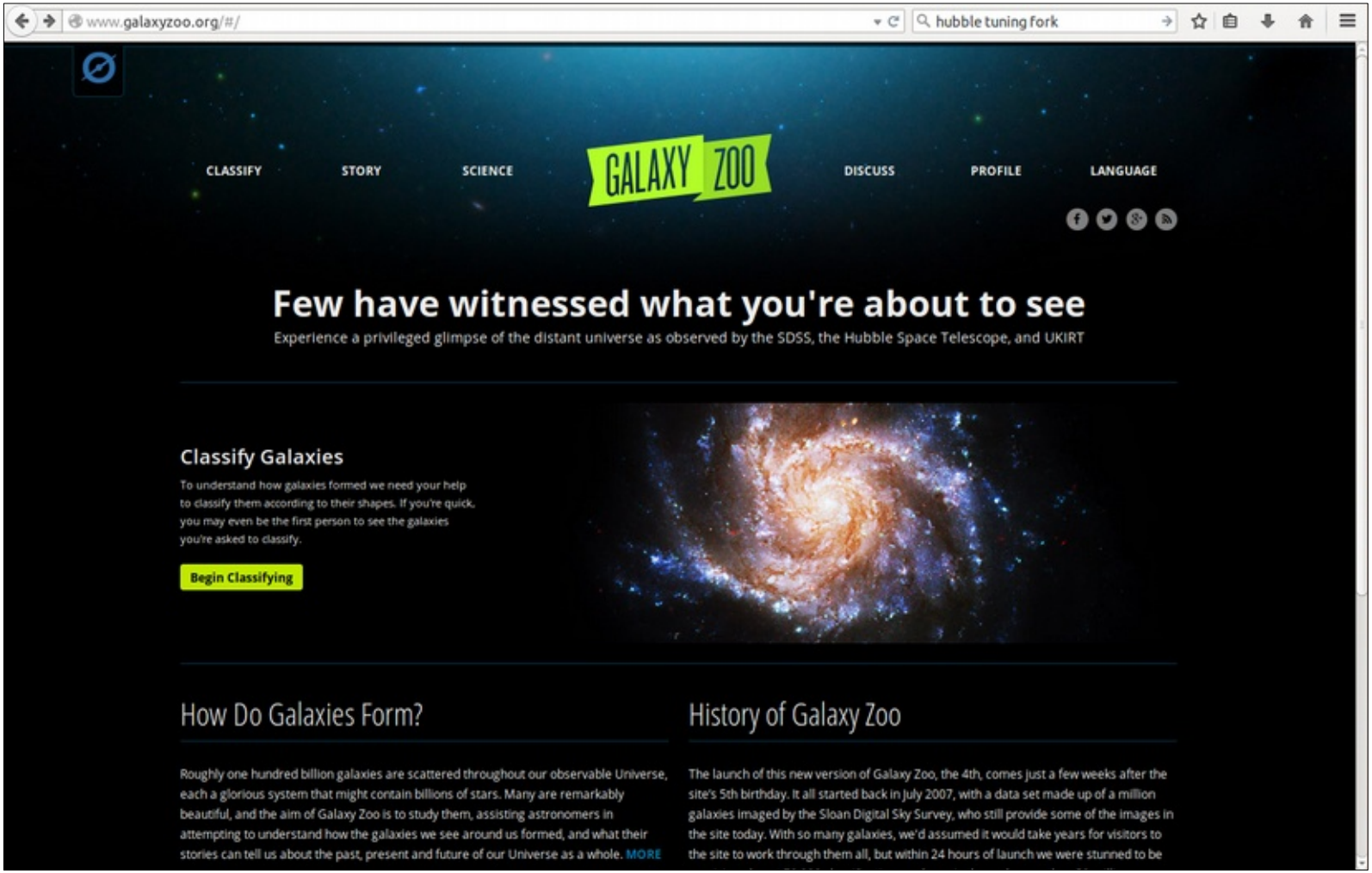
200.000 stellar spectra

- “Pickering’s Computers” → Annie Jump Cannon

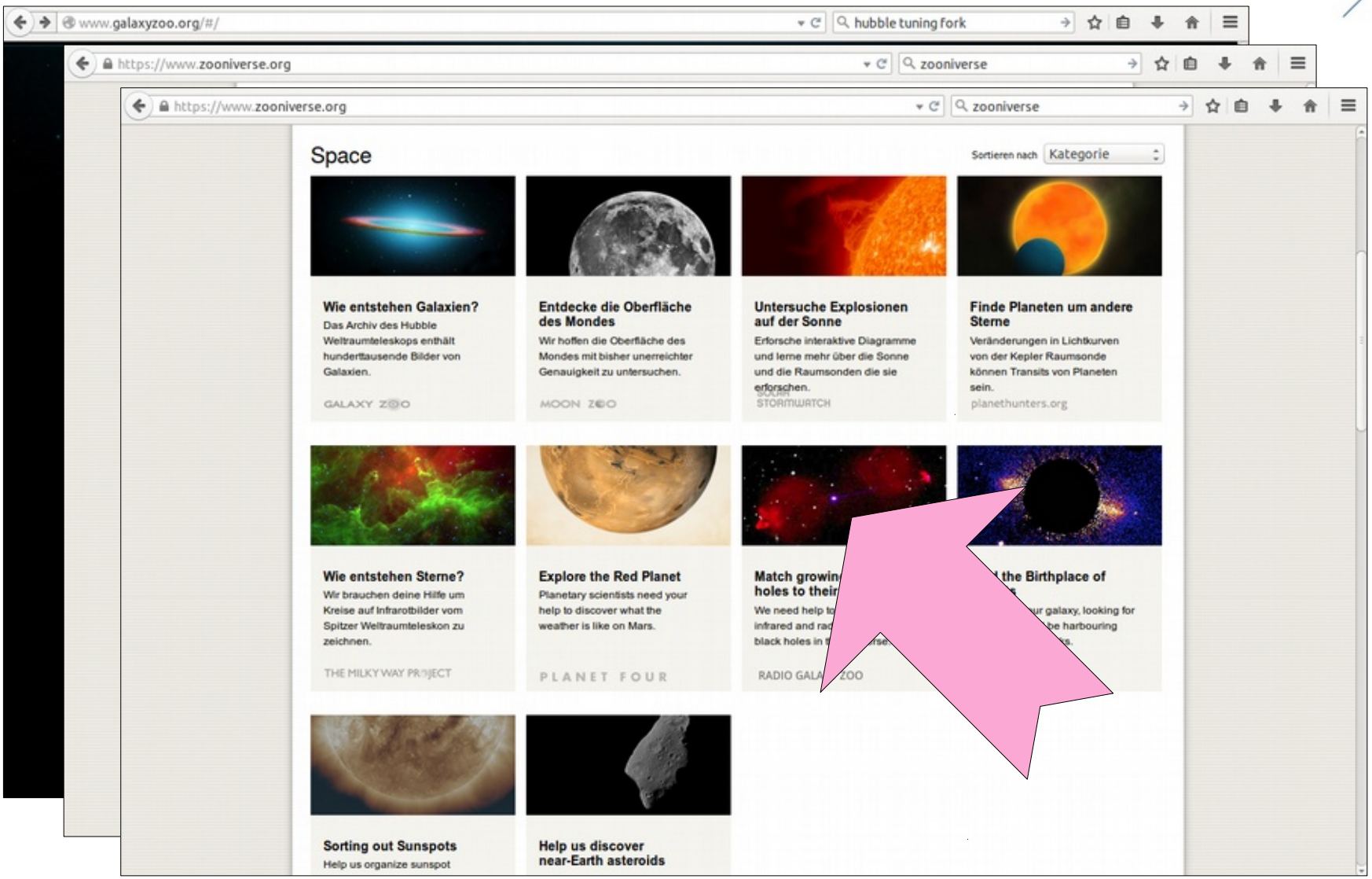
50.000.000 images of galaxies

