

0: ½ MPC ~ 1.5 Mly, the **Milky Way**, including its two Magellanic Cloud irregular spirals and many spheroidal dwarf galaxies and GCs.

1: 2 Mpc - 5 Mly, the **Local Group**, The *Milky Way – Andromeda – Triangulum* galaxies with their satellites, plus the *Sculptor Group* (N55 at ~10 Mly).

2: 6 Mpc ~ 20 Mly, the **Local Supercluster**, The *M81 - CVn – M83 – CenA* groups, plus the **Leo Groups** (several Messiers at ~40 Mly).

3: 20 Mpc ~ 70 Mly, the **Virgo Supercluster**, The *UMa – Coma -Virgo* groups, all in the background at ~50 Mly.

4: 90 Mpc ~ 300 Mly, the **Surrounding voids and supercluster filaments**, for instance *Taurus Void* and *Perseus-Pisces wall*.

5: And beyond...

Most galaxies as seen in small telescopes from a suburban backyard will show up as just faint patches or stellar points surrounded by tiny halos; What interests me though is not so much what I'm able to catch of details in the individual objects, but rather the **large-scale location and distribution of the galaxies**, that is: how the groups can be seen "wide field" on the celestial dome as I zoom out from our *Milky Way*.

Below I've listed the Messier galaxy objects, arranged according to their distance from our own Milky Way galaxy:

5: Galaxies [40]

M NGC LOCAL GROUP (5 Mly) Autumn

M31 N224 S And *Great Andromeda*
M32 N221 E And Dwarf to M31
M110 N205 E And Dwarf to M31
M33 N598 S Tri *Triangulum/Pinwheel*

M NGC LOCAL SUPERCLUSTER (Near~ 15 Mly)

M81 N3031 SA(s)ab UMa *Bode's*
M82 N3034 IO UMa *Cigar*
M94 N4736 (R)SA(r)ab CVn *CrocEye* Canes-I
M64 N4826 (R)SA(rs)ab Com *Black Eye*
M83 N5236 SAB(s)c Hya *S.Pinwheel* Cen-A

M NGC LOCAL SUPERCLUSTER (Far~ 30 Mly) M101-Cloud

M101 N5457 SAB(rs)cd UMa *Pinwheel*
M51 N5194 SAbc CVn, *Whirlpool*
M63 N5055 SAbc CVn *Sunflower*
M66 N3627 SAB(s)b Leo E Triplet
M65 N3623 SAB(rs)a Leo E Triplet
M96 N3368 SAB(rs)ab Leo W Triplet
M95 N3351 SB(r)b Leo W Triplet
M105 N379 E1 Leo W Triplet

M NGC VIRGO SUPERCLUSTER (60-70 Mly) →

- VIRGO-I Core
- UMa-I Association (SUPERGROUP)
- COMA-I Association (SUPERGROUP)

5: Galaxies 40 -- continued]

M NGC VIRGO-I CORE (60 Mly)

M87 N4486 cD pec Virgo A Wall W
M86 N4460 E2 Vir *Markarian* Wall W
M84 N4374 E1 Vir *Markarian* Wall W
M58 N4579 SAB(rs)b Vir Wall E
M59 N4621 E5 Vir Wall E
M60 N4649 E2 Vir Virgo C Wall E
M49 N4472 E2 in Vir Virgo B Outskirts
M61 N4303 SAB(rs)bc Virgo S Outskirts
M85 N4382 SA0+(s)pec Com Outskirts
M88 N4501 SA(rs)b Com Hook N
M91 N4589 SB(rs)b Com Hook N
M89 N4552 E0-1 Vir Hook S
M90 N4569 SAB(rs)ab Vir Hook S
M98 N4192 SAB(s)ab Com Triangle
M99 N4254 SSA(s)c Virgo N Triangle
M100 N4321 SAB(s)bc Com Triangle

M NGC COMA-I Association (60 Mly)
-- N4725,N4565 --<no Messier galaxies>

M NGC UMa-I Association (70 Mly)

M106 N4258 SAB(s)bc CVn
M108 N3556 SAB(s)cd UMa
M109 N3992 SB(rs)bc Uma

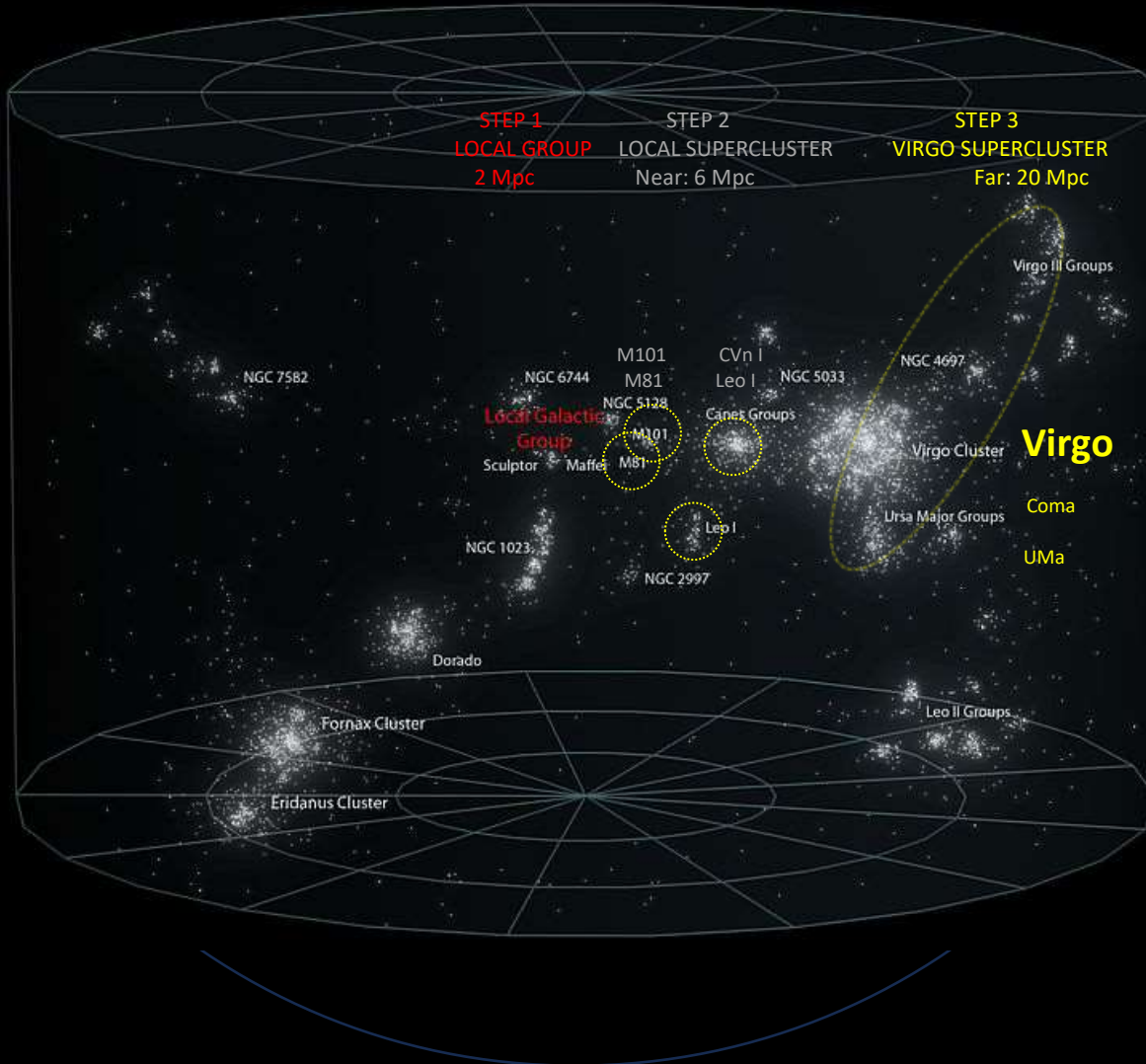
M74 N628 SA(s)c Psc *Phantom* 30 Mly
M104 N4594 SA(s)a Vir *Sombrero* 30 Mly
M102 N5866 SA0 Draco *Spindle* 50 Mly
M77 N1068 (R)SA(rc)b Cetus 50 Mly

Step 3: 20 Mpc ~ 70 Mly The Virgo Supercluster

The *UMa* – *Coma* -*Virgo* groups,
all in the background at ~50 Mly.

Our own **Local Group** of galaxies includes the large *Milky Way* and *Andromeda* spirals with their associated satellites and dwarf galaxies (inside a space volume of ~3 Mpc). The Local Group is a foreground member of the **Local Sheet**, located per definition at origo (coordinate 0,0,0) in the Super Galactic reference frame. The Local Sheet stretches as a “*Spring Milky Way of galaxies*” from north to south on the night sky, roughly around 12h R.A., and encompasses (besides the Local Group):

- the **nearby (~5 Mpc) galaxy groups** of M81/82 Group in UMa, the CVn-I Group in Canes Venatici and the M83 Group in Centaurus, and also the **more distant (~10 Mpc) galaxy spurs/clouds** of the M101 Group in UMa and the Leo-I Groups in (you guessed it) Leo. These groups are all referred to as our Local Supercluster.
- far in the background (~15 Mpc)** are found remote galaxy groups such as the *M108/109 UMa* Group, the *Coma and Virgo* galaxy clusters plus the *Centaurus* Cluster (A3526), all part of the **Virgo Supercluster**



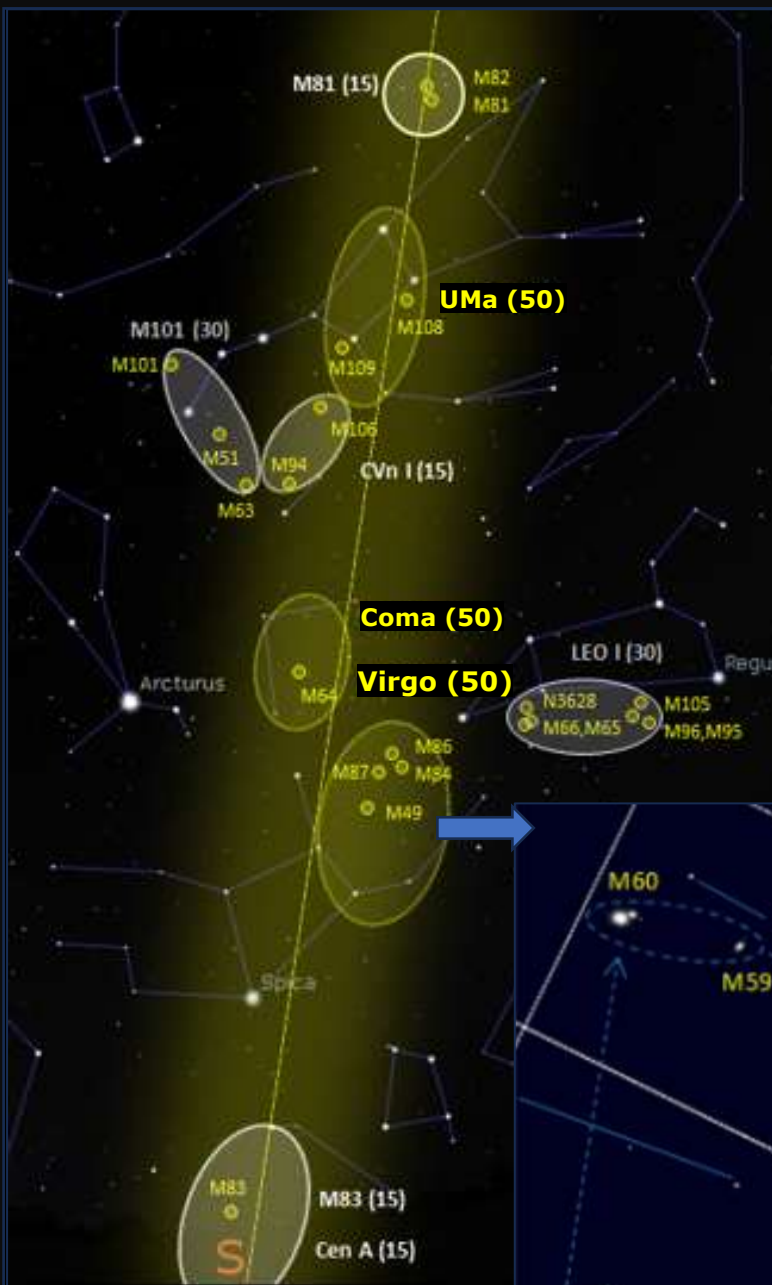
The Virgo Supercluster

has at its gravitational center the large **Virgo Cluster**, which is composed of ~2000 galaxies located in three distinct substructures, each centered on old massive “early” spherical/elliptical systems:

- Virgo A:** M87 E0-1 plus M86 E3 - M84 E1, the largest subgroup that also includes: M89 E0, M84 E1 - M85 S0, and the spirals M58 SBb, M88 Sb - M91 SBb, M90 SBab, M100 SBbc.
- Virgo B,** M49 E2
- Virgo C, or E (East):** 60 E1, including M59 E5

Moving out to the **Virgo Cluster**, the galaxies (though many of them giant in size) are now starting to shrink to mostly featureless 'faint fuzzies' in small amateur telescopes (like mine), showing only few outline characteristics such as orientation, differentiation in bulge/bar and disk, major starburst regions in spiral arms, -- and occasionally a few details such as colliding galaxies and jets.

