



Contribution ID: 410

Type: **Invited talk in a parallel session**

X-ray echoes and the structure of molecular clouds in the Galactic Center

Thursday, 11 July 2024 17:25 (20 minutes)

Molecular clouds in the Galactic Center reprocess radiation from past outbursts, generating a strong Fe $K\alpha$ fluorescent line (6.4 keV). Reflecting the radiation that reaches them as mirrors, these clouds retain the historical activity of their illuminating sources. Studying this echo radiation provides crucial information about the source, the clouds' properties, and the relative geometry between the clouds and the illuminating source. We examined fluorescence in molecular clouds near Sgr A*, specifically in the Circumnuclear Disk and the Sgr A complex, located within 15 arcminutes of the SMBH.

In the Circumnuclear Disk, we detected a signal generated by the outburst of the magnetar SGR J1745-2900 (which happened in April 2013). Using the known luminosity of this outburst and the measured X-ray intensity, we estimated the mean hydrogen column density of the Circumnuclear Disk. In the Sgr A complex, the fluorescence is most probably due to Sgr A*'s flaring activity over the past few hundred years, as suggested by multiple studies. Thanks to 25 years of XMM-Newton observations of the Galactic Center, we were able to track the interaction of the wavefront of this past energetic event with the molecular cloud distribution. By analyzing the evolving signal, we reconstructed a 3D map of the molecular cloud distribution and studied the internal structure of the Sgr A complex.

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Session Classification: Latest results from Galactic center observations

Track Classification: High-precision astrometry (HP): Latest results from Galactic center observations