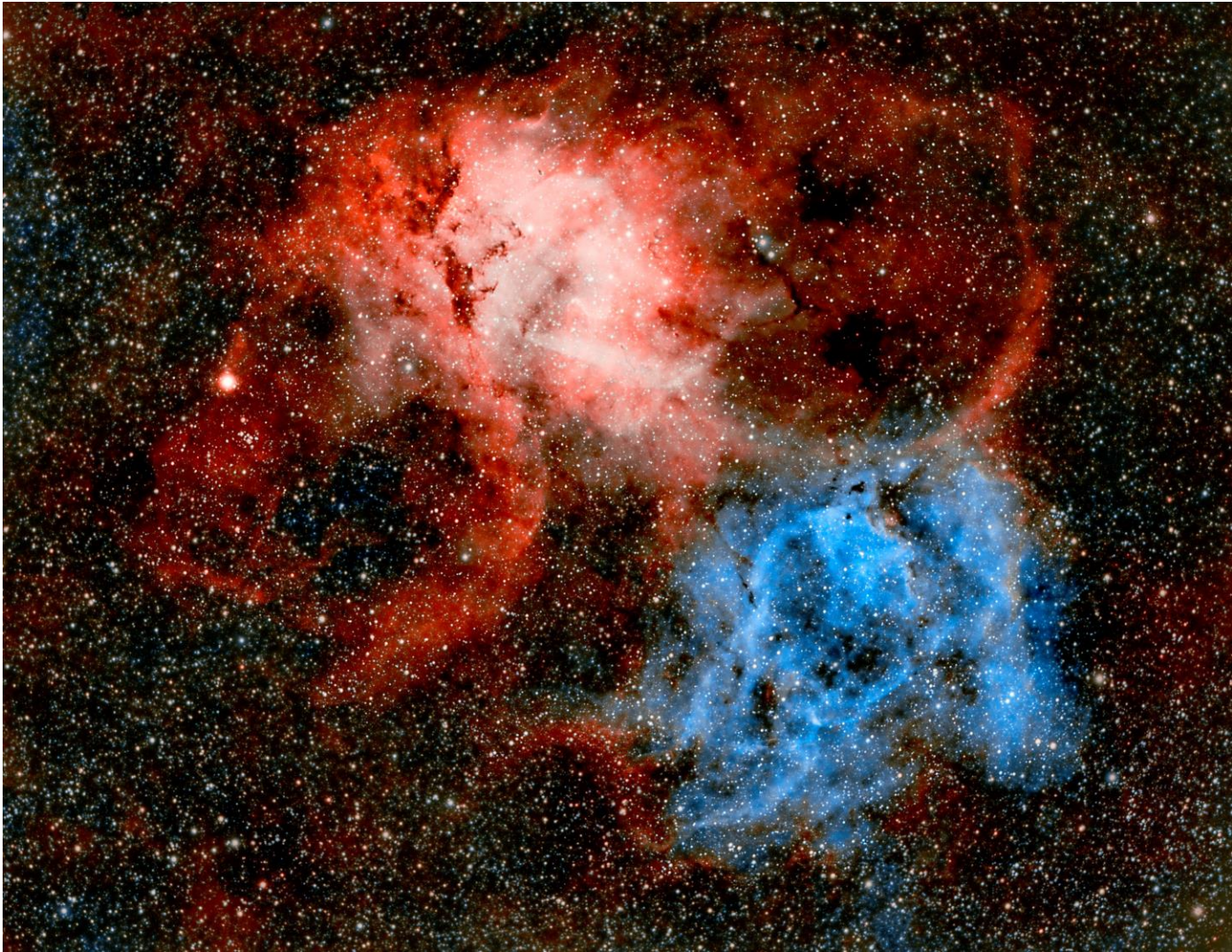


Photonic Cleaning Technologies Presents: Ram Samudrala



Lion Nebula (Sh2-132)

The Intimate Cosmos

From my backyard to a galaxy some 30 million light-years away

Ram Samudrala

I have been interested in the night sky since childhood, but astrophotography became a serious pursuit much later, when technology, time, and a move to relatively dark skies on Lake Ontario finally came together. What began as looking upward gradually became a way of moving outward: from phenomena in our own atmosphere, through the Solar System, into the Milky Way, and finally to other galaxies.

