NOVA
NEWSLETTER OF THE VANCOUVER CENTRE RASC
VOLUME 2015 | ISSUE 2 MARCH APRIL 2015

Infinite Horizons: Visions of Distant Galaxies

by Bill Burnyeat

Virgo is the maid of the harvest, second largest of the constellations by area; only Hydra takes more space on the Celestial Sphere. This figure is a zodiac sign and shares some of the interest with others of the ecliptic club due to the regular passage of the sun, moon and planets through this mediator between the winter and the summer skies. The sun pauses here astride the sky's equator during the fall equinox on the otherwise unremarkable 22nd of September each year.

Image credit: NASA/ESA and The Hubble Heritage Team (STScI/AURA)

M104 – The Sombrero Galaxy

The member lights of the Virgo region, although interesting (for there are no dull stars) do not form the primary point of interest, here. The area enjoys more deep sky objects than just about any other constellation. However, the Milky Way is absent and it is into deep space that the telescope peers. William Herschel discovered over 300 galaxies in Virgo and at least 200 of these are observable in a 12-inch telescope.

A glance at a sky map typically shows red ellipses plotted in great numbers here that indicate the presence of external galaxies. These are the members of the Virgo galaxy cluster. We are used to hearing of clusters of stars but here the galaxies themselves swagger about in a vast lump. The cluster members sit in a sizeable ball at a great distance which is getting greater, for in the time it takes to read one sentence they retreat about 10,000 kilometres. About three quarters of the Virgo cluster members are spiral galaxies, but the appearance at the eyepiece is often an ellipse of light due to the reduced luminance of the spiral arms.

16 megaparsecs is the distance to the middle of the cluster. This is

continued on page 7

MARCH 12 **SFU**
Dr. Jaymie Matthews of UBC: A decade of exoplanets with MOST - From dark giants to ocean superEarths.

APRIL 9 **HRMSC**
A night at the Space Centre, featuring a free show in the Planetarium. Members will receive details by email. RSVP required.

MAY 14 **SFU**
TBA. See Meetup for details.

Comet C/2014 Q2 (Lovejoy) Gallery

Evan Digby
Taken from SFU on Jan. 20 with a Canon 60D and a 80-200mm L Series F2.8 lens. There are roughly 20 exposures at 30 seconds each, 100 ISO, lens at 200mm with an equal number of dark frames. Frames were stacked/processed the frames using PixInsight. The mount used was an older EQ3 with a motor on the polar axis (no computer tracking).

Oleg Mazurenko
Also taken from SFU on Jan. 20 with a Canon DSLR 350D through a Sky-watcher Equinox-80. This is a stack of six 30-60 sec exposures at ISO 1600.

Gordon Farrell
A parting shot taken Feb. 21 through a C5 SCT with a Canon 40D at ISO 1600 for 30 sec.

Observing Report

by Scott McGillivray

2015 has been incredible thus far for Vancouver astronomers, with an unprecedented number of clear nights. The RASC has hosted several observing events in 2015 focused on Jupiter, Comet Lovejoy, and the conjunction of Mars and Venus. As we look forward to the opening of the Trottier Observatory at Simon Fraser University later this spring, here are some astronomy notes to help you prepare for the next two months.

First off, my favourite planet, Saturn, returns to our evening sky this month. At the moment, it rises around midnight but will be visible in the east by 9pm toward the end of April. With Jupiter already high overhead, the tandem make a great planetary observing evening especially for sidewalk astronomers.

A total solar eclipse will occur on March 20th, however it won't be visible from the Western hemisphere. Starting at the

continued on page 4

About RASC

The RASC Vancouver Centre meets at 7:30 PM on the second Thursday of every month at SFU's Burnaby campus (see map on page 4). Guests are always welcome. In addition, the Centre has an observing site where star parties are regularly scheduled.

Membership is currently $75.00 per year ($43.00 for persons under 21 years of age; family memberships also available) and can be obtained online, at a meeting, or by writing to the Treasurer at the address below. Annual membership includes the invaluable Observer's Handbook, six issues of the RASC Journal, and, of course, access to all of the club events and projects.

For more information regarding the Centre and its activities, please contact our P.R. Director.

