

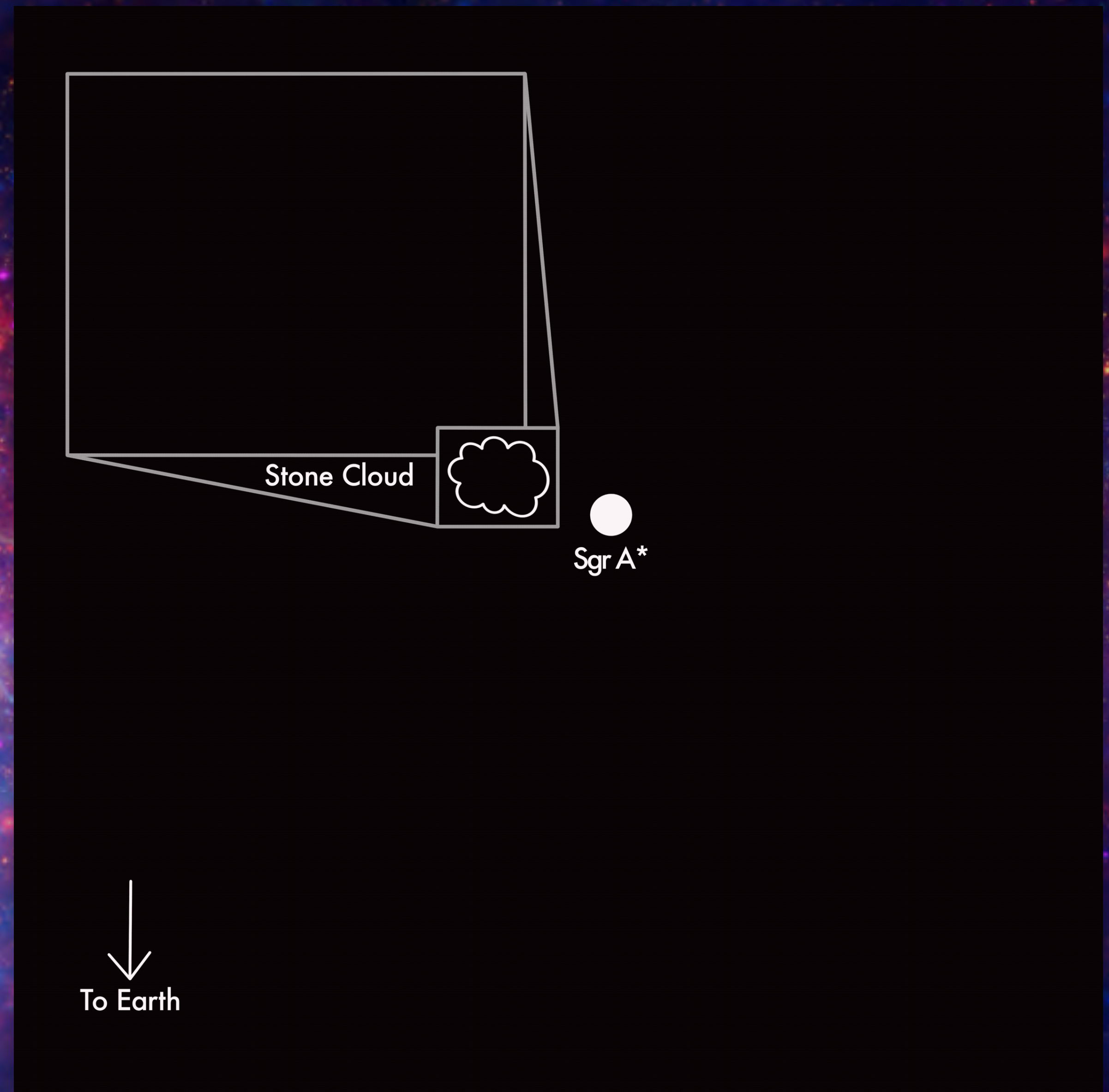
# X-ray echoes from Sgr A\* provide insight on the 3D structure of molecular clouds in the Galactic center

Danya Alboslani<sup>1</sup>, Cara Battersby<sup>1</sup>, Samantha Brunner<sup>1</sup>, Maïca Clavel<sup>2</sup>, Daniel Walker<sup>3</sup>, & Dani Lipman<sup>1</sup>

<sup>1</sup>-University of Connecticut, <sup>2</sup>-Université Grenoble Alpes, <sup>3</sup>-ALMA Regional Centre Node, The University of Manchester

Contact: [danya.alboslani@uconn.edu](mailto:danya.alboslani@uconn.edu) or [cara.battersby@uconn.edu](mailto:cara.battersby@uconn.edu)

# X-ray echoes from Sgr A\* provide insight on the 3D structure of molecular clouds in the Galactic center



Danya Alboslani<sup>1</sup>, Cara Battersby<sup>1</sup>, Samantha Brunner<sup>1</sup>, Maïca Clavel<sup>2</sup>, Daniel Walker<sup>3</sup>, & Dani Lipman<sup>1</sup>

<sup>1</sup>-University of Connecticut, <sup>2</sup>-Université Grenoble Alpes, <sup>3</sup>-ALMA Regional Centre Node, The University of Manchester

