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# The StarGazer

Newsletter of the Rappahannock Astronomy Club

No. 4 Vol. 11 February 2023–April 2023

## Want to Find Virginia's Dark Skies?

By Linda Billard

Whether you're an astronomer or just someone who just enjoys looking at the stars, dark skies offer the best conditions for seeing as much as possible. This story isn't about light pollution—even though it is a growing concern without an easy solution. This story is about where you can still find dark skies in Virginia. This issue of the newsletter also includes a report from Myron Wasiuta on his experiences at Natural Bridge State Park—Virginia's newest dark sky park.

**Introduction.** The [International Dark Sky Places \(IDSP\) conservation program](#) was established in 2001 by the International Dark Sky Association (IDA), which was recently renamed Dark Sky International. The program recognizes excellent stewardship of the night sky. Locations are designated as dark sky places based on stringent outdoor lighting standards and innovative community outreach. Since the program began, 10 communities, 25 parks, and 9 reserves have received International Dark Sky designations.

Here in Virginia, we are fortunate to have four state parks designated as IDSPs—Staunton River State Park, James River State Park, Sky Meadows State Park, and Natural Bridge State Park. In addition, Rappahannock County has also gained IDSP status for its county park.



**Staunton River State Park.** Staunton River State Park, in Scottsburg, was designated an IDSP in 2017, and was the first park in Virginia and the 25th park in the world to gain that status. It is managed by the Virginia Department of Conservation and Recreation (DCR), as are all the Virginia state parks. The park is 2,400 acres situated in southern Virginia, about 25 miles north of the North Carolina border. Its forests and meadows along the banks of the Dan and Staunton rivers are popular with outdoor enthusiasts of all kinds. In addition to various recreation opportunities, the park offers overnight accommodations in campgrounds and historic cabins built in the 1930s by the Civilian Conservation Corps.

In addition to establishing an outdoor lighting policy to minimize light pollution, conducting outreach to the local community, park staff host and promote the Staunton River Star Party (SRSP) for guests to enjoy stargazing and camping. (*Continued on page 4*)

## How to Join RAC

RAC—located in the Fredericksburg, Virginia, area—is dedicated to the advancement of public interest in, and knowledge of, the science of astronomy. Members share a common interest in astronomy and related fields, as well as a love of observing the night sky.

Membership is open to anyone interested in astronomy, regardless of his/her level of knowledge. Owning a telescope is not a requirement. All you need is a desire to expand your knowledge of astronomy. Most RAC members are from the Fredericksburg area, including, but not limited to, the City of Fredericksburg and the counties of Stafford, Spotsylvania, King George, and Orange. We also have several members who live outside Virginia and have joined to have the opportunity to use the Mark Slade Remote Observatory (MSRO)—one of the benefits of membership.

RAC offers you a great opportunity to learn more about the stars, get advice on equipment purchases, and participate in community events. We meet once a month and hold regular **star parties**. Our website, [www.raclub.org](http://www.raclub.org) is the best source of information on our events.

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Website: [www.raclub.org](http://www.raclub.org)

Groups.io: Members-only group. When you join RAC, you will receive an invitation to join from the RAC President.

### **RAC Officers**

[Glenn Faini](#) President  
[Myron Wasiuta](#), Vice President  
[Matt Scott](#) Treasurer  
[Bart Billard](#) Secretary

### **Points of Contact**

[Glenn Faini](#) Public Outreach  
[Glenn Holliday](#) Scout Clinics  
[Glenn Faini](#) Star Parties  
[John Maynard](#) Web Editor & Image Gallery Editor  
[John Maynard](#) Internet Administrator  
[Scott Busby](#) Equipment Loan  
[Jerry Hubbell](#) Astrophotography  
[Myron Wasiuta](#) Mark Slade Remote Observatory (MSRO)

### Options for Dues Payment

**RAC annual membership is \$20 per family. Student membership is \$5.00.** [Editor's note: the student membership has been lowered from 7.50 to 5.00.] You can pay your dues in two ways. (For reference, the RAC membership year is January–December.) If you join anytime in the last quarter, your membership covers the upcoming year. Astro League dues run July to June.