NOVA, the newsletter of the Vancouver Centre, RASC, is published on odd-numbered months. Opinions expressed herein are not necessarily those of the Vancouver Centre.

Material on any aspect of astronomy should be e-mailed to the editor or mailed to the address below.

Remember, you are always welcome to attend meetings of Council, held on the first Thursday of every month at 7:30pm in room P8445.2 of the Physics wing of the Shrum Science Centre at SFU. Please contact a council member for directions.

2015 Vancouver Centre Officers

President/LPA	Mark Eburne president@rasc-vancouver.com	**Past President/Events**	Howard Trottier telescopes@rasc-vancouver.com	**Webmaster**	Rick Vandenberg webmaster@rasc-vancouver.com
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Library

The centre has a large library of books, magazines and old NOVAs for your enjoyment. Please take advantage of this club service and visit often to check out the new purchases. Suggestions for future library acquisitions are appreciated.

On the Internet

http://rasc-vancouver.com or
http://www.rasc.ca/vancouver
http://astronomy.meetup.com/131/
http://www.facebook.com/RASC.Van

@RASCVancouver

Mailing Address

RASC Vancouver Centre
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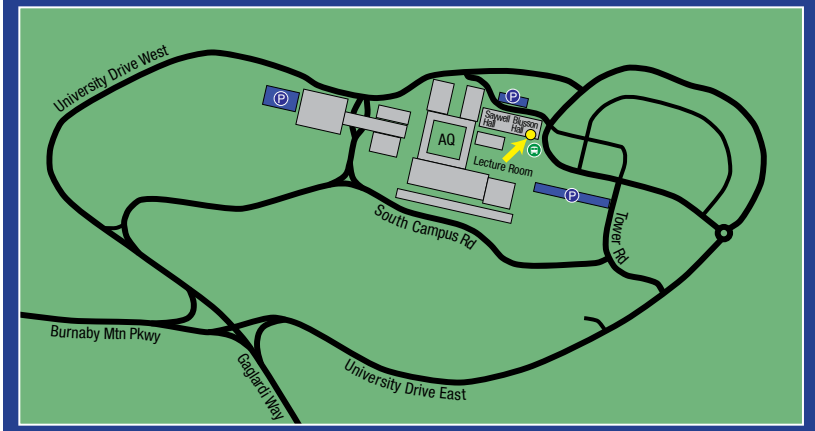
Map to Meeting Site



Our SFU meeting site is in room 9660 (the Mowfaghian Theatre) of Blusson Hall. After entering through the east doors, turn right then take the stairs on the left down one floor. The theatre is just to your left.

Pay parking is available at several locations located around campus (indicated as "P" on the map).

continued from page 3

North Pole, the eclipse finds a path across the Arctic Ocean between Greenland and Northern Europe, passing directly over the Norwegian islands of Svalbard. These remote Arctic islands have a total population of only 2,500 but are expecting over ten thousand visitors for the eclipse.

A total lunar eclipse occurs in the early morning of April 4th. The Moon will begin darkening around 2am, with the real excitement starting at 3:17am when the Moon reaches the edge of the Earth's shadow. The eclipse will have peaked by 5:00am and the Moon will set around 6:40am while it begins to leave the Earth's shadow. In the days or weeks following the lunar eclipse, expect large ocean tides which may flood Vancouver's seawall as they did in the fall of 2014. Page 178 of the *2015 RASC Observer's Handbook* describes a rare alignment peaking in September of 2015 where lunar eclipses two weeks either side of the solstice result in a series of extreme tides seen every 18 years.

The night of April 22nd to April 23rd is the peak of the annual Lyrid meteor shower. The Lyrids are one of the lesser meteor showers, but being only 4 days following a new moon, this year's event should be surprisingly strong for anyone under a dark sky.

Early morning of May 6th is the best time to view the annual Eta Aquarid meteor shower, one of two meteor showers associated with Halley's Comet and usually a good show with around 60 meteors per hour. Unfortunately, 2015's shower peaks two days after a full moon and may be a disappointment compared to other years.