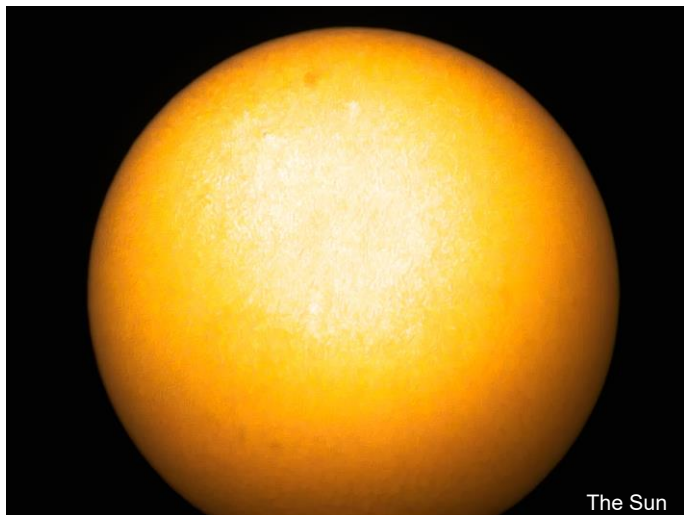
The images here are arranged roughly as that journey. The distances rapidly become almost impossible to comprehend, yet astrophotography has always felt strangely intimate to me. I can stand in my backyard and, mostly through the simple act of seeing, the Moon, a nebula thousands of light-years away, and an entire galaxy millions of light-years away all appear here. The distances and distinctions are real and useful. It appears that fundamental separation in the experience itself isn't findable.

The backyard

Sometimes the universe comes all the way down to the horizon. Aurorae over Lake Ontario can turn a familiar landscape into something almost extraterrestrial. These green and purple displays were photographed handheld with a phone; the long exposures captured colors and structure that the eye experienced more fleetingly.



The Sun offers a different kind of immediacy. My solar images span a full disk, sunspots, a transit of Mercury, and the 2017 total solar eclipse from Hopkinsville, Kentucky. They were made with different equipment and processing approaches, and I treat processing as part of the art of astrophotography: the data are real, while contrast and color can make structures much easier to see. The eclipse, with Baily's beads breaking through at the lunar limb, makes the geometry especially tangible.



Then there is the Moon: close enough to reveal an entire geography of craters and maria, yet already another world. Comet NEOWISE provides a bridge outward, a transient visitor whose appearance in 2020 briefly made orbital mechanics into something visible from home.

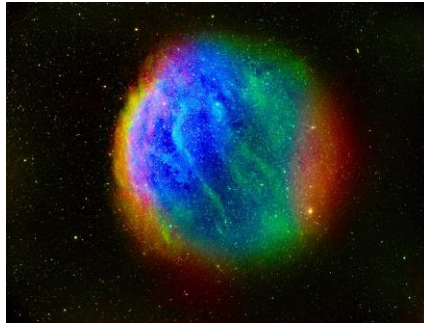


Into the Milky Way

Beyond the Solar System, distance changes scale abruptly. The Pleiades are hundreds of light-years away, their blue reflection nebosity surrounding a familiar cluster. Sh2-216 is an enormous, faint planetary nebula and one of the nearest known examples of its kind. Gamma Cassiopeiae illuminates the Ghost nebulae around it. These objects are no longer places one could imagine visiting in any ordinary sense, yet their photons still arrive at a telescope in the backyard.



