Probing filamentary star formation and the role of magnetic fields on various interstellar scales with Millimetron-B-BOP

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Abstract

Far-infrared and submillimeter imaging with Herschel and Planck have revolutionized our understanding of the link between the structure of the cold ISM and the star formation process, supporting a paradigm in which magnetized filaments play a central role. One of the next steps is to clarify the detailed role of the magnetic field in the physics of such filaments.
With the cancellation of SPICA, the Millimetron Space Observatory approved by the Russian Space Agency, represents the best chance to see a new-generation large far-infrared telescope in space and allow us to take this next step by the end of the coming decade.

I will describe the science driver for Millimetron-B-BOP, the imaging polarimeter concept derived from SPICA-B-BOP and currently envisaged for Millimetron. The proposed instrument would have the same six bands from 70 to 500 microns as Herschel, observing the sky simultaneously albeit toward separate fields of view.

Thanks to a cryogenically-cooled 10-m telescope, Millimetron-B-BOP will be able to deliver wide-field images of linearly polarized dust emission in Stokes Q and U with a signal-to-noise ratio, and both intensity and spatial dynamic ranges comparable to those achieved by Herschel images of the cold ISM in unpolarized emission (Stokes I). The Millimetron-B-BOP (I,Q,U) images will also have a factor _~ 3 higher resolution than Herschel I images and a factor of $>$ 50 higher resolution than Planck polarization data.

Millimetron-B-BOP will make it possible to resolve prestellar-core formation along 0.1 pc-wide
filaments out to 1.5 kpc and to image a few % polarized dust emission through the entire extent of cloud complexes from the low-density atomic envelope of molecular clouds (Av $<$ 0.5) all the way to the densest filaments and protostellar cores (Av $>$ 100). This will make Millimetron-BOP a unique tool for shedding light on the formation and evolution of the magnetized interstellar web of dusty molecular filaments giving birth to most stars in our Galaxy. It will also be a powerful instrument for characterizing the magnetism of external galaxies and constraining the physics of dust grain alignment.

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