- Galaxy Zoo

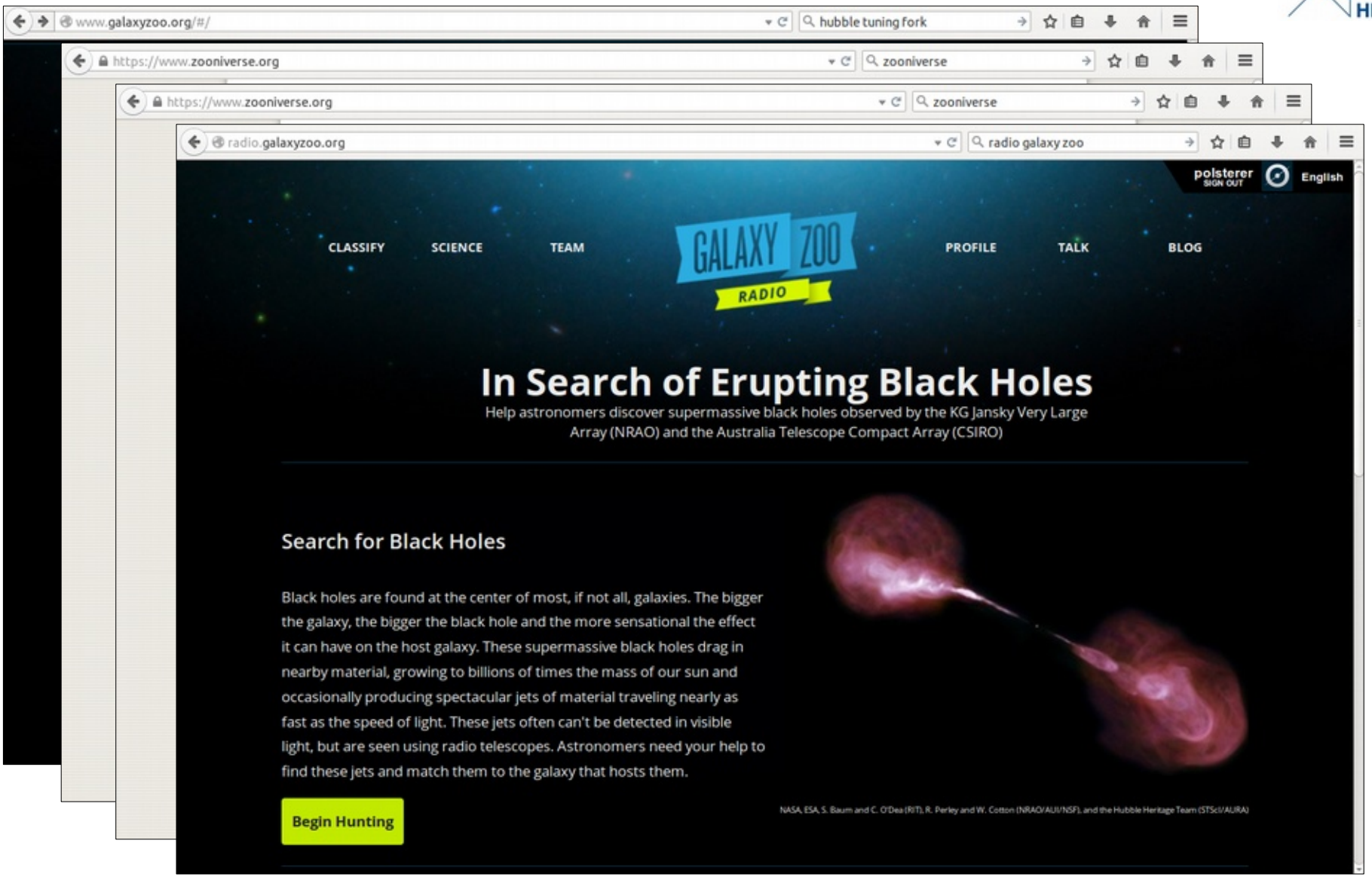
Manual Visual Inspection



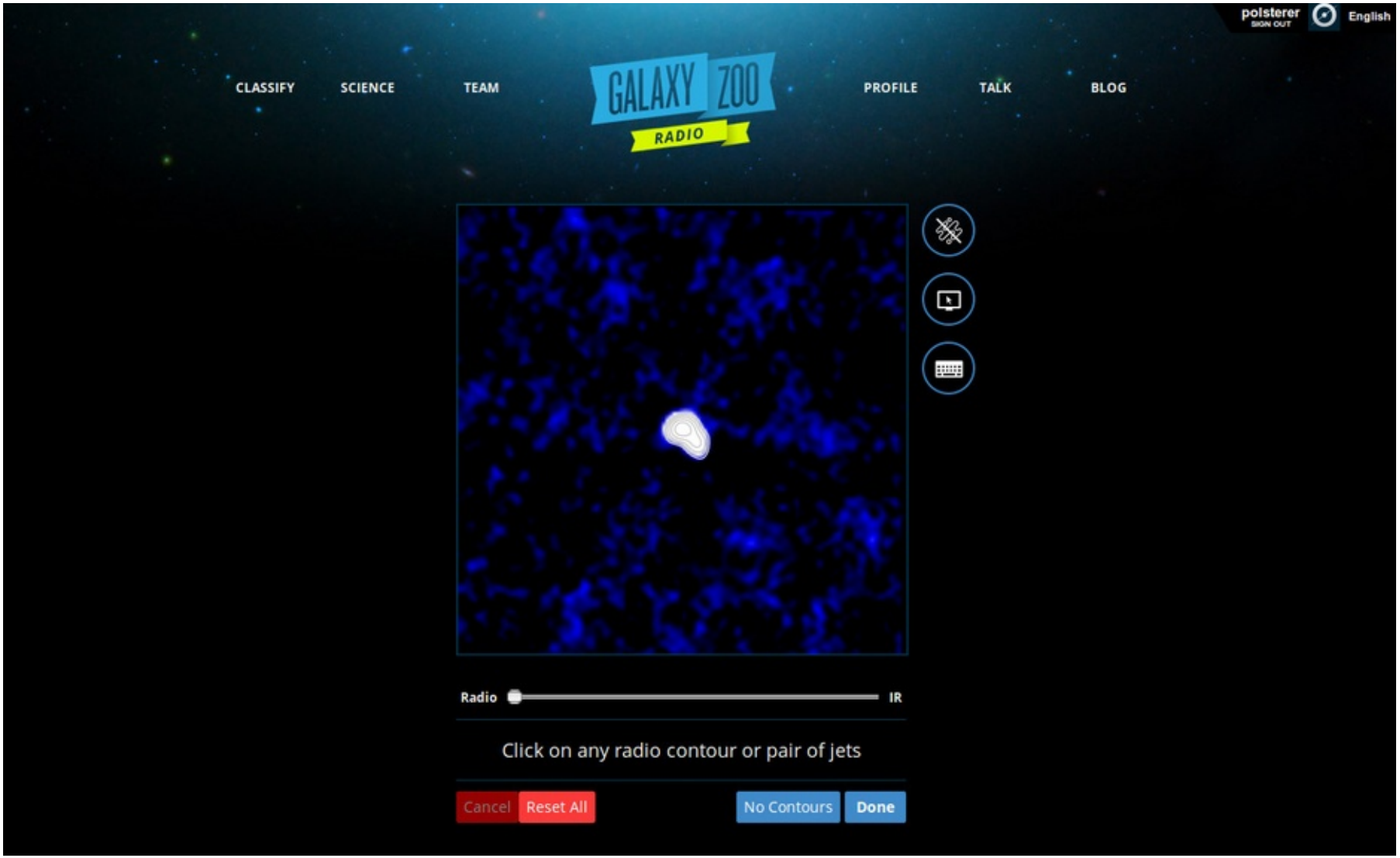
Manual Visual Inspection



Manual Visual Inspection

