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Uncovering the Energetic of the Interstellar and the Intergalactic Medium with the SKA

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Investigating the physics and energetic of the medium where galactic structures, on various scales, are formed is the most fundamental step to understand the formation and evolution of galaxies. Modern galaxy evolution models suggest gas accretion from the intergalactic medium or from cosmic filaments as a mechanism to maintain star formation and AGNs. Through gas heating and/or gas removal, these models also propose supernova feedback and AGN feedback as mechanisms to quench massive star formation. Observational studies however have not reached to a conclusive result, showing that feedback can, in some cases, trigger star formation, leaving the issue as an open challenge. It seems that we have missed some basic concepts about the formation of structures in the ISM and the IGM: What are physical parameters/agents governing the structure formation on various scales? and what is their relative importance? How does the ISM/IGM energy balance change over the cosmic time? Addressing these, it is vital to obtain a more complete picture of the ISM & IGM than what is known currently. The advent of the SKA and its new instrumental capabilities tracing the most energetic ISM components combined with the ground-breaking results from the ALMA, HST, VLT/MUSE, etc has opened a new window shedding light on the issue. The SKA's sensitive radio continuum observations will trace high-energy particles and magnetic fields not only in star forming regions and AGNs, but also in more quiescent regions in molecular clouds and diffuse ISM, enabling us to study the role of magnetic fields/cosmic rays in structure and star formation. On larger scales, these observations will allow us to address what determines the accretion rate from the IGM. Sensitive radio continuum observations on large scales may also bring constrains on the entity of the dark matter mapped by the HST and DECam.

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