Contribution ID: **177** Type: **Flashtalk with Poster**

Understanding galaxy cluster evolution with contrastive learning

Tuesday, 30 April 2024 17:19 (3 minutes)

The intracluster medium (ICM) holds signatures of the dynamical history of the galaxy cluster, including the dark matter density profile, mergers with other clusters, and energetic activity (from supernovae and supermassive black holes) in its member galaxies. For all but the most relaxed galaxy clusters observed at high spatial resolution by instruments such as the *Chandra* and *XMM-Newton* X-ray telescopes, it is extremely challenging to infer such properties as the mass and baryon fraction from the ICM emission. Reproducing these features is a key test of the realism of a given cosmological simulation. I use Nearest Neighbour Contrastive Learning (NNCLR) to reduce images of the X-ray emission of the clusters in TNG-Cluster to a compact representation space. We find that the self-supervised representation space forms a continuous distribution from cool to non-cool core clusters, as well as from relaxed to merging objects. It also shows trends in redshift, halo mass, stellar mass, time since last major merger, and offset between the peaks of mass and X-ray emission. The self-supervised sorting of the images clusters known populations of galaxy clusters, providing simulated analogues to famous observed objects like the Bullet cluster and Perseus.

Primary authors: Dr PILLEPICH, Annalisa (MPIA Heidelberg); EISERT, Lukas (MPIA Heidelberg); Dr CHADAYAMMURI, Urmila (MPIA Heidelberg)

Presenter: Dr CHADAYAMMURI, Urmila (MPIA Heidelberg)

Session Classification: 3.2 Physics-informed AI & Integration of physics and ML

Track Classification: Session A