Contribution ID: **65** Type: **Review/Invited talk**

Cosmic ray ionization in the local Milky Way: How well do we understand it?

Friday 9 May 2025 10:20 (20 minutes)

I will present recent advances in understanding properties of low-energy CRs in molecular clouds.

In the first part of my talk I will summarize results of reevaluation of CR ionization rate (CRIR) derived from available measurements. Previous estimates of CRIR for these measurements relied on model-dependent assessments of the gas density along the probed sight lines. Now, we utilized the recently developed 3D dust extinction maps that allowed us to precisely identify the location of molecular clouds probed in each measurement, and also to derive the gas density in these clouds. This helped us to evaluate CRIR in each cloud without involving any model-dependent assumption about the environment. Our results indicate that (i) values of CRIR probed in individual diffuse molecular clouds in the local Galactic environment may vary by an order of magnitude from cloud to cloud, and (ii) the average CRIR value is a factor of 5-10 smaller than that derived previously.

I will also discuss resent theoretical development in understanding dominant mechanisms that govern attenuation of Galactic CRs penetrating molecular clouds. Apart from regular attenuation mechanisms, associated with ionization energy losses, penetrating CRs may also be scattering on self-generated turbulence excited in diffuse envelopes of the clouds. We found that significant self-modulation of non-relativistic CRs may already operate in clouds with the gas column density of a few times 10^21 cm−2, while for a few times 10^22 cm-2 the effect becomes strong for GeV protons. The obtained results are in excellent quantitative agreement with recent Fermi LAT observations of nearby giant molecular clouds.

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