The Ionized Milky Way: The Local Volume Mapper (LVM) in SDSS-V

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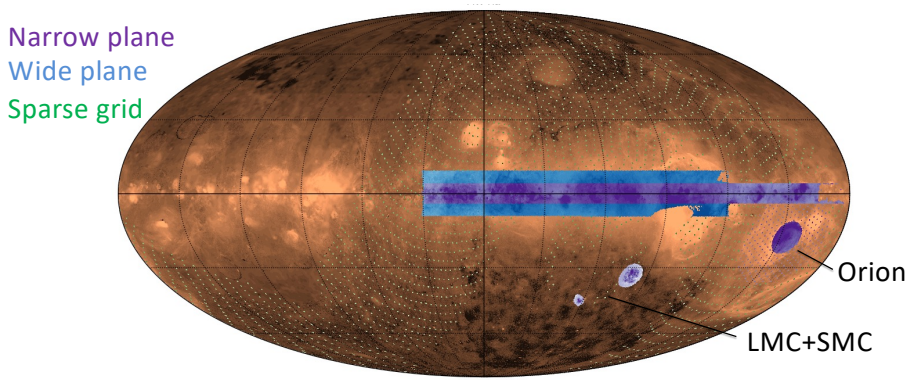
Connecting studies across the pc (sub-GMC) and kpc (galaxy-wide) scales is fundamental to understanding the physics governing star formation, the structure and energetics of the ISM, the baryon cycle, and ultimately, the evolution of galaxies. LVM in SDSS-V will take the first step towards the "spectral panopticon", a full spectroscopic image of the sky, providing optical IFU data-cubes to resolve, e.g., SF structures, GMCs, H II regions and young stellar clusters. LVM will cover the bulk of the MW disk at 0.1-1 pc resolution over about 1 steradian of sky. It will also cover the Magellanic Clouds at 10 pc resolution. Future plans include a northern facility to observe M31 & M33 at 20 pc resolution [1].

Stellar spectroscopy with accurate typing and abundances from previous APOGEE observations and from SDSS-V itself, as well as resolved stellar photometry and CMDs, will allow us to connect the structures in the ISM to the radiation field and to individual sources of feedback. The wide area covered by the LVM will sample a large variety of SF regions caught at different stages of their life cycles, directly constraining the processes, timescales and length-scales for the transfer of energy and momentum from young stars (and supernovae) to the gas.

Surveying the Milky Way and Local Group (2023-2027)



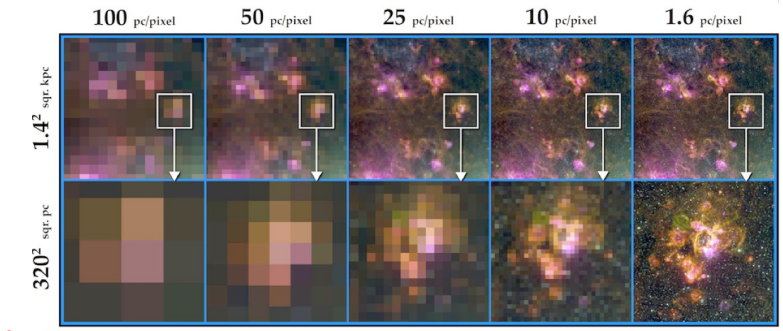
In our LVM survey we aim to map almost one full steradian of the sky. This will cover the vast majority of known optically selected Milky Way H II regions and their interface with the diffuse ionized ISM. Our coverage includes all of Orion, narrow and wide Milky Way plane coverage, the LMC/SMC, along with a full sky sparse grid.

We will detect strong emission lines to map the metallicity and ionization structure of the ISM over the full surveyed area, characterize the feedback induced kinematics of gas in and around HII regions, and study electron temperature fluctuations and their impact on chemical abundance measurements for a significant fraction (20-30%) of optically visible HII regions in the sky which are bright enough to allow for the detection of auroral lines.

Tracing the Multi-Scale Ionized ISM

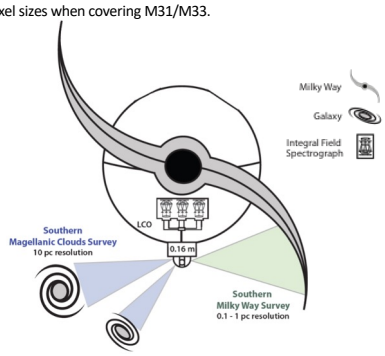
The left two panels show how the best current datasets see galaxies; the right two panels show the range of resolution that the LVM will provide. Each pixel in these images will contain a full spectrum. In particular, the bubbles, shock fronts, filaments, and flows of the gas will be resolved and characterized.

Our survey depth in the Local Group will enable stellar population work in the continuum and allow for the likely detection of auroral lines on the majority of H II regions in the LMC and SMC.



Building Towards All Sky Coverage

The LVM will use DESI spectrographs that span 3600–9800Å at a resolving power of $R \sim 4000$. We will couple the spectrographs (3 per hemisphere) to newly designed large IFUs. We are currently focused on building our southern facility, at LCO, featuring small 160 mm telescopes. With 1800 fibers of 37" diameter, we achieve a 490 arcmin^2 fov. Future plans include a northern facility at APO that will further include a 1 m telescope (6" fibers, 12 arcmin^2 fov), necessary to provide a dynamic range in spaxel sizes when covering M31/M33.



In addition to the MW survey with the LVM160 telescopes, we will cover all of the SMC and 70% of LMC with the LVM160 telescope. We are currently developing plans to further survey a representative subset of ~50 gas rich (predominantly dwarf) galaxies in the Local Volume (D<10Mpc, at kpc scales).

Orion: Stars in their ISM Context

In Orion, we will achieve 0.07 pc/spaxel. Existing APOGEE spectra provide key physical parameters (Teff, L, Z, [X/H], f_{uv}) for each star. With LVM, we will be able to connect these ionizing sources to the gas temperature, density, kinematics, and abundances.

With a spatial resolution of < 1 pc out to distances of 3 kpc in the MW, we will resolve the ionized gas surrounding the smallest optically visible young clusters and separate individual ionizing sources (massive stars) in OB associations, most of which will be targeted for NIR spectroscopy as part of the SDSS-V Milky Way Mapper (MWM) program.

The NIR spectral coverage of LVM will further enable us to detect Paschen lines (e.g. P8 9546Å), ensuring we can observe HII regions out to distances of 10 kpc (A_v~6-8 mag) across the disk.

We will also cover ionization structures surrounding PNe,WR stars, and SNRs.

References

[1] Kollmeier et al. 2017

https://www.sdss.org/future/

SDSS-V

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