A FIELD GUIDE TO M31'S BRIGHTEST OBSERVABLE GLOBULAR CLUSTERS & MORE…

…in a 10-inch SCT!

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This PDF is part of a zip folder also containing these other documents:

80+ Extragalactic Objects of M31.xlsx
Main M31 Observing Charts.pdf
Halo Globular Cluster Finder Charts.pdf
Robert Gendler's [2.2°x1.5°] Mosaic of M31.jpeg
25 GCs for Telescopes 12-inches & Up.pdf

Acknowledgments

Before I begin, I must first thank Philip Harrington who introduced me to the crazy idea of spotting deep-sky objects in M31 in his 2011 book *Cosmic Challenge: The Ultimate Observing List for Amateurs*. At the time, just the simple idea of such a thing blew me away and I've never lost that feeling of awe when looking at them! Next I must thank Brian Skiff and Christian Luginbuhl who expanded my knowledge of which ones might be visible in their 1989 book *Observing Handbook and Catalogue of Deep-Sky Objects*. I also want to thank Ronald Stoyan, who supplied an excellent map in his 2008 book *Atlas of the Messier Objects: Highlights of the Deep Sky* and was the first source to inform me that G073 is the brightest globular cluster of NGC 205. I owe a thanks to Sue French's 2011 *Deep-Sky Wonders* book for being the only early resource of mine that actually plotted where G001, the galaxy's brightest globular cluster, can be found. I also have to thank Larry Mitchell, who wrote the November 1997 *Sky & Telescope* article titled "The M31 Challenge", for giving me yet another source for several new objects. A big thank you goes out to astrophotographer Robert Gendler who took the amazing mosaic image of the Andromeda Galaxy that I'm using for my main chart. My deepest gratitude however goes out to Steve Gottlieb for helping me feel confident publishing this article by confirming the location and identity of the objects that I was unsure about. And also for being kind enough to host it for download on his and Mark Wagner's website. Here is a link to his page of observations on this same subject that he's made with his larger telescopes over the years.

Cover Photo: NGC 206 and the Star Clouds of Andromeda (From the September 25th, 2014 Astronomy Picture of the Day**); Image Credit and Copyright:** Subaru Telescope (NAOJ), Hubble Space Telescope, Local Group Galaxy Survey (Phil Massey, PI), Mayall 4-meter, Robert Gendler

How many of our sister galaxy's best kept secrets can you spy?

My Problem

I have always relished the fact that there lies an exceptionally large galaxy not too far from our own. Nothing was more awe-inspiring to my younger-self or nowadays helps convey the size and distance of M31 to me more than a naked-eye view of this grand spiral galaxy. To be visible as a 3°-long smudge of light under my dark skies and yet know that it lies at the incomprehensible distance of 2.5 million light-years makes it feel just truly enormous. Even in binoculars I find it still retains a lot of that eerie feeling of immense size for me. Whenever I'd turn my 10-inch telescope its way however, I would only get a gentle feeling of disappointment as I panned across its large but surprisingly dull surface.

I'm sure one of the reasons why I felt that way is because I can't achieve the same field of view given by smaller telescopes to frame it nicely. However, it wasn't until I first learned about and saw NGC 604, a massive H-II region in the naked-eye galaxy M33, that I understood what I was really feeling. You see, M31 has virtually no H-II regions large enough to be visible in amateur telescopes while M33 and even much farther galaxies such as M101 have a good handful. At the time that really seemed odd to me since M31 is both *closer* and *larger* than M33 – which is most likely only a satellite of M31's!

The Answer

Then, a year after first seeing NGC 604, while reading Philip Harrington's 2011 book *Cosmic Challenge: The Ultimate Observing Guide*, I found what I'd been looking for: Challenge 178. Titled "Globular Clusters in M31", he had a list of globular clusters (GCs) brighter than magnitude +15.5 and a map to find them. I can remember at the time being ecstatic just to be able to see the OB association NGC 206 along with several of the brightest GCs.