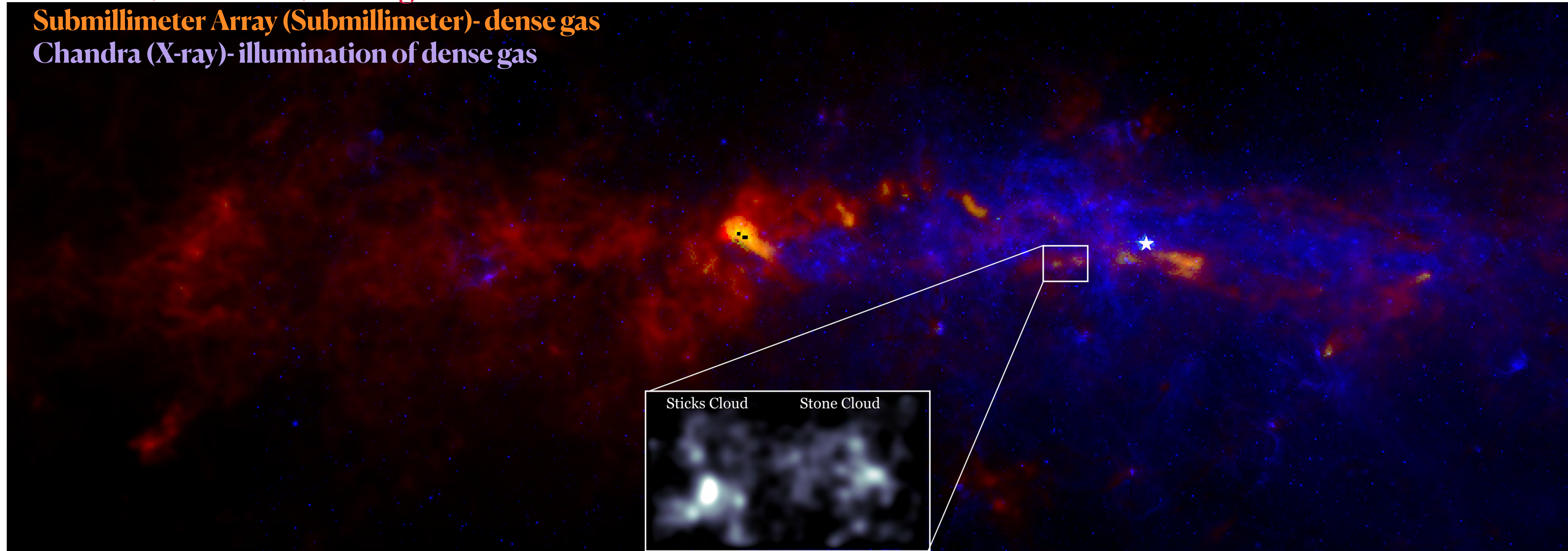
Contact: [danya.alboslani@uconn.edu](mailto:danya.alboslani@uconn.edu) or [cara.battersby@uconn.edu](mailto:cara.battersby@uconn.edu)

**Spitzer (Infrared)- warm gas & dust**

**Herschel (Far-Infrared)- dense gas**

**Submillimeter Array (Submillimeter)- dense gas**

**Chandra (X-ray)- illumination of dense gas**

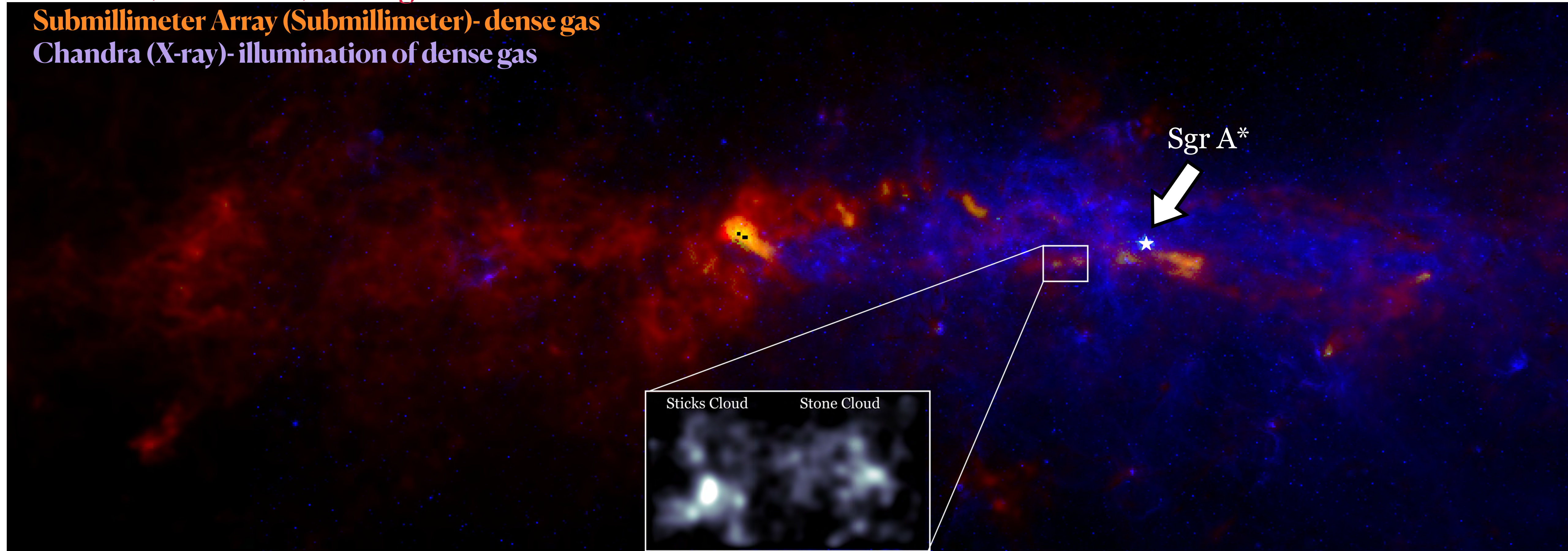


**Spitzer (Infrared)- warm gas & dust**

**Herschel (Far-Infrared)- dense gas**

**Submillimeter Array (Submillimeter)- dense gas**

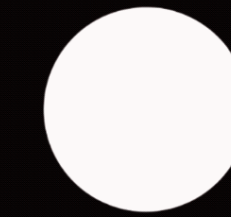
**Chandra (X-ray)- illumination of dense gas**