But always rewarding, if you are persistent, and like a challenge...



The Virgo Cluster proper is an aggregate of several separate sub-clumps:

- Virgo A, centered on M87 - M86/84, and
- Virgo B, centered on M49,
- Virgo N (north) centered on the galaxy M99
- Virgo E (east) centered on M60
- Virgo S (south) centered on M61



Features(s): VIRGO CLUSTER, The Wall E Date: 2016-04-08 Time: 23:30 UT Location: 56N 12E DENMARK
 Conditions: Trsp. 5/7 falling to 1/7 Seeing: 8/10 Instrument: VIXEN FL-80S
 Aperture: 80mm f:8 Focal Length: +1.7x GPC ~ f:13.6 EP/Filter/Mags: CZJ 0-25mm, 44x @ 1° FOV
 Notes: Observation 01:30-02:30 Loc, High haze/cirrus at the end, NELM 5.3 (SQM 18.4)
 Field drawn using CZJ 25 ortho (44x @ 1° FOV)
 Galaxies drawn using CZJ 16 ortho (68x @ 0.6° FOV)

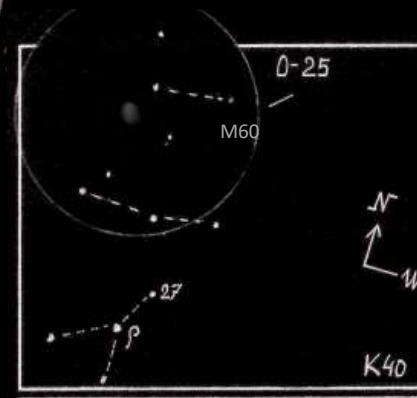
VIRGO CLUSTER, "The Wall", East: M60 - M59

It's past midnight (01:30-02:30 Loc. Time) in early April, 2016. I have the Vixen FL-80S out under a Bortle 7/Red suburban transition night sky in my backyard, -- the seeing is steady at 8/10, and the transparency just above medium at 5/7, with NELM 5.3^m (SQM 18.4); However, there's a curtain of haze rising up 15° from the horizon, so my time for observation will be limited.

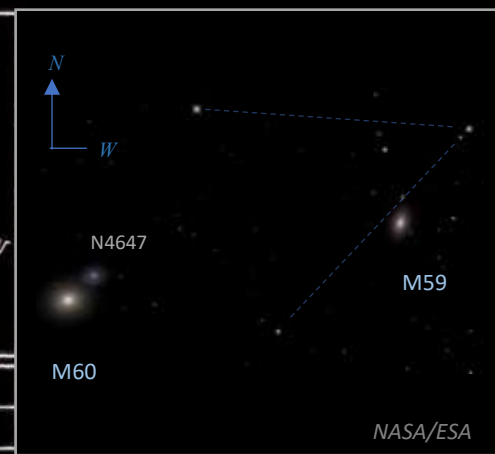
I start out by centering my small refractor on *Rho VIR*, which is easily found naked eye ca. 5° W of *Eps VIR* (*Vindemiatrix*). In my K-40mm eyepiece (27x @ 1.5° FOV), *Rho Vir* is at the center of a bright, easily recognized LAMBDA (λ) asterism, and there's a line of 3 fainter (~9^m) stars at the top of the same field of view. Placing the 3 stars now at the bottom of the field (i.e., moving up almost 1° in DEC), I get a smaller line of 2 faint (9^m) stars in the upper part of the field; M60 and M59 are just below (to the SE) of these two stars.

- M60** : is the easternmost galaxy of this pair; It is easily seen at 27x, but I choose to click up the magnification to 44x (O-25mm) for my drawing, which will thus be framed at ~1° FOV. In this frame I can nicely hold the pair of Virgo galaxies: M60 and M59, which form the eastern part of *The WALL* in the Virgo Cluster. M60 is the larger and brighter of the pair. It shows up in my 80mm refractor (68x, O-16mm) as a bright core, somewhat triangular in shape with the triangle apex oriented towards NW, surrounded by a fainter halo. The observed asymmetry of the core is probably due to the merged images of M60 + the nearby smaller galaxy NGC 4647.

- M59**: is seen as a slimmer, oval patch of nebulosity, roughly only half the size and brightness of M60. It does have a brighter core, slightly elongated towards the N. There's a 11^m star ca. 3' to the N of M59.

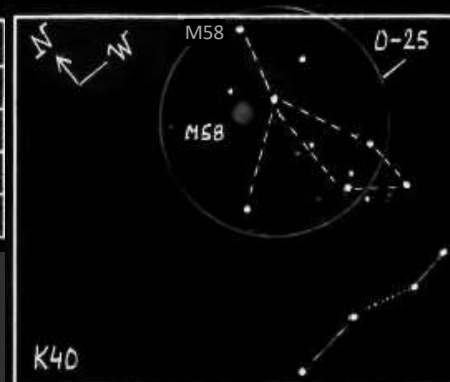


Time: 2016-04-08 23:30 UT EP/Mag: K40 / 44x
 ID/PA: 1.5° FOV



VIRGO CLUSTER, "The Wall", East: M58

Feature(s): VIRGO CLUSTER, The Wall E	Date: 2016-04-09	Time: 21:30 UT	Location: 56N 12E, DENMARK
Conditions: Trsp, 4-5/7, NELM 5.0	Seeing: 8/10	Instrument: VIXEN FL-80S, 80mm f/8	
Aperture: 80mm	Focal Length: +1.7GPC ~ 1088mm	EP/Filter/Mags: Field CZJ 0-25, 44X @ 1° FOV	
Notes: Galaxy observed w/ CZJ 0-16, 68x @ 0.6° FOV Round outline, No obvious orientation or brighter core			



Time:	EP/Mag: K40, 27x
ID/PA:	1.5° FOV

Switching back to my "finder eyepiece" (K-40mm, 27x @ 1.5° FOV), I now move W in RA, until the line of 3 stars mentioned above is just swept out of the FOV (ca. 1½°). I now have a **KITE asterism** (of 9^m stars) in the field, and just E of the easternmost star in the KITE, I see M58.

M58 is a rather featureless galaxy in the 80mm refractor, round with no obvious orientation or structure of the core. It appears less bright than both *M60* and *M59*.



2019-03-26, 00:10 CEST (UT+1)
Temp 2°C, Hum.87%, DewPt 0°C
Moon71% (20dy) at SE horizon
LP 19.6 (NELM 5.8) Suburban
Trsp.: 5-6/7, Seeing 8-9/10

Zeiss APQ 100/640
610nm Red Longpass
PVS 14, Photonis 4G Intens
Gain: Medium-High
iPhone 5S, NightCap 9.4
Exp.: 0.5s, Ave 35s, ISO 1600



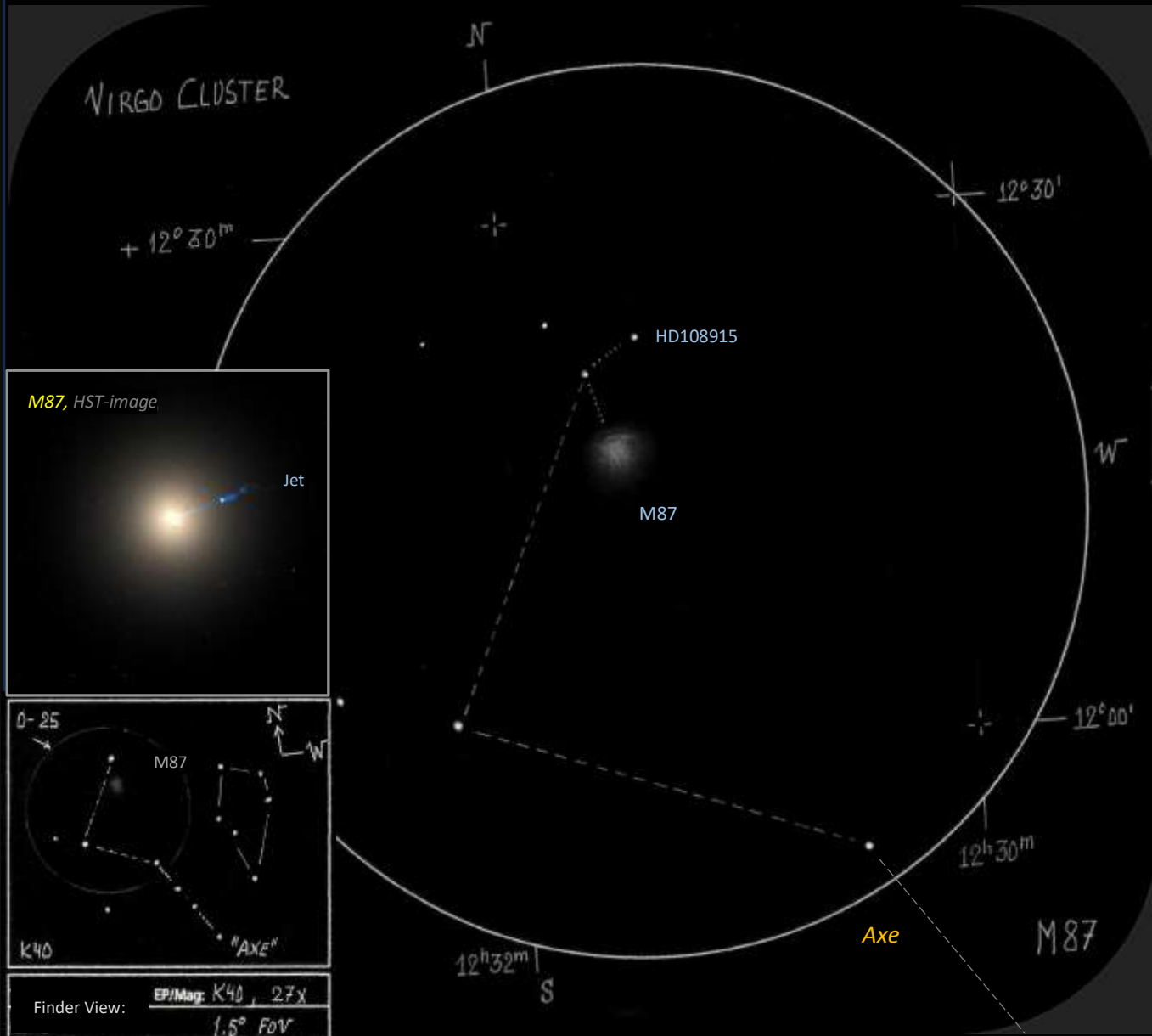
M58 ("The Ring Bearer") is an anemic barred spiral galaxy with little neutral hydrogen gas and low star formation in the disk, but with an ultra-compact nuclear ring (UCNR) featuring a series of star-forming regions around the center.

VIRGO CLUSTER, "The Wall", West: M87

Feature(s): VIRGO CLUSTER, The Wall W	Date: 2016-04-09	Time: 23:30 UT	Location: 56N 12E, DENMARK
Conditions: Trsp. 3-4/7, NELM 5.0	Seeing: 8/10	Instrument: VIXEN FL-80S, f:8	
Aperture: 80mm	Focal Length: +1.7x GPC ~ 1088mm	EP/Filter/Mags: Field: CZJ 0-25, 44x @ 0.9° FoV	

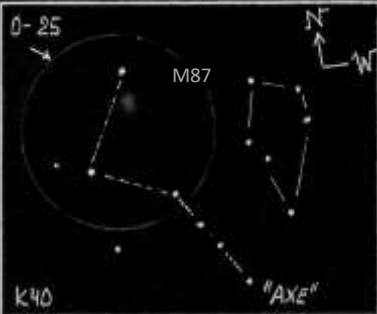
Using my "finder eyepiece" (K-40mm, 27x @ 1.5° FOV), I now move further W in RA, until the *KITE-asterism* of 9^m stars mentioned for M58 is just swept out of the FOV (ca. 1½°); I now have a new *AXE-asterism* (of ~9^m stars) in the field, and just below (to the SW) of the tip of the AXE I find: **M87**. This galaxy is easily seen as a relatively bright and round nebulous spot. In the 80mm it looks like a mottled fuzzball, reminiscent of a globular cluster.

