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VISTA MILKY WAY PUBLIC SURVEY

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RESUMEN

Proponemos un "survey" público denominado "Variables Vista en la Vía Láctea" (VVV), el cual se desarrollará en el infrarrojo y abarcará el bulbo galáctico, al igual que en la porción sur del disco interior donde la formación estelar es alta, cubriendo un área total de 520 grados cuadrados. Dicha área contiene 33 cúmulos globulares conocidos y cerca de 350 cúmulos abiertos conocidos. Los productos finales serán un atlas profundo en 5 bandas infrarrojas y un catálogo de $\sim 10^6$ de fuentes puntuales variables, los cuales permitirán construir un mapa en 3 dimensiones de la región relevada utilizando indicadores muy bien conocidos, tales como las estrellas RR Lyrae, que permitirá obtener importante información sobre las edades de las poblaciones. Las observaciones serán combinadas con datos obtenidos de los proyectos MACHO, OGLE, EROS, 2MASS, DENIS, HST, SPITZER, CHANDRA, INTEGRAL y ALMA, para lograr un conocimiento completo de las fuentes estelares variables en la región interior de la Vía Láctea. De este "survey" surgirán importantes implicaciones para el estudio de la historia de la Galaxia, la evolución de los cúmulos globulares y el censo de poblaciones del bulbo y del centro de la Vía Láctea.

ABSTRACT

We propose a public IR variability survey, named "Vista Variables in the Vía Láctea" (VVV), of the Milky Way bulge and an adjacent section of the mid-plane where star formation activity is high. This would take 1920 hours, covering $\sim 10^9$ point sources within an area of 520 sq deg, including 33 known globular clusters and $\sim$ 350 open clusters. The final products will be a deep IR atlas in 5 passbands and a catalogue of $\sim 10^6$ variable point sources. These will produce a 3-D map of the surveyed region (unlike single-epoch surveys that only give 2-D maps) using well-understood primary distance indicators such as RR Lyrae stars. It will yield important information on the ages of the populations. The observations will be combined with data from MACHO, OGLE, EROS, VST, SPITZER, HST, CHANDRA, INTEGRAL, and ALMA for a complete understanding of the variable sources in the inner Milky Way. Several important implications for the history of the Milky Way, for globular cluster evolution, for the population census of the bulge and center, and for pulsation theory would follow from this survey.

Key Words: Galaxy: structure — surveys — techniques: photometric

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1. THE BULGE

Most of the stars, gas and dust in the Milky Way are confined to the bulge and plane of the Galaxy. For this reason, extinction and crowding make it difficult to unveil the inner structure of the Milky Way and to study in detail the formation and evolution of this representative galaxy. Traditional distance indicators have been used with varied success in the past. The approach was to concentrate in the clear "windows", where optical surveys can be carried out (MACHO, OGLE, EROS). With VISTA, it is now possible to map the whole bulge systematically for several epochs in the near-IR. We propose to cover a 300 sq deg area between $-10° < l < 10°$ and $-5° < b < 10°$, containing $\sim 5 \times 10^8$ point sources. Our survey will give the most complete catalogue of variable objects in the bulge, with $\sim 10^6$ variables. Chief among them are the RR Lyrae, which are accurate primary distance indicators, being well understood from their chemical, pulsational and evolutionary properties. For the sake of space and coherence we concentrate on the RR Lyrae and the star clusters, noting that similar worthy studies can be done for many of the other populations of variable objects.

2. THE PLANE

In order to understand the Milky Way populations globally (and to account for the disk contribution along the line of sight), it is necessary to survey the inner Galactic plane. In addition to the Bulge Survey, we therefore propose to survey an adjacent region of the mid-plane in order to provide a Legacy Database and 3-D Atlas of a large Population I region. We have selected the inner Galaxy region at $-65° < l < -10°$, $|b| < 2°$, where star formation activity is high and there will be complementary optical, mid-IR and far-IR data from VPHAS+ and the SPITZER GLIMPSE and MIPSGAL surveys. The addition of this region will also permit us to settle the controversial question of inner Galactic structure, discriminating between models with a long bar and a ring and triaxial Bulge models without bar.

The Plane Survey will also be a multi-epoch survey, with the aims described in the goals below. Extinction maps for clusters will be provided by an initial single epoch of $ZYJHKs$ imaging. Distances will then be derived using a variety of methods, e.g. main sequence fitting for mature clusters and analysis of foreground star counts vs. extinction for star formation regions. For the field population, the use of several reddening-independent indices such as $(J-H)-(Y-J)$ will be used to probe changes in the stellar population along every line of sight, statistically measuring the ratios of dwarfs to giants and hot stars to cool stars. The multi-colour data will also be valuable for robust detection of rare objects and characterisation of every type of stellar population.

3. INMEDIATE OBJECTIVES

The major VVV survey products will be a high-resolution $ZYJHKs$ colour atlas of the bulge and plane regions, and a catalogue of variable point sources, including positions, mean magnitudes, and amplitudes. This database would be public, a significant treasure for the whole community to exploit for a variety of scientific programmes.

The top 10 scientific goals of the VVV survey are:

- To find RR Lyrae in the bulge
- To study variables belonging to known star clusters
- To search for new star clusters
- To map star forming regions along the plane
- To find eclipsing binaries and planetary transits in large numbers
- To search for microlensing events
- To identify rare variable X-ray sources
- To monitor the variability around the Galactic Center
- To find variable stars in the Sgr dSph galaxy
- To identify high proper motion objects and background QSOs

More information could be retrieved from the WEB page for the VVV Survey:

`www2.astro.puc.cl/VVV/`

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