And, of course, we are all extremely excited for the opening of the Trottier Observatory which will be the home to many RASC observing nights. ✸

cartoon by Dan Collier

The Observer's Chair

by Alan Jones

Sometime in the blur of the past, I bought an observer's chair. It is one of the best tools the observer can have. When you begin observing, you accept the need to spend money on a good telescope. Then you find out that it is only as good as the weakest link. You need to spend good money on good eyepieces. They don't need to be the most expensive but they do need to have high quality designed and implemented optics that give the observer good contrast if not wide fields. More money buys wider fields.

One of an observer's challenges is learning how to hold your head steady at the eyepiece. It has been said that just using a good chair is like adding a couple of inches of aperture and I agree with that. Each different telescope type puts the eyepiece in a different relative position for favourable viewing. The chair sweetens that spot, allowing you to sit comfortably and hold your head and eye steady at the same time. This allows you to see more of any object. It is pretty much the only way you can see enough detail to sketch an object.

Expect to pay from $150 and up for a good chair that is sturdy and easy to adjust in the dark. There are designs on the web for the Denver observing chair that you can build in wood for less if you are handy with wood tools. Sometimes you can find a used chair.

On a recent trip, I made the unwise decision to leave my observer's chair at home. It's a less serious omission than leaving the trusses of a Dobsonian behind or remembering the complete telescope but finding you forgot to bring the eyepiece case. I've made both of those mistakes. I missed my observer's chair so much it reminded me to recommend the observer's chair to observers that don't have one yet. ✸

Membership has its Privileges!

New members, did you know? The Vancouver Centre has several telescopes available for loan free of charge! We have telescopes ranging from 60mm to 10" in diameter. For more information see the Director of Telescopes after the members meeting. The loaner period is for one month, to be returned after the next meeting. Telescopes are not allowed to circulate outside of these meetings. You can now reserve two different telescopes per year and use what is left at the end of the meeting anytime.

Your greatest opportunity as a member of the RASC is to take advantage of the company of other enthusiasts to increase your knowledge, enjoyment and skill in astronomy.

The best thing you can do to gain the most from your membership is to get active! Take in the club meetings; engage other members with questions; come out to observing sessions (also known as "star parties"), and, by all means, volunteer to take part in our many public events.

For the usual observing sites and times, visit our website at http://rasc-vancouver.com/observing-sites/ or contact the Observing Chair at observing@rasc-vancouver.com.

Upcoming Events

March
28 – Night Quest at Pacific Spirit Park

May
9 – Astronomy Day at SFU

July
1-5 – RASC General Assembly in Halifax

August
8 - 16 – Mt. Kobau Star Party

September
Sept. 11 - 19 – Merritt Star Quest

December
10 – AGM

INTERNATIONAL ASTRONOMY DAY

SATURDAY, MAY 9

Sponsored by the ROYAL ASTRONOMICAL SOCIETY OF CANADA – VANCOUVER CENTRE and hosted at SIMON FRASER UNIVERSITY, BURNABY CAMPUS

AFTERNOON ACTIVITIES 11 am to 4 pm
(free admission and free parking in Lot B)

Activities to include:

Children's crafts (3 tables)
Hand's on science activities
Solar telescopes
Astronomy Bingo
Apollo Mission Display
Solar System displays
Light Pollution display
and more

AFTERNOON LECTURES 12 pm to 3 pm

(schedule and topics to be announced)

Followed by a Star Party at 9 pm

For more information on the day's and evening's activities, go to www.rasc-vancouver.com

In addition, this event is being held in conjunction with SFU's Science Rendezvous, a Canada-wide celebration of science. SFU's Faculty of Science has many activities and displays planned as well.

Cool Astronomy Facts

by Gordon Farrell

Back in early January, I started posting a "Cool Astronomy Fact of the Day" on Facebook, just to see how long I could keep it up. After reaching 50 factoids, I moved them to a "Cool Astronomy Facts" page and continue to post one a day. Here's a sampling of some of those quick little facts:

Amino acids, the building blocks of proteins, are surprisingly commonplace in space. They have been found inside meteorites, in comets, and in the molecular clouds that fill interstellar space.

If you were to stand on the surface (well, cloud-tops) of Saturn, you'd weight only slightly more than you do on Earth.

The most distant object that can be seen with the naked eye is the Andromeda Galaxy (aka M31), some 2.5 million light years away (or, if you prefer, about 24 million million million km).