- **By Mail:** Make out a check to RAC Treasurer and send it to Matthew Scott, RAC Treasurer, PO Box 752, Fredericksburg, VA, 22404-0752. Both new and renewing members should also print out the membership application [here](#), fill it out, and return it with their payment to keep our records up to date.
- **By PayPal:** You can also pay your dues online. Simply go [here](#), scroll down, and select the appropriate membership type from the dropdown box and click *Pay Now*. You do not need to complete an application because the notification the club receives of your payment will contain all the additional info needed. NOTE: If you pay using PayPal, your actual charge (including the PayPal usage fee) will be: Single/Family \$21.23, Student \$5.69, Single/Family & AL \$29.00, Student & AL \$13.46.

## President's Corner

Dear Members—

RAC's business meetings are at 8 o'clock on the third Wednesday of each month. Please consider joining us and participating. If a presentation is scheduled, it will begin at 7 o'clock and will be announced in advance. If a presentation is not scheduled, I will host a social hour at 7 o'clock so members can chat and socialize before the meeting.

I send Zoom meeting invitations to RAC members via our Groups.io eMail list. The invitation eMail will specify the meeting time and if there is a presentation. Please make sure you are subscribed to get the meeting invitations, to get timely club eMails, and to participate in club conversations. Non-members may join our meetings by sending me a request at [president@raclub.org](mailto:president@raclub.org).

The club meetings are far more interesting when they begin with a presentation. Please consider giving a presentation on a topic or piece of astronomical equipment that interests you. Perhaps some of you can dust off and update a presentation you gave years ago that many of our new members haven't seen. May's presentation will be given by a representative of Dark Sky International.

Monthly Star Parties are now held at three location—Belmont Observatory, Bowling Green, and Caledon State Park (upon request). Check your eMail or the [RAC website](#) for latest status.

May God bless you with transparent skies and excellent seeing.

Glenn Faini  
President



## Star Party Update

Recently, RAC greatly expanded its outreach efforts. However, the list of **Upcoming Events** shows only those events currently scheduled. Additional events may be scheduled between now and the next newsletter (end July), so be sure to check the website. To request an event, please contact [Glenn Faini](#).

We have also changed the location of our regular monthly star parties. Weather permitting, events will be held simultaneously at Belmont Observatory near Lake Anna in Spotsylvania County and at the VDOT parking area at the intersection of Rtes. 2 and 301 in Bowling Green (Caroline County). To attend a Belmont star party, please contact Scott at (540) 273-0063 for info and directions. To attend a Bowling Green star party, contact Corey at (757) 329-7611 for info. Also, please check the top banner on our [website](#) for updates on our public star parties.

Upcoming Events		Recent Events Completed	
Star Party, Belmont & Bowling Green	May 20	Star Party, Motts Run	February 8
Star Party, Belmont	June 17	Star Party, Bowling Green	February 18
Star Party, James River State Park	July 17	Star Party, Natural Bridge State Park	April 22
Star Party, Belmont & Bowling Green	July 22		

## Did You Know?

by Scott Busby

The young Isaac Newton coined the word spectrum in 1666, to describe the rainbow colors that arose like ghostly apparitions when daylight passed through cut glass or crystal. Although his contemporaries thought glass corrupted the purity of light by imparting color to it, Newton held that colors belonged to light itself. A prism merely revealed white light's component hues by refracting them at different angles, so that each could be seen individually.

**Source:** *The Glass Universe*, Dava Sobel, Viking Penguin 2016.



## Want to Find Virginia's Dark Skies? (Continued from page 1)



The SRSP is held twice a year (spring and fall) and runs for a full week each time. Several members of RAC have attended—some more than once—and highly recommend the event, the site, and the staff. The Fall 2023 SRSP is currently scheduled for October 9–15. Astronomers are allowed to camp on the Observation Field during this event. To reserve a campground or cabin reservation for the Star Party, contact the [park](#). Bathrooms, showers, and food service are offered by the park during this event. Registration for the fall star party will open in July. For info, see <https://chaosastro.org/starparty-home/>



**James River State Park.** James River State Park, a 1,500-acre site located in the geographic center of Virginia, became an IDSP in 2019. The park has more than 2 miles of river frontage, wooded area, three ponds, and open meadows. In addition to numerous recreational opportunities, the park offers overnight accommodations in its campgrounds and modern cabins. The night skies at the park offer incredible viewing opportunities, especially considering its proximity to several larger cities. The park offers several programs throughout the year using local astronomy groups to give visitors the opportunity to see the dark sky through some remarkable telescopes. RAC will be supporting an IDA Astronomy Night at the park on May 6. Contact [Myron Wasiuta](#) for more info on the May event.



