

# *The Eldorado Star Party*

## *2017 Telescope Observing Club*

*by Bill Flanagan*  
*Houston Astronomical Society*

### **Purpose and Rules**

Welcome to the Annual ESP Telescope Club! The main purpose of this club is to give you an opportunity to observe some of the showpiece objects of the fall season under the pristine skies of Southwest Texas. In addition, we have included a few items on the observing lists that may challenge you to observe some fainter and more obscure objects that present themselves at their very best under the dark skies of the Eldorado Star Party.

The rules are simple; just observe the required number of objects listed while you are at the Eldorado Star Party to receive a club badge.

### **Big & Bright**

The telescope program, “**Big & Bright,**” is a list of 30 objects. This observing list consists of some objects that are apparently big and/or bright and some objects that are intrinsically big and/or bright. Of course the apparently bright objects will be easy to find and should be fun to observe under the dark sky conditions at the X-Bar Ranch. Observing these bright objects under the dark skies of ESP will permit you to see a lot of detail that is not visible under light polluted skies. Some of the intrinsically big and bright objects may be more challenging because at the extreme distance of these objects they will appear small and dim. Nonetheless the challenge of hunting them down and then pondering how far away and energetic they are can be just as rewarding as observing the brighter, easier objects on the list.

You only need to observe **22 of the 30** objects on the list with a telescope to qualify for the Telescope Observing Club badge.

### **Previous ESP Observing Clubs**

Please note that all previous observing programs offered at ESP from 2004 onward are still available. Club badges from these earlier programs (*with the exception of 2009 - Texas Hash*) are also available and will be awarded to anyone completing them at ESP. Check the Eldorado Star Party website at [www.eldoradostarparty.org](http://www.eldoradostarparty.org) to select one (or more!) of these observing lists.

### **Club Badges**

Any size telescope or binocular can be used to complete the observing programs. Again, all observations must be made at the Eldorado Star Party in order to qualify for an ESP observing badge. To receive your badge, please turn in your observations to Bill Flanagan any time during ESP. I will try to be available on the observing field as well as in the Lodge prior to the meals and talks. If you finish the list on the last night of ESP, or I am not available to give you your badge, just mail a copy of your observations to me at 815 Azalea, Houston, TX 77018, and I will send you your badge.

Good Luck and Good Observing!

## *Big & Bright*

Primary ID	Alternate ID	Type	Con	RA 2000	Dec 2000	Mag	Size	Distance	Date	Time
NGC 6166	MCG 7-34-60	cD Gal	Her	16h28m38s	+39°33'04"	12.9	2.2'x 1.7'	400 Mly		
PG 1634+706	Q1634+0706	QSO	Dra	16h34m29s	+70°31'33"	14.2-14.7		8.63 Gly		
KUV 18217+6419	Q1821+0643E	QSO	Dra	18h21m57s	+64°20'36"	13.3-14.2		3.27 Gly		
UY Sct	PPM 234561	Var	Sct	18h27m36s	-12°27'59"	7.9-10.0		9,500 ly		
M 22	NGC 6656	Glob	Sgr	18h36m24s	-23°54'12"	5.2	32.0'	9,800 ly		
M 54	NGC 6715	Glob	Sgr	18h55m03s	-30°28'42"	7.7	12.0'	55,000 ly		
Dumbbell	M 27	PNe	Vul	19h59m36s	+22°43'16"	7.3	8.0'	1,100 ly		
NGC 6946	Arp 29	Gal	Cyg	20h34m53s	+60°09'14"	9.8	10.5'x 10.0'	22.5 Mly		
68 Cyg	V1809 Cyg	Var	Cyg	21h18m27s	+43°56'45"	5.0		4,600 ly		
M 15	NGC 7078	Glob	Peg	21h29m58s	+12°10'00"	6.3	18.0'	42,000 ly		
M 39	NGC 7092	Open	Cyg	21h31m48s	+48°26'00"	5.3	29.0'	1,100 ly		
BL Lac	PKS 2200+420	BL	Lac	22h02m43s	+42°16'40"	10.5-17.3		864 Mly		
RW Cep	HD 212466	Var	Cep	22h23m07s	+55°57'48"	6.0-7.3		2,700 ly		
Helix	NGC 7293	PNe	Aqr	22h29m38s	-20°50'14"	6.3	16.0'	530 ly		
Blue Snowball	NGC 7662	PNe	And	23h25m54s	+42°32'05"	8.6	17"	4,600 ly		
NGC 7720	MCG 4-55-36	cD Gal	Peg	23h38m29s	+27°01'51"	13.4	1.7'x 1.3'	410 Mly		
PZ Cas	HIP 117078	DVar	Cas	23h44m03s	+61°47'22"	8.2-10.2		9,160 ly		
Andromeda Galaxy	M 31	Gal	And	00h42m44s	+41°16'07"	4.3	2.6°x 1.1°	2.6 Mly		
Sculptor Galaxy	NGC 253	Gal	ScI	00h47m33s	-25°17'20"	7.9	28.2'x 5.5'	13 Mly		
NGC 262	Markarian 348	Gal	And	00h48m47s	+31°57'25"	14.2	1.2'x 0.7'	200 Mly		
UGC 545	I Zw 1	Gal/QSO	Psc	00h53m35s	+12°41'38"	13.9-14.5	29"x 20"	744 Mly		
Almaak	Gamma 1 And	Bin	And	02h03m54s	+42°19'46"	2.1		350 ly		
3C 66A	Q0219+0428	BL	And	02h22m40s	+43°02'08"	12.8-16.5		4.47 Gly		
NGC 1275	Perseus A	cD Gal	Per	03h19m48s	+41°30'42"	12.6	2.5'x 1.7'	240 Mly		
NGC 1502	Collinder 45	Open	Cam	04h07m50s	+62°19'54"	4.1	8.0'	2,700 ly		
NGC 1569	Arp 210	Gal	Cam	04h30m49s	+64°50'53"	11.8	3.3'x 1.7'	5.8 Mly		
Great Orion Nebula	M 42	Neb	Ori	05h35m18s	-05°23'00"	4.0	40.0'x 20.0'	1,344 ly		
Sirius	Dog Star	Bin	CMa	06h45m08s	-16°43'20"	-1.5		9 ly		
Intergalactic Wanderer	NGC 2419	Glob	Lyn	07h38m08s	+38°52'54"	10.3	4.6'	275,000 ly		
Ceres		MP	Cnc	08h48m57s	+22°40'19"	8.6		21.6 lmin		

## *Big & Bright – Observing List Notes*

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**NGC 6166** This elliptical galaxy is the supermassive central dominant (cD) galaxy of the Abell 2199 galaxy cluster. It is one of the most luminous galaxies known in terms of X-ray flux. The core of NGC 6166 is very active and appears to contain a supermassive black hole greater than 1 billion solar masses. Recent studies of NGC 6166 also indicate that as many as 39,000 globular clusters are associated with it.

**PG 1634+706** At a redshift of  $z=1.337$ , this quasar is the most distant object on the list. Assuming current cosmological models, the light travel time for this quasar is 8.6 billion years! With a bolometric magnitude of  $M_B = -29.7$ , it is also the brightest and most energetic object on the observing list. Although it appears visually as a dim star through amateur telescopes, this quasar is worth hunting down and observing. Once you locate it in the eyepiece, just reflect for a moment that the photons you detected with your eyeballs have been traveling for a period of time that is almost twice the age of our solar system!

A finder chart for PG 1634+706 can be found in the last section of this document. Once you locate the star field that contains PG 1634+706 try different eyepieces to see which one gives the best view of this extremely distant quasar. When seeing permits, higher powers will improve the contrast between the background sky and this object making it more visible.

**KUV 18217+6419** Like PG 1634+706, this quasar also resides in constellation Draco. KUV 18217+6419 has a redshift of  $z=0.297$ , making the light travel time from this quasar equal to 3.3 billion years. Like most of the quasars in the sky, the visual magnitude of KUV 18217+6419 is variable and fluctuates between 13.3 and 14.2. Therefore it should be slightly brighter and easier to detect than PG 1634+706, so give this one a try if you have trouble observing PG 1634+706.