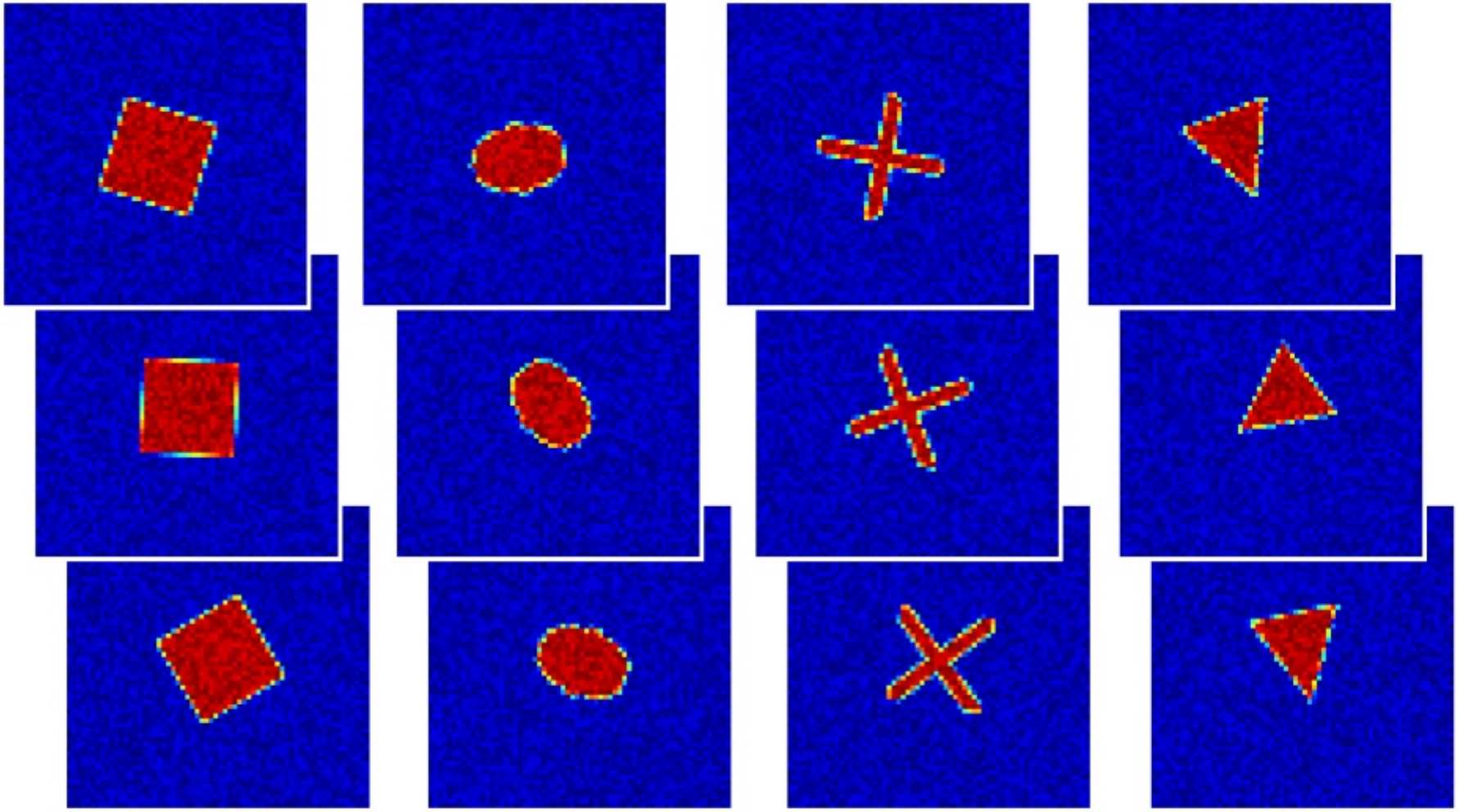


Radio Galaxy Zoo

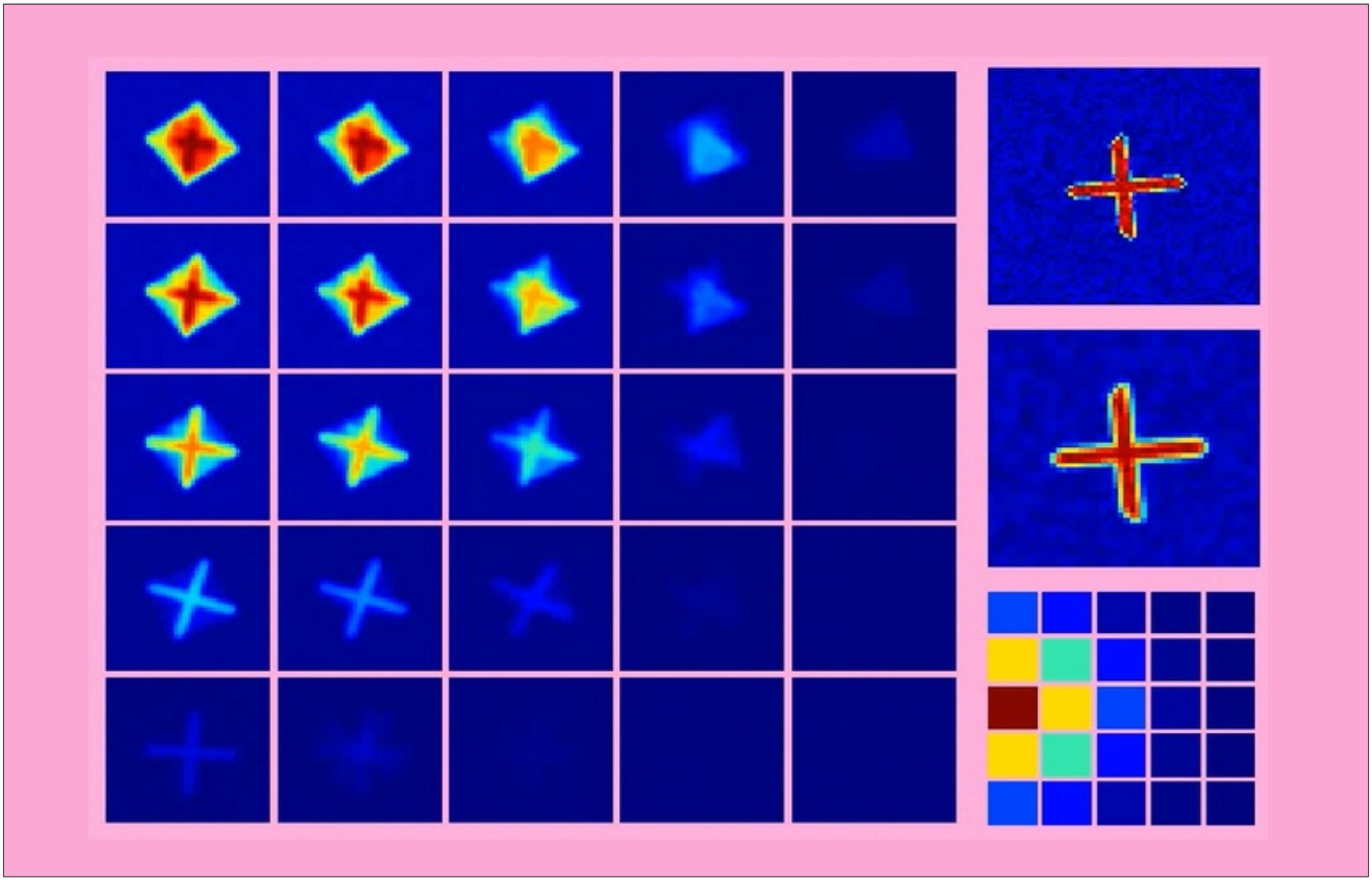


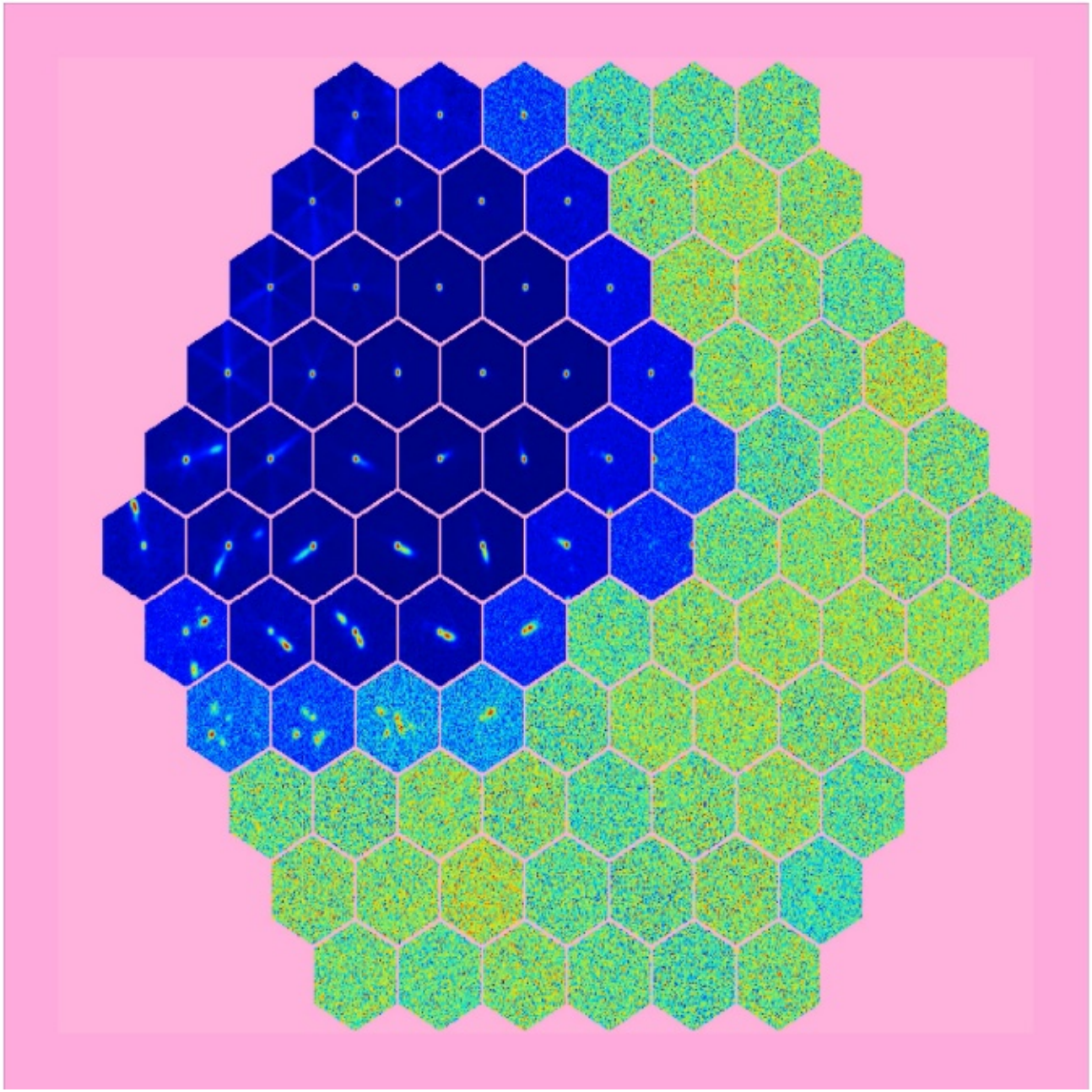
Human Pattern Recognition

Dimensionality Reduction