**Sky Meadows State Park.** [Sky Meadows State Park](#) is a 1,860-acre site in northern Virginia, about an hour west of the Washington metro area in Delaplane. The name “Sky Meadows” comes from the name of the property that became the park—Skye Farm, named after the Isle of Skye in Scotland. The history of the park’s land extends some three centuries into the past when it was associated with Ashby’s Gap, through which early European settlers first entered the Shenandoah Valley. Among many other activities, the park holds astronomy outreach programs every month.



**Natural Bridge State Park.** This park is Virginia’s most recent addition to the list of world IDSP list, receiving its designation in 2021. For more details, see Myron Wasiuta’s article [below](#).





the target.

I used my Televue NP127is telescope with a Canon EOS Ra camera. In its description of the camera, Canon says: "The infrared-cutting filter (positioned immediately in front of the CMOS imaging sensor) is modified to permit approximately 4x as much transmission of hydrogen alpha rays at the 656nm wavelength, vs. standard EOS R cameras. This modification allows much higher transmission of deep red infrared rays emitted by nebulae, without requiring any other specialized optics or accessories." I attempted to apply dark and bias calibration frames, and although I didn't do a great job, the calibration was applied equally in all four cases.

I used the following filters: Astronomik L-2, Baader Moon and Sky Glow, Optolong L-eHhance, and Optolong L Ultimate. My results are displayed in the following images.

**Rappahannock County Park.** This 7.3-acre park in Rappahannock County is located near the town of Washington, Virginia, just east of Shenandoah National Park. The park offers a quiet area for picnicking, hiking, outdoor activities such as butterfly counting, birding, trout fishing, and stargazing. Located only a few miles from the Appalachian Trail access near Chester Gap, the park serves as a mini gateway to the historic Virginia Blue Ridge foothills, one of the darkest remaining areas within the eastern United States.

