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Chemical impacts of X-ray from an active supermassive black hole in our galaxy

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ABSTRACT

This is an abstract...

Keywords: To be continued...

1. INTRODUCTION

Supermassive black holes (SMBHs) are widely held in galaxies. The bright radio object Sagittarius A* (Sgr A*) located in the galactic centre 8 kpc away from earth is believed as the SMBH in our galaxy. It weighs $4 \times 10^6 M_\odot$ and is quite faint with surprisingly low luminosity $L \sim 10^{33-35}$erg s^{-1}. This is no more than $10^{-9} L_{\rm Edd}$, where $L_{\rm Edd} \approx 1.3 \times 10^{38}\,(M_{\rm BH}/M_\odot)\,{\rm ergs}^{-1} \sim 5 \times 10^{44}{\rm ergs}^{-1}$ is the Eddington luminosity (Sabha et al. 2010), showing that Sgr A* is on quiescent state.

More recent researches challenge the conventional understanding of Observations have shown evidence that Sgr A* went through an active phase 6 million years ago (Nicastro et al. 2016). Activation of Sgr A* triggers radiation of hard X-ray photons. For a hydrogen atom, the photo-ionization cross section $\sigma_p^{\rm H}$ is proportional to $(h\nu)^{-3}$ (Brown & Gould 1970), where ν is the frequency of the photon, indicating tiny cross sections with high energetic photons. Hard X-ray photons can therefore transmit much farther than optical and UV photons in galactic disk. Amaro-Seoane & Chen (2014) calculated the X-ray irradiation from Sgr A* due to accretion of gas (like an AGN) and the tidal disruption, Sgr A* could precipitate on Earth a hard X-ray (i.e. $h\nu > 2$ keV) flux comparable to that from the current quiescent sun, while UV and soft X-ray photons suffer from heavy extinction and are not significant 8 kpc away from galactic centre. These energetic photons may leave significant physical and chemical records in molecular gas around galactic centre(Krolik & Kallman 1983; Neufeld et al. 1994; Aalto 2014) and planetary atmospheres (Loeb & Forbes 2018; Wisłocka et al. 2019). In our case, we focus on the chemical evolution in dense molecular clouds under the X-ray radiation of an active Sgr A*.

2. METHODS

2.1. *X-ray flux in different distances from Sgr A**

2.2. *X-ray chemistry*

2.2.1. *Primary ionization*

Hard X-ray photons significantly influence the ionization fraction of the neutral molecular cloud and thus influence its thermal and chemical evolution. When a X-ray photon comes across an atom

2.2.2. *Secondary ionization*

2.2.3. *Ionization of heavy elements and molecules*

2.3. *Cosmic-ray chemistry*

2.4. *Chemical networks*

3. MODELS

3.1. *X-ray models*

3.2. *Molecular cloud models*

Pseudo-time-dependent approach KROME package[1] (Grassi et al. 2014)

[1] http://kromepackage.org/

4. RESULTS

5. DISCUSSIONS

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