That was three years ago, and after countless hours of research and viewing, I've come upon an interesting observation. Which is that while M33 has many H-II regions but only a *few* GCs visible in amateur telescopes, M31 is decidedly the opposite with few H-II regions visible but *many* GCs visible. Studies have even indicated that most of its GCs are very similar to the ones in our Galaxy – just more numerous by at least a 4:1 ratio! That means that what I've seen is only about a tenth of the galaxy's total population. However, it's about the same number of GCs that I've seen in the Milky Way – but with only 7x35 binoculars. I bring this up because it's interesting to me that I can see *just as many* GCs in M31 as I can in the Milky Way only by seeing 6 magnitudes fainter!

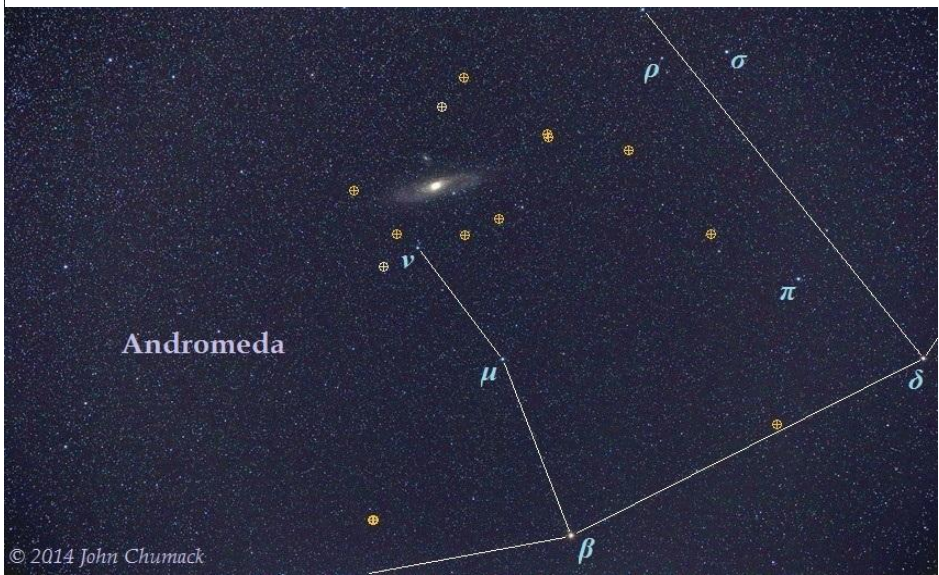
Meet Messier 31 (NGC 224)

While the Andromeda Galaxy was discovered over a thousand years ago, it's only been thought of as a galaxy like our own for about a hundred years. We now know that it is the largest galaxy in the Local Group and one of the largest spiral galaxy's known in the Universe. It currently resides 2.54 million light-years (~780 kpc) away, though it is moving towards the Milky Way at a rate of 68 miles per second (110 kps). At that rate, it is estimated that M31 will collide with the Milky Way four and a half billion years from now. Physically, its disk is over 200,000 light-years across – but since it's tipped only 12.3° from edge-on, its western side is closer to us. So although 1' is equal to about 740 light-years along its major axis, that number changes dramatically as you sweep across it from NW to SE. And in case you're wondering, we see it as rotating counterclockwise.

With M31 being so near, its halo of GCs is very spread out in our sky. So

Far Out

Some of M31's brightest globular clusters are scattered pretty far out from it.



it's best to come at this project much like you would for a large, loose galaxy cluster like Abell 1367 in Leo – only looking for a few faint points of light in each field of view. Fourteen of the GCs I saw were beyond a whole degree out from it while the farthest out of the bunch, MGC1, sits roughly 8.5° to the SSE of M31 just into Pisces. I strongly encourage anybody with an 8-inch or larger telescope to try and see it because it lies farther out from M31 than our farthest confirmed GC (AM 1) does from the Milky Way. That may make it sound more difficult, but since it lies *in front* of M31, it is actually the closest globular cluster of M31's to us at a distance of about 2 million light-years. Hence it is also the second largest visually!