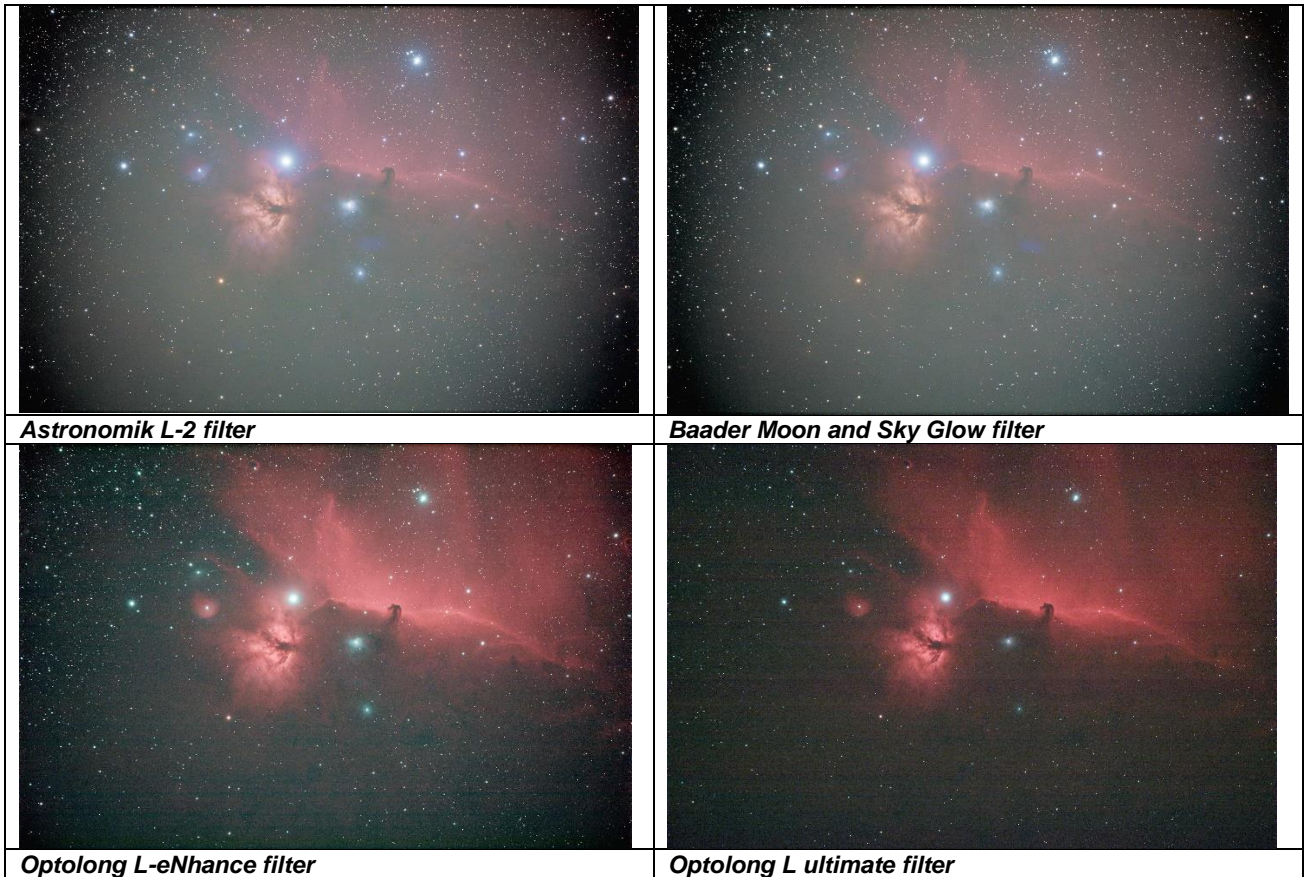
During 2023, the park will host astronomy events once a month (twice in June) during 2023 for the public to come and observe the night skies. Four of these events are Dark Sky Events (May 20, June 3, July 15, and September 16), and at least one viewing device will be available for public use on these evenings. The other events are described as "Free Observation Evenings" (June 17, August 19, October 10, and November 11). On these dates, the park is open for viewing, but there will be no program presentation or viewing devices provided. For more information go [here](#) and download the "Dark Skies Calendar for 2023.". Note that reservations are required for free observation evenings.

## Narrowband and Broadband Filter Experiment on Horsehead Nebula

By Andy Hulon

I am fairly new to photography and wanted to find out how different filters would perform. I conducted the following test: Over a 2-hour period, I acquired 30 minutes of data on each of four filters using the Horsehead Nebula as





Clearly, the broad band filters—L2 and Baader—are a better fit to get the color range but with the price of lots of light pollution. The Optolong dual narrow band filters bring out the Ha and filter a lot of the light pollution but at the cost of the color range. However, with less light pollution, you also see the inherent camera noise in the Optolong data.

*Editor's Note: Please see the Picture of the Quarter [below](#) at the end of this newsletter for Andy's finished image that used a combination of the filters.*

## **A Brief Account of the Natural Bridge State Park Stargazing Program (April 22, 2023)**

By Myron Wasiuta

At the James River Star Party last November, I was asked whether I would be interested in becoming a Virginia State Park Astronomy Program volunteer. All that was required was to pass a background check and to be able to volunteer some time during the coming year as an astronomy expert for the regular park astronomy programs. In particular, Natural Bridge State Park had just become an International Dark Sky Association Dark Sky Place and was looking for volunteers. I agreed to provide at least one program in 2023. That program was on April 22, 2023. This article describes my experience.

First, let me say that volunteering for these programs is a great way to help the Virginia Park system as well as to meet many really nice and interesting people. Plus, you get to see some of the most beautiful places in Virginia! Kenneth Horowitz was my contact Ranger for this park, and he recommended that I piggy-back a program on a night that they were already scheduled to provide a stargazing event. The park has three 10-inch f/4.7 Orion dobsonians and a 6-inch f/8 Criterion Dynascope, as well as a green laser pointer and a host of red flashlights. They also have Ranger Summer Holiday and Ranger Brittany who have taken it upon themselves to figure out