M87 is the dominant central galaxy of the *Virgo Cluster*, and the most massive galaxy known, with many smaller companion galaxies and >16,000 globular clusters! It has a central jet, that is 65 KLY (25") long, caused by fast particles accelerated in a strong magnetic field and emitting synchrotron radiation. The jet is ejected by a super-massive black hole surrounded by a central accretion disk that is one of the strongest radio and X-ray sources in the sky (*Virgo A*, "The Smoking Gun"). The jet gains direct visibility only in telescopes with a relatively large aperture and magnifications > 300x.



2019-03-29, 23:00 CESTR (UT+1)
 Temp.: 6°C, Hum.: 84%, DewPt.: 4°C
 Moon 34% (43 dy) -40° @ E horizon
 LP: SQM 19.0 (NELM 5.6) suburban
 Trsp.: 4-5/7, Seeing 6-7/10

Vixen FL-80S/640 f/8 refractor
 +1.7x GPC ~f/13.6
 R2 ccd/lcd Live video + 0.5x red
 Manual Exp.: 5s, Ave.: 6 DNR
 One frame live video capture



Finder View: EP/Mag: K40, 27x
 1.5° FoV

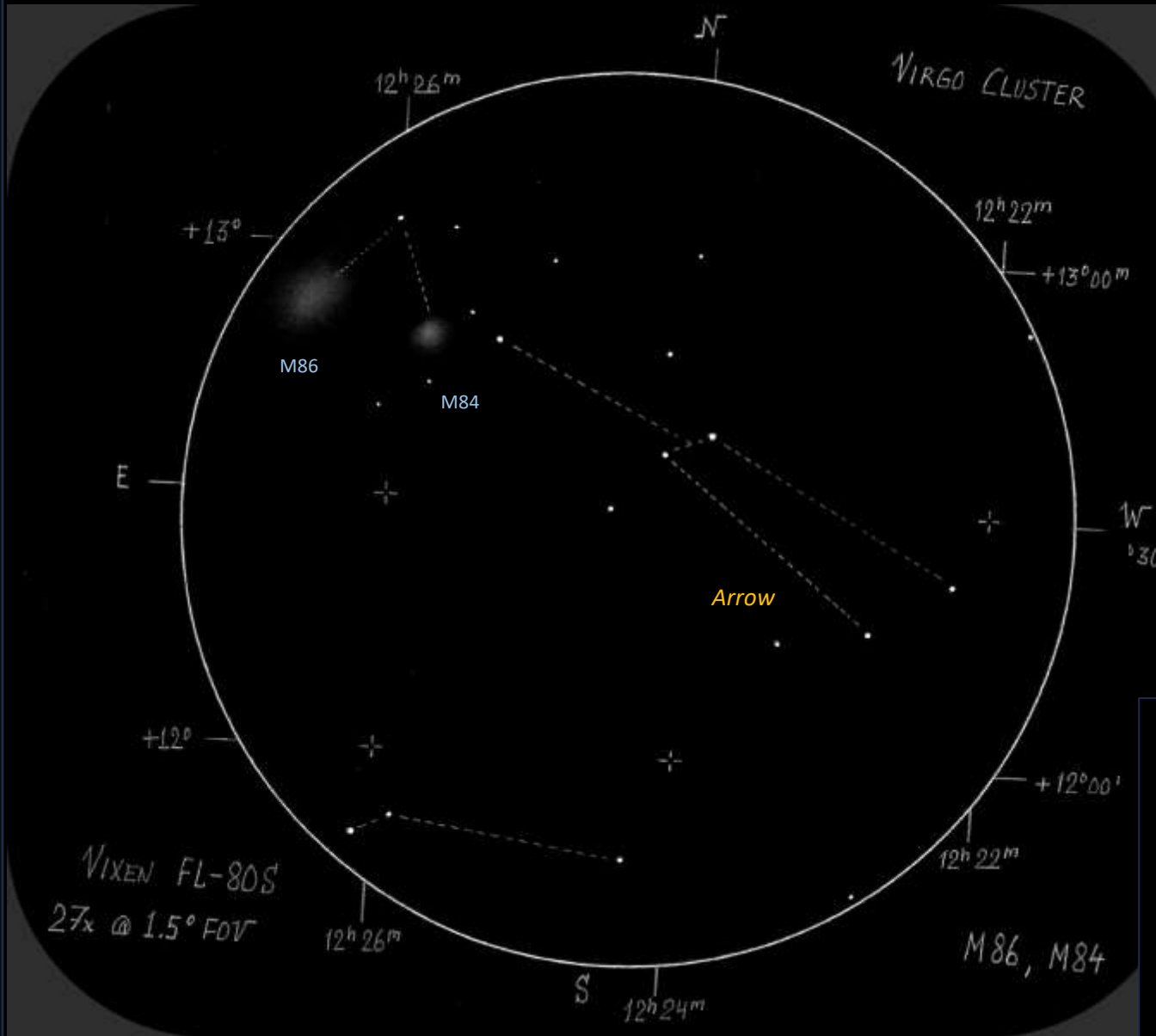
It's the end of March, closing in on midnight (2019-03-29, 23:00). The temperature is a comfortable 6°C, with a medium humidity (84%) and DewPt (4°C). The 34% (24 Dy) Moon is way down -40° Alt. below the horizon, so the LP is a controlled NELM 5.6 (SQM 19) suburban. All set for my quest tonight: the **M87 Jet**.

I have brought out my Vixen FL-80S f/8 refractor, and have zoomed in on M87 with my Zeiss O-10mm eyepiece (108x, 0.4° FOV); With glass only, the giant elliptical galaxy is seen as a relatively bright and round nebulous spot, like a globular cluster.

For more detail, I now switch to live video using my R2 ccd/lcd, yielding approximately the same magnification (110x in ½° FOV) as the Zeiss O-10mm, but with improved brightness and contrast. Both seeing and transparency tonight are just above medium (6-7/10 & 4-5/7 respectively), and a light wind plus a high atmospheric haze do limit the resolution somewhat. In moments of good seeing, I am however able to spot the jet shooting like a Jedi lightsaber out NW from the "dark side": the powerful central supermassive black hole in the giant elliptical galaxy core. **WOW!**

VIRGO CLUSTER, "The Wall", West: M86 – M84

Feature(s): VIRGO CLUSTER, The Wall W Date: 2016-04-11 Time: 22:00 UT Location: 56N 12E, DENMARK
 Conditions: Trsp. 5-6/7, NELM 5.6 Seeing: 8/10 Instrument: VIXEN FL-80S
 Aperture: 80mm f:8 Focal Length: +1.7x GPC ~ 1088mm EP/Filter/Mags: FIELD : ATC K-40, 27x @ 1.5° FOV



This is the night following my observation of M87 (described above). The humidity and haze of the previous night are gone, and I have relocated to my "darker site" at our weekend cottage; All in all, the observing conditions are as excellent as it gets, here just north of Copenhagen. I start out with the AXE asterism (anchoring M87) in my K-40mm eyepiece, for 27x @ 1½° FOV.

Moving now one FOV in RA to the W (~1½°), I get an **ARROW asterism** (somewhat like a small Sagitta constellation) in the field, and to the E, just off the tip of the arrow, I spot the **M86 – M84 pair** of galaxies as two faint fuzzies, separated by only 20'. They both have brighter centers and softer outer haloes.

M84 and M86 are two giant elliptical galaxies forming a physical pair at the base of **Markarian's Chain**, which is at the heart of the Virgo cluster, ca. 54 MLY from our solar system. The two galaxies are each of ~9^m luminosity, ca. 20' separated, and both show condensed centers with softer outer halos. M86 is the larger, more elongated and diffuse elliptical, and hence with a lower SB than M84.

M86 : is the easternmost of the pair, noticeably larger but more diffuse and slightly elongated towards the NW.

M84 : is closer to the tip of *The Arrow*, with a rounder and brighter appearance