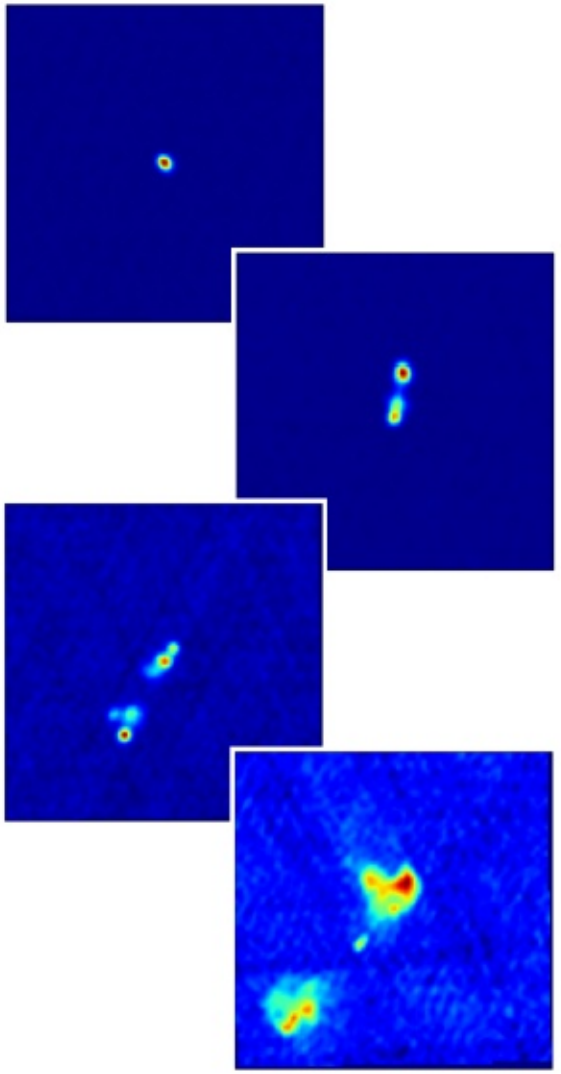
Self-organizing Maps / Kohonen Maps



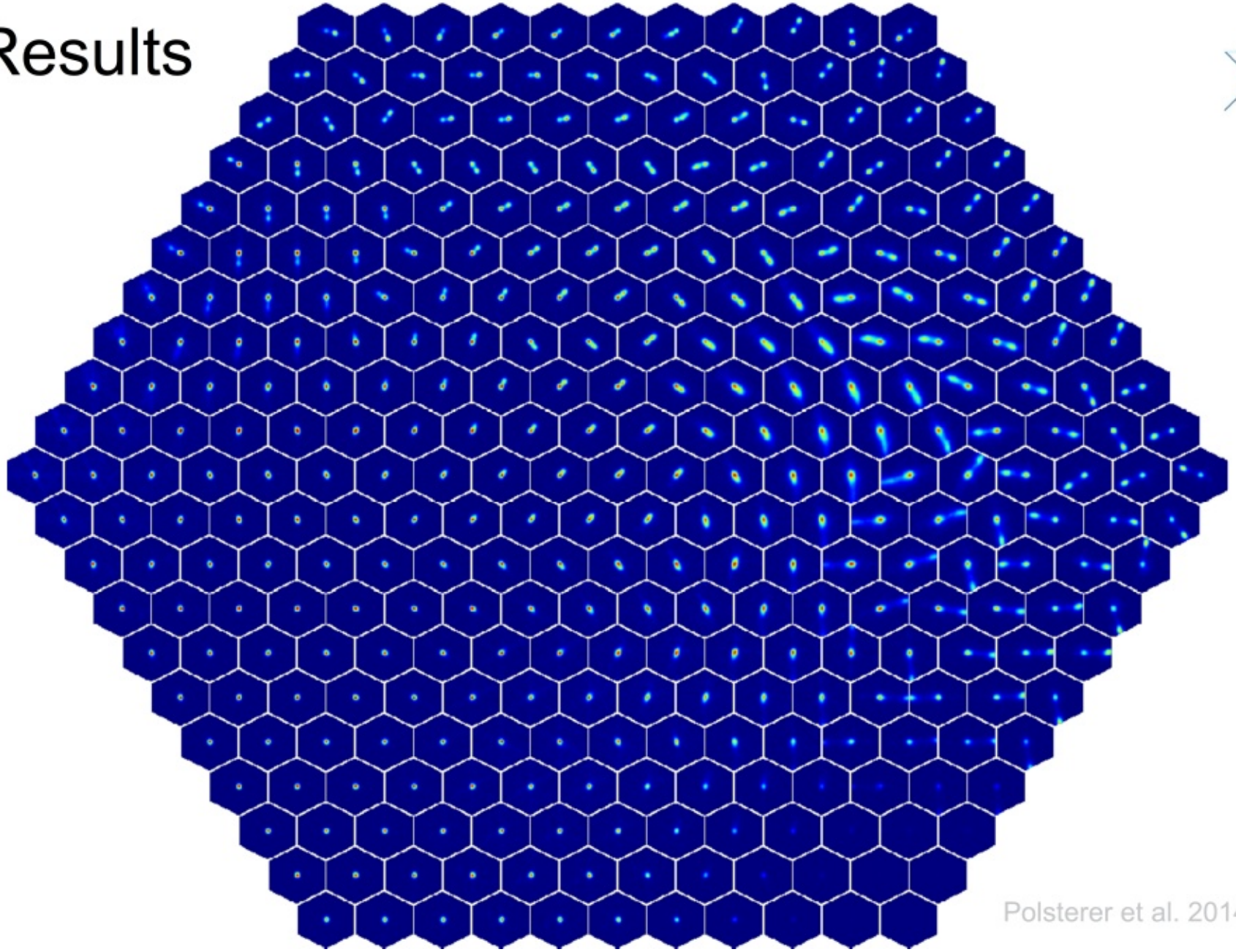


PINK

HITS

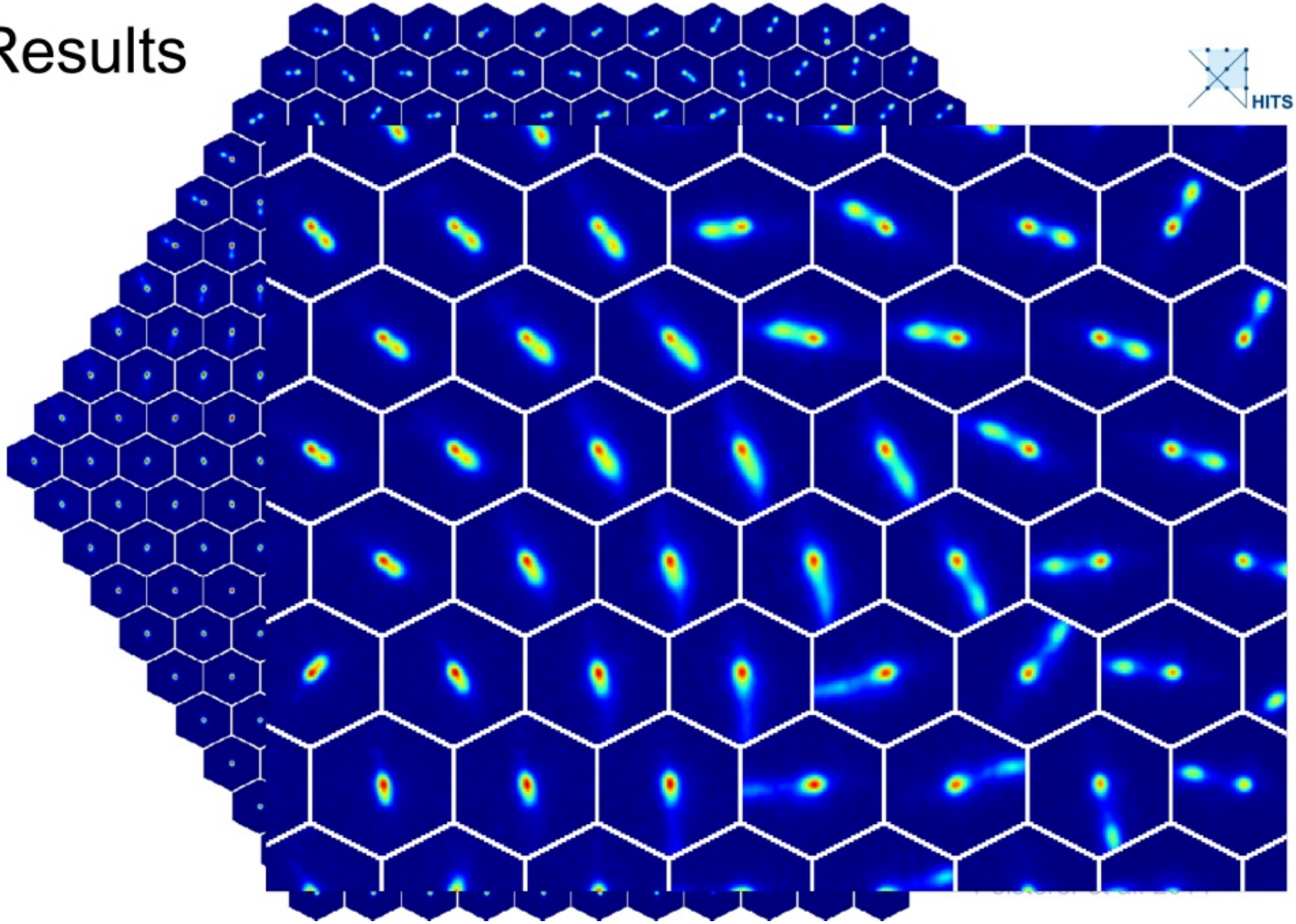


Results