It can take photons of light up to 1 million years to travel from the Sun's core to its surface. ✸

For more fun facts, see http://www.facebook.com/CoolAstronomyFacts

continued from page 1
about 50 million light years. Since the cluster's diameter occupies 10 degrees on the Virgo/Coma border, its linear diameter is about 2 or 3 megaparsecs. Within this immense volume reside between 1200 and 2000 galaxies.

Sometimes I show the public a galaxy at this range and answer questions about it. I explain the object is so many millions of light years away and, consequently, the image they are seeing shows the object as it was millions of years ago. Frequently, after the visitor has had time to absorb this they ask: if that's what it looked like then, what does it look like now?

The answer to this seems strange. The galaxy has no "now" in terms of a universal time coordinate located here. The mistake is to think there is an absolute time frame, centred here, in which all other places have a relative time. Put another way, my son is a high school student. Is there a copy of him that is my age that we could approach and talk to "now?"

The same is true of the distant galaxy. They have no now. This was first appreciated by Albert Einstein who saw we have given special honours to time and separated it from spatial coordinates without any justification: it was simply a bad habit we fell into like watching the Oscars or eating potato chips.

Consider the whole universe. What can we say about a place that contains the Virgo Cluster? When the very largest structures in the universe are examined, it seems the cosmos is homogenous. That is the starting point for any number of speculations and it is surprising just how fruitful it is.

At the simplest, we might suppose that our homogenous cosmos is in equilibrium. This means it will show no net motion. This is the simplest way to continue our analysis of the state of the universe. It could be that the total configuration of the whole universe gets us this static cosmos. At first glance, this seems impossible to verify or refute. Yet it can be and with only, to a point, using the system of Isaac Newton.

Suppose we are given a ball of matter that is uniform. A basketball might do. We place a test particle inside the sphere. If the test body is within, the closer it is to one side of the sphere, the greater is its gravitational attraction to the near side but on the opposite side the area of attraction—that is a region on the ball defined by a constant angle from the test body—grows at the same rate at which its attractive potency declines. The result is the test body inside the uniform sphere of matter experiences no net force. We say: F=0.

Now, let's imagine a second sphere just outside the first. Like the inner globe, this one produces no net effect on its own interior. We can add as many additional spheres outside as we wish and nothing will change. This shows the arrangement of the total mass of the universe does not act to produce a static or balanced universe since these progressively more remote attractions add up to F=0. It leaves the door open for the universe to be governed by local gravitational effects without any counterbalance that might negate the on-the-spot situation.

Consider a second situation. If we move our arbitrary test body right onto the surface of the sphere we get a nonzero sum of forces, $F \neq 0$. This is the case since the gravitational attraction is $F = -G \times m \times M/r^2$ where the larger M is the mass of the sphere and the small m is the test mass.

It won't do to have different answers depending on how the problem is set up. The flaw is at first hard to spot, but is related to the same hassle as the time puzzle and thinking the galaxy has a "now" look to it. The fly in the ointment is contained in the Newtonian view of the universe and the F in the gravitational equation. Force is a vector quantity which means it has both magnitude and direction. A mass or a number, such as 14, is a scalar—it has magnitude only. The Newtonian notion of space, in which bodies move, assumes a remote set of axes against which local motion is referred. This is called the absolute frame of reference. The vectors inhabiting this frame can be thought of as straight arrows defining the direction of the force. But in a homogenous universe, all directions are equal, so direction has no obvious meaning and unwittingly we have violated the principle of a uniform cosmos. It's always something isn't it?

In the 19th century, investigators tried to find the Earth's vector against the absolute background of space. This was conceived to find not the velocity of the Earth

continued on page 8

continued from page 7
around the sun or some other body but the "real" velocity of Earth within the giant box of space itself. A clever apparatus was devised in which light beams ran a race and the beam pointed in the direction of Earth's travel would be able to beat its neighbour because it had the advantage of travelling at the Earth's speed plus the speed of light. Of course, no such easy addition is possible and the beams always ran the race in the same "time," to the consternation of the experimenters.