A finder chart for KUV 18217+6419 is provided at the end of this document. As with all of these dim distant objects, try different eyepieces to see which one gives the best view. When seeing permits, higher powers will improve the contrast between the background sky and these objects making them more visible.

**UY Sct** UY Scuti is a bright red supergiant star in Scutum. The visual magnitude of UY Scuti varies from 7.9 - 10.0. It is currently thought to be the largest star in the sky with a diameter equal to 1,700 Suns! This means that if it occupied the Sun's location in space, UY Scuti would swallow up Jupiter almost reaching out to the orbit of Saturn! Visually through the telescope, UY Scuti should stand out from the neighboring stars in the field with its ruddy appearance.

**M 22** With an apparent magnitude of 5.2, M22 is the brightest globular cluster in the northern hemisphere. Also, with an apparent size of 32', M22 is one of the biggest globular clusters in the sky, exceeded in apparent size by only M4, 47 Tucanae, and Omega Centauri (*which are not easily visible from ESP*). If the seeing permits, make sure you take the time and use high magnification to study the interior of this big globular. M22 has a visual magnitude of 5.5 and is the brightest globular cluster listed in the Messier catalog. It is bright enough to be visible with the naked eye under dark skies so check to see if you can detect M22 at ESP without any optical aid.

## *Big & Bright – Observing List Notes*

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**M 54** M54 is the 2<sup>nd</sup> largest known globular associated with the Milky Way. Because of M54's remote distance of 87,000 light years, its apparent size of 12' betrays its true size of 304 light years. Only NGC 2419 is bigger at 400 lyrs. For comparison, M22's true size is only about 100 lyrs which is 3 times smaller than M54.

**Dumbbell (M 27)** M27 is a big and bright planetary nebula in Vulpecula. Transiting just before twilight, M27 is well placed in the sky at ESP 2017. Make sure to use both low and high powers to observe this object. At high powers (>100x) the central star is easily visible and the delicate structure of the nebula shows well under dark skies.

**NGC 6946** This bright galaxy is on the border of Cygnus and Cepheus and is known as the "Fireworks Galaxy" because of the high frequency of supernova occurring in it. There have been 10 recorded supernovae in NGC 6946 over the last 100 years, and even though it contains only half the number of stars as the Milky Way, this rate of supernova occurrence translates to a rate that is 100 times more frequent than the rate in the Milky Way. The last observed supernova in NGC 6946 was as recent as May 2017. See if the dark skies of ESP allow you to see the spiral arms of this galaxy.

**68 Cyg** A massive blue giant star of spectral type O, 68 Cygni is currently thought to be 1,050,000 times more luminous than our Sun. Its visual magnitude is approximately 5.0. However 68 Cygni's absolute magnitude is -6.7 making it 11.5 magnitudes brighter than our Sun which has an absolute magnitude 4.8.

**M 15** M15 is a bright globular cluster in Pegasus. Transiting about an hour after twilight, it is well placed in the sky for observing at ESP. Make sure you spend some time and study this big beautiful globular at different powers. M15 is at a distance of 34,000 light years from us and is 178 light years in size.

**M 39** A big and bright open cluster in Cygnus, M39 consists of a couple dozen Mag 6-9 stars arranged in a triangular pattern. It's embedded in the Milky Way, and there appear to be many dark streaks and mottling running through it. With an apparent size of 29', M39 is about the same size in the sky as a full moon.

**BL Lac** BL Lacertae is the active galactic nucleus (AGN) of a distant galaxy about 864 million light years away. Originally thought to be a variable star, in 1968 it was discovered to be the optical counterpart of a strong radio source and actually an extragalactic object. Later optical studies showed that BL Lac lies at the center of a giant elliptical galaxy. It is a violently variable object with a total range of nearly 7 magnitudes varying between 10.5 and 17.3. BL Lacertae became the prototype namesake for a whole class of AGNs called the BL Lacertae or BL Lac objects.

BL Lac typically hovers around magnitude 14 and should be visible at ESP. Once you locate the star field use different powers to optimize the visibility of this stellar object. A finder chart for BL Lac can be found in the last section of this document.

## *Big & Bright – Observing List Notes*

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**RW Cep** RW Cephei is a hypergiant star located in Cepheus. At an estimated diameter that is 1,500 times larger than our Sun, it rivals UY Scuti as one of the largest known stars that is visible in our sky. It is also a highly luminous star at an estimated brightness that is 625,000 times greater than the Sun. See if you can detect the orange color of RW Cephei as you observe it.

**Helix** The Helix is a large beautiful planetary nebula located in Aquarius. It is big but maybe not so bright. Try using a UHC or OIII filter to bring out the detail of the nebula. With dark skies and good seeing, see if you can detect the central star and radial spokes on the inside of the nebula.

**Blue Snowball** The Blue Snowball (NGC 7662) is well placed in the sky at ESP. It ranks near the top of planetary nebula in terms of surface brightness so it should be an easy find. Once you have this planetary centered in your eyepiece, try increasing the power until you can detect the mottled surface of this nebula. If the seeing permits using powers above 300x, you should be able to see some of the delicate structure of the Blue Snowball.

**NGC 7720** NGC 7720 is an intrinsically bright Seyfert 1 elliptical galaxy in Pegasus. It is the central dominant galaxy of galaxy cluster Abell 2634. It is also coincident with the radio source 3C 465. Located some 410 million light years distant, this galaxy will appear almost stellar in amateur telescopes. High powers in larger aperture scopes will begin to bring out the extended fuzzy appearance of this object.

**PZ Cas** PZ Cassiopeiae is a red supergiant star located Cassiopeia shining at magnitude 8.3. Current estimates place its size as somewhere between 1190 and 1940 times the diameter of the Sun. It should show as a yellowish point of light in the telescope when compared to surrounding stars. Look for its magnitude 12.8 companion located about 12" to the east.

**Andromeda Galaxy** The biggest and brightest galaxy in our sky, extending over two degrees in the sky and bright enough to see with the naked eye! Through the telescope, you can scan around the galaxy and observe the dark lanes and bright core. For a challenge, see if you can spot some of the globular clusters associated with M31. Also step back from your telescope and observe the Andromeda Galaxy with your naked eyes and ponder that you are seeing something over 2.5 million light years away with your unaided eyes!

**Sculptor Galaxy** NGC 253 is another big and bright galaxy observable from ESP. Although not visible with the naked eye, this galaxy will show a lot of detail even in modest aperture telescopes under the dark skies of ESP. Take some time and soak in all the detail visible in the mottled surface of this galaxy some 13 million light years distant!

## *Big & Bright – Observing List Notes*

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**NGC 262** NGC 262 is a monster spiral galaxy located in Andromeda. Current measurements place the diameter of this galaxy at 1.3 million light years, more than 10 times larger than our Milky Way! NGC 262 has a redshift of  $z=0.01$ , placing it about 200 million light years distant.

**UGC 545 / I Zw 1** UGC 545 / I Zw 1 is a compact Seyfert 1 galaxy located in the constellation Pisces. Due to its high absolute brightness, it is also classified as a quasar. Although it varies in apparent brightness between magnitudes 13.9 - 14.5, it is intrinsically bright enough for us to observe in amateur telescopes even though it is 744 million light years distant. Telescopes of 8" to 10" in aperture will show this galaxy as a faint stellar object. Larger aperture telescope may begin to show the halo of the host spiral galaxy when observed under good transparent skies. A finder chart for this object can be found in the last section of this document.

**Almaak** Almaak or Gamma Andromedea is a beautiful bright double star with striking color contrast. The brighter companion has a bright golden-yellow color while the dimmer companion glows with a blueish color. The dimmer companion, Gamma 2 Andromedea, is actually a triple star, so the whole system really consists of 4 stars. However, the companions to Gamma 2 are too dim and close to the brighter companion to be visible through the telescope.