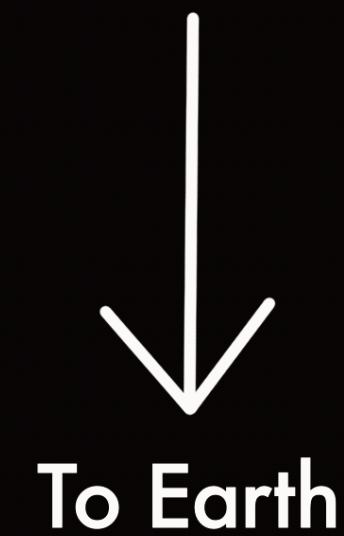
# 3D geometry of X-ray echoes

Sgr A\* → Cloud → Observer

Molecular Cloud



Sgr A\*



To Earth

Image credit: Dr. Samantha Brunker

# 3D geometry of X-ray echoes

Sgr A\* → Cloud → Observer  
Cross-sectional slice illuminated

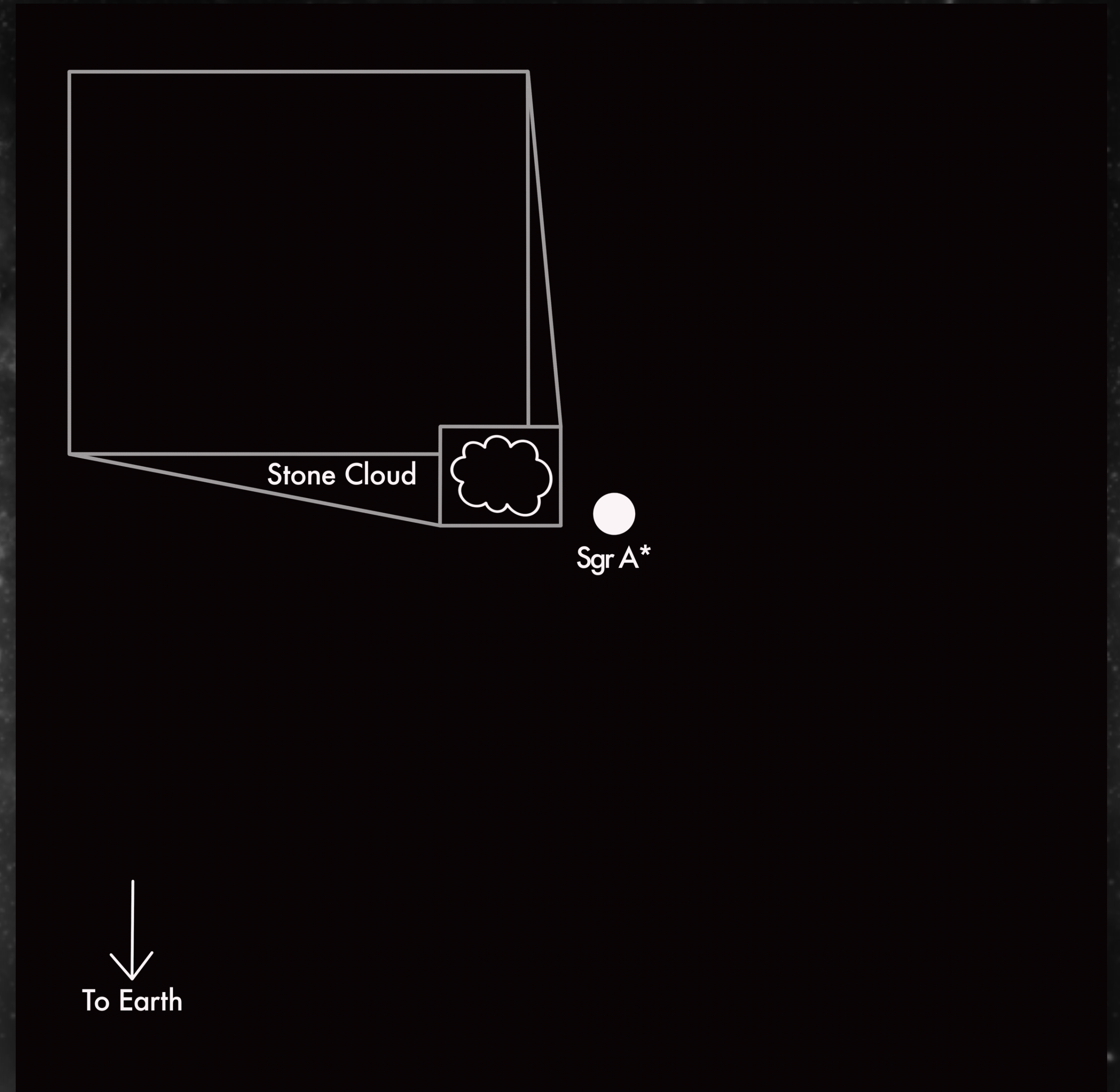
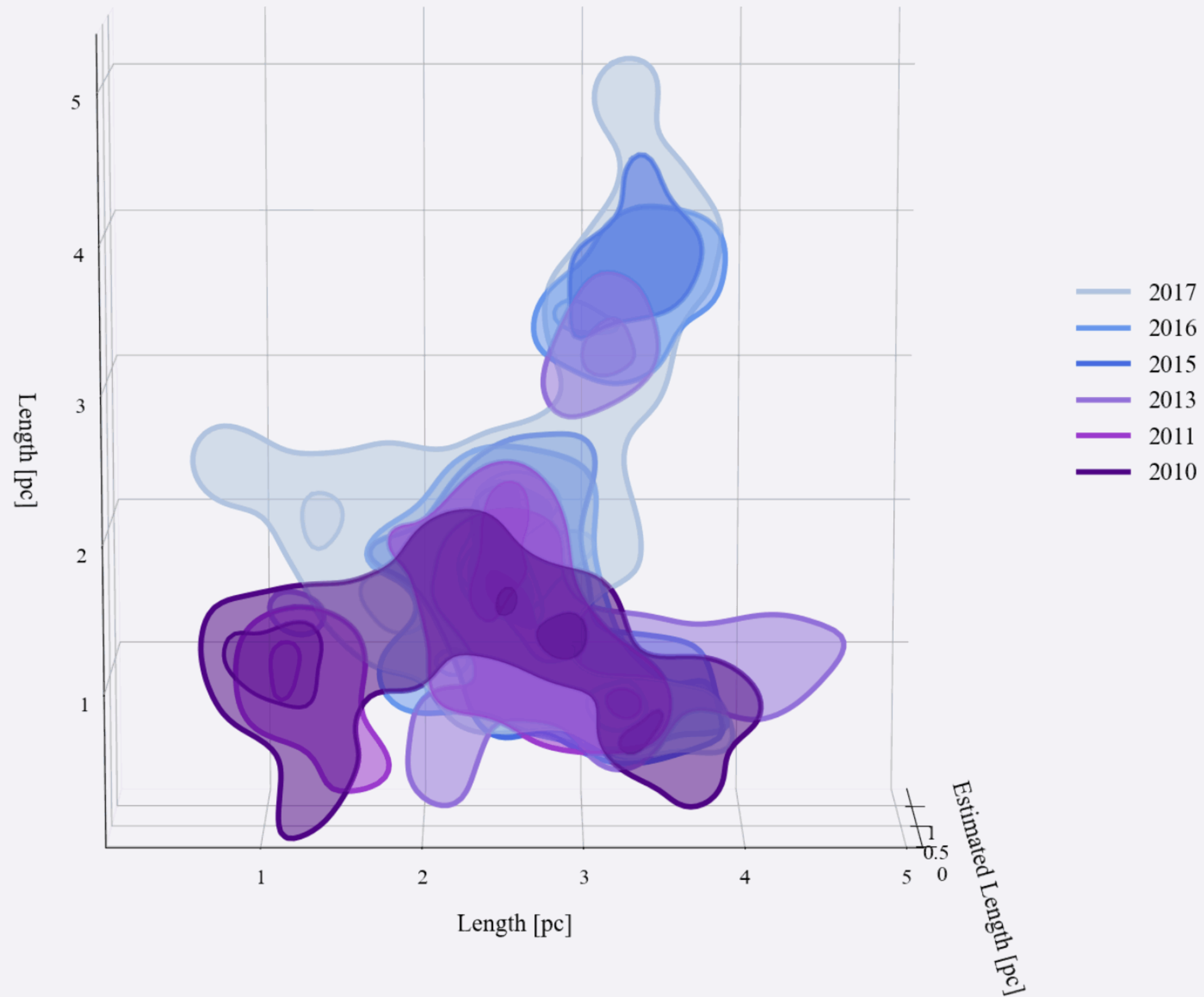