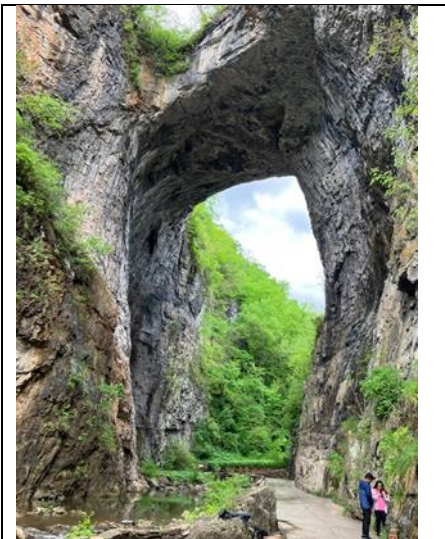
how to use the telescopes and locate objects in the night sky. However, as both were quick to admit, they had a lot to learn and were very happy that an expert (me!) was there to help.

My wife Terry, dog Zoe, and I arrived at the park about noon during a rain storm. A cold front was moving through, but the forecast was for clear skies by dusk. When we entered the Visitors Center, Summer showed us the area where all the telescopes were kept. I quickly did an inspection to make sure they were all collimated and in good working order (they were). We then were given a complimentary pair of tickets to see the Natural Bridge and hike the Cedar Creek Trail.

So off we went. The first sight is just after you start down the long flight of steps to the Cedar Creek Trail. On the left is, or was, the oldest Arbor Vitae Tree in the world. It died in 1980, and at the time was more than 1,600 years old (see photo at left).



Once you reach the bottom of the canyon, you must buy your ticket at the Trail Store and Cedar Creek Pavilion to see the Natural Bridge. Many people are surprised to learn it is not visible anywhere from Rt 11 (which actually crosses over the top of it) and cannot be seen without entering the park and purchasing the tickets. As we walked past the pavilion and started down Cedar Creek Trail, the immense and magnificent arch came into view. (See photo below.)



Natural Bridge was carved by Cedar Creek and is thought to be several hundred million years old. It is 215 feet tall, 90 feet wide at the inside, and 40 feet thick at the top. George Washington visited the area, along with Thomas Jefferson. On the walls of the arch across the creek are his initials. I asked a ranger at the pavilion on my way back what all the other carvings were near George Washington's initials. He replied, "18th century graffiti."

There are many sights to see along the trail as it crosses under the arch. On this day, because it had just rained, one could stand under the arch and look up and see spherical water droplets falling for 4–5 seconds, appearing at first to be barely moving (almost suspended in mid-air), only to rush past at the very last second. In some cases, they made a hard



splat on my forehead! In addition, an abundance of beautiful wildflowers, including Red Columbine (shooting star) appeared to be growing out of the walls of the arch.



A few tenths of a mile after the arch, you can find the "Lost River." Legend has it that early miners in the area heard underground water flowing and blasted several holes into the side of the rocks of the canyon until they sprung a leak. The source of this underground river remains a mystery.

Another interesting attraction along the trail is a replica of a Monocan Indian village. The exhibit is currently closed, but you can still walk up to the palisade fencing and gardens and wonder what it must have been like to live out in these woods so long ago.

At the end of the trail is a viewing area for Lacy Falls. The sound of the cascading waterfall was very relaxing.





The hardest part of the hike was climbing back out of the canyon to the Visitor Center. Our legs were tired after tackling about 115 steps. We pulled our camper to the campground and set up for the night. As it was getting dark, I unhitched the truck, which was loaded with the 5-inch f/15 Edmund refractor and tried to climb the service road to Jefferson Ridge where the star programs are usually held. It's about a 15-minute walk from the parking area, but the park offers a wagon ride for those who do not want to walk. However, on this evening, after so much rain, neither my truck nor the park truck could make the climb. Mud was flying everywhere! Rangers Summer and Brittany quickly decided we would move the star program to the Children's Discovery Area, which was a lot easier to get to. Located on a small hill near the trail head parking lot, it was an ideal location! There

were even star maps provided at the trail head sign.