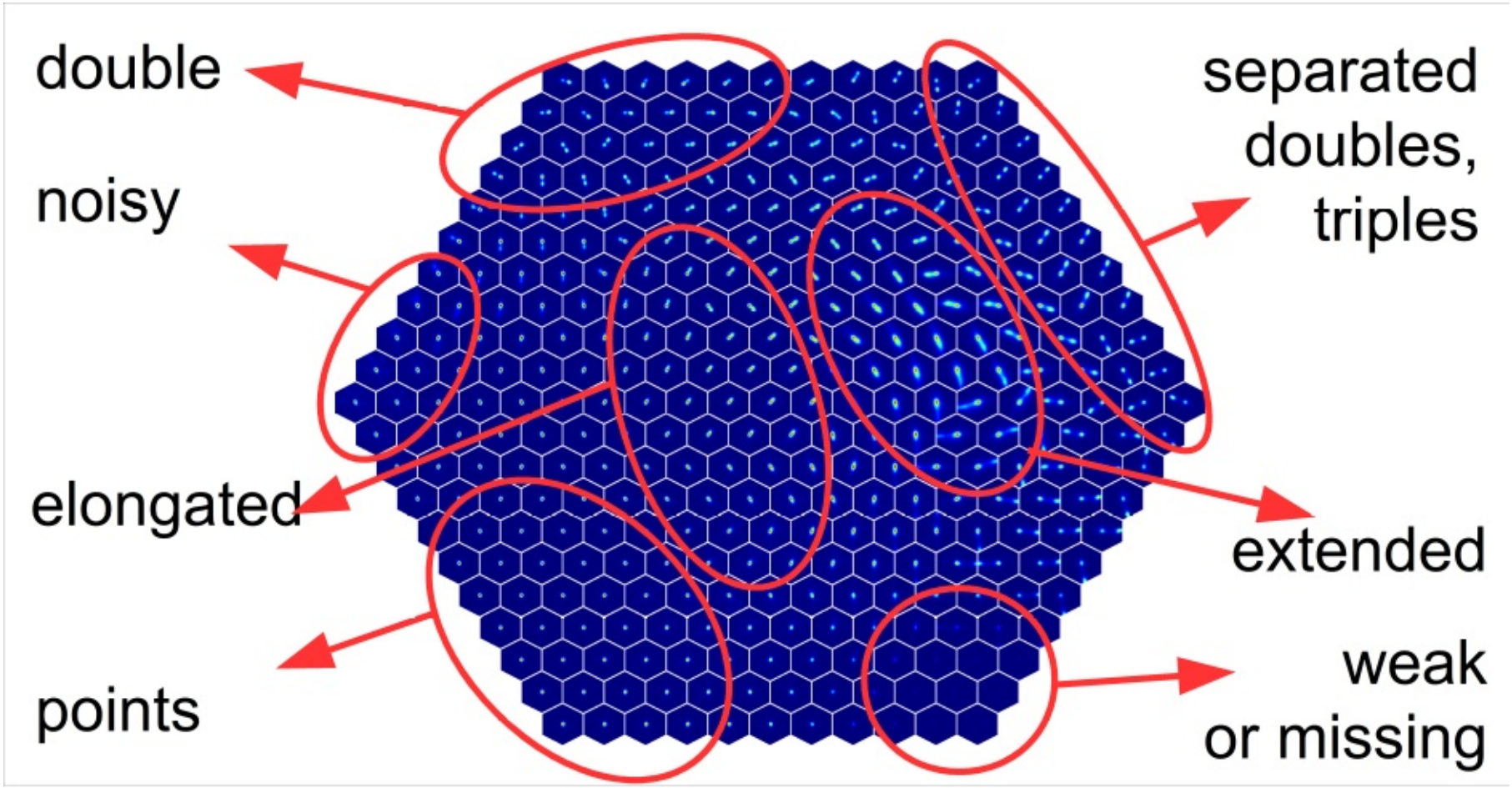


Polsterer et al. 2014

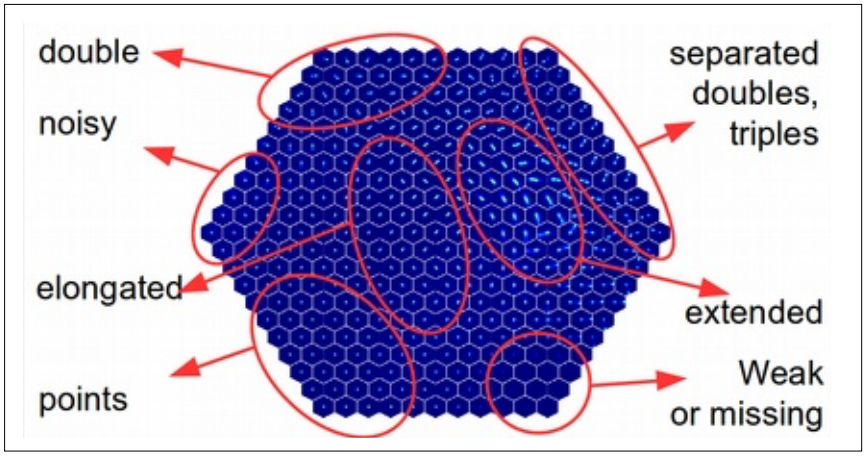
Results

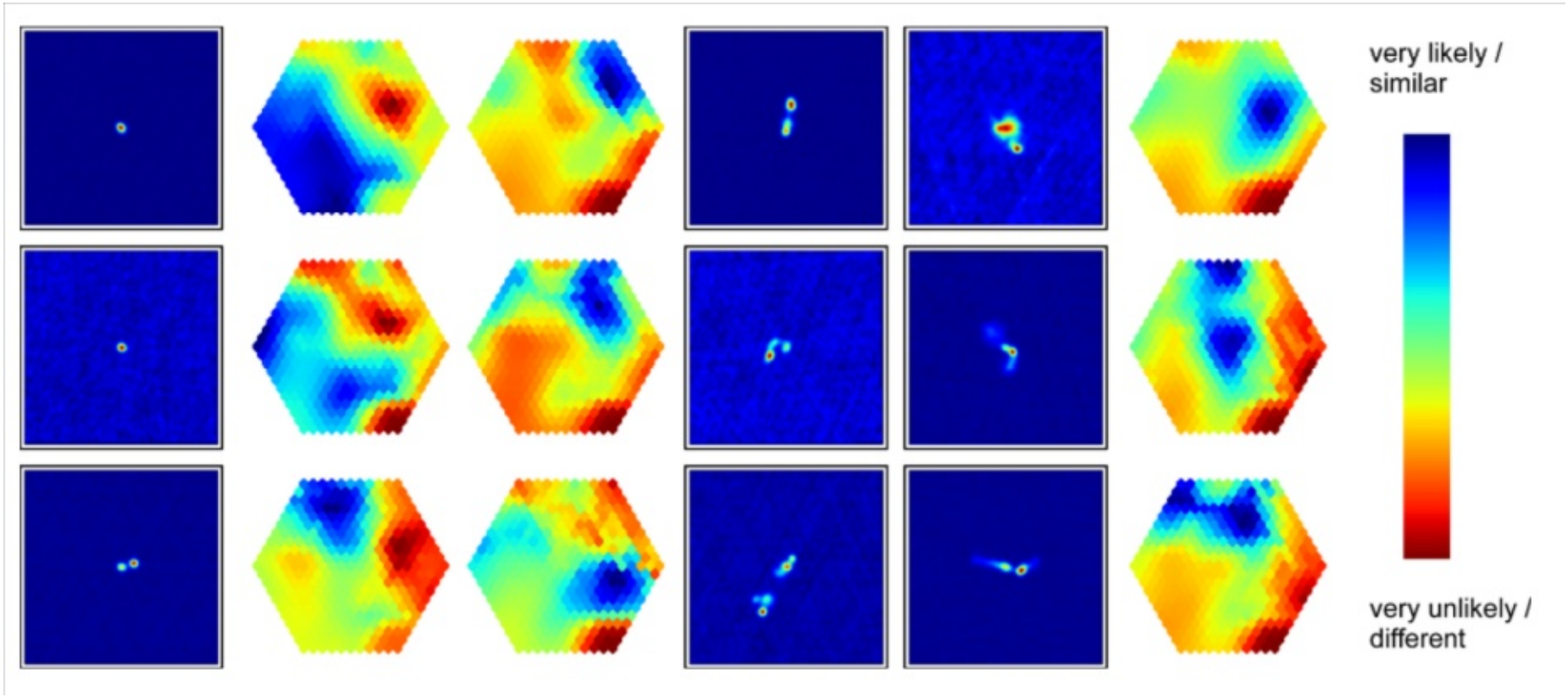


Results / Analysis / Annotation