Once the vectors are retired, new mathematical tools get us the right way of dealing with the motion of the universe. The approach of Einstein was hinted at earlier in a paper in 1870 in which William K. Clifford put forward the view that a particle is nothing but a sort of hill in the geometry of space. So, particles make their presence known by shifts and wrinkles, space being like a table cloth that is pulled and pushed. More steep-sided wrinkles generate effects we see as an increased gravitational effect. This is why the Newtonian inadequacy was first noted in cases of high speeds and sharp gravitational gradients. The vectors, as straight as a pool cue, no longer describe the local space milieu. Alternatively, in the absence of wrinkled space, situations of low speed and constant gravitational flux saw the Newtonian solution as quite a good fit. This explains its remarkable success over more than three centuries.

We conclude that the universe is governed locally by gravity and the Virgo cluster takes part in the motions of a non-static universe. Within the cluster, gravity can act strongly enough to toss some members right out into intergalactic space. The cluster is a kind of laboratory where we can try to piece together what is happening in other, much more remote systems.

Our assumption that the universe is homogenous allows us to bet that uncounted copies of the Virgo cluster exist out of the reach of our instruments and that truths found here would still be true very much farther away.

In describing the starry constellations, there is a danger of being unable to see the forest for the trees. A mere list of things to look at, one after another, has the look of a phone book or a random page taken from a deep sky catalogue. In these little essays, I have undertaken to focus on ideas suggested by our human encounter with the sky and leave lists to others. The list sort of article can readily be found with a glossy cover on the front.

On the other hand, it seems negligent to pass over the individuals in the Virgo cluster. Some readers equipped with a computer-assisted scope may want to retain these pages as a little guide to the region while I hope others may be motivated to hunt down the little lights themselves. Naturally, this list is incomplete and the galaxies selected are either visible in smaller scopes, famous, or interesting in some way compared with others I might have included but have left out. If somebody's favourite Virgo galaxy isn't included, I'm sorry.

PART TWO: THE LIST

M104 is the famous "Sombrero" galaxy in Virgo. This is a giant galaxy with a dark lane visible running the length of the object. It does look somewhat like a hat with a large brim. The galaxy benefits from good seeing and higher magnifications. Too little power and the views are unimpressive. The galaxy has been photographed with giant telescopes and is a favourite of those selecting pictures for the covers of textbooks.

M104 is a nearly edge-on spiral and seems to be a large galaxy showing, to great telescopes, large numbers of attendant globular clusters.

M90 is a fairly bright member of the Virgo cluster of galaxies. It is a large, spiral galaxy and one of the best for viewing by amateurs. M90 is fairly distinct in a small telescope. A slightly larger scope, of 150 mm or better, shows an apparently stellar nucleus. This is a 12th magnitude foreground star. The galaxy is thousands of times more distant than the star. Coincidences happen where such huge numbers of objects are involved.

M90 is within an area known for numerous faint galaxies. Hundreds of fuzzy patches may be sampled in large telescopes. Most galaxies in the region are moving away from us due to the expansion of the universe. M90 is unusual in that it has a net motion towards us. Random motions in the Virgo cluster have combined to give it this odd push towards the Milky Way.

M89 is a faint elliptical galaxy near M87 and M90 in the densely

continued on page 9

continued from page 8

populated area of the constellation Virgo. It appears as a small dot in modest telescopes and looks bigger (although not much richer) in larger instruments. It seems to be similar but smaller and fainter than nearby M87. Both M objects can be seen in the same field with a low power, but the reduction of magnification will rob both galaxies of any detail.

This area of sky is often viewed by the Hubble Space telescope since it is an eye out into deep sky and away from the relatively nearby objects that form the Milky Way.

M87 is a giant elliptical galaxy in the Virgo region of the sky. It is famous for being one of the largest known galaxies, far larger than our Milky Way. The galaxy contains well over a thousand billion stars, and while our galaxy sports about 130 globular clusters, M87 has about 2000.

This elliptical is merely the largest and brightest galaxy in a vast area highly peppered with fainter galaxies. This region is far from the Milky Way's main axis and we have in Virgo a window out into truly deep space. Hundreds of faint galaxies may be sampled in larger telescopes.

In small telescopes, M87 looks like a bright ellipse with a star like centre.

Small and remote, it may seem hard to believe that 20 copies of our own Milky Way might be placed within M87.

M86 is a faint elliptical galaxy in the constellation Virgo. It is a faint disk in small telescopes, looking much like nearby M84. Larger telescopes reveal the ellipse shape that both these M objects share.