The Prizes

As you can imagine, since I've spent *so much time* viewing the Andromeda Galaxy, I've seen more than just GCs. In fact, I've seen quite a few OB associations (young stellar groupings), open clusters, emission nebulae, dark nebulae, and even a couple stars associated with the galaxy. The only other galaxy that reveals more wealth to amateurs is the Large Magellanic Cloud – the fourth largest galaxy in the Local Group. The great William Herschel discovered the first object in M31 back in 1786. Now known as NGC 206, it's a giant stellar association in the SW part of the galaxy's disk. Compared to NGC 206 though, the two dark lanes on its western side are probably the easiest to spot in a small telescope.

For all but two of the 80-plus objects that I logged, I used my vintage Meade 10-inch Schmidt-Cassegrain telescope and only a magnification of 140x. I intentionally used a moderate magnification to set the bar low to better encourage those under brighter skies or with smaller telescopes. As to the magnitudes of the faintest objects that I saw, I can firmly say that they were all brighter than +16.2 – regardless of their listed magnitude. This is simply because the faintest stars I have been able to see near the zenith at *high power* were magnitude +16.2! That may sound incredible – and it is – but I was aided by my observing site, which is at my home (altitude 650 feet/195 meters), where I can occasionally see stars down to magnitude +7.5 with the unaided eye. But the main reason I believe other observers will find my observations so useful are because I have put a rating of visibility on virtually every object I was able to see. Spanning from 1 (easiest) down to 5 (hardest), I made most of my final ratings on four nearly consecutive nights at the very end of 2017 under great conditions.

I would like to note that I found that the magnitude +7.0 star HD 3914, which lies 13.5' SW of M32, was perfect for focusing my 19mm Tele Vue Wide Field eyepiece. But whatever star you use, do check back to it from time to time to make sure you've still have perfect focus because it's very important. Any slight change won't be readily noticeable but will have an impact on how faint you're able to reach.

Challenges Galore

Because most of M31's GCs appear stellar even at high magnification, they allow amateurs with surprisingly small telescopes opportunities to glimpse them. For example, Danish amateur Thomas Jensen has amazingly seen four in his high-quality 85mm refractor and Finnish amateur Jaakko Saloranta has seen a dozen in his 4.7-inch reflector.

In my journey to find all the GCs of M31 that are visible in my telescope, I learned of and attempted to view many that were just a tad too faint. Because of that, I now believe that if I had used a higher magnification on a 12-inch telescope, I could have seen 80 GCs. For those with larger telescopes than myself, I've included a PDF in the zip folder with a list of what I believe are the next 25 easiest GCs to see.

Like our knowledge of M31 itself, its list of GCs is constantly growing and evolving as new ones are discovered or old ones reclassified. The first catalog of them was published way back in 1932 by Edwin Hubble. My list contains many from that first catalog and even two new ones from a survey published in 2014. Which means they've been discovering GCs of M31 that are bright enough for me to observe in only my 10-inch telescope for over 80 years! So I wouldn't be surprised if in the near future a few more GCs could be added to my list or a few objects reclassified. But I stress that as of its

publishing in late 2018, my list contains the most up-to-date classifications and information.

Your Maps

The main photographic finder-chart that I have made up is from a beautiful image taken by Robert Gendler of www.robgendlerastropics.com. It is the most splendid mosaic of M31 that I've ever seen, but I must point out that it has processing defects that make an occasional star appear dimmer than it actually is. Due to its immense size, it should be sufficient for finding all but fourteen of the GCs. For those that are more than 1° out, I've created a set of PDF finder-charts.

I would like to mention that for those who have a larger telescope than myself, you might also try for GCs in other Local Group galaxies. You're best chances to glimpse a few would be in M33, NGC 147, NGC 185, NGC 205 (M110), NGC 6822, the Fornax Dwarf, and Wolf-Lundmark-Merlotte (WLM). For myself, the only other galaxies that I've managed to see GCs in are M33, NGC 205, NGC 6822, WLM (each with one), and the Fornax Dwarf (with four). For more on this subject, Alvin Huey offers finder-charts in his free PDF guide titled "The Local Group", which is downloadable at www.faintfuzzies.com.