# The Isaac Newton Telescope Monitoring Survey of Local Group Dwarf Galaxies VIII, Detection of the Long Period Variable Star of Andromeda Dwarf Satellites

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## Abstract

An extensive analysis of observed spheroidal dwarf satellites of the Andromeda galaxy was conducted to provide a comprehensive catalog of long-period variable (LPV) stars. The study is part of an optical monitoring survey to observe 55 dwarf galaxies and four globular clusters within the Local Group. The dwarfs were observed using the wide field camera (WFC) of the 2.5-meter Isaac Newton Telescope (INT). These observations were conducted through near-infrared (*i* Sloan) and optical (*V* Harris) bands at nine epochs. Our focus is on detecting asymptotic giant branch (AGB) stars when their magnitude amplitude becomes higher than 0.2 mag to track dwarf evolution. In dwarf galaxies, LPV stars with ages ranging from 30 Myr to 10 Gyr provide powerful tools for reconstructing the star formation history (SFH). LPV stars are suitable for study due to the relation between their birth mass and luminosity at the end of their evolution. Star formation scenarios could also be studied by comparing the age gradient of variable stars between two half-light radii. This study also provides estimates of satellite characteristics such as the half-light radius, the RGB-tip, the distance modulus, the quenching time, and the total stellar mass. Our work is extended by estimating the mass-loss rates of detectable LPVs to produce dust maps for each dwarf. Mass-loss of LPVs contributes to galaxy chemical enrichment and star formation. A combination of ground-based observations and space-based telescopes was used to simulate the spectral energy distribution (SED) for LPVs based on observations in the optical to mid-infrared bands. It is also possible to estimate the re-ignition time for SFH by calculating the total mass return of LPVs. Additionally, the distance modulus has been updated using RGB-tip through the tip detection of the Sobel filter in this study. The distance modulus of Andromeda satellites ranges from 23.57±0.08 to 25.62±0.17 mag.

## Observation

The WFC of the INT telescope observed 59 objects, including isolated dwarfs, globular clusters, satellites of the Milky Way, and Andromeda galaxy. The observations were made over 2.5 years in 9 epochs using 3 filters and a primary mirror diameter of 2.54m with each of the 4 CCDs having a field of view of 33 arcmin.

## The distribution of LPVs in the And VI as an example of a Andromeda satellites

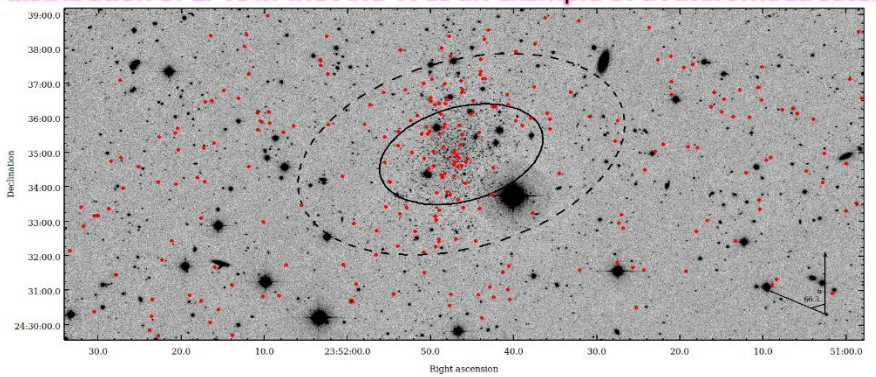


Figure 1. The dashed line represents two half-light radii of the And VI dwarf galaxy. The black eclipse is the half-light radius. Red circles indicate detected LPVs. The arrow pointing at a 66.3° is directed towards the center of the Andromeda galaxy.

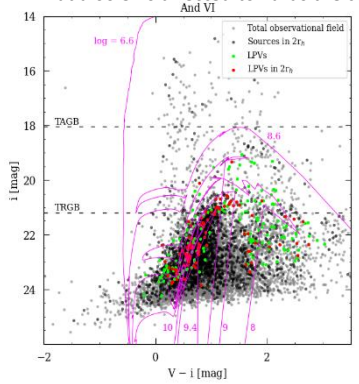


Figure 2. The CMD of And VI dwarf satellite. Purple lines represent isochrones from Padova et al. 2017.

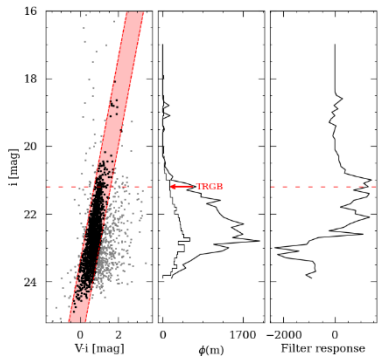


Figure 3. The TRGB of the And VI ~ 21.20±0.10 mag in *i*-band magnitude.

## Procedures

Observation: 2.5 m Isaac Newton Telescope (INT)
Data reduction: THELI (Transforming Heavenly Light into Image) code
Photometry: DAOPHOT/ALLSTAR package, Photutils python code
Detecting variables: Stetson variability index, machine learning methods
SFH: SFR in age bins
Dust: Dusty code

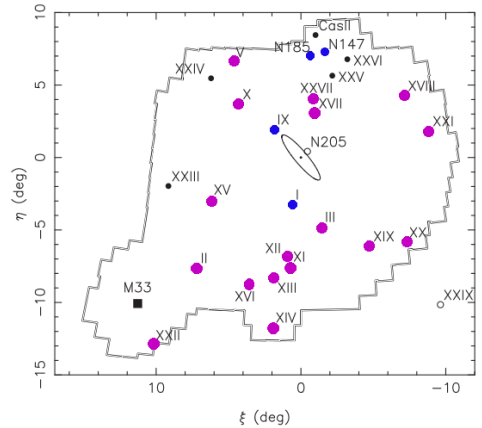


Figure 4. The distribution of dwarf galaxies around M31. The purple circles represent the Andromeda satellites studied in the INT survey (Paper VIII), whereas the blue circles represent satellites previously examined in the INT survey. Image Credit: Martin et al. 2016.

## Prospective

This paper discusses detecting LPV stars, while the following paper will cover SFH and dust production rate from AGBs.

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