Matt imaged the Andromeda Galaxy at the Trottier Observatory on November 15 2015, with a field of view of about 28', covering part of the galaxy’s disk south-west of its core. An integrated luminance is shown here (the result of only 96 minutes total exposure!), after applying some modest sharpening and dynamic range compression (that’s M32 on the bottom edge).
Howard later realized that this FOV contains the first Cepheid variable studied by Edwin Hubble, referred to as “M31_V1”, and labelled in our image. The idea to look for it came from an extraordinary new book by Robert Buchheim\(^1\) that details a wide range of sophisticated observation projects for amateurs. The penultimate project in the book is to estimate the distance to M31 by measuring the period of V1, based on the famous Cepheid variable period-luminosity relation. It seemed almost too fantastic at first that this can be done by amateurs!

This report gives a proof of principle that this project is, in fact, easily within our capabilities.

It turns out that the Hubble Heritage Project partnered with amateur astronomers from the American Association of Variable Star Observers (AAVSO) in 2010 to monitor M31_V1 for the first time since 1965.\(^2\) The Hubble Heritage composite portrait below identifies M31_V1 in an “amateur” image of the galaxy by Robert Gendler; the insets are Hubble Space Telescope images of V1. Its period is 31.4 days, and its magnitude varies between about 18.2 and 19.4.

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A close-up comparison between our luminance image (we'll add-in our colour data later!), and Gendler’s galaxy image from the Hubble portrait, in the vicinity of the Cepheid, is shown below (Gendler’s image was rotated slightly for easier comparison). A reproduction of Hubble’s original photographic plate with his famous annotation “VAR!”, is also shown (a portion of Hubble’s plate, zoomed-into at roughly the same scale as other closeups, is shown on the left).
At this point we have an image of M31 from only one night, and the actual project of measuring the light curve of M31_V1 will have to wait until late summer, when Andromeda is again well placed in the sky. But to show that the photometry is definitely doable, the magnitude of the Cepheid in the one image that we have was estimated using MaxIm DL, as described below.

First, here is an AAVSO chart centred on M31_V1, with reference magnitudes of a number of nearby comparison stars, superimposed on an inverted deep-sky image from the Digital Sky Survey; the plot is turned sideways to match the orientation we have been using, following the Hubble Heritage portrait. The white rectangle superimposed on the chart shows the field of view in the MaxIm DL readouts of our image on the next two pages.

MaxIm DL has an easy-to-use aperture photometry tool. It is calibrated by clicking on a comp star (after the user inputs its magnitude), and then estimates for other stars can be read out. The magnitude of M31_V1 was estimated using several comp stars, as illustrated on the next two pages using the mag 16.3 comp star that is up-and-left from V1 in the AAVSO chart.

The next page has a screen capture of the aperture tool calibration readout (more precise photometric estimates of the comp stars are provided by the AAVSO, in this case the quoted V magnitude is 16.285 ± 0.049). Note that the “raw” integrated image in linear form is used here, with no sharpening or dynamic range compression applied; the MaxIm “Screen Stretch” only enhances the image as displayed on the screen, and is not applied to the raw data.
The aperture tool readout for M31_V1 is shown on the next page: the estimated magnitude is 18.8, with a signal-to-noise of about 12.5, implying an uncertainty of about 0.1 mag. So it turns out that on this night the Cepheid was about half-way between its minimum and maximum magnitudes (unfiltered magnitudes run from about 18.2 to 19.4 – see the AAVSO papers cited in the footnote on page 2). Doing the calibration with other comp stars from the AAVSO chart gives consistent results.

These results clearly demonstrate that we will be able to accurately follow the Cepheid through its entire cycle, with just a few hours of integration on a given night!