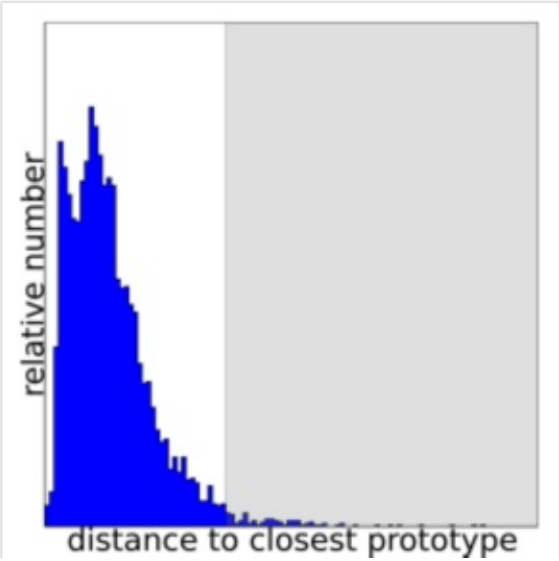
Transfer

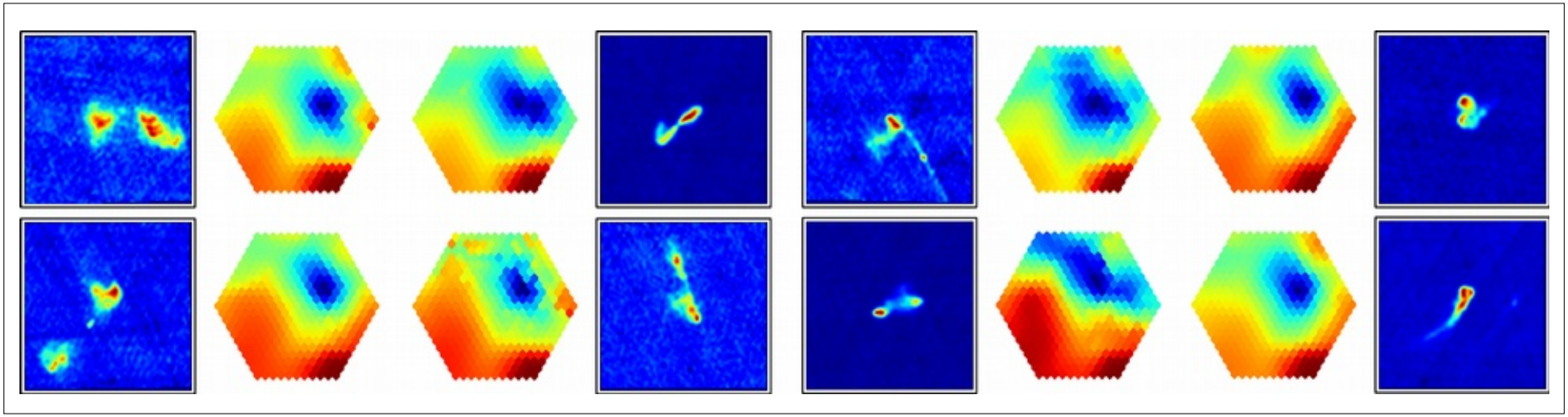

double
noisy
elongated
points
separated
doubles,
triples
extended
Weak
or missing