Markarian's Chain

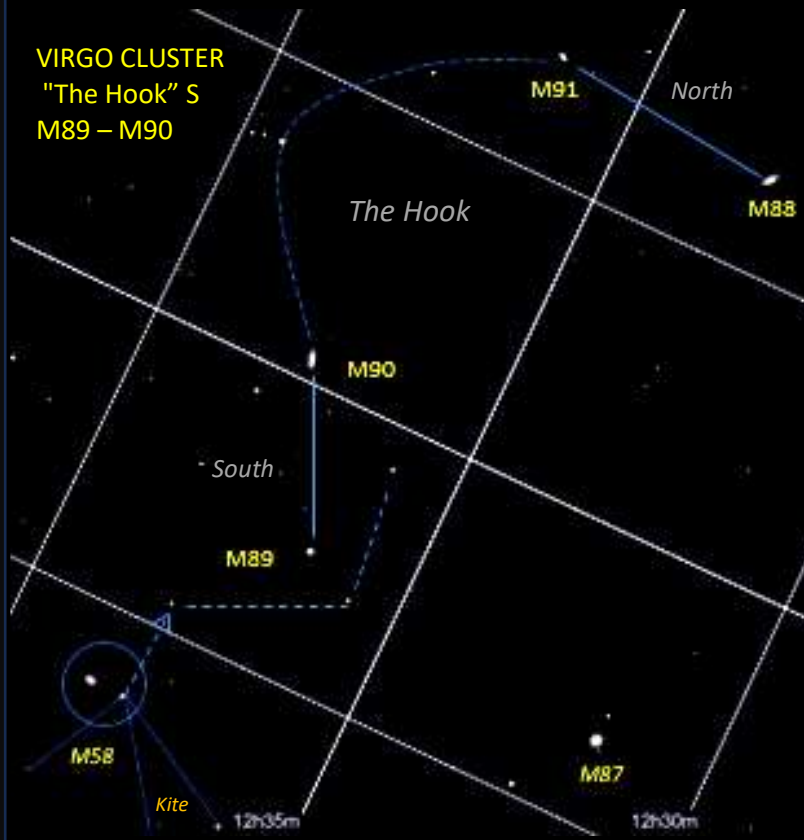


M86, HST-image

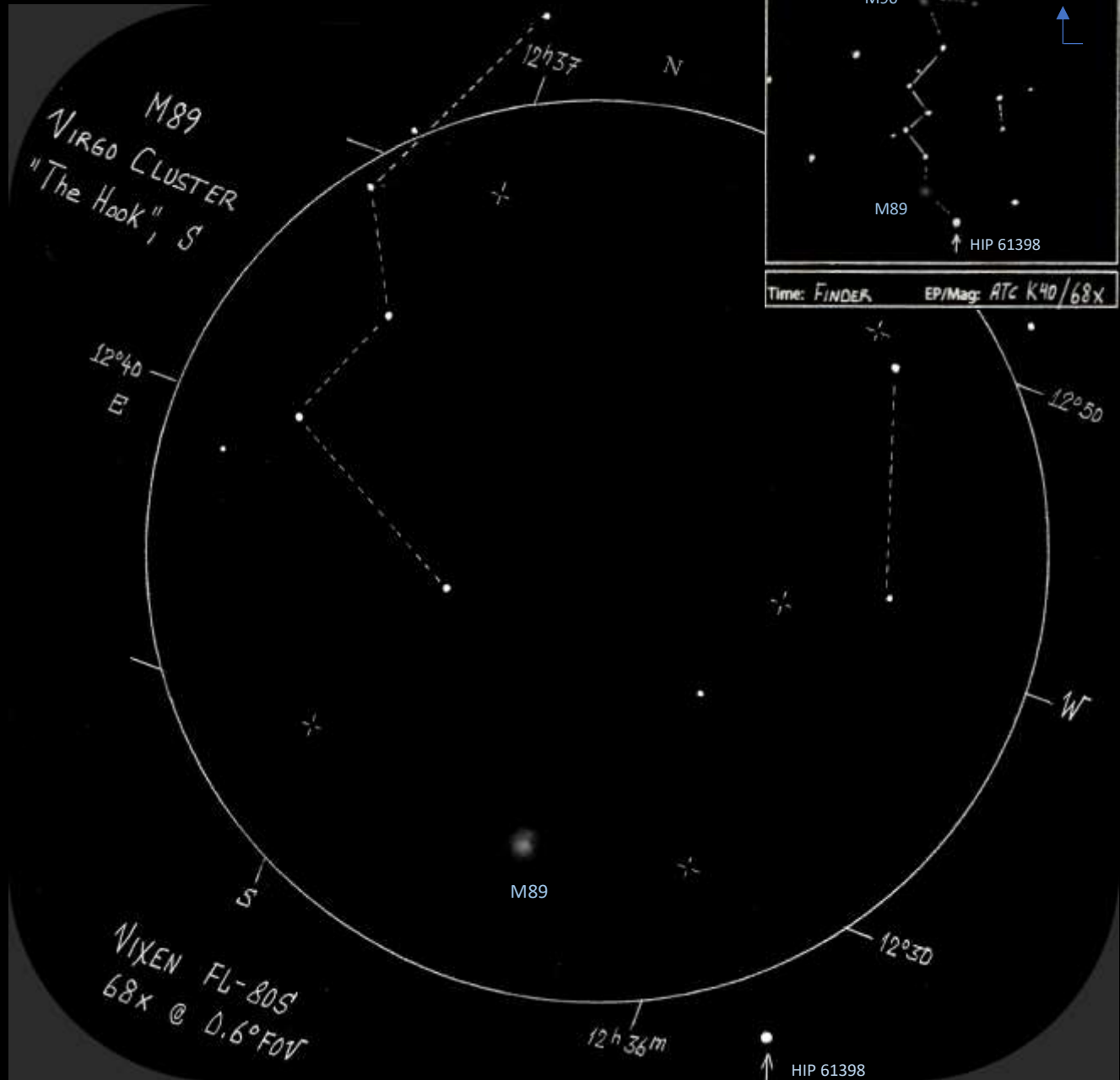


M84, HST-image

VIRGO CLUSTER
"The Hook" S
M89 – M90



Feature(s): VIRGO CLUSTER, The Hook S	Date: 2016-05-04	Time: 21 ³⁰ -22 ⁰⁰ DT	Location: 56 N 12 E, DENMARK
Conditions: Trsp. 5-6/7, NELM 5.3	Seeing: 7/10	Instrument: VIXEN FL-80S, f:8	
Aperture: 80mm	Focal Length: +1.7 GPC ~ 1088mm	EP/Filter/Mags: F/ELD: CZJ 0-16, 68x @ 0.6° FOV	



"For the night is dark and full of terrors..., but the fires burn them all away" (Melisandre, Game of Thrones). -- Well, certainly the sky at our cabin in the local nature reserve is dark this night, May 04. 2016 23:30 local: a NELM of ~5.4 is the best I have experienced in the past 3 months; But to be honest, the closest the night can muster of terror is the soft honking of wild geese out in the bog...

A high pressure has settled over *Scandinavia* today, with spring in its wake. This afternoon I heard the first cuckoo, the first litter of blackbird chicks in our woodshed flew from the nest, and the song-thrush was conjuring up vocal wonders while I put up my Zeiss TM mount with the Vixen FL-80S on top.

My targets for tonight are the Messier-galaxies in the **Virgo Cluster** north of "**The Wall**", starting with the ones forming "**The Hook**" of the *Virgo Galaxy Coat Hanger* (where "The Wall" would then be the proper hanger). M89 will be my starting point at the base of The Hook, and to reach this, I star-hop from *Rho VIR*, then N to the pair M59/M69, and further W along "The Wall" to M58 just before a kite asterism. Placing M58 in the S part of my K-40mm wide field eyepiece (27x @1.5° FOV), I now clearly spot **M89** to the NW, a little to the right of the center; M89 is seen with indirect vision as a round fuzzy patch with a clearly brighter core, that however fades away with direct vision. It has a still fainter outer halo, but all-in-all shows no clear orientation or detail in my 3" refractor.

From M89 a fine line of 10^m stars goes zig-zag up NE, forming a letter W ("*Cassiopeia*") asterism, and at the end of this line, I glimpse the faint glow of **M90**

VIRGO CLUSTER, "The Hook" S: M89 – M90

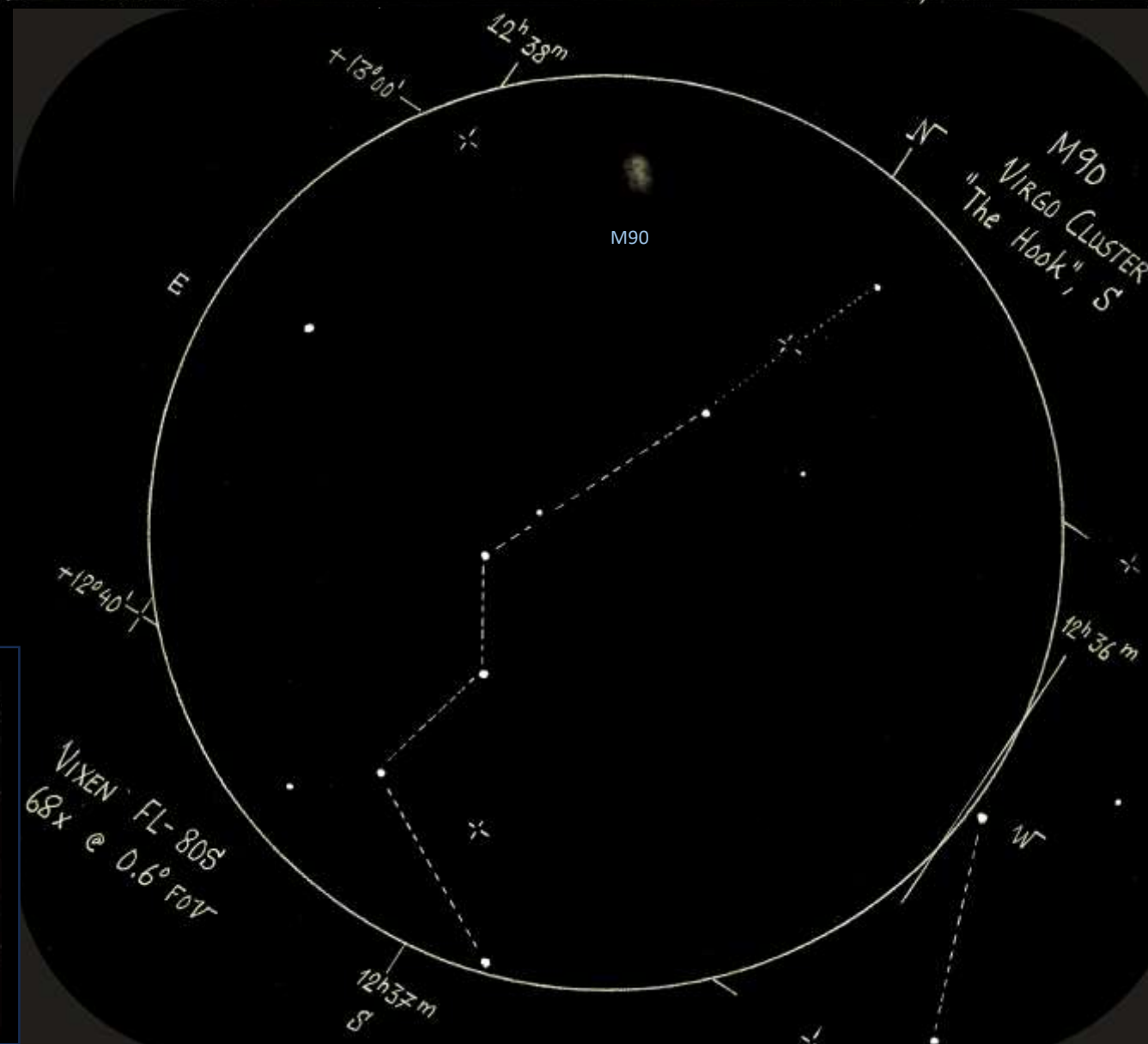
Having observed **M89** for half an hour, I have reached midnight local time, and the night has darkened a little to NELM 5.5. Still no terror, though... ☺

I now nudge the FOV slightly, just 20' up N, thus moving the "W" asterism of 10^m stars from the top to the bottom of the field. To the NE of the end of the zig-zag line of stars, I immediately notice the faint glow of **M90** – most obvious with indirect vision. I keep the field of the O-16 eyepiece for my drawing (68x @ 0.6° FOV), but switch to O-25mm (44x @ 0.9° FOV) for a cleaner view. M90 is fainter than M89, but the blurred haze shows an elongation to the NE, plus a slightly brighter core that appears mottled with indirect vision.

M89 is a round spherical (EO elliptical viewed end-on?) galaxy, with a large, low-luminosity halo. In small telescopes it is seen as a circular structureless nebula with a star-like nucleus. It is a giant galaxy with surrounding structures of gas and dust, showing evidence of previous mergers in combination with a spinning central supermassive black hole. It also features jets of heated particles extending >150 KLY light-years outwards, -- a sign that it was once an active quasar.

M90 is located almost midway between *Beta LEO (Denebola)* and *Epsilon VIR (Vindematrix)*. It's a pale, oval spiral galaxy (PA 25°), with its W side tilted towards us, two massive tightly wound arms, and a star-like nucleus. It has a small irregular satellite galaxy: *IC 3583*, 6' to the N (which I couldn't spot). M90 has lost much of its interstellar medium (ISM: gas & dust) in interactions with other *Virgo Cluster* galaxies (so called "ram-pressure stripping"). It is "anemic" in the sense that it has little star formation (HII-regions) in the arms, but it does have many O-B-A super giants in its compact starburst core. HST images of M90 show plumes of Ha-emitting gas perpendicular to the galaxy disk, probably caused by stellar winds from supernovae in the core, ~30 MYR ago.

Feature(s): VIRGO CLUSTER, The Hook S	Date: 2016-05-04	Time: 22 ⁰⁰ -22 ³⁰ UT	Location: 56N 12E, DENMARK
Conditions: Trsp. 6/7, NELM 5.5	Seeing: 7/10	Instrument: VIXEN FL-80S, f:8	
Aperture: 80mm	Focal Length: +1.7GPC ~ 1088mm	EP/Filter/Mags: FIELD: CZJ O-16, 68x @ 0.6° FOV	



M89, SDSS-image



M90, SDSS-image



VIRGO CLUSTER, "The Hook" N: M88 – M91

Obs-1: It's past midnight, 00:30 local time, and I have been out observing M89 and M90 in the southern part of "The Hook" of the Virgo Cluster for an hour; Now for the big jump to the pair of northernmost galaxies in "The Hook": **M88 and M91**.

I first switch to my K-40mm wide field eyepiece (27x @ 1.5° FOV), then place M89 at the center of the field, and finally hop one whole field of view (1.5°) to the NW. This places bright **M88** (SB 21.5^m/arcsec²) close to the center of view, easily recognized by being embedded in the short side of an obtuse angled triangle of 8^m-9^m-10^m stars. M88 is seen as a clearly SE-NW elongated haze, that appears mottled with indirect vision. It has a somewhat brighter nucleus, but not to the amount of a stellar core. There's a 12^m star at the NW end of the oval, plus a nice pair of 11^m/12^m stars at the SE end (not to be confused with a still fainter pair of stars: 13.8^m/14.2^m, just at the SE tip of the galaxy). All in all, M88 is a beautiful sight in my small 80mm refractor!

Being fainter (SB 22.2^m/arcsec²), **M91** is considerably harder to spot, but I should be able to glimpse it in the same 1.5° FOV as M88, at the tip of an arrow asterism, just E of M88. – Try as I may..., I can't, and as the dew is starting to condense and the temperature is fast dropping to 4°C, I decide to pack up and hit the pillows.