As I set up the telescope, Summer and Brittany posed for a picture. Just after I took this picture, the public began arriving! Despite the heavy rains earlier in the day and the predicted cold temperatures, we had about 25 people show up! I started the program by showing the Moon in the telescope and went on to talk about the constellations and meteor showers. We then discussed the Lyrids in particular because this night was the maximum for the shower. We did see a few, but the radiant was still low in the northeast by the end of the program at 11 pm, so the best viewing of the meteors was just getting started as we ended the program. Frost had formed on many car windshields, and the cold was finally taking its toll. As everyone left, Summer helped pack up our stuff, and I went back to the camper. It was a great night with absolutely awesomely dark skies. The front had really cleared up the haze, and without a doubt, this was one of the darkest skies I had seen in a long time!



The next morning, as we were leaving the campground, I stopped and looked at the field we were in. That's when I noticed the IDA sign. Natural Bridge State Park truly does have some very dark skies worth preserving, and I hope to be back again soon. I would highly recommend this park not only as a beautiful destination for scenery, but as a place to enjoy the infinite expanses of the Universe!

## Astronomy Math—The Next Level (TNL)

By Scott Busby

In the next few editions of TNL, we will explore orbital motion, center of mass, a small mass orbiting a much larger mass, orbits of comparable masses, and artificial satellites in Earth orbit.

**Orbital Motion.** By studying the orbital motions of two gravitating bodies, we can discern information relating to the mass of the two-body system. Generally, two point masses orbiting under the influence of their mutual gravitational attraction describe orbits about a common point called the *center of mass* of the two-body system.

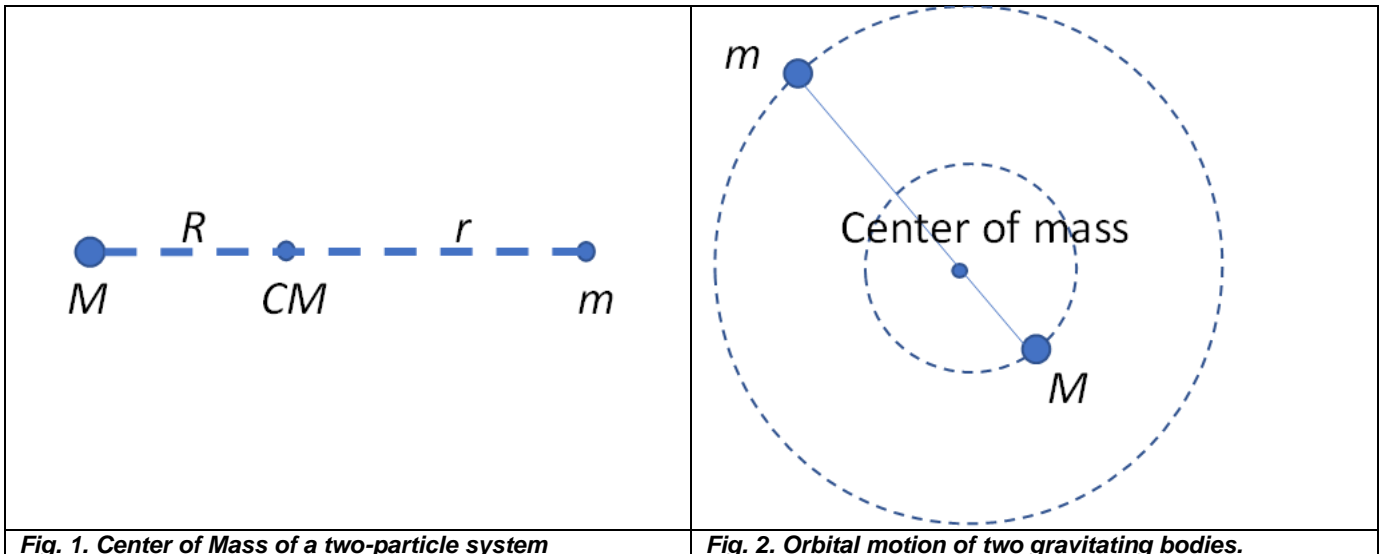
**Center of Mass.** The center of mass can be described as a point between two masses on a straight line connecting them. Let  $m$  represent the smaller mass and  $M$  the larger one. The distance of  $M$  from the center of mass is denoted by  $R$ , and  $m$  is located at distance  $r$  from the center of mass. To complete the definition of the center of mass, we require that