very likely /
similar
very unlikely /
different

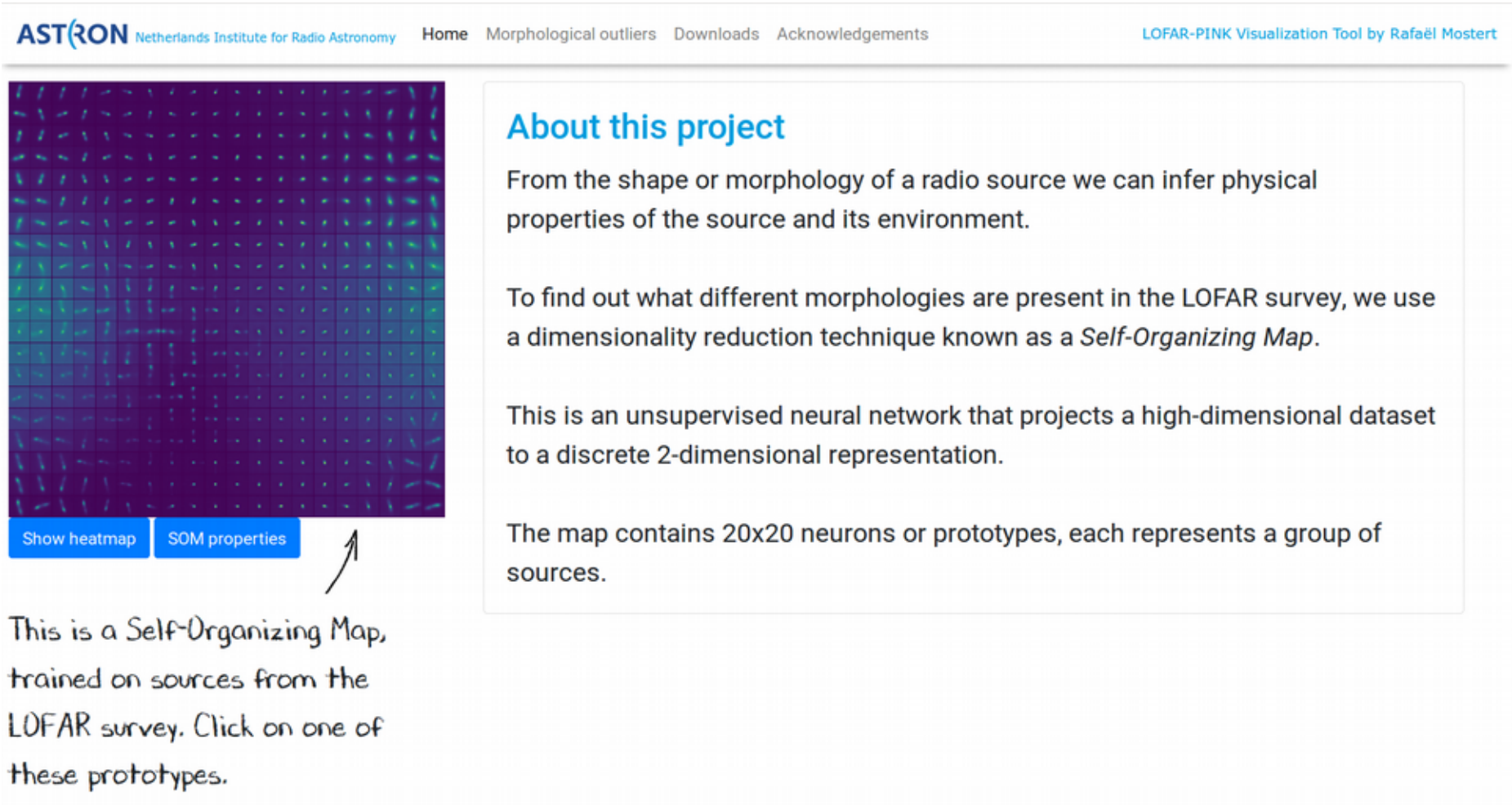
Rare Objects

find outliers based on similarity measures





Demo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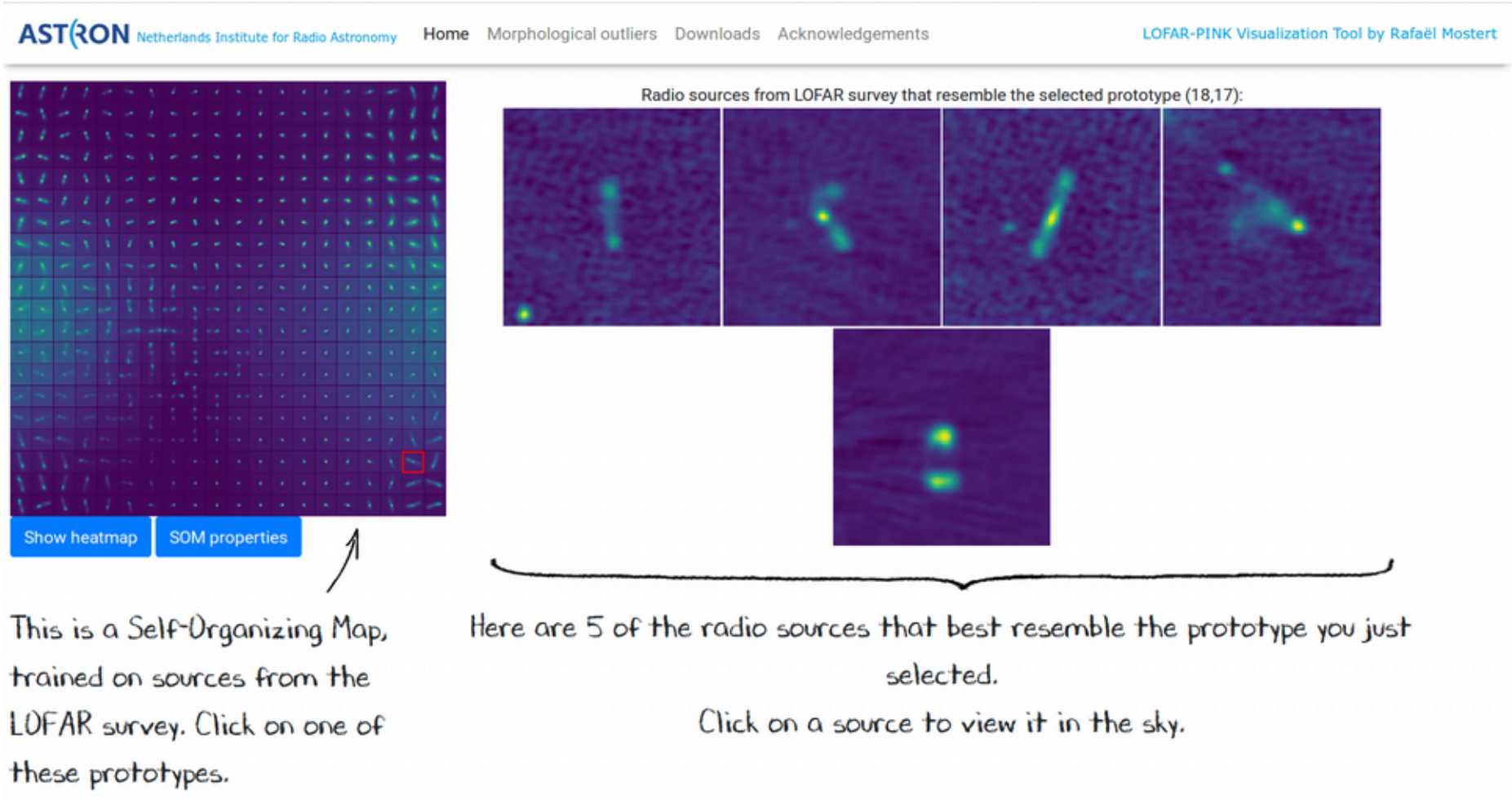
Acknowledgements
LOFAR-PINK Visualization Tool by Rafaël Mostert
Show heatmap
SOM properties
About this project
From the shape or morphology of a radio source we can infer physical properties of the source and its environment.
To find out what different morphologies are present in the LOFAR survey, we use a dimensionality reduction technique known as a Self-Organizing Map.
This is an unsupervised neural network that projects a high-dimensional dataset to a discrete 2-dimensional representation.
The map contains 20x20 neurons or prototypes, each represents a group of sources.
This is a Self-Organizing Map, trained on sources from the LOFAR survey. Click on one of these prototypes.

Demo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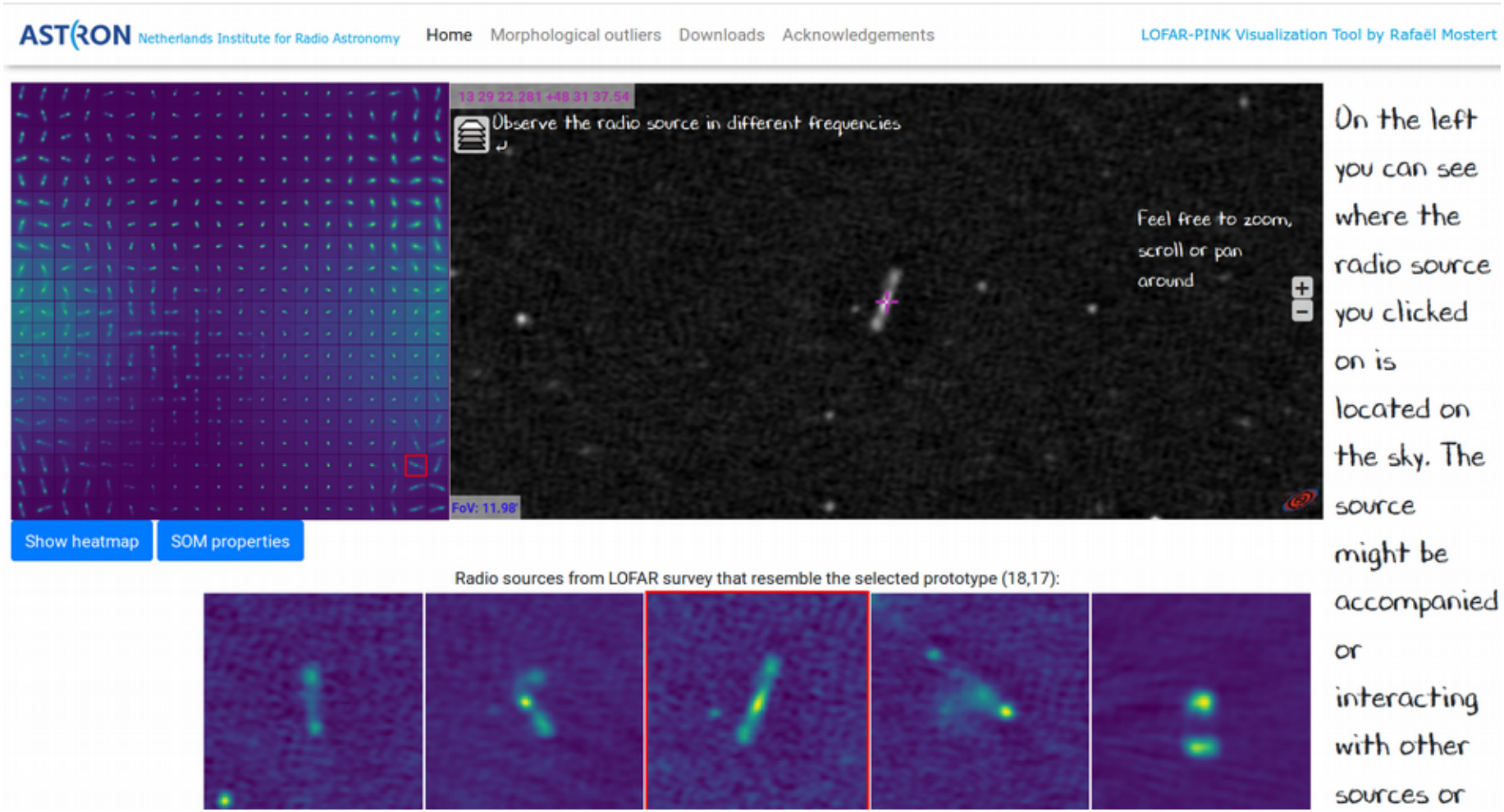
LOFAR-PINK Visualization Tool by Rafaël Mostert
Radio sources from LOFAR survey that resemble the selected prototype (18,17):
Show heatmap
SOM properties
This is a Self-Organizing Map, trained on sources from the LOFAR survey. Click on one of these prototypes.
Here are 5 of the radio sources that best resemble the prototype you just selected.
Click on a source to view it in the sky.