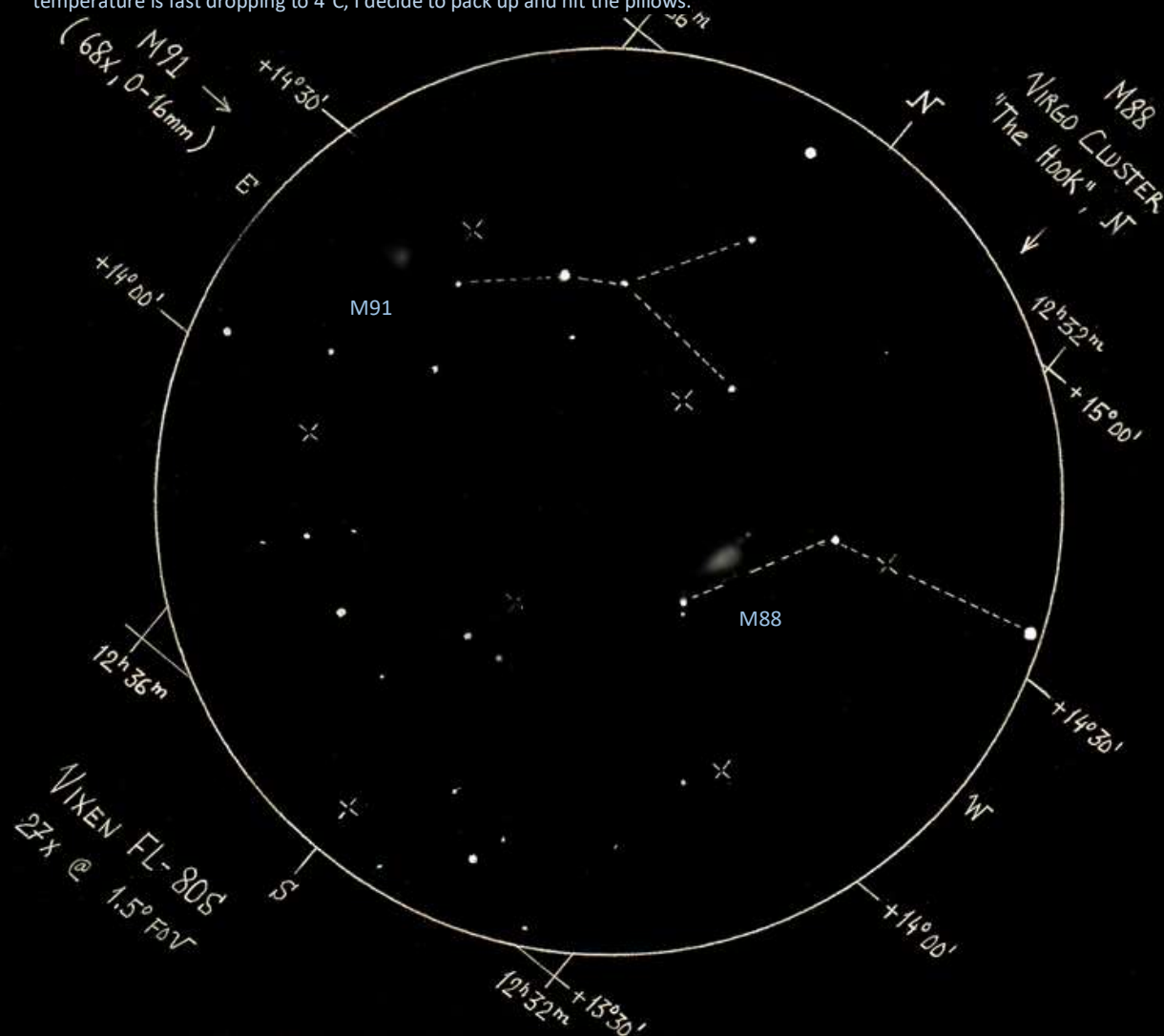
Obs-2: It's the day after my first observation of M88 & M91, again past midnight, and now 01:30 local time. I'm going to give **M91** another try this early May morning, where the observation conditions are as fine as last morning (Bortle: 5-4).

With M88 at the center of the 1.5° FOV of my K40mm eyepiece (27x), I now direct my attention ½° up NE from M88, where I identify an arrow asterism of 10^m stars. The tip of the arrow points towards SE, and just off the tip (a good 5' east) is the location of M91. I now center this location in the field, and click up the magnification to 44x (CZJ 25mm ortho, 0.9° FOV). There's no nebulosity to be seen, and nothing seems to emerge even with indirect vision. I relax, close my eyes and let my night vision fully adapt. Then I open my eyes, direct my attention at the location of M91 with averted vision, and slowly pan the field a little back and forth in the FOV (and thus on my retina). After prolonged observation I think I detect a very faint haze at the location of M91..., it's at the limit of visibility, and I suspect that I may have seen M91 (but I can't say with absolute certainty)...

Obs-3: It has been a couple of days, and the observation conditions have improved marginally, from very good to excellent; My previous two tries at seeing **M91** were slightly hampered by a hint of high cirrus reducing the transparency, but this midnight the sky is clear as can be, and the seeing is steady. I decide to give M91 another try.

Starting with 27x magnification (ATC K-40mm), I center the location of M91 in the 1.5° wide field eyepiece, -- but fail to see any nebulosity; I now click up the magnification to 44x (CZJ O-25 @ 0.9°), and after prolonged dark adaptation (using an eye patch) plus some hyper-ventilation, I finally can hold glimpses of M91 persistently with indirect vision. It is seen as a very faint roundish spot, a veil of thin nebulosity, that disappears as soon as I move it outside the most sensitive part of my averted eyesight. Clicking up the magnification to 68x (CZJ O-16 @ 0.6° FOV) darkens the sky a bit and makes it a little easier to hold the diffuse sight of M91, still only with averted vision.

Well, M91 is after all the faintest of all the Messier objects, and by many considered the hardest to observe. I for one can attest to that, and though others have reported identifying it in a 63mm telescope, and even seeing hints of a bar in a brighter core with just 80mm aperture (under a dark sky and very good observing conditions), I guess I should be satisfied just identifying this distant, pale anemic ghost with my FL-80S in my orange/suburban (Bortle 5-4) backyard.

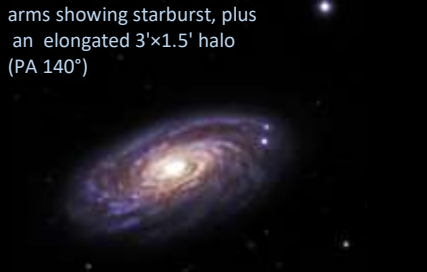


M91 : is a barred spiral galaxy (bar: 70° PA) in *Coma Berenices*. The arms are anemic (stripped of gas & dust), while the core has a high metallicity (Fe/H ratio) due to many "fast" O-B-A stars

M88 is a Sbc spiral galaxy, 64° inclined to the line of sight. It has a small bright core with emission of highly ionized gas (*Seyfert* galaxy with a supermassive black hole). The core is surrounded by spiral arms showing starburst, plus an elongated 3'x1.5' halo (PA 140°)



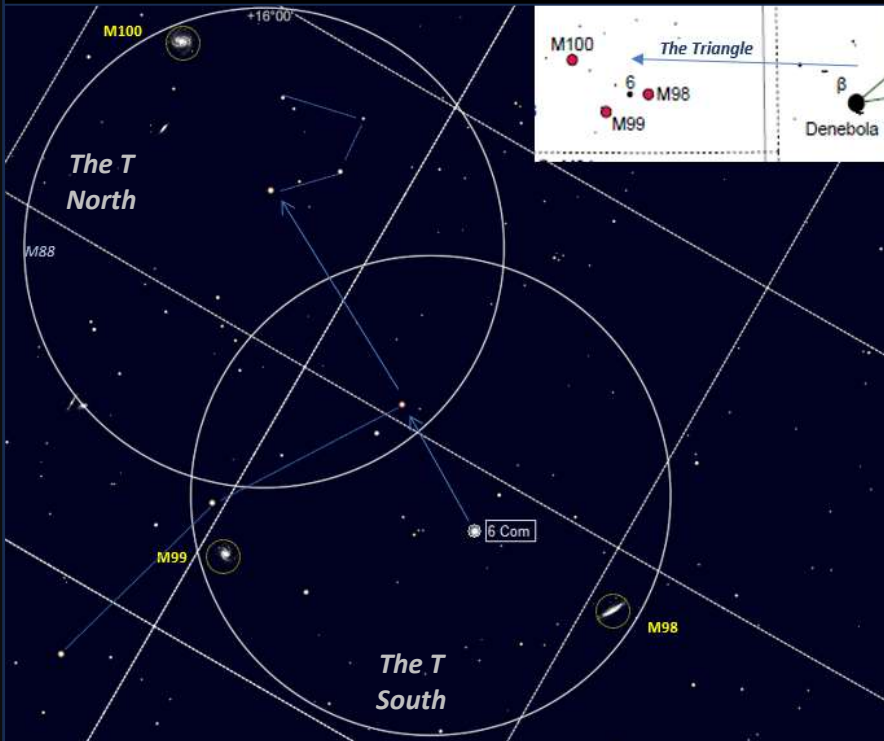
M91
Univ. Of Arizona



M88
Wiki

VIRGO CLUSTER: "The T"

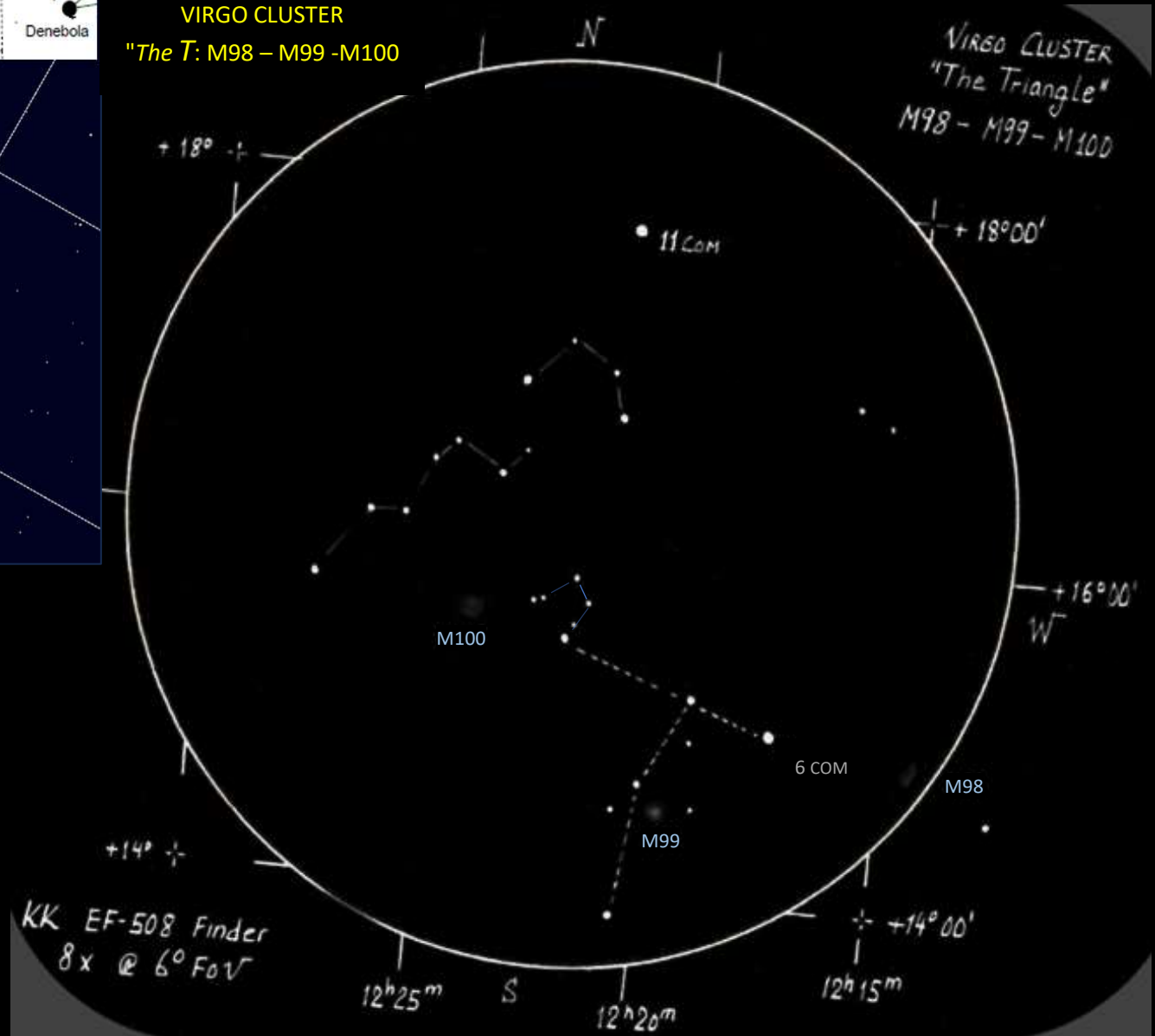
It's a calm, relatively balm spring evening in early May, 23:30 local time. The Moon is below the horizon, and the transparency and seeing are good (NELM 5.4^m), so tonight I will continue my hunt for Messier galaxies in the *Virgo Cluster*, this time focusing on **M98-M99-M100** forming "The Triangle" (aka *The T*) to the NW of the center of the galaxy cluster.