**3C 66A** 3C 66A is an energetic BL Lac object with a cosmological distance of about 4.5 billion light years! It will appear as a dim stellar object in the telescope. Although sometimes it can get to magnitude 12.8, its apparent brightness usually ranges between magnitudes 14 and 15. It lies about 40' north of the beautiful edge-on galaxy NGC 891 in Andromeda. If you manage to hunt down this dim but intrinsically bright object, think about the fact that the light from it that you are observing left 3C 66A about the same time that the Solar System was forming. A finder chart for 3C 66A can be found in the last section of this document.

**NGC 1275** NGC 1275 is the large central dominant (cD) Seyfert galaxy of the Perseus Galaxy Cluster. It has a very energetic active nucleus that is producing huge amounts of X-ray and radio emissions as entire galaxies fall into a supermassive central black hole located at its core. The estimated size of this black hole is 340 million solar masses. Also known as the Perseus A radio source, NGC 1275 is located about 240 million light years away and spans a distance of about 100,000 light years.

**NGC 1502** NGC 1502 is a small but bright open cluster located in Camelopardalis. Through a telescope, the cluster shows about 45 bright stars arranged in an interesting pattern and occupying a space of about 8 arc minutes. Kemble's cascade flows nearby NGC 1502 and taken together they make a very beautiful field in binoculars.

**NGC 1569** NGC 1569 is a nearby dwarf irregular galaxy in the constellation Camelopardalis. NGC 1569 is a starburst galaxy forming stars at a rate that is about 100 times faster than the Milky Way. When observing NGC 1569, see if you can detect the asymmetric shape and mottled appearance of this irregular galaxy.

## ***Big & Bright – Observing List Notes***

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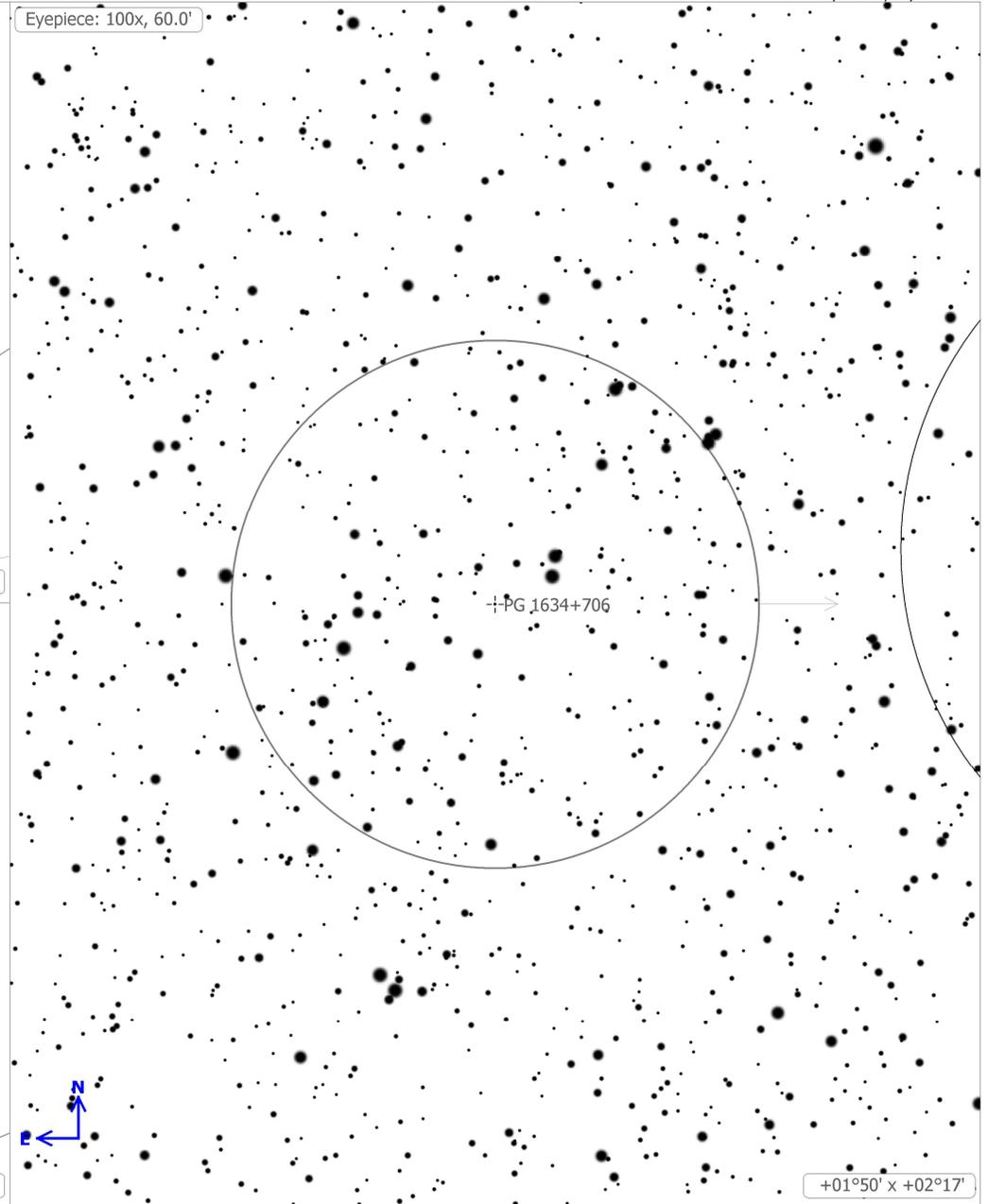
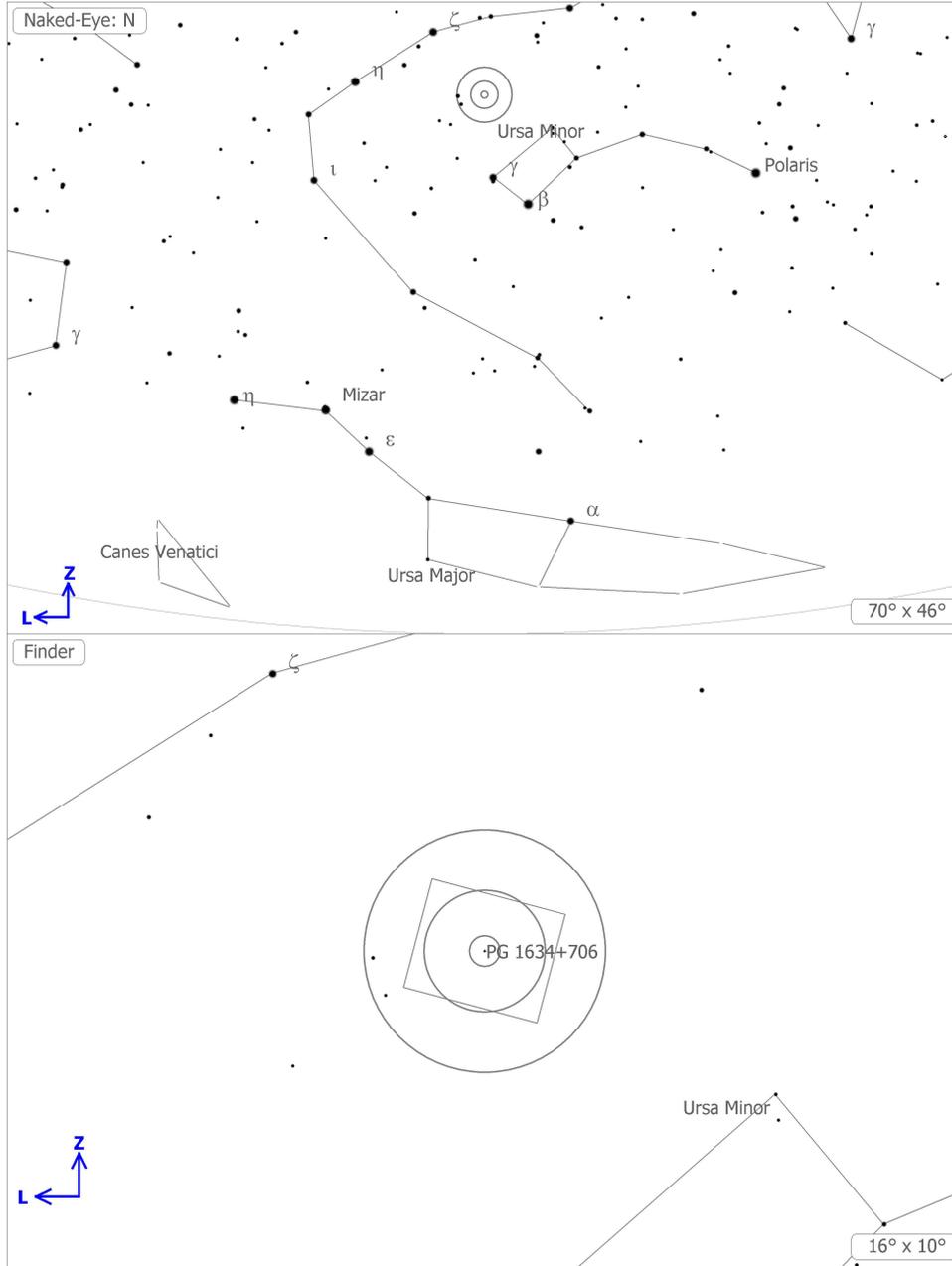
**Great Orion Nebula** Yes, this one is big and bright and yes, you probably have observed it a thousand times before, but give it another look at ESP. Spend some time and study it with different powers and filters. You will be amazed at how much more detail can be seen in this bright nebula when you observe it under dark skies!