Demo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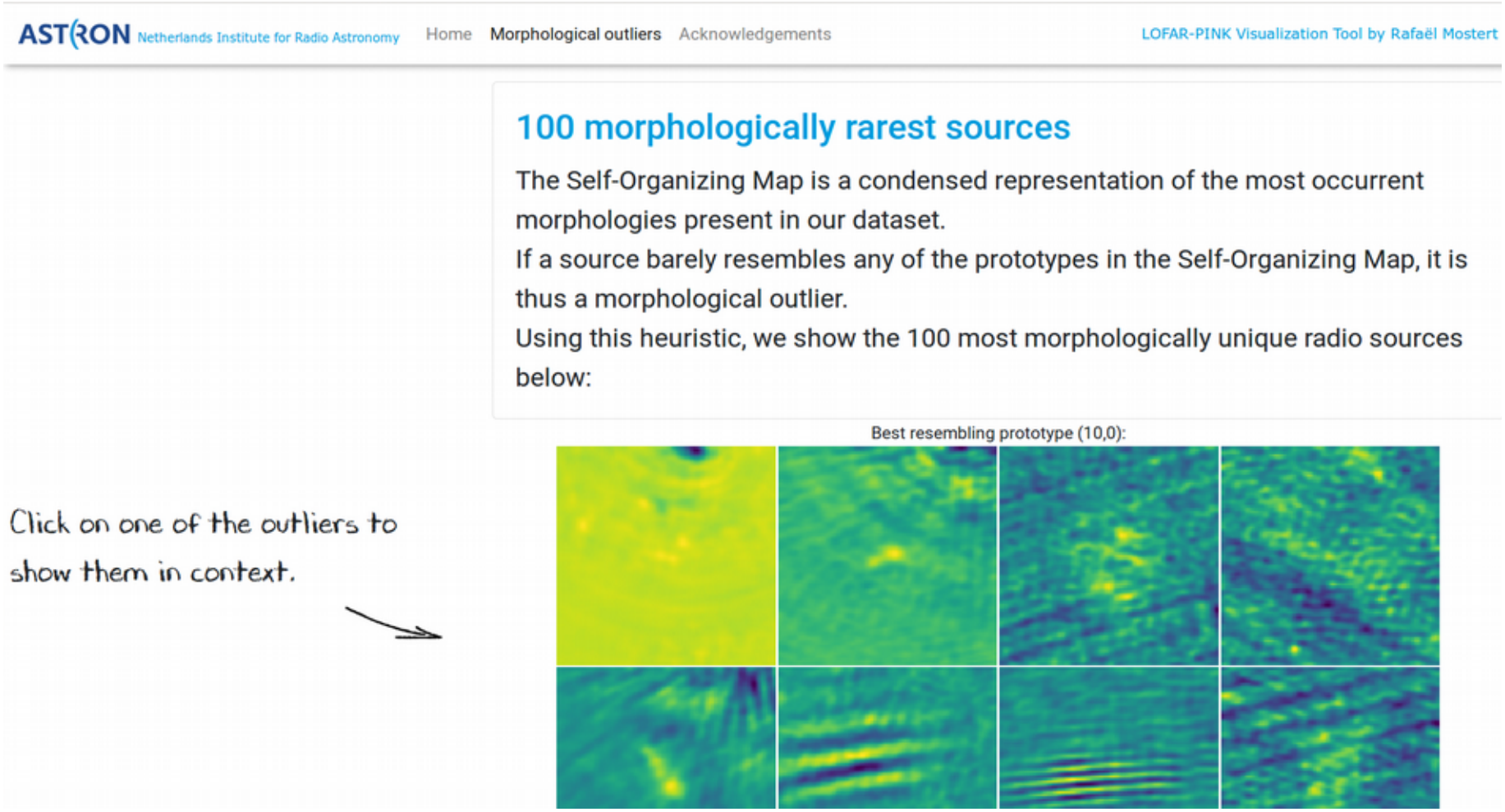
13 29 22.281 +48 31 37.54
Observe the radio source in different frequencies
Feel free to zoom, scroll or pan around
FoV: 11.98'
Show heatmap
SOM properties
Radio sources from LOFAR survey that resemble the selected prototype (18,17):
On the left you can see where the radio source you clicked on is located on the sky. The source might be accompanied or interacting with other sources or

Demo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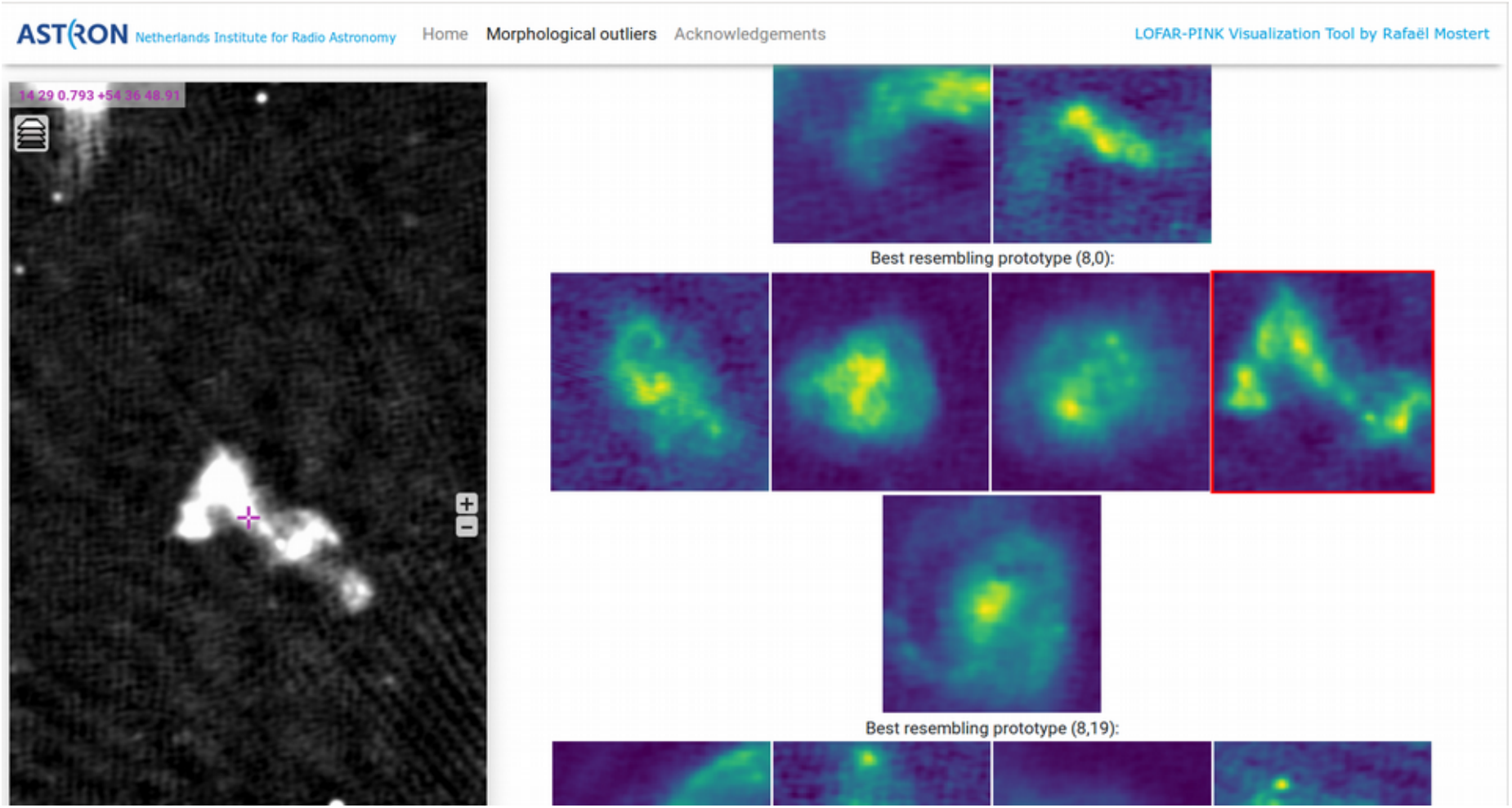
100 morphologically rarest sources
The Self-Organizing Map is a condensed representation of the most occurrent morphologies present in our dataset.
If a source barely resembles any of the prototypes in the Self-Organizing Map, it is thus a morphological outlier.
Using this heuristic, we show the 100 most morphologically unique radio sources below:
Best resembling prototype (10,0):
Click on one of the outliers to show them in context.

Demo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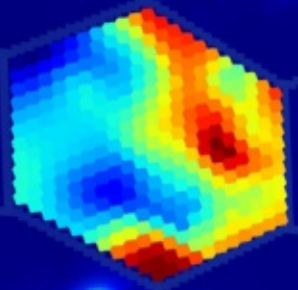
14 29 0.793 +54 36 48.91
Best resembling prototype (8,0):
Best resembling prototype (8,19):

Open Questions

- How to store annotations?
- How to describe projections?
- How to transfer/preserve/publish annotations?
- What about semantics?



Thanks for your attention!

AiN

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