Image credit: Dr. Samantha Brunker

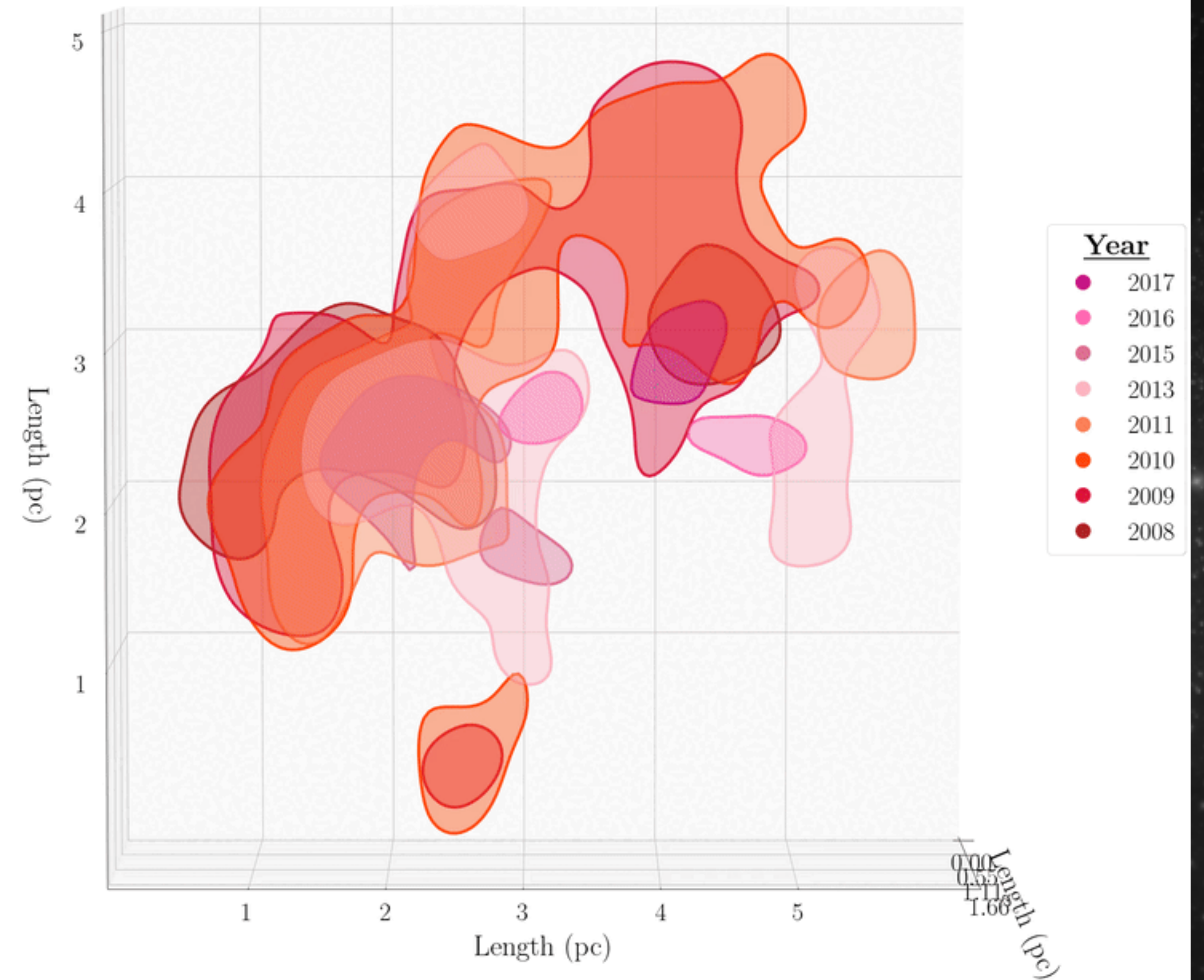
# 3D geometry of X-ray echoes

## Sticks Cloud



Brunker et al. submitted

## Stone Cloud

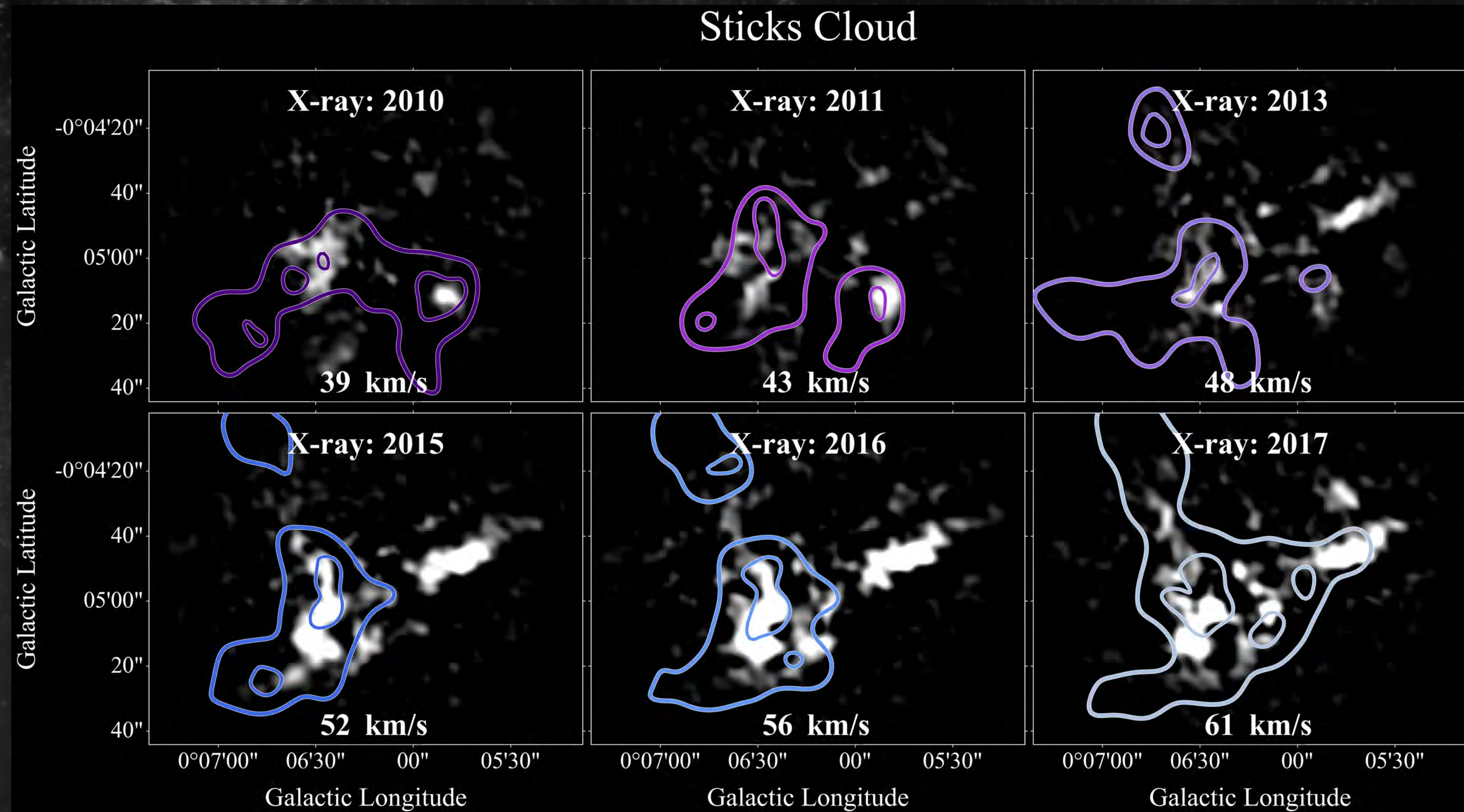


Alboslani et al. submitted

# X-ray structures correspond to molecular structures

Grayscale: molecular gas

Colors: X-ray echoes