**Sirius** At apparent magnitude of -1.5, the “Dog Star” is the brightest star in the sky. However, it is also a double star and if the seeing is good, you should be able to detect its dim companion affectionately known as the “Pup”. Sirius B or the “Pup” shines at magnitude 8.5 about 11” east of its extremely bright companion Sirius A. Sirius rises about 1 am and transits at the start of twilight, so save this one for the last object of the night to allow it get high enough in the sky to provide the best seeing.

**Intergalactic Wanderer** NGC 2419 or the “Intergalactic Wanderer” is intrinsically bright and large but at the remote distance of 275,000 light years, it appears relatively dim and small for such a large globular cluster. With a diameter of 400 light years, it is the largest known globular cluster associated with the Milky Way. It was originally thought that NGC 2419 was not gravitationally bound to the Milky Way and had either broken away from the Milky Way or was just passing through the neighborhood, hence the nickname “Intergalactic Tramp” or “Intergalactic Wanderer”. It has since been determined that NGC 2419 is in a highly elliptical orbit around the Milky Way and takes about 3 billion years to complete one orbit.

**Ceres** The dwarf planet Ceres is the largest object residing in the asteroid belt. It has a diameter of about 600 miles, making it the largest minor planetary body residing within the orbit of Neptune. At magnitude 8.6, Ceres should be easy to spot in small telescopes. However even at its closest position to Earth, its apparent diameter is only 0.8”, and therefore it will appear as a stellar object in most amateur telescopes. Ceres will be moving relatively fast through the sky with a total motion of about 44” per hour during ESP 2017. As a result it should be easy to detect its motion over the course of an hour. Night to night, it will move almost 0.3 degrees and its motion will be obvious. Use a wide field eyepiece and draw a quick chart of Ceres and its neighboring star field one night and then use the chart to confirm its motion through the sky the next night. Ceres rises at about 1:30 a.m. at ESP 2017, so try to stay up late and give it shot. A finder chart for Ceres is included in the last section of this document.

**PG 1634+706**



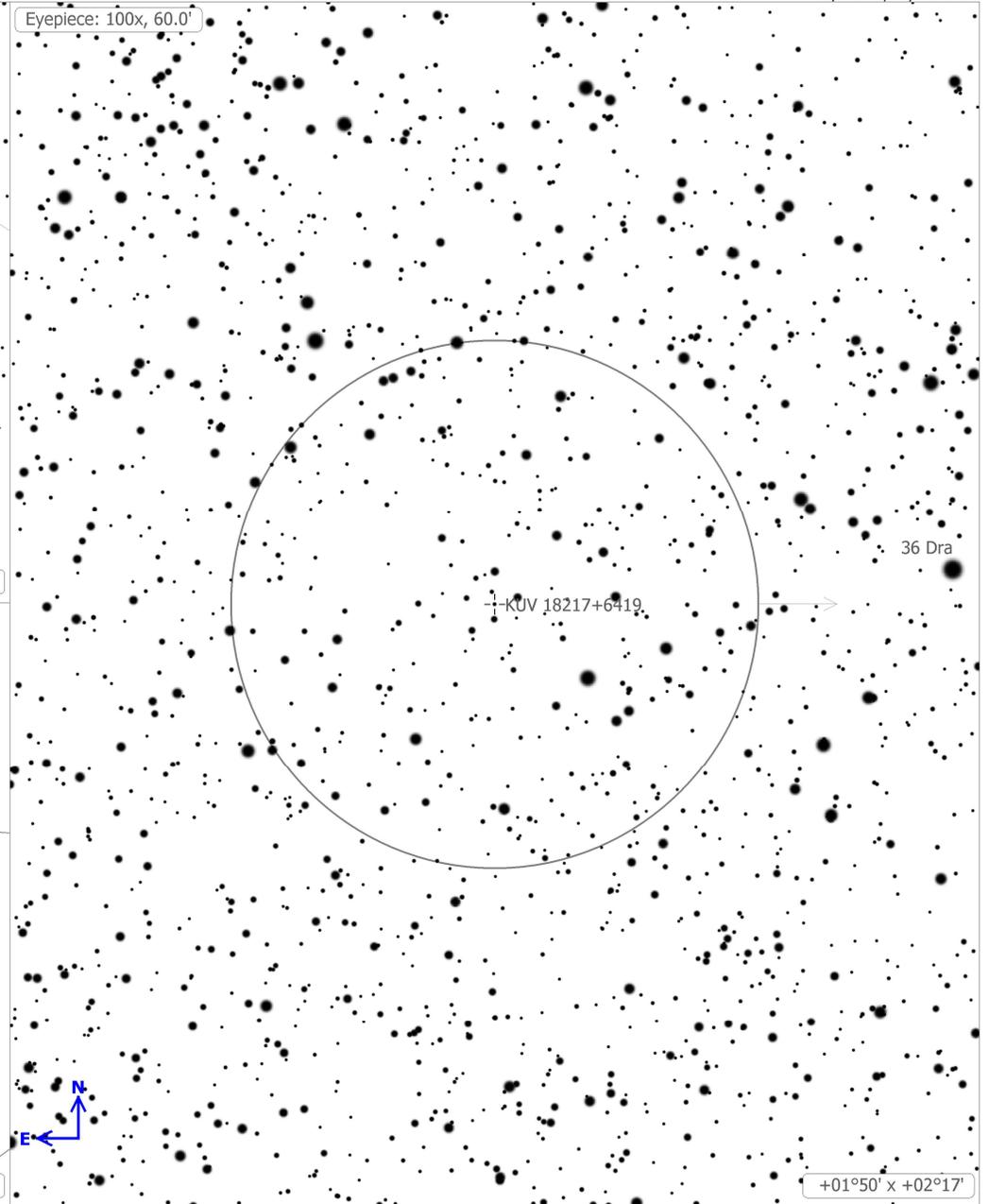
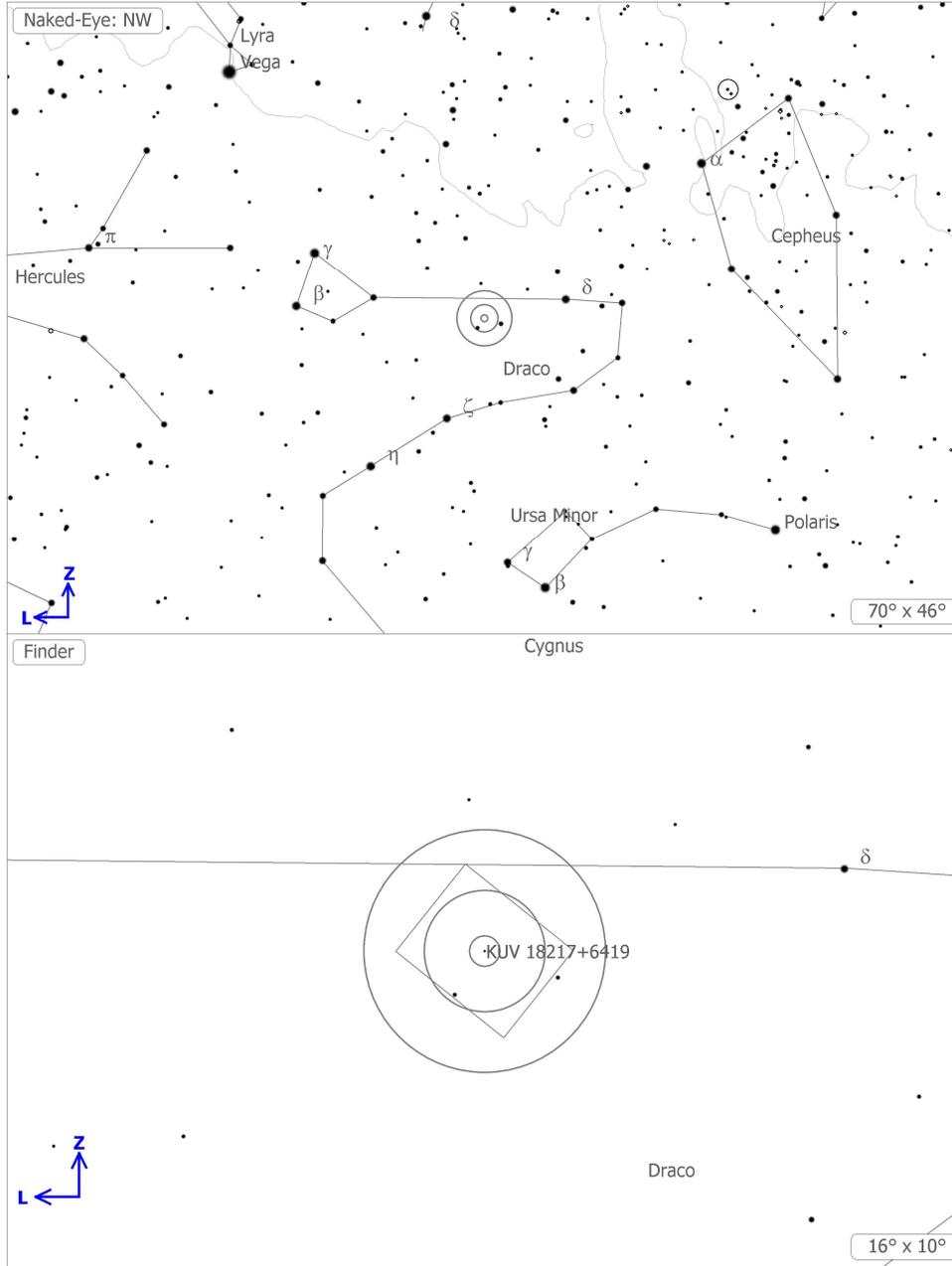
2017 October 19 20:33, Eldorado Stary Party  
 Fully dark ML 15.3 target challenging  
 PG 1634+706 (Quasar)  
 aka Q1634+0706  
 16h34m29.0s Dec.: +70°31'33" J2000 (Dra)  
 Magnitude: 14.70 V Size: unknown Light Time: 7.6 Gyr