$$MR = mr$$

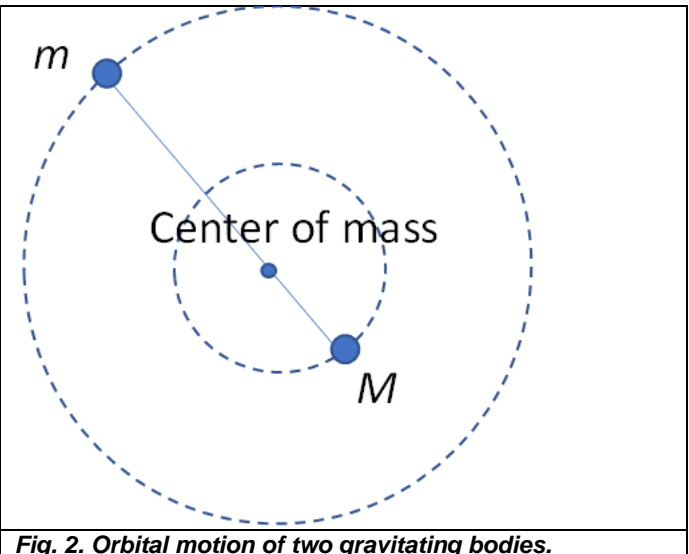


The notion of center of mass can be generalized to a system consisting of any number of mass points. Extended bodies are *many-body* systems consisting of large numbers of particles (molecules, etc.) that can be regarded as point masses. Therefore, every extended body has its own center of mass. To a good approximation, most celestial objects—stars, planets, and so on—have enough symmetry that we can regard the center of mass of any of these objects to be located at the geometrical center of the body.

In our treatment of the orbital motions of gravitating bodies, we shall consider the motions of the centers of mass of the two interacting bodies orbiting about their common center of mass. Figures 1 and 2 describe the center of mass of a two-particle system and the orbital motion of two gravitating bodies.



**Fig. 1. Center of Mass of a two-particle system**



**Fig. 2. Orbital motion of two gravitating bodies.**

From Figure 1, it is clear the center of mass is closer to the heavier body (i.e.,  $R < r$ ). For very large mass differences, the center of mass of the system may be *inside* the more massive body. For example, the Earth's mass is so large compared with the mass of the Moon that the center of mass of the Earth–Moon system is inside the Earth.

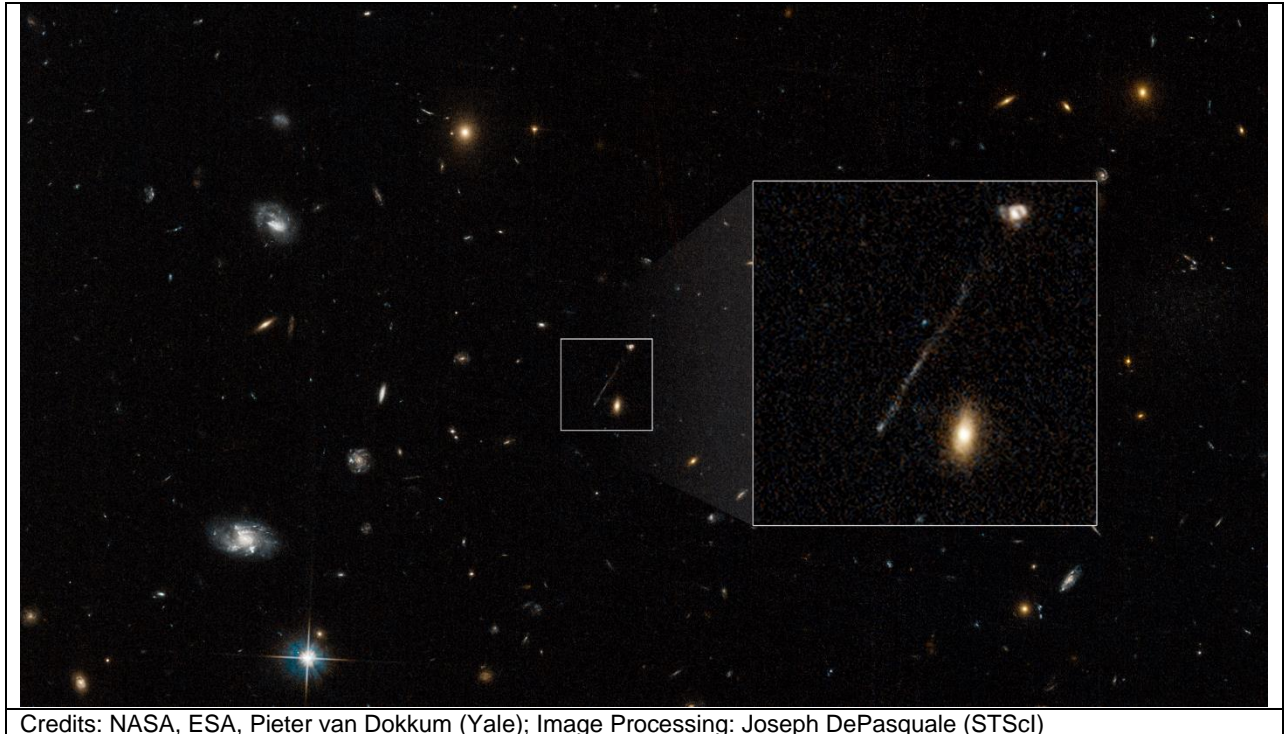
Strictly speaking, the Earth and the Moon orbit about a common center of mass, but the orbit of the Earth is so small because of its large mass that it makes sense to say that the Moon goes around the Earth. Actually, they both go around their common center of mass. *In the next TNL, we'll consider, in more detail, the motion of the lighter mass  $m$  as shown in Figure 2.*