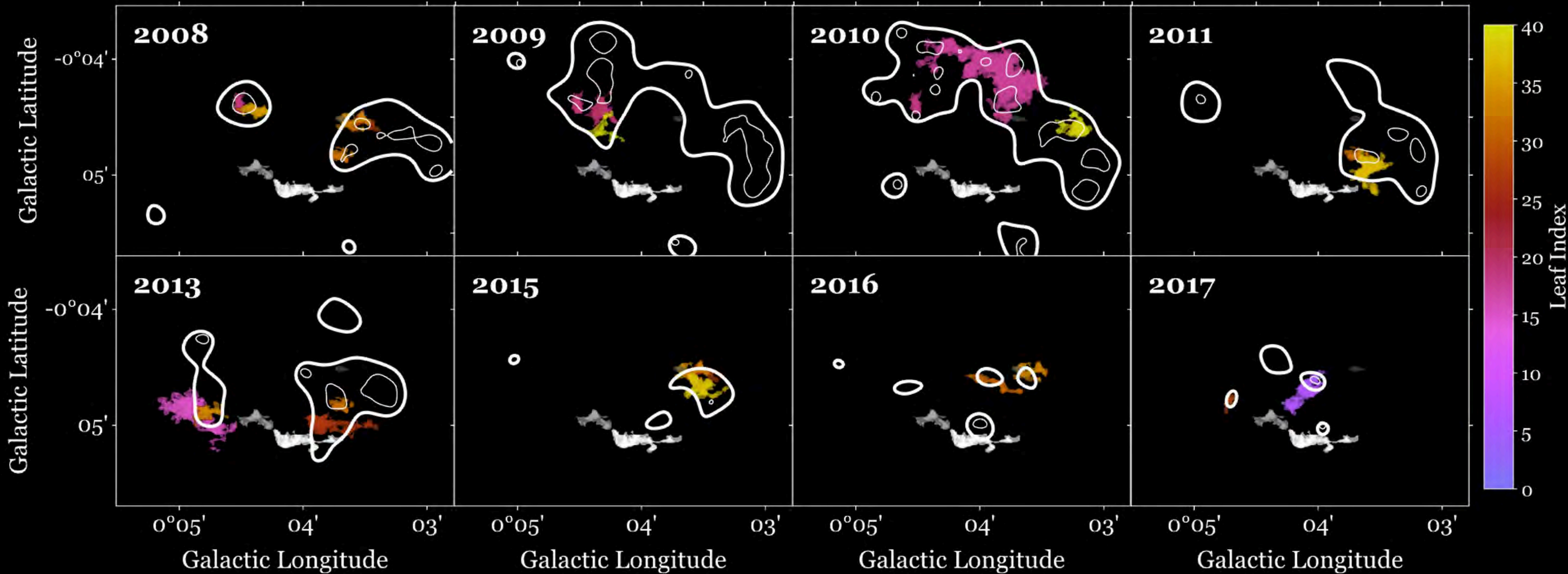


Brunker et al. submitted

# X-ray structures correspond to molecular structures

White: X-ray echoes

Colors: molecular gas



Alboslani et al. submitted

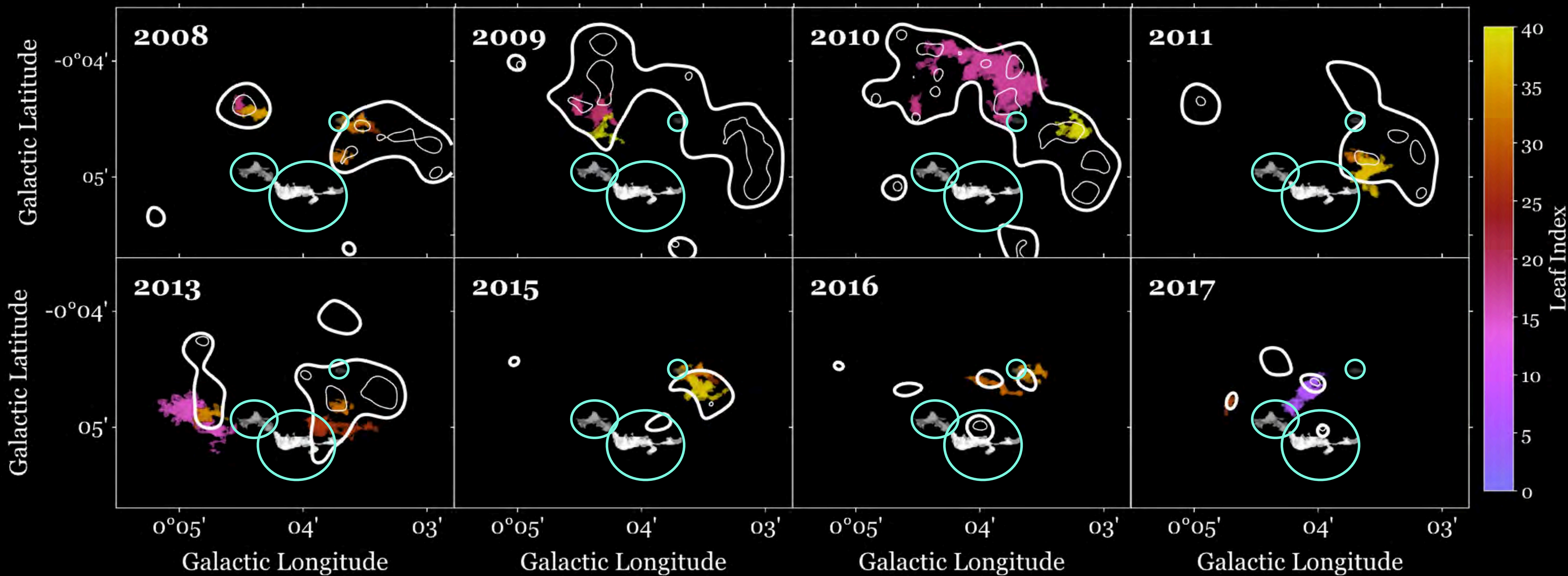
Contact: [danya.alboslani@uconn.edu](mailto:danya.alboslani@uconn.edu) or [cara.battersby@uconn.edu](mailto:cara.battersby@uconn.edu)