Bright Quasar - 8.6 Billion Lyrs Distant!  
 At a redshift of  $z=1.337$ , this quasar is the most distant object on the list. Assuming current cosmological models, the light travel time for this quasar is 8.6 billion years! With a bolometric magnitude of  $M_B = -29.7$ , it is also the brightest and most energetic object on the

observing list. Although it appears visually as a dim star through amateur telescopes, this quasar is worth hunting down and observing. Once you locate it in the eyepiece, just reflect for a moment that the photons you detected with your eyeballs have been traveling for a period of time that is almost twice the age of our solar system!

- 14 ● 11 ● 8
- 15 ● 12 ● 9
- 13 ● 10

# KUV 18217+6419



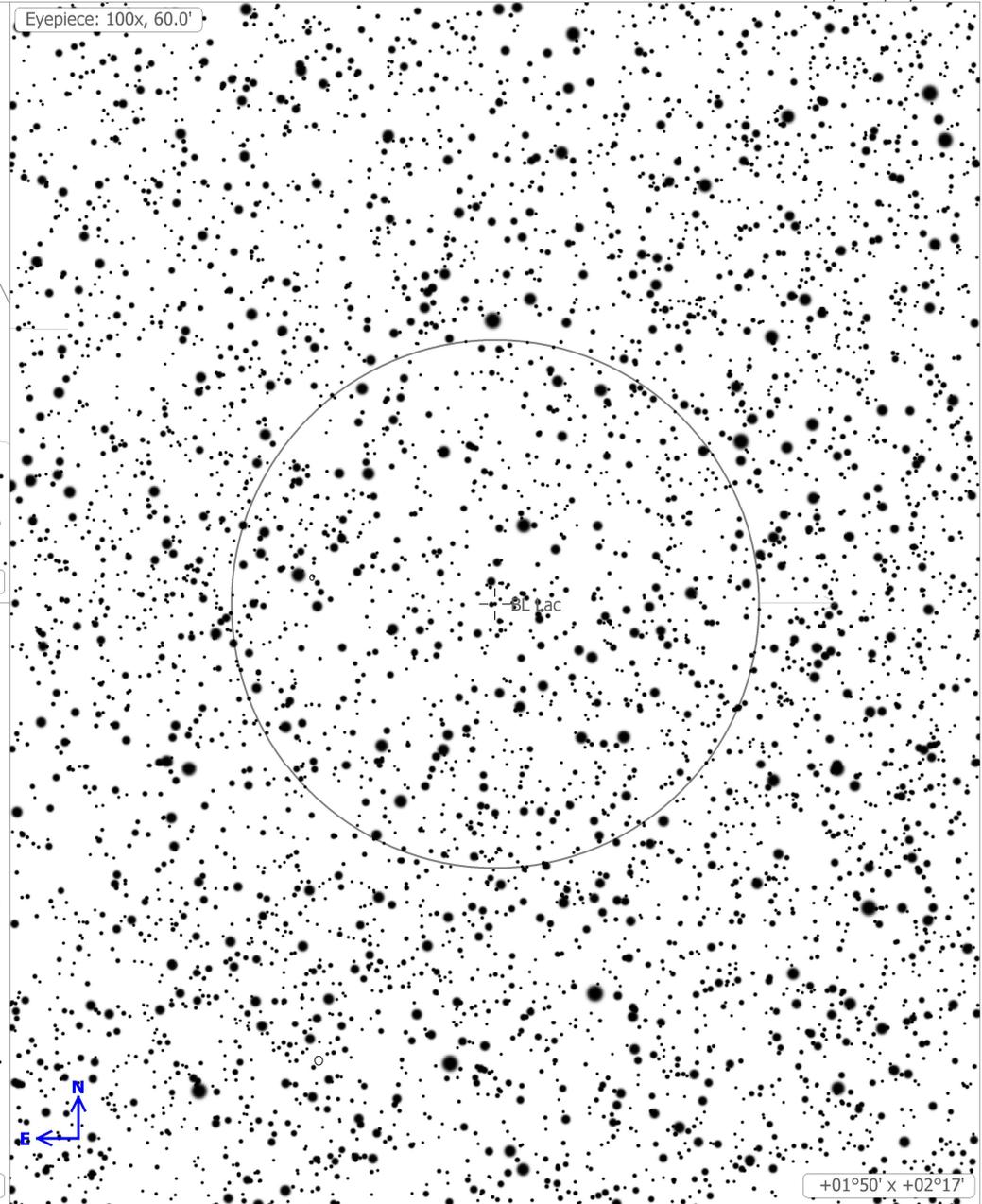
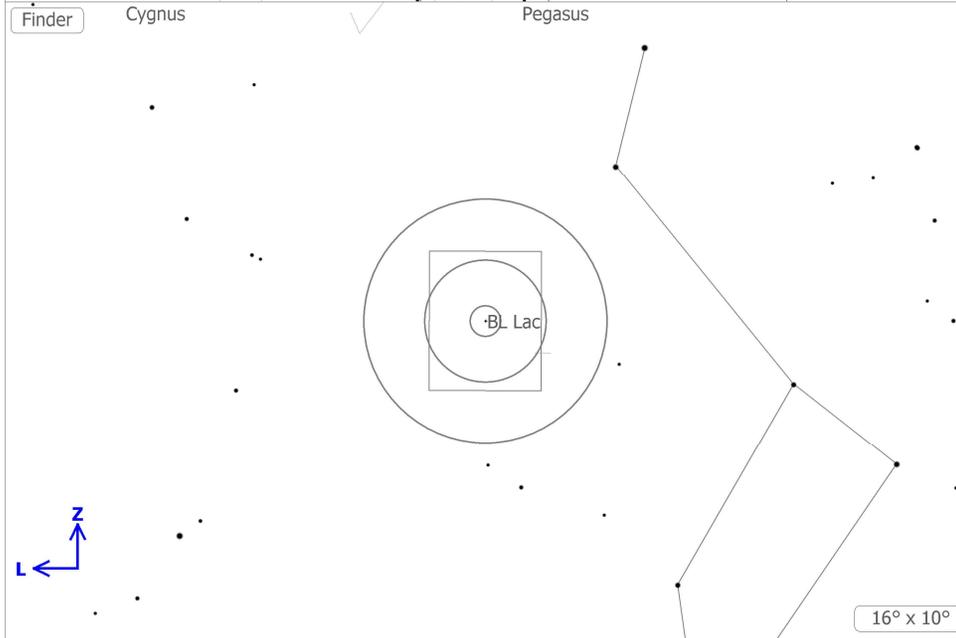
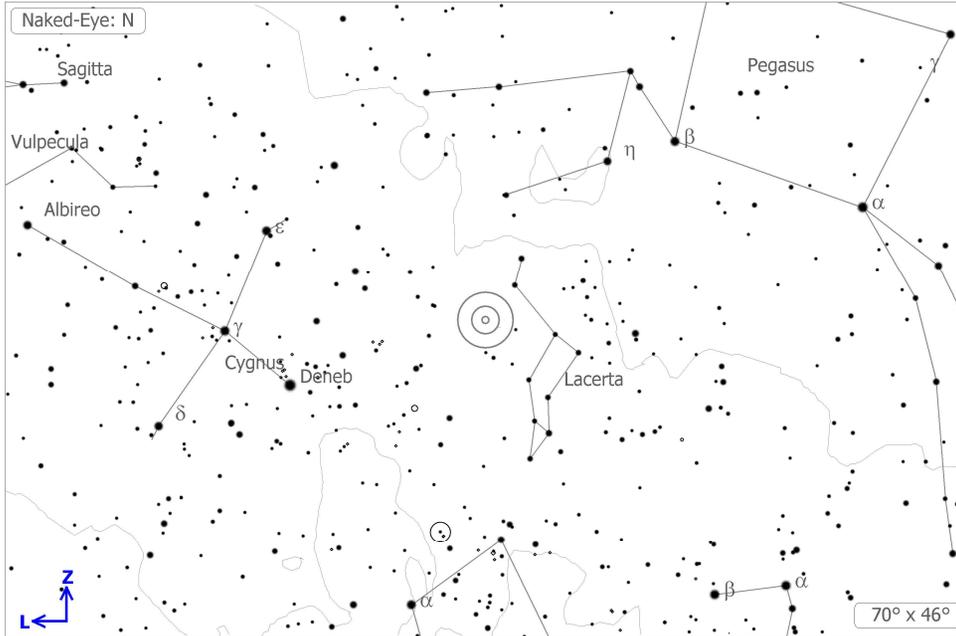
2017 October 19 20:36, Eldorado Stary Party  
 Fully dark ML 15.4 target difficult  
 KUV 18217+6419 (Quasar)  
 aka Q1821+0643E  
 18h21m57.2s Dec.: +64°20'36" J2000 (Dra)  
 Magnitude: 14.20 V Size: unknown Light Time: 3.1 Gyr

Bright Quasar - 3.3 Billion Lyrs Distant  
 Like PG 1634+706, this quasar also resides in constellation Draco.  
 KUV 18217+6419 has a redshift of  $z=0.297$ , making the light travel time from this quasar equal to 3.3 billion years. Like most of the quasars in the sky, the visual magnitude of KUV 18217+6419 is

variable and fluctuates between 13.3 and 14.2. Therefore it should be slightly brighter and easier to detect than PG 1634+706, so give this one a try if you have trouble observing PG 1634+706.