Feature(s):	Search Map M98-M99-M100	Date: 2016-05-06	Time: 21:00 UT	Location: 56N 12E, DENMARK
Conditions:	Trsp. 5/7	Seeing: 7-8/10	Instrument: KK 8x50mm Finder Scope	
Aperture:	50mm	Focal Length: ca. 250mm	EP/Filter/Mags: Kelner EP	
Notes:	6° FOV			
"T" - asterism for locating "The Triangle" of M-galaxies in the VIRGO CLUSTER Kokusai Kohki EF-508 8x50 correct view finder (w. internal Pechan prism).				

VIRGO CLUSTER

"The T": M98 - M99 - M100



Starting at *Denebola* (Beta LEO), I first scan (naked eye) due E ca 6°, where I find *6 Coma Berenices*. Centering my 8x50 finder scope on **6 COM**, I now see a **T-shaped asterism of 6-7^m stars** in the field of view, with 6 COM at the right end of the upper bar in the "T". I use this asterism to locate the 3 Messier galaxies in "*The Triangle*" part of the *Virgo Cluster*:

- off the left (E) upper end of the "T" is **M100**,
- off the right (W) upper end is **M98**, and
- midway in the downstroke of the "T" is **M99**.

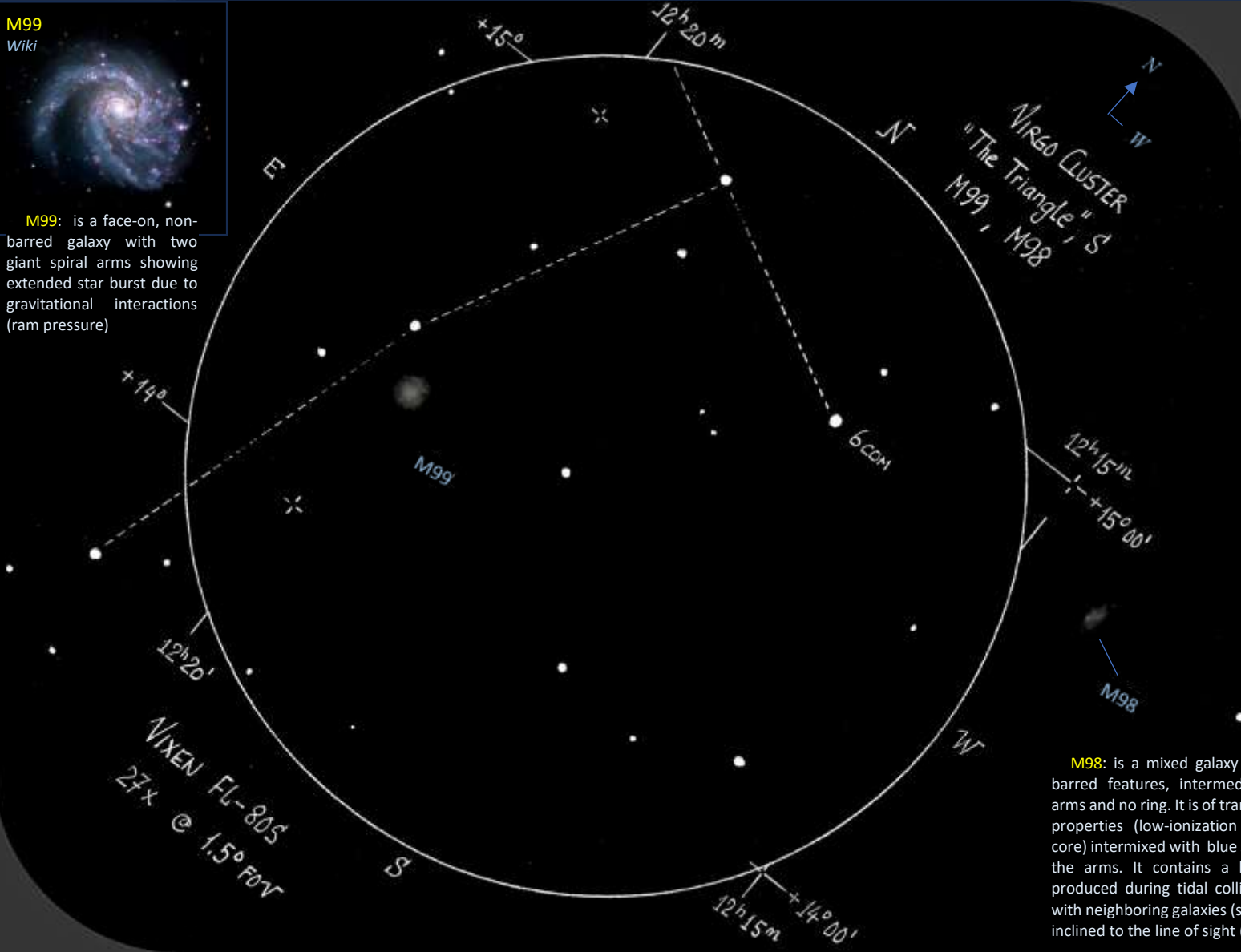
VIRGO CLUSTER, "The T" South:
M98 - M99

Feature(s): VIRGO G. "The Triangle", S Date: 2016-05-06 Time: 21³⁰-22⁰⁰ UT Location: 56N 12E, DENMARK
 Conditions: Trsp, 5/7 Seeing: 8/10 Instrument: VIXEN FL-80S, f/8
 Aperture: 80mm Focal Length: +1.7x GPC ~ 1088mm EP/Filter/Mags: Field ATC K-40mm, 27x @ 1.5° FOV

M99
Wiki



M99: is a face-on, non-barred galaxy with two giant spiral arms showing extended star burst due to gravitational interactions (ram pressure)



M99 is the brightest of the three galaxies, so I start with this one, which I can just glimpse at 27x in my ATC K-40 finder EP.

I keep the field of my drawing as seen with the K-40mm eye piece (i.e., 1.5° FOV), but for the galaxy observation, I increase the magnification, first to 44x (0.9° FOV): M99 is now seen as a weak, round nebulousity without any specific orientation or structure. It does get denser towards the center, but shows no stellar core.

Clicking up the magnification to 68x (0.6° FOV), I suspect a mottled core, and a weak NE-SW asymmetry of the galaxy. One more click to 108x (0.5° FOV), and I can definitely see a mottled core, -- and even suspect fainter, outer sprawling arms! (Says my notes... maybe I was carried away by the nice view).

Continuing my observation of M-galaxies in the S part of "The Triangle" in the Virgo Cluster, I now shift my attention from M99 to M98. I first return to the 1.5° field of my K-40mm EP, and center it on 6 COM in the "T" asterism. This should give me M98 in the W part of the field; -- but I am not able to spot this galaxy at only 27x magnification.

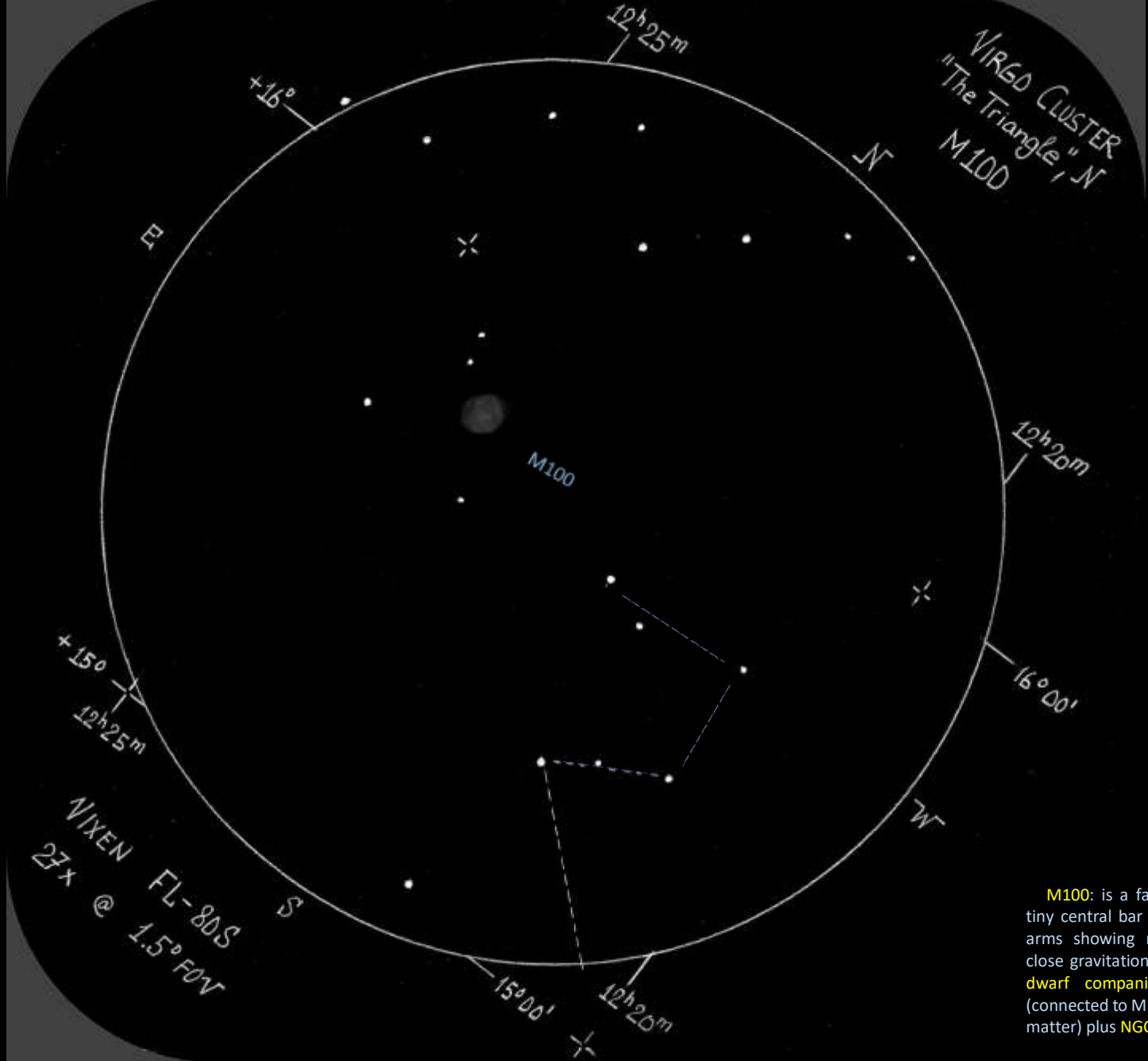
I keep the field for my drawing at 1.5° though (which allows me to draw M98 on the same observation sheet as M99), but I increase the magnification to 44x (CZJ O-25 @ 0.9° FOV); I now catch glimpses of the faint nebulousity of M98 with averted vision: it is seen as a hazy streak of diffuse light with a NW-SE orientation, but with no brighter center or texture (no core, no mottling). It is difficult to observe, as I can catch no more details by shifting the field or increasing the magnification to 68x (O-16mm).

M98
Wiki



M98: is a mixed galaxy with barred and non-barred features, intermediate to tightly-wound arms and no ring. It is of transition type, with LINER properties (low-ionization nuclear emission-line core) intermixed with blue starburst H-II regions in the arms. It contains a large amount of dust produced during tidal collisions and interactions with neighboring galaxies (such as M99). It is highly inclined to the line of sight (angle 74°).

Feature(s): VIRGO G, "The Triangle", N Date: 2016-05-06 Time: 23⁰⁰-23³⁰ UT Location: 56N 12E DENMARK
 Conditions: Trsp, 5/7 Seeing: 8/10 Instrument: VIXEN FL-80S, f/8
 Aperture: 80mm Focal Length: +1.7X GPC ~ 1088mm EP/Filter/Mags: ATC K-40mm, 27X @ 1.5° FOV



VIRGO CLUSTER,
 "The T" North:
 M100

It's past midnight (01:00 Local Time) this May morning, and I've been out observing M99 and M98 for a good hour by now. The night has darkened a bit (now at NELM 5.6^m), so I want to continue and close this observation night with a look at **M100**, the third Messier galaxy in "The Triangle" part of the Virgo galaxy cluster.