# X-ray structures correspond to molecular structures

White: X-ray echoes

Colors: molecular gas

Cyan: non matched structures



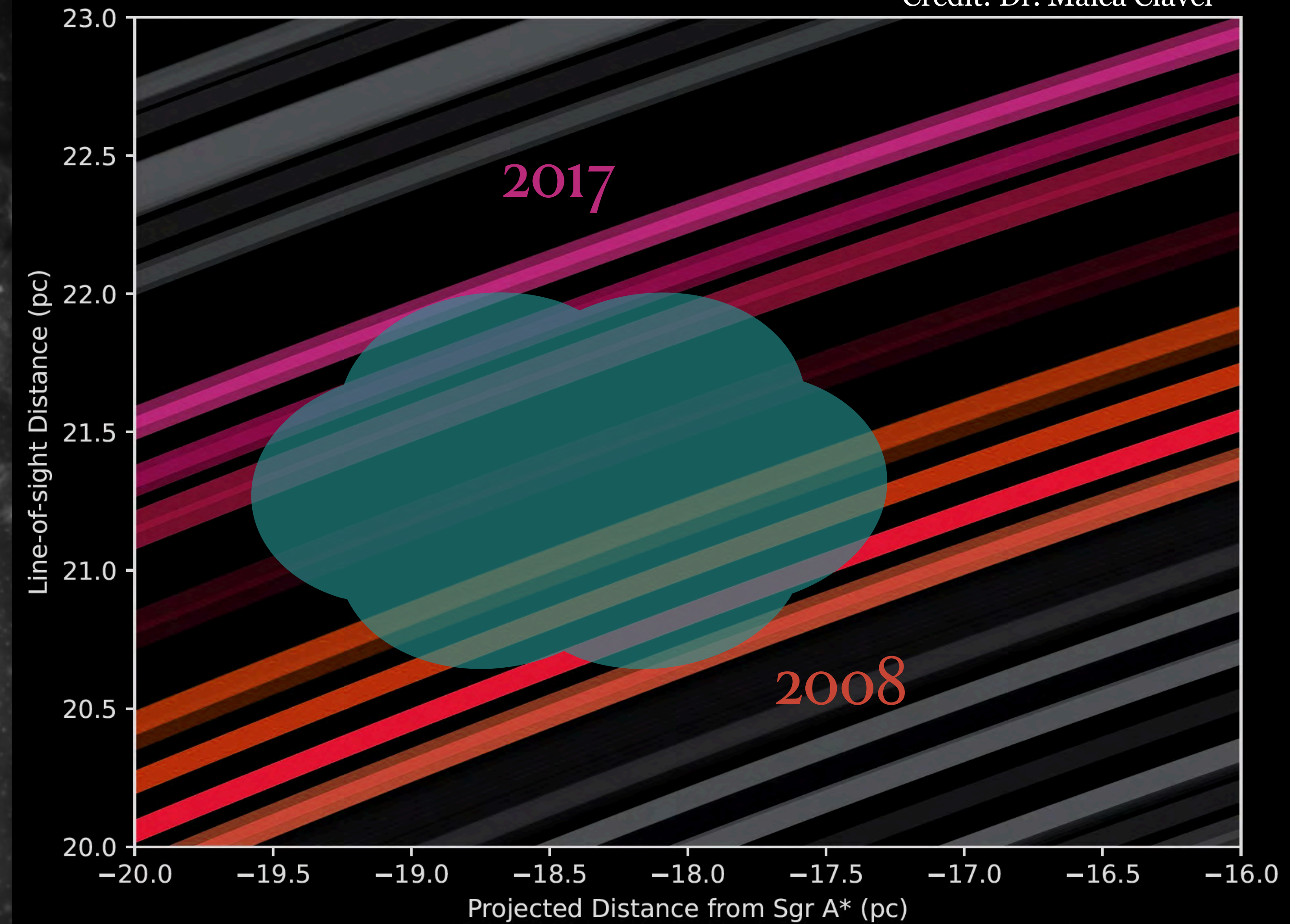
Alboslani et al. submitted

Contact: [danya.alboslani@uconn.edu](mailto:danya.alboslani@uconn.edu) or [cara.battersby@uconn.edu](mailto:cara.battersby@uconn.edu)