- 14    ● 11    ● 8
- 15    ● 12    ● 9
- 13    ● 10

# BL Lac



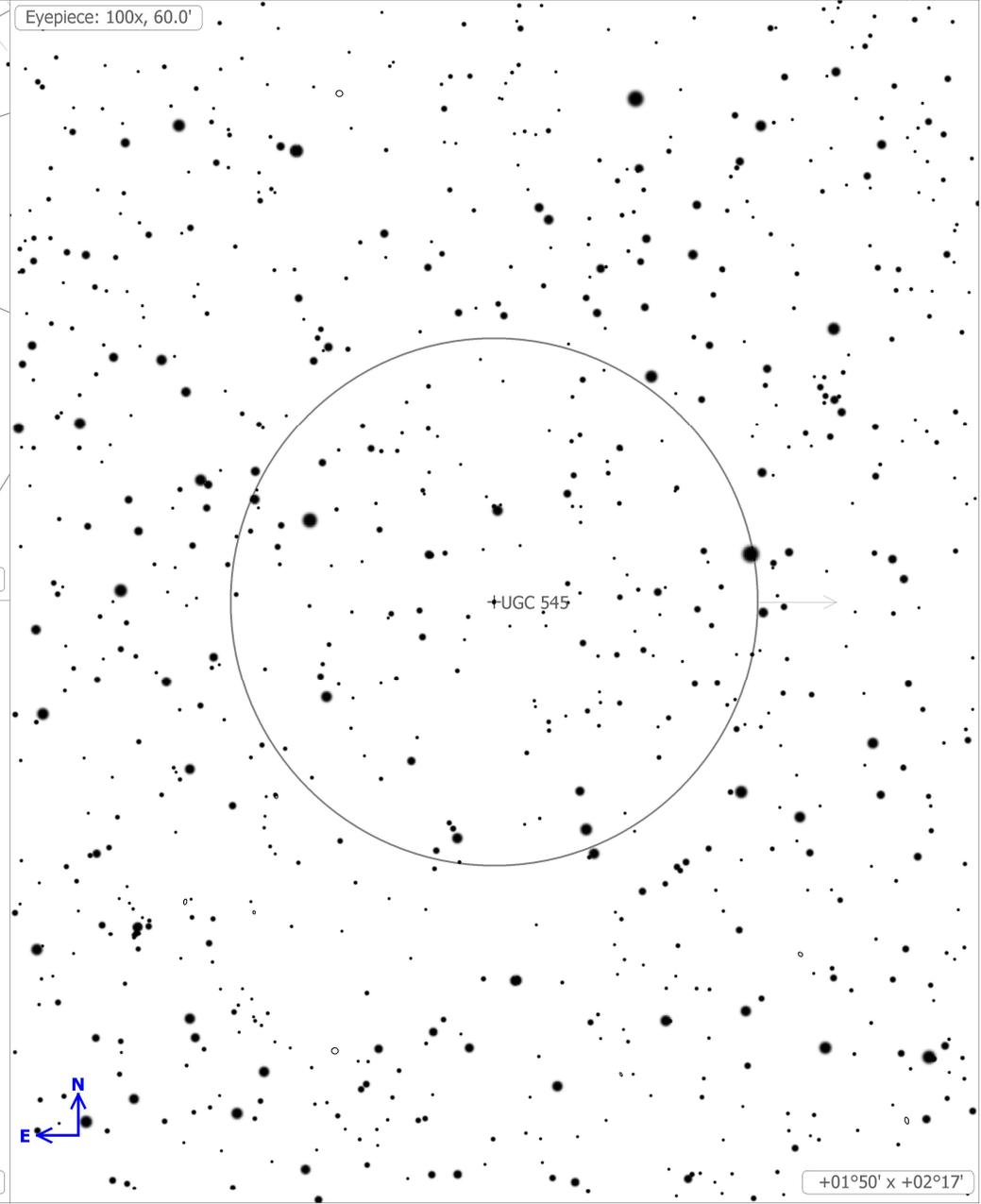
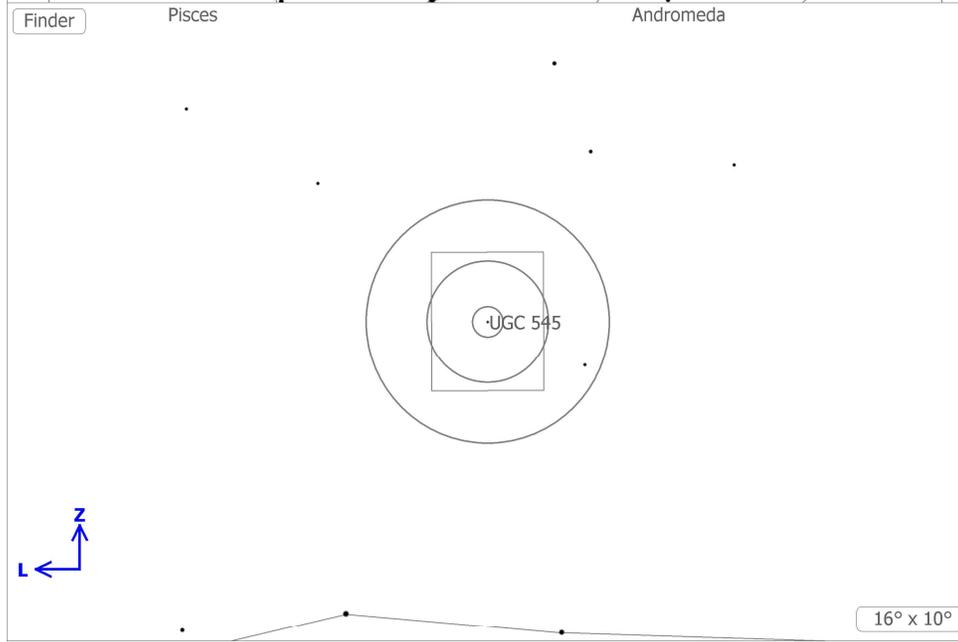
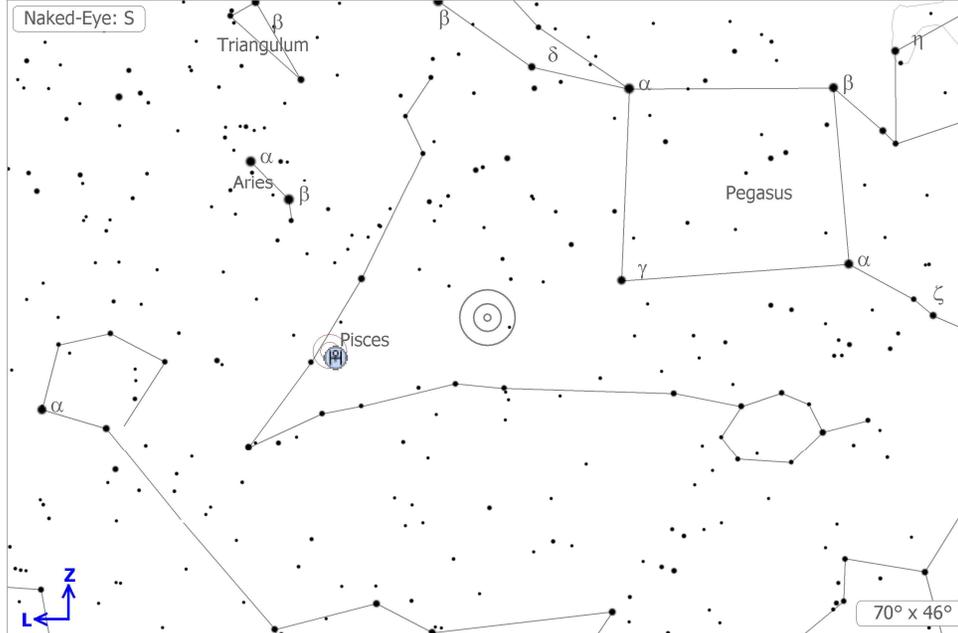
2017 October 19 21:52, Eldorado Stary Party  
 Fully dark ML 15.5 target easy  
 BL Lac (Variable Star)  
 aka GSC 03206-1047, J220243.2+421639  
 R.A.: 22h02m43.3s Dec.: +42°16'40" J2000 (Lac)  
 Magnitude: 12.80

**Bright Distant Galaxy with an AGN**  
 BL Lacertae is the active galactic nucleus (AGN) of a distant galaxy about 864 million light years away. Originally thought to be a variable star, in 1968 it was discovered to be the optical counterpart of a strong radio source and actually an extragalactic object. Later optical

studies showed that BL Lac lies at the center of a giant elliptical galaxy. It is a violently variable object with a total range of nearly 7 magnitudes varying between 10.5 and 17.3. BL Lacertae became the prototype namesake for a whole class of AGNs called the BL Lacertae or BL Lac objects.

- 14    ● 11    ● 8
- 15    ● 12    ● 9
- 13    ● 10

# UGC 545



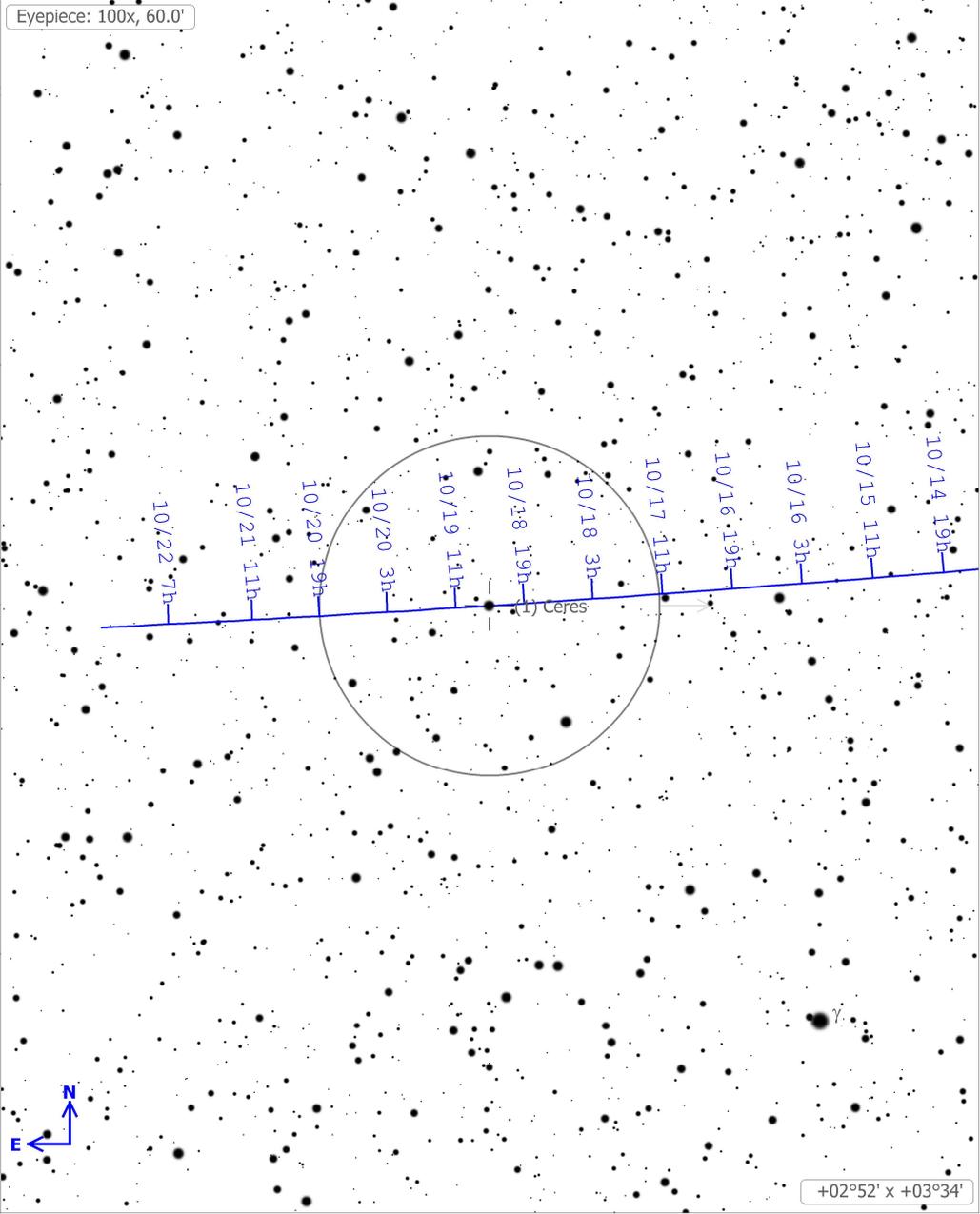
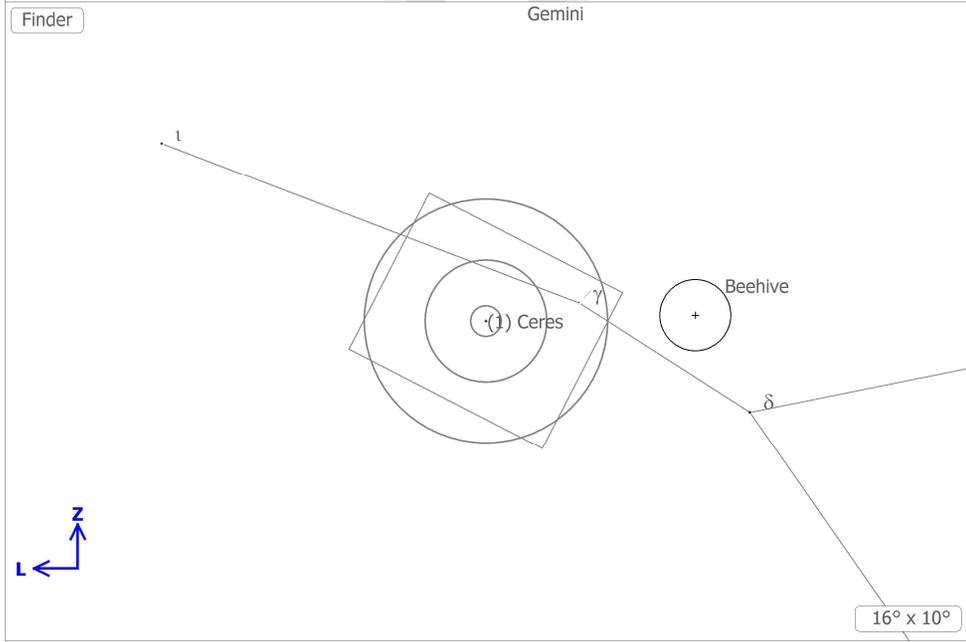
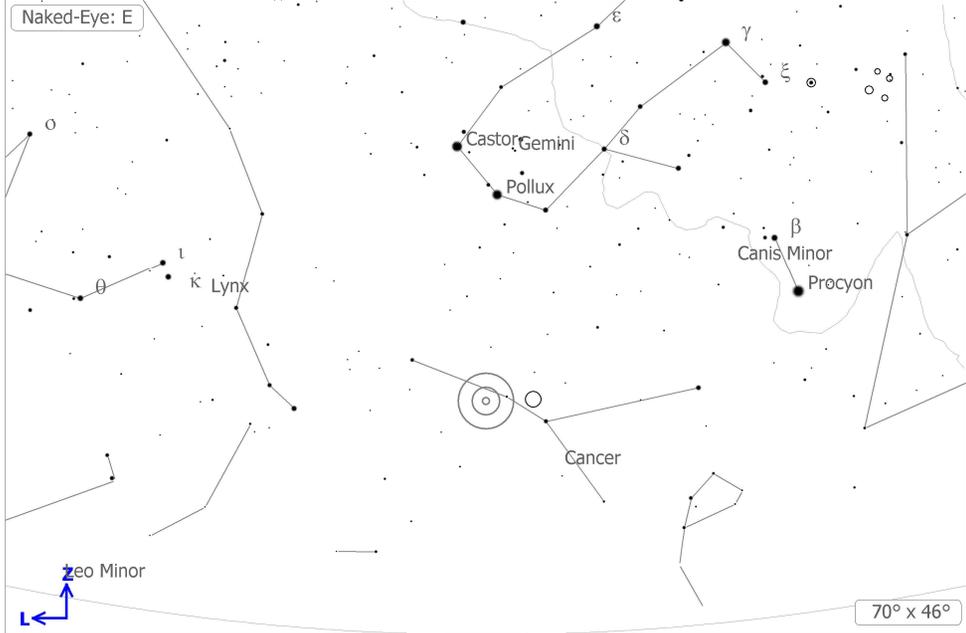
2017 October 20 00:42, Eldorado Stary Party  
 Fully dark ML 15.5 target detectable  
 UGC 545 (Galaxy)  
 aka PGC 3151  
 R.A.: 00h53m34.9s Dec.: +12°41'38" J2000 (Psc)  
 Magnitude: 14.40 B Size: 29"x 20" Nearly face on SBR: 20.6

Mag/arcsec<sup>2</sup> Light Time: 0.8 Gyr  
 Galaxy with Bright Quasar - 744 Mly Away!  
 1 UGC 545 / I ZW 1 is a compact Seyfert 1 galaxy located in the constellation Pisces. Due to its high absolute brightness, it is also classified as a quasar. Although it varies in apparent brightness

between magnitudes 13.9 - 14.5, it is intrinsically bright enough for us to observe in amateur telescopes even though it is 744 million light years distant. Telescopes of 8" to 10" in aperture will show this galaxy as a faint stellar object. Larger aperture telescope may begin to show the halo of the host spiral galaxy when observed under good transparent skies. A finder chart for this object can be found in the last

- 14    ● 11    ● 8
- 15    ● 12    ● 9
- 13    ● 10

**(1) Ceres**



2017 October 19 03:00, Eldorado Stary Party  
 Fully dark ML 15.0 target obvious  
 (1) Ceres (Minor Planet)  
 R.A.: 08h47m27.6s Dec.: +22°41'36" J2000 (Cnc)  
 Magnitude: 8.63 Earth Distance: 2.6 AU

**Largest Object in the Asteroid Belt**  
 The dwarf planet Ceres is the largest object residing in the asteroid belt. It has a diameter of about 600 miles, making it the largest minor planetary body residing within the orbit of Neptune. At magnitude 8.6, Ceres should be easy to spot in small telescopes. However

even at its closest position to Earth, its apparent diameter is only 0.8", and therefore it will appear as a stellar object in most amateur telescopes. Ceres will be moving relatively fast through the sky with a total motion of 44.3" per hour during ESP 2017. As a result it should be easy to detect its motion over the course

an hour. Night to night, the motion will be obvious. Draw a quick chart of Ceres and its neighboring star field one night and use the chart to confirm its motion through the sky the next night. Ceres rises at about 1:30 a.m. at ESP 2017, so try to stay up late and give it shot.

- 12 ● 8
- 13 ● 9
- 14 ● 10
- 15 ● 11