Pleiades M45



Planetary Nebula Sh2-216

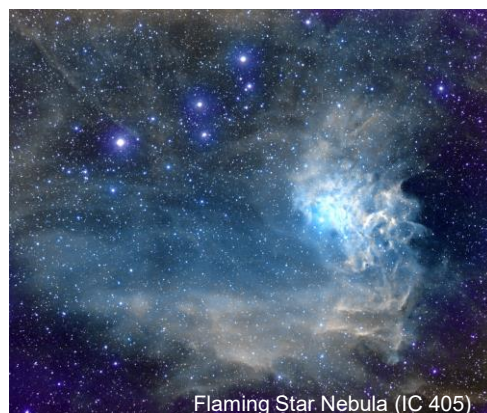


Ghost of Cassiopeia (IC59/IC 63)

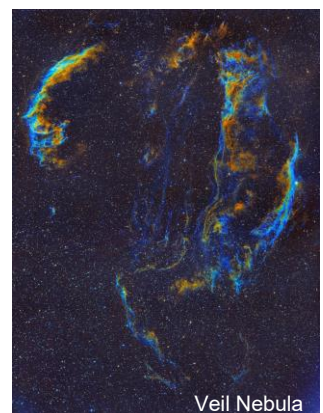
Emission nebulae are where narrowband astrophotography becomes particularly expressive. The California and Flaming Star nebulae reveal enormous clouds of glowing gas, while the Veil is the remnant of a supernova: a stellar death spread across a huge apparent area of sky. Narrowband filters separate emission from hydrogen, oxygen, and sulfur, and mapping those signals into visible colors lets otherwise faint structure become legible.



California Nebula (NGC 1499)



Flaming Star Nebula (IC 405)



Veil Nebula

IC 1396 is one of my favorite regions. The wide view, which includes the Elephant's Trunk, won the 2019 U.S. Wiki Science Competition in astronomy; the closer view turns the dark trunk into the subject itself. Putting both together shows something I enjoy about astrophotography: changing scale can make the same physical region look like an entirely different object.

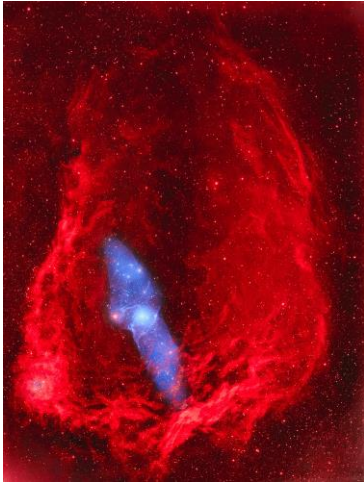


IC1396 and the Elephant's Trunk

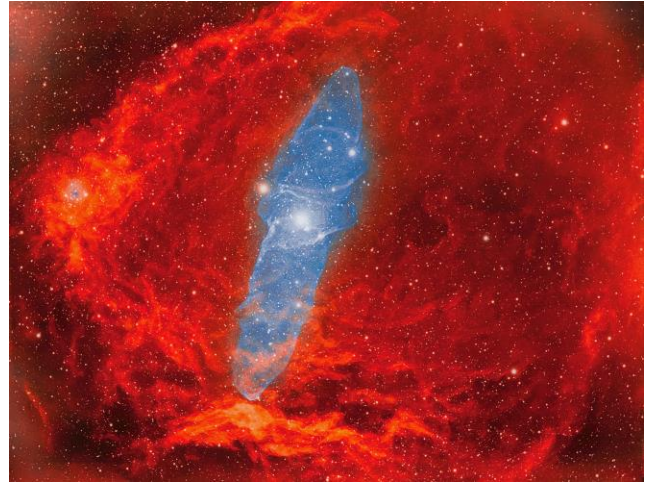


Elephant's Trunk Nebula (IC 1396)

The Flying Bat and Squid region pushes that idea further. My combined data set accumulated about 131 hours of exposure, and both wide and narrow framings show the enormous, extraordinarily faint Squid nebula Ou4 embedded in Sh2-129. Long integrations like this are exercises in patience: individual exposures may reveal little, but accumulated photons gradually make structure appear.



Flying Bat and Squid Nebulae (Sh2-129/Ou4), widefield



Flying Bat and Squid Nebulae (Sh2-129/Ou4), Narrow

Farther along are NGC 7822, the Jellyfish, the Heart and Fishhead, and the Cocoon nebulae. The Jellyfish won the astronomy category of the 2021 International Wiki Science Competition. The Cocoon wide field is especially appealing to me because the nebula is only part of the picture: the surrounding field of stars and the dark lane B168 give a sense of the larger stellar environment rