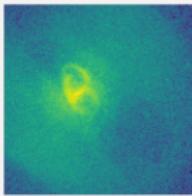


# Cavity Detection Tool (CADET)

Input image



**Block 1**  
 $32, 32, 16, 8, 4, 2, 1 \rightarrow 32$

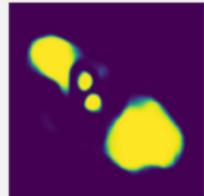
**Block 2**  
 $32, 32, 16, 8, 4, 2, 1 \rightarrow 64$

**Block 3**  
 $32, 32, 16, 8, 4, 2, 1 \rightarrow 64$

**Block 4**  
 $32, 32, 16, 8, 4, 2, 1 \rightarrow 32$

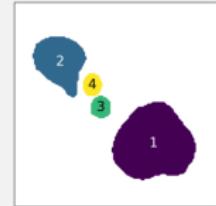
**Final block**  
 $8, 4, 2 \rightarrow 1$

Pixel-wise  
detection



DBSCAN

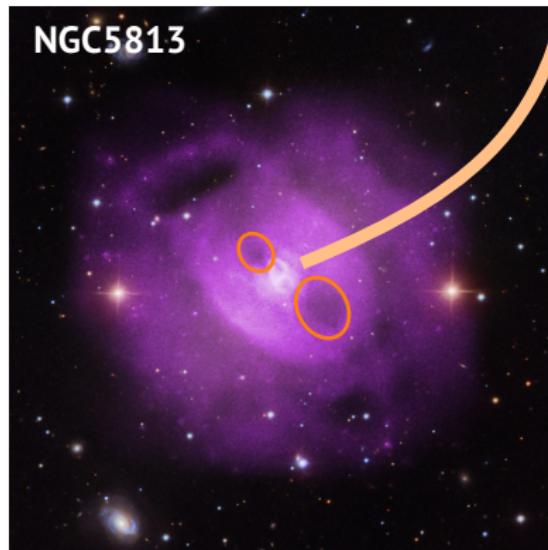
Cavity prediction



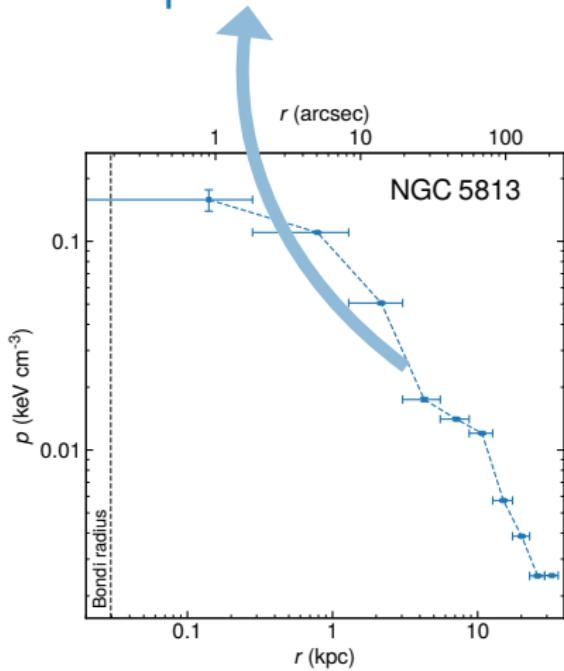
# X-ray cavities



$$\text{Energy} \propto \text{Volume} \times \text{pressure}$$



Credit: Randall et al. 2015



Credit: Plšek et al. 2022

# X-ray cavities

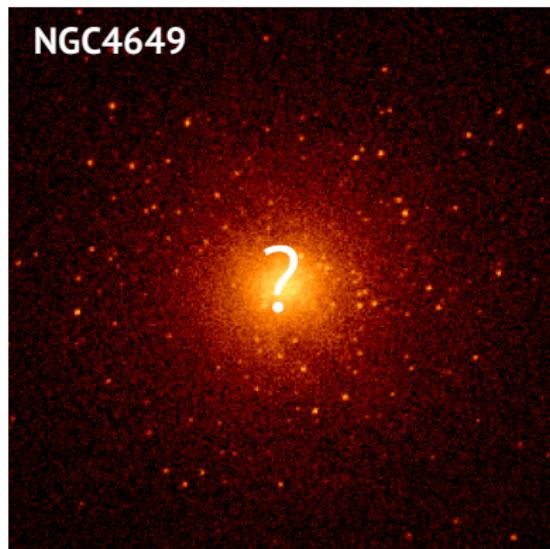
---



$$\text{Energy} \propto \text{Volume} \times \text{pressure}$$



NGC5813



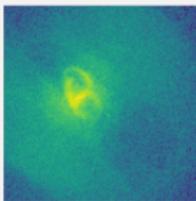
NGC4649

Credit: Randall et al. 2015

# Cavity Detection Tool (CADET)



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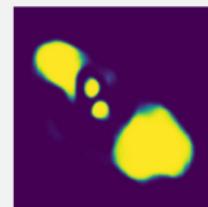
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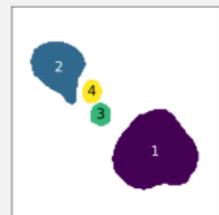
**Final block**  
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Pixel-wise  
detection



DBSCAN

Cavity prediction

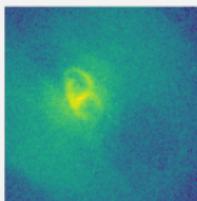


- convolutional neural network  
+ DBSCAN clustering

# Cavity Detection Tool (CADET)



Input image



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32, 32, 16, 8, 4, 2, 1 → 32

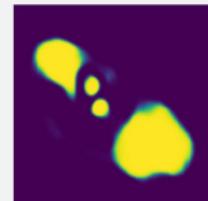
**Block 2**  
32, 32, 16, 8, 4, 2, 1 → 64

**Block 3**  
32, 32, 16, 8, 4, 2, 1 → 64

**Block 4**  
32, 32, 16, 8, 4, 2, 1 → 32

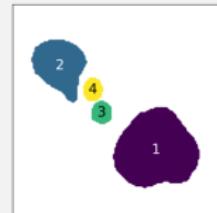
**Final block**  
8, 4, 2 → 1

Pixel-wise  
detection

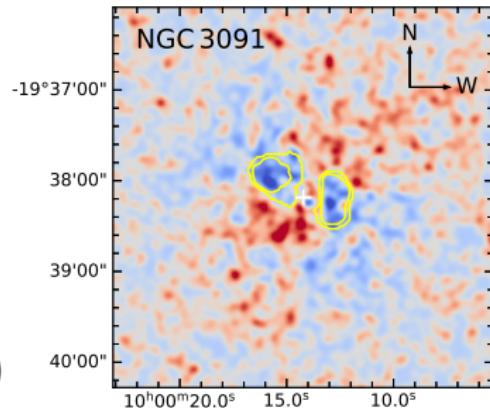


DBSCAN

Cavity prediction



- convolutional neural network  
+ DBSCAN clustering
- 93 of 97 known X-ray cavities  
- abs. volume error  $23^{+18}_{-11}\%$
- 7 new X-ray cavities (+ 8 candidates)



# How to use CADET?

---



- raw Keras model

```
from tensorflow.keras.models import load_model  
  
model = load_model("CADET.hdf5")  
  
y_pred = model.predict(X)
```

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- web interface (HuggingFace Spaces)

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- DS9 plugin (installed with pycadet)