White paper contribution, A. siebert: Milky Way structure and evolution, ISM

MSE will be an outstanding tool to study the structure, the formation and evolution of the Milky Way. A large field, high multiplexing and high resolution instrument reaching faint targets would complement existing data-sets --especially the Gaia catalog-- to provide the missing information at faint magnitudes such as the radial velocity and detailed chemical composition of the target stars.

MSE would be crucial to map the 3 dimensional velocity field beyond the extended solar neighborhood. A detailed 3 dimensional map of the velocity field contains not only information the the mass distribution of the Galaxy, it also holds the signatures of the ongoing perturbations of the disc, such as the spiral arms or the central bar and their back reaction. It allows to measure the various pattern speeds at play in the Galaxy and the location of their resonances. In order to gain knowledge on the perturbations, a spatial resolution on each axis of less than ~50pc is needed on the constructed 3D maps. Such a resolution requires a large number of stars to be observed over large patches on the sky which makes MSE the best suited candidate to achieve such a project. Especially, the combination of both a high resolution and a low resolution mode would allow to separate in a clean way the stellar populations (when using the HR mode) for a more local sample, while the LR mode would be suited to study the targets further out (or in more absorbed regions) where the appropriate SNR would not be reached using the HR mode, but still providing appropriate data to recover the 3D velocity field.

Another topic where MSE would play an important role is the mapping

of the
interstellar medium. So far, only the ~2kpc sphere around the sun is mapped
for the absorbing material while only the Hipparcos sphere is to a good
accuracy. The high resolution mode of MSE allows to observe interstellar
absorption lines (such as DIBs, NaI D1 and D2, CaII H and K) along line of
sight to targets. With Gaia parallaxes, this can be used to reconstruct a
full 3D map of the ISM using tomography or similar methods. The large scale
structure of the ISM can then be compared to the map of the potential
perturbations to give additional constraints on the structure and evolution
of the disc. Also the construction of such maps for different IS species
allows the reconstruction of the ionization field and its link to the star
formation in the Milky Way.