



ID de Contribution: 26

Type: **Oral presentation**

3D dynamic study for the 450th anniversary of Tycho supernova remnant

mercredi 2 novembre 2022 11:00 (15 minutes)

In November 1572, a nearby star exploded in a supernova and was observed at the time by Tycho Brahe. Exactly 450 years later, we can study its remnant, the huge cloud made of all the matter of the star ejected at high speeds. The ejected material is heated to tens of millions Kelvin and radiates most of its energy in the X-ray (0.1-10 keV) band.

Currently, the Chandra X-ray telescope measures the photons one by one from this object and we obtain data cubes (x, y, E). This study consists in analyzing these data cubes using innovative methods to understand the remnant's dynamics in three dimensions (x, y, z).

Knowing precisely these dynamics gives information about the original supernova: was the explosion asymmetric? Was matter ejected beforehand and thus formed obstacles on the path of the remnant? We can therefore constrain a phenomenon 450 years after it took place.

This study allows us to develop tools that can be adapted for other data cubes, coming from other spectro-imaging telescopes or even from other domains, like videos. The complex data involved also raises questions about the scientific representation, especially in 3D, of our results.

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Classification de Session: Oral Presentations (second in the morning)