## Hubble Detects Trail of Stars That Could Be Evidence of a Runaway Black Hole

By Linda Billard

On April 20, Yale astronomy and physics professor Pieter van Dokkum and his colleagues published a [paper](#) that attempts to explain an unusual phenomenon captured serendipitously by the Hubble Space Telescope (HST) (see photo below). This HST archival photo captures a curious linear feature so unusual that it was first dismissed as an imaging artifact.





Credits: NASA, ESA, Pieter van Dokkum (Yale); Image Processing: Joseph DePasquale (STScI)

Because it was so weird, van Dokkum and his team did follow-up spectroscopy with the W.M. Keck Observatories in Hawaii. He describes the star trail as "quite astonishing, very, very bright and very unusual." The spectroscopic analysis led to the conclusion that he was looking at the aftermath of a black hole flying through a halo of gas surrounding the host galaxy.

The black hole that produced the trail is moving through intergalactic space so fast that if it were in our solar system, it would travel from Earth to the Moon in 14 minutes. It weighs as much as 20 million Suns, and its "contrail" of new stars is twice the diameter of our Milky Way galaxy. Rather than eating up stars in its path, the speedy black hole is pushing through gas in front of it triggering new star formation along a narrow corridor.

The phenomenon is likely the result of multiple collisions of supermassive black holes. The researchers suggest that three black holes came together about 40 million years ago in the aftermath of the collisions of their host galaxies. Due to the strong gravitational forces unleashed by this galactic pileup, one of the black holes ended up speeding away from the scene of the "accident."

The line of gas and stars that the researchers spotted in the Hubble image would be the "wake" of the runaway black hole. Its endpoint is a bright point of light, which may be where the runaway black hole is located.

The notion of a runaway black hole originated in the 1970s, as researchers considered the implications of galaxy collisions for the formation and evolution of black holes. "It was very exciting to piece this puzzle together," said van Dokkum. "Even though Hubble has been around for many years now, it can still find entirely new phenomena in the night sky."

The next step is to do follow-up observations with NASA's James Webb Space Telescope and the Chandra X-ray Observatory to confirm the black hole explanation. If confirmed with further observations, the discovery would prove the 50-year-old theory predicting the existence of runaway black holes.

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## Image of the Quarter: Horsehead Nebula

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By Andy Hulon



Andy said: This is the result of my experiments with filters (see my article [above](#)). It is a combination of exposures of 83x120 sec using the Astronomik L-2 uv/ir filter and 21x307 sec using the Optolong Ultimate dual narrow band filter. Images were taken over 3 nights—December 1 and January 14 and 21—for a total of about 4.5 hours. I used 30 darks and bias to calibrate. Stacked and processed in Astro Pixel Processor. Telescope is the Televue NP127is with a Canon EOS Ra camera.