I start by returning to **6 COM**, which is my anchor for navigating "The Triangle". I first center the "T" asterism (which includes 6 COM at the NW end) in the 1.5° FOV of my K-40mm finder eyepiece; then I slide the field up, so the pair of stars at the NE tip of the "T" is centered, -- and there I see **M100** in the NE part of the FOV, as a faint, round spot of nebulosity.

I keep the field of 1.5° as the framing for my drawing, but crank up the magnification stepwise, first to 43x (O-25) and later to 108x (O-10) to catch more details. With increased magnification the galaxy is seen (using averted vision) to have a slightly brighter, mottled core inside a large, diffuse and faint halo.

M100: is a face-on spiral galaxy with a tiny central bar and two prominent broad arms showing massive starburst due to close gravitational interaction with its two dwarf companion galaxies: **NGC 4323** (connected to M100 by a bridge of luminous matter) plus **NGC 4328**.

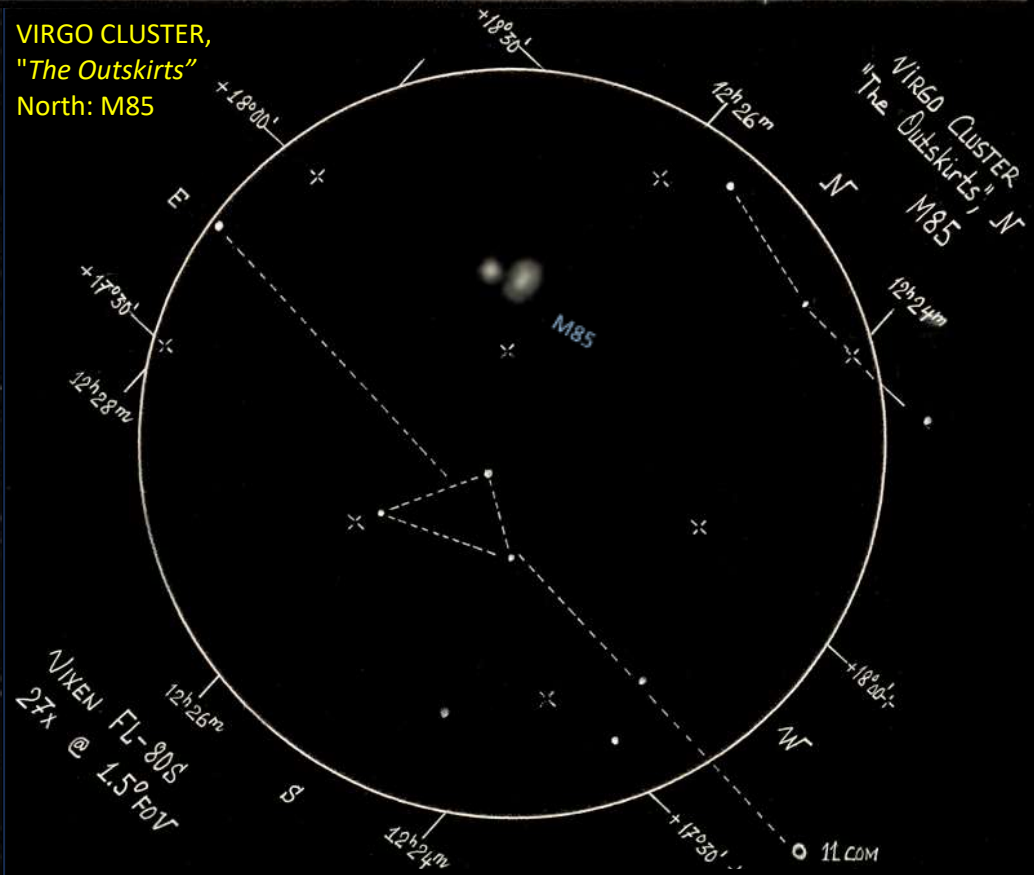


Feature(s): VIRGO C. "The Outskirts", N Date: 2016-05-08 Time: 23:00 UT Location: 56N 12E, DENMARK
 Conditions: Trsp. 5+/7, NELM 5.4" Seeing: 8+/10 Instrument: VIXEN FL-80S, f18
 Aperture: 80mm Focal Length: +1.7x GPC ~ 1088mm EP/Filter/Mags: ATC K-40mm, 27x @ 1.5° FOV



M85 is an anemic (hydrogen stripped) lenticular spindle-type galaxy with warped starburst shells and a counter-rotating core, -- all likely formed by the merger with a satellite galaxy. It has current strong gravitational interaction with nearby **satellite NGC 4394**. There's a bright (10^m) star to the SE, and another fainter (12.5^m) foreground star just 50" N of the galaxy core.

VIRGO CLUSTER,
 "The Outskirts"
 North: M85

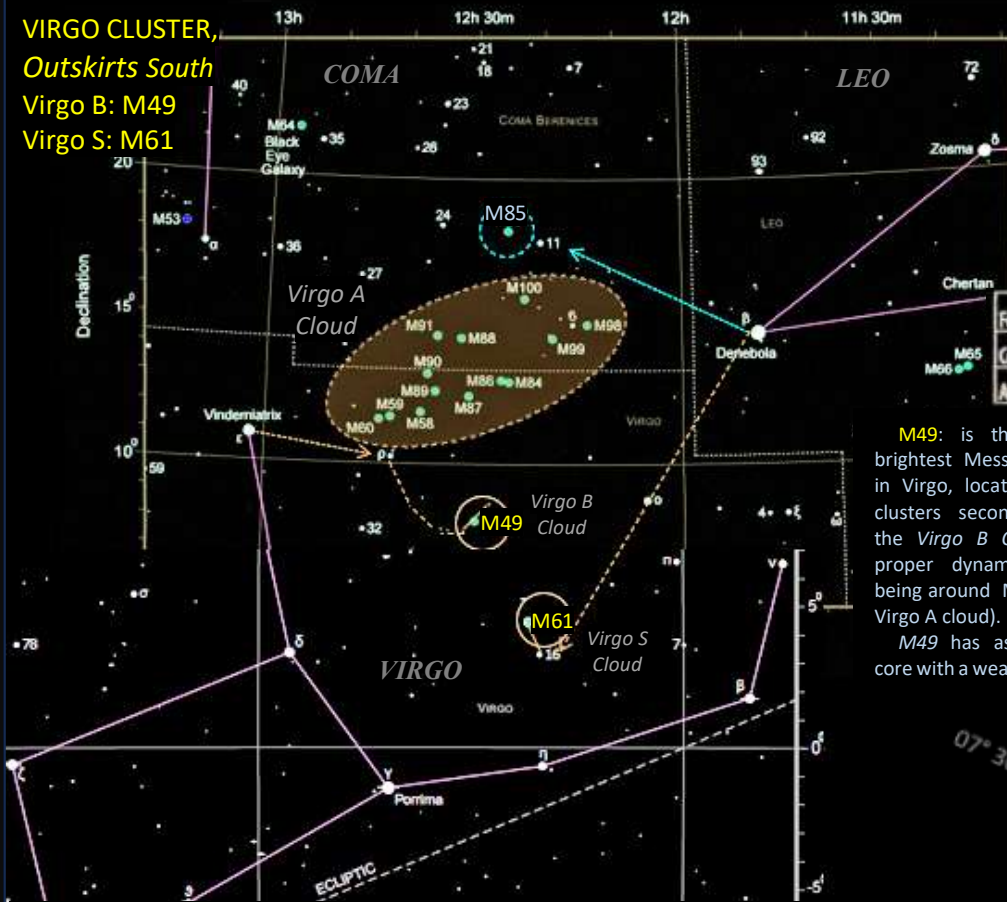


It is just past midnight in the start of May, 00.30 Loc. time. The sky is not quite as dark as in deep winter, given that we now approach nautical twilight, where the sun doesn't sink deeper than 18° below the horizon (for the *Copenhagen* area, this starts in just 3 weeks from now). The cuckoo has entertained us all day the past week, but we have yet to hear the nightly liquid trills and repeated crescendos of the nightingale. Anyway, there's still some time to catch a few more galaxies, before the onset of the white nights with the Swan and the Eagle patrolling along the summer milky way.

My target for tonight is **M85** in the northern outskirts of the *Virgo Cluster*. I prefer to star hop *the Virgo Cluster* by entering "the gates" of either *Rho VIR* (in the Lambda-asterism) or *6 COMA B*. (in the T-asterism). For M85 I start the hop from *Denebola* (Beta LEO), E to *6 COM* and then N to *11 COM*; From *11 COM* I pan slowly almost 1° due E, to a small orthogonal triangle of 9-10^m stars. The N tip of the triangle points directly towards the double glow of M85 + the companion **NGC 4394**.

The paired nebulosity, with two clearly brighter cores is easily seen at 27x in the 1.5° field of my ATC K-40mm eyepiece. A splendid view, which I keep for framing my drawing! Clicking up the magnification to 44x (CZJ O-25mm @ 0.9° FOV), the E galaxy (NGC 4394) is seen to have a small stellar nucleus, while M85 to the W shows up as a larger, brighter oval haze, with a mottled texture, using indirect vision.

**VIRGO CLUSTER,
Outskirts South**
Virgo B: M49
Virgo S: M61

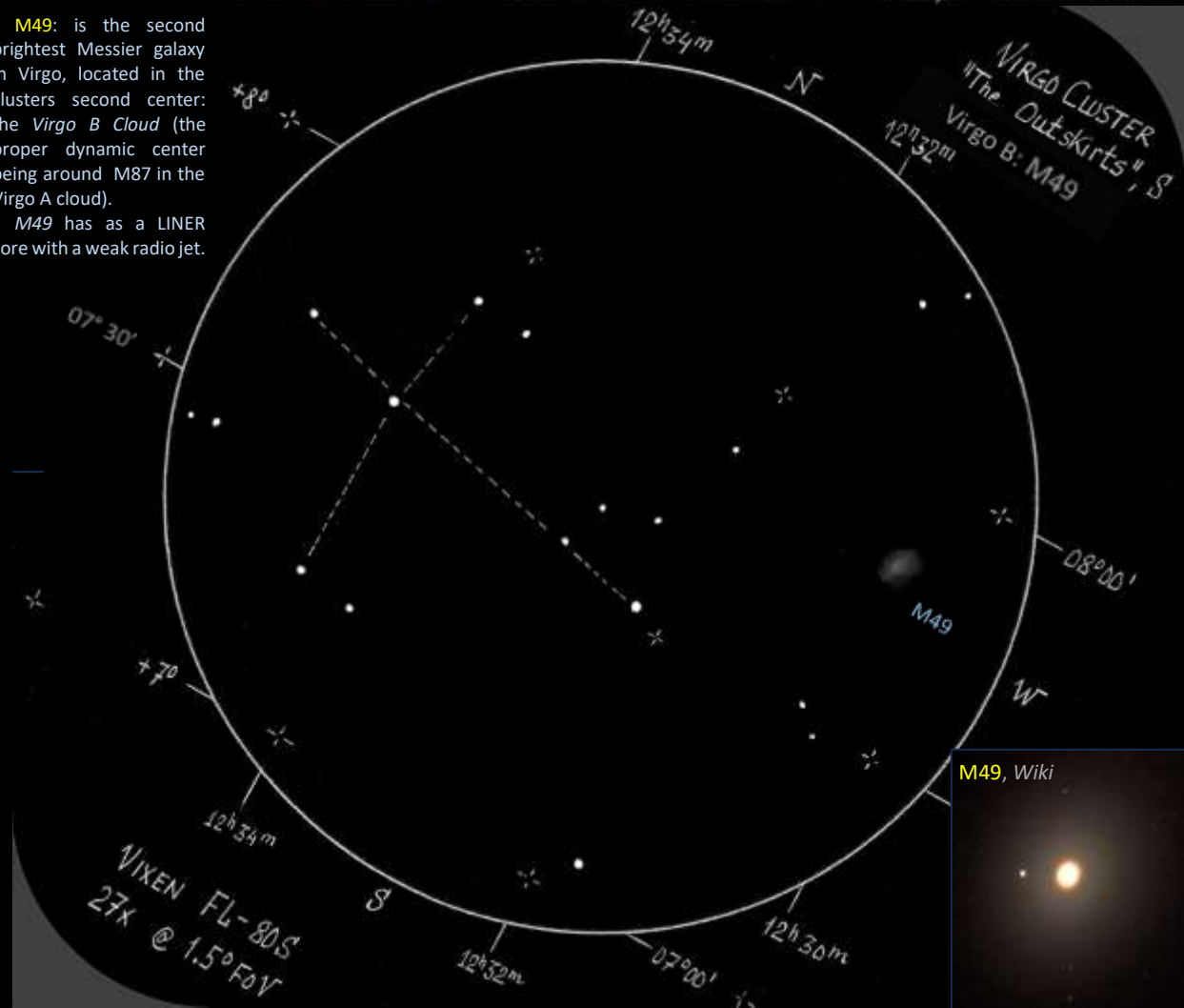


M49: is the second brightest Messier galaxy in Virgo, located in the clusters second center: the *Virgo B Cloud* (the proper dynamic center being around M87 in the *Virgo A cloud*).
M49 has as a LINER core with a weak radio jet.