M86 (centre) and surrounding galaxies

M86 is within an area highly peppered with fainter galaxies. This region is far from the Milky Way's main axis and we have in Virgo a window out into truly deep space. Hundreds of faint galaxies may be sampled in larger telescopes.

M84 is a faint elliptical within the Virgo cluster of galaxies. It looks like an indistinct disk in small telescopes and in a 250 mm reflector some vague details may be glimpsed. It is nearby to M86, a very similar object.

M84 is within an area highly peppered with fainter galaxies.

M61 is a classic spiral galaxy and looks like the image the average person has of a galaxy. Its arms, like a windmill in motion, surround a round centre and it gives the impression of great distance, majesty, and size along with the utter stillness and reserve that seeing so remote a wonder fosters in the onlooker.

M61 is in the Virgo constellation and is the brightest member of dozens of nearby faint fuzzies that the larger telescope can find. M61 itself may be seen in a 76 mm scope as a dot. Larger telescopes show a superimposed roundish glow and the spiral structure is evident in a 300 mm or larger telescope.

NGC 4567 is one of a pair of interacting galaxies in Virgo. Its partner is NGC 4568 and in photos they can be seen merged at one end,

continued on page 10

continued from page 9
like conjoined twins. The pair is one in a set of such interacting galaxies that astronomers have studied to try to unravel the effects of rapid change within these external systems. It's important to remember that rapid change is still to be measured in millions of years.

Visually, this object shows little to the small telescope user and at least a 250 mm instrument is needed see much of the action.

NGC 4631 is a bright, edge-on galaxy in the constellation Canes Venatici, the hunting dogs. The galaxy is in a mainly blank area of the sky where it is possible to look out from the Milky Way into the wonders of truly deep space. The constellation has few stars but dozens of external galaxies may be viewed here.

4631 is an attractive object with a high surface brightness. Visible in a 60 mm refractor, it is a line of mottled light and faint details are visible along the whole body of the object in a 150 mm telescope. Larger instruments reveal a small galaxy beside 4631 and the pair looks like a hockey stick with a puck nearby. At least Canadian observers say this.

Just north of this galaxy is Cor Coroli, the brightest star in the hunting dogs. The name means the "heart of Charles" and it is said the star shone with great brightness to celebrate the return from exile of the English King Charles II. The star is a very easy double with subtle and attractive colours in small telescopes.

NGC 5746 is a remote galaxy in the constellation Virgo. It is one of countless galaxies on view in this region of the sky far from the local scene in the Milky Way. The object is a fine example of an edge-on, with a dust band along the middle. It's a spiral galaxy and the dusty lane is its own Milky Way. Not less than a 250 mm telescope is needed to appreciate these fine points. An even fainter galaxy is just nearby.

5746 may be found with the help of a bright star. Starting with the Big Dipper's handle, imagine an arc that connects to Arcturus. Then, continue the arc about another half as long. This is where the galaxy is found. ✸

For Sale

CELETRON C90 TELESCOPE & Autoguiding kit $290

Use as autoguiding scope for astrophotography...

• old as complete setup: Celestron C90 *(FL: 1100mm f/11, 90mm aperture)* w 5x finder-scope + 25mm eyepiece+ shop-made star diagonal w removable mirror + adjustable Losmandy-type dovetail mount *(fits any Losmandy)* + QuickCam B/W camera (DOS or WindowsXP-based).

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• C90 catadioptric is an excellent choice for autoguiding: 90mm aperture = bright image + rel long focal length (f/11) in short optical tube = much less wind buffeting—*a major problem when guiding with long refractors* + superior resolution vs off-axis guider

• entire pkg weighs 6 lb. incl C90.

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• *prism provides corrected left-right, erect images*

• *mounts on any camera tripod*

• *25mm Plossl eyepiece gives 40x mag*

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Karl Miller
A matter of perspective

There was a nice combination of the Moon, Mars, and Venus visible in the west on the evening of Feb. 20. This picture was cropped from the original, taken with a 200mm lens, ASA 800, 1/20 sec, handheld. Moon, Mars, and Venus aligned in the evening sky. The Moon (top) is closest (360 000 km), Venus (bottom) is about 213 million km away, and Mars (middle) 330 million km. ✸