# Constraining the duration of X-ray flares

Credit: Dr. Maïca Clavel

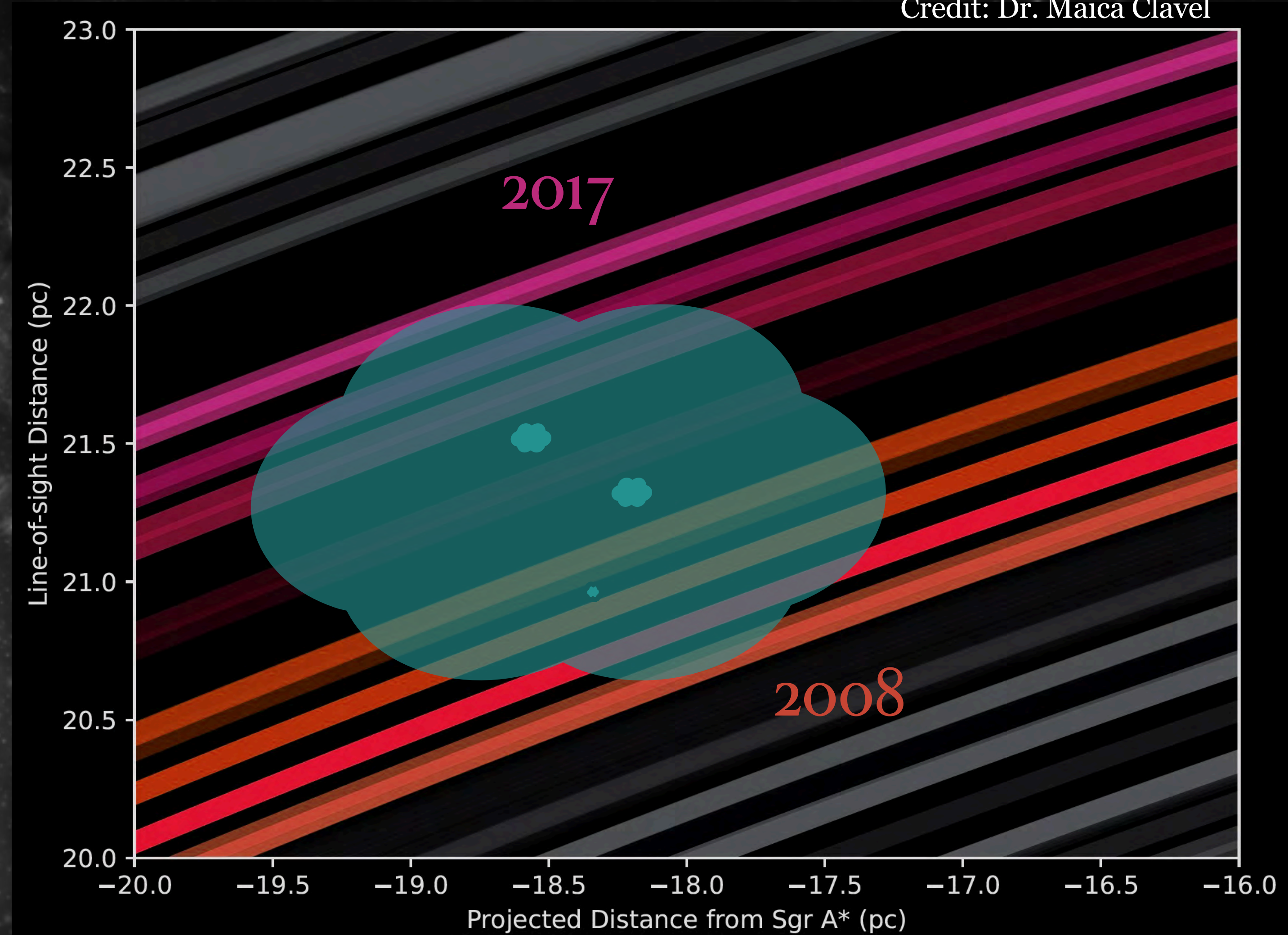
X-ray data is not continuous



# Constraining the duration of X-ray flares

Credit: Dr. Maïca Clavel

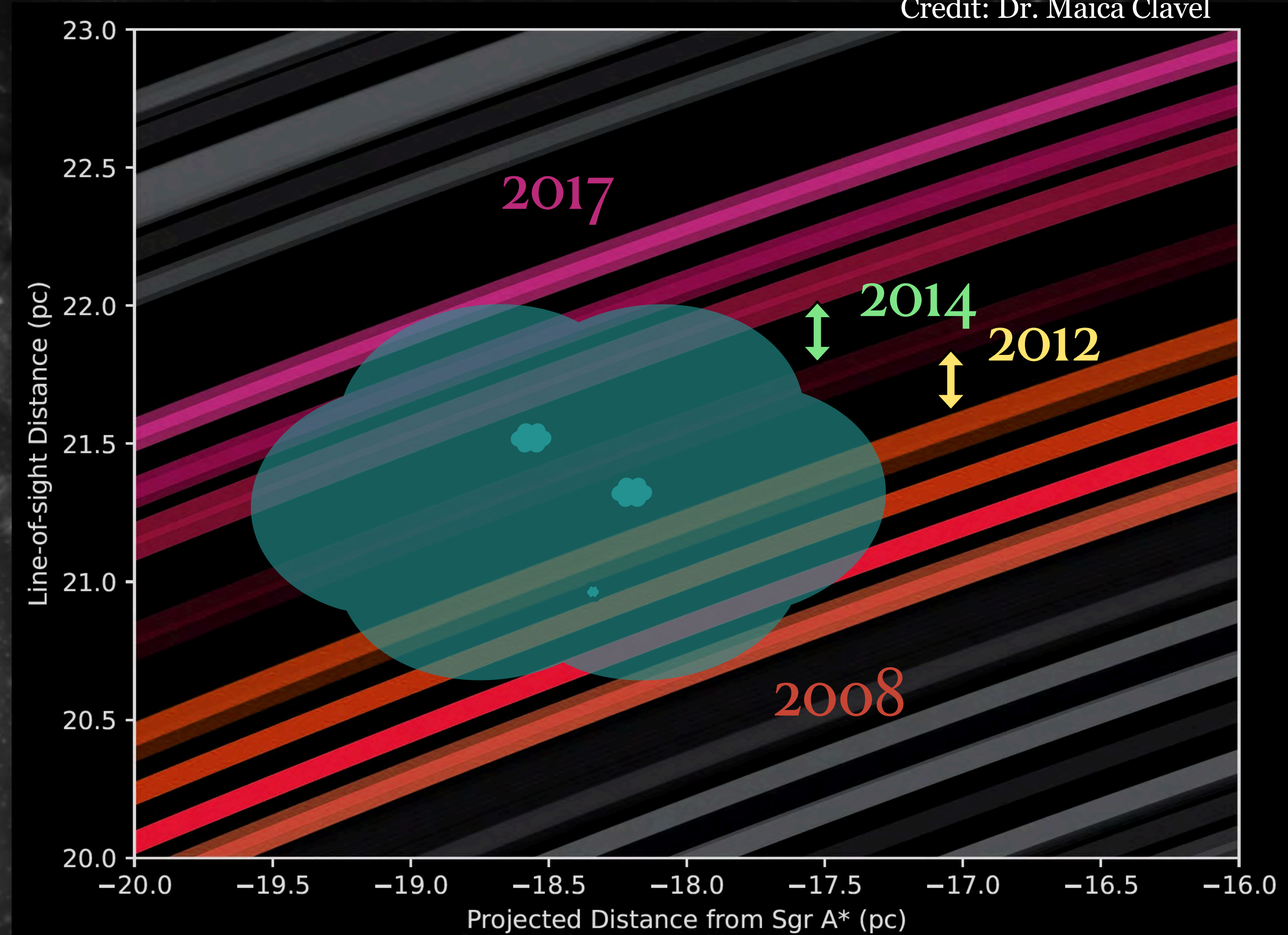
X-ray data is not continuous



# Constraining the duration of X-ray flares

Credit: Dr. Maïca Clavel

X-ray data is not continuous  
Gaps in data > structures



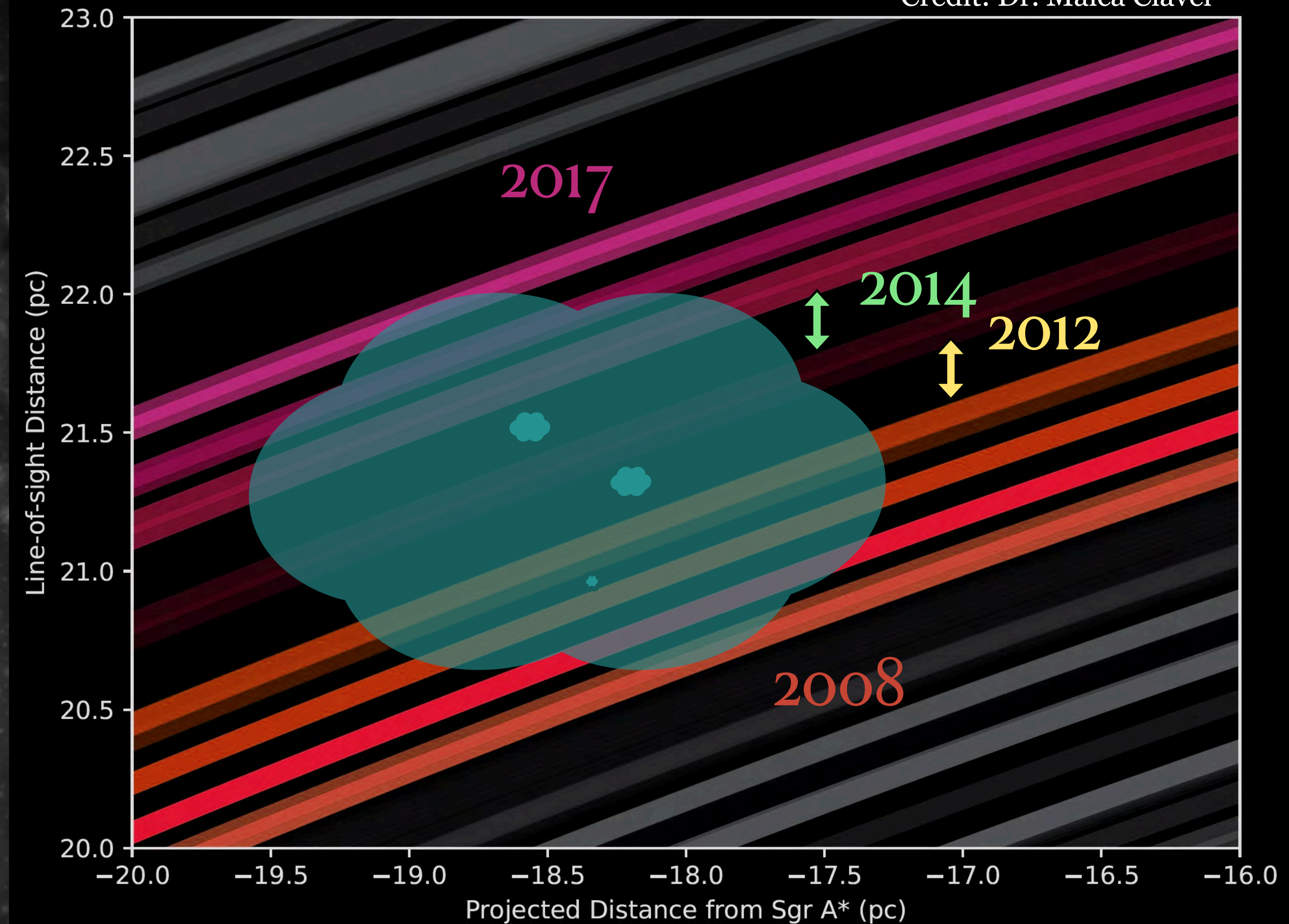
# Constraining the duration of X-ray flares

Credit: Dr. Maïca Clavel

X-ray data is not continuous

Gaps in data > structures

Separation → constraints



Duration of X-ray flare is **no longer than ~5 months**

# X-ray tomography traces the 3D structure of molecular clouds

- X-ray flares from Sgr A\* highlight dense molecular gas
- Echoes from molecular gas indirectly place constraints on the past activity of Sgr A\*