I start with M49, which I prefer to locate by first centering the "Lambda" asterism (including Rho VIR) in my 1.5° K-40mm eyepiece; From there I pan 2 x FOVs (i.e., 3°) to the SW, where I get a "Cygnus" like cross asterism in the eyepiece; Now moving the base of the cross to the E part of the eyepiece field, I have M49 towards the W of the FOV. I can easily hold this whole star hop from Rho VIR to M47, including the Lambda and Cross asterisms, in the 8° field of view of my CZJ 8x30 bino.

I choose to keep the scale of my drawing as seen at 27x in the 1.5° FOV in my K-40mm eyepiece. Here M49 is clearly identified as a hazy spot with a decidedly brighter core (actually M47 is the second brightest of the M-galaxies in the Virgo Cluster). Clicking up the magnification to first 44x (O-25) and later 68x (O-16), I can identify a slightly mottled nucleus in a round, fainter halo. A very nice view!

Features:	VIRGO C, "The Outskirts", S	Date:	2016-05-08	Time:	21:30	UT	Location:	56 N 12E, DENMARK
Conditions:	Trsp. 5+/7, NELM 5.3"	Seeing:	8+/10	Instrument:	VIXEN FL-80S, f/8			
Aperture:	80mm	Focal Length:	+1.7x GPC ~ 1088mm	EP/Filter/Mags:	ATC K-40mm, 27x @ 1.5° FOV			



M49, Wiki

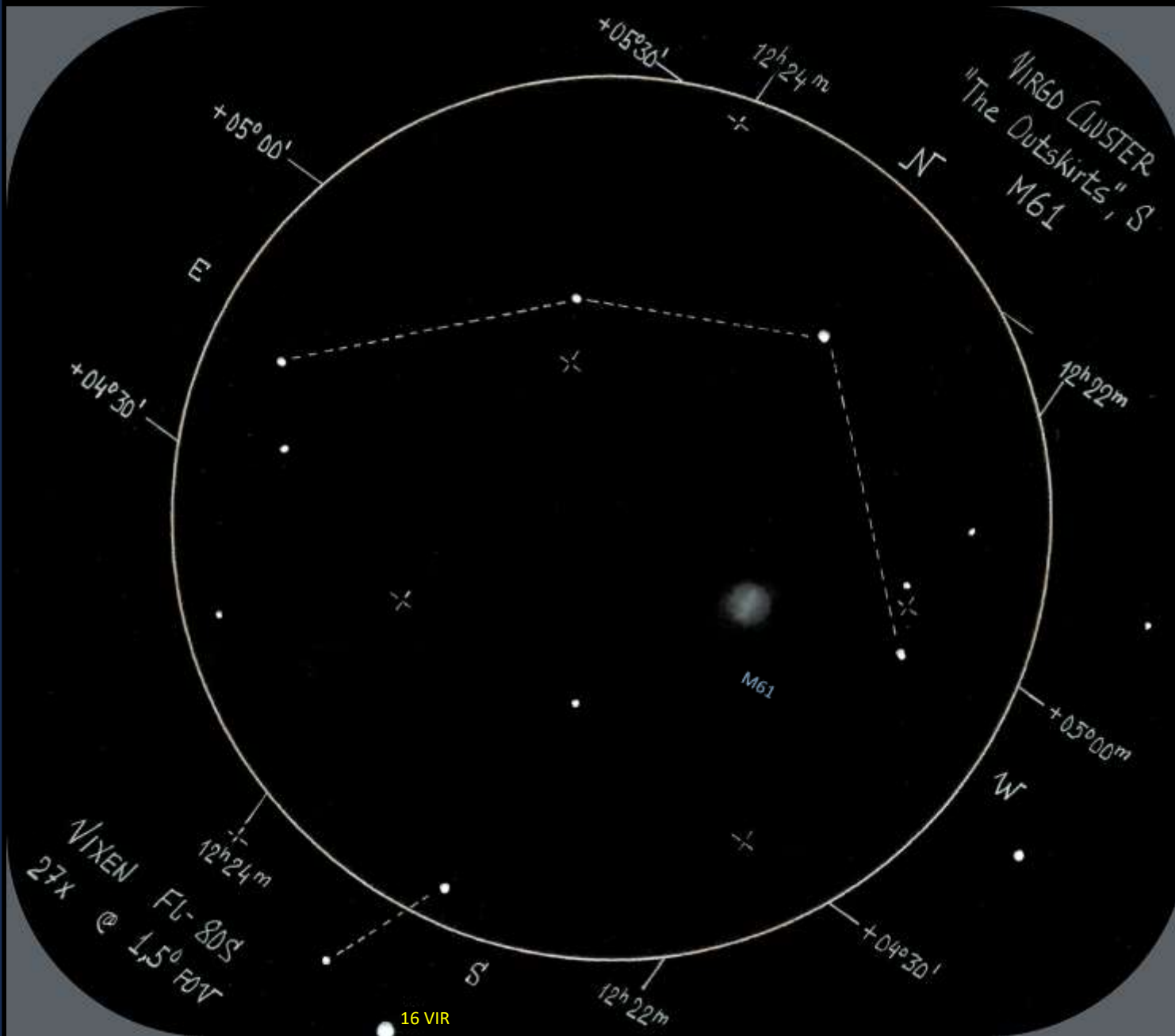
It's the end of the first week of May, and today our pair of European Pied Flycatcher (*Ficedula hypoleuca*) arrived at the nesting box we have put up in the beech just outside the kitchen window, after their long flight across *Sahara* from their wintering site in Western Africa. What an incredible performance for such a small passerine! Today I also found a female black Oil Beetle (*Meloe proscarabaeus*), just outside the door at our weekend cabin. This large beetle has an extraordinary life cycle: the larvae climb up on to flowers in the grass, and when a solitary bee comes to collect pollen, they grab the bee with their hooked feet and ride back on it to the bee's burrow. Here in the nest, they disembark and start their development, while feasting on the bee's eggs and store of pollen and nectar. I have already spotted some of the oil beetle's larvae (known as *Tringulins*, and previously thought to be a separate species), lurking in our dandelions!

Now, from the birds and the bees, and the flowers and the trees (but no moon up above...), I turn my attention towards the night sky this fine starry midnight, local time.

The observation conditions are excellent, calm with good seeing and it's starting to get reasonably dark (NELM 5.3"). I have the previous nights covered the Messier galaxies in the central part of the Virgo Cluster (*The Wall, The Hook and The Triangle*), and so tonight I will be moving on to the remaining M-galaxies in *The Outskirts* of the cluster: M49 and M61 to the south, plus M85 to the north.

Feature(s): VIRGO CL., "The Outskirts," S Date: 2016-05-08 Time: 22:15 UT Location: 56N 12E, DENMARK
 Conditions: Trsp. 6/7, NELM 5.7^m Seeing: 8⁺/10 Instrument: VIXEN FL-80S, f/8
 Aperture: 80mm Focal Length: +1.7x GPC ~ 1088mm EP/Filter/Mags: ATC K-40mm, 27x @ 1.5° FOV

VIRGO CLUSTER,
 Outskirts South
 Virgo S: M61



Having observed M49 for half an hour, it's now just past midnight local time this wonderful morning in early May, and the sky has darkened to a NELM of 5.7^m. I start with a long star hop using my 8x50mm 6° erecting KK finder scope: from *Denebola* (Bet LEO), SE 7° to the bright wide pair *Omi* and *Pi VIR*, and further another 7° in the same direction to the 5^m star: **16 VIR**. Now placing 16 VIR at the S edge of my 1.5° K-40mm finder eyepiece, I have M61 in the N part of the FOV.

The galaxy is seen as a faint nebulosity at 27x magnification. I keep this for my drawing of the star field, but click up the magnification to 44x (O-25, 0.9°), and finally 68x (O-16mm EP) for the best view of the galaxy. **M61** is now seen as a broad oval nebula with a brighter, mottled central area, roughly oriented in the N-S direction.



M61, HST

M61 is a gas-rich spiral galaxy with an active galactic nucleus (AGN) and widespread starburst.

Virgo Cluster Messier galaxies, sorted descending by surface brightness

Virgo Cluster Part	Galaxy MM - NGC#	Constel.	Galaxy type	Dimension amin (')	Visual Mag.	S.B. $m^2/amin^2$	S.B. $m^2/asec^2$
The Wall, W	M86 - 4406	Virgo	Lenticular E3	12.0 x 9.3	8.90	13.9	22.8
The Hook, S	M90 - 4569	Virgo	Spiral Sb	10.5 x 4.4	9.50	13.6	22.5
The Outskirts, S	M61 - 4303	Virgo	Spiral Sc	6.0 x 5.9	9.70	13.4	22.3
The Hook, N	M91 - 4548	Coma B.	Spiral SBb	5.0 x 4.1	10.20	13.3	22.2
The Outskirts, S	M49 - 4472	Virgo	Elliptical E4	8.1 x 7.1	8.40	13.3	22.1
The Hook, S	M89 - 4552	Virgo	Elliptical E0	3.4 x 3.4	9.80	13.3	21.2
The Triangle, S	M98 - 4192	Coma B.	Spiral Sb	9.1 x 2.1	10.10	13.2	22.1
The Triangle, S	M99 - 4254	Coma B.	Spiral Sc	4.6 x 4.3	9.90	13.0	21.9
The Outskirts, N	M85 - 4382	Coma B.	Lenticular S0	7.5 x 5.7	9.10	13.0	21.9
The Triangle, N	M100 - 4321	Coma B.	Spiral Sc	6.2 x 5.3	9.30	13.0	21.9
The Wall, E	M58 - 4579	Virgo	Spiral SBc	5.9 x 4.7	9.70	13.0	21.9
The Wall, E	M60 - 4649	Virgo	Elliptical E2	7.1 x 6.1	8.80	12.8	21.7
The Wall, W	M87 - 4486	Virgo	Elliptical E1	7.1 x 7.1	8.60	12.7	21.6
The Hook, N	M88 - 4501	Coma B.	Spiral Sc	6.1 x 2.8	9.60	12.6	21.5
The Wall, E	M59 - 4621	Virgo	Elliptical E5	5.4 x 3.7	9.60	12.5	21.4
The Wall, W	M84 - 4374	Virgo	Lenticular S0	5.1 x 4.1	9.10	12.3	21.2

My journey this spring through the Messier galaxies in the distant (more than 50 MLY) **Virgo Galaxy Cluster** has come to an end.

My travel companion has been the classic 80mm refractor (Vixen FL-80S), and my observation sites have been my Bortle red/orange (NELM ~5.2) suburban backyard plus my Bortle yellow (NELM ~5.7) suburban weekend cabin.

Here is a short summary of my experiences.

The indisputably **most difficult Messier galaxies** to observe were the two faintest spiral galaxies (visual magnitude >10^m) :

- **M98** : a nearly edge on (10° inclination) galaxy, glimpsed as a faint spindle
- **M91** : although face on, has a thin bar and diffuse outer halo. The bar can be discerned as a faint hazy spot

The Messier galaxies I found **most interesting to observe** all had a surface brightness in the better half of the SB-distribution of the M-objects in the Virgo Cluster (from 12.5 – 13 $m^2/amin^2$), and the spirals had a good inclination (not edge-on) while the ellipticals had a close companion to make the view more appealing :

- **M60+NGC4647** (E2 + Sc)
- **M88** (Sc, 58° inclined)
- **M85+NGC4394** (S0 + Sb)
- **M99** (Sc, face on)
- **M100** (Sc, face on)

Looking forward to re-visit these objects with my 4" FL-102S, when I have completed the Messiers with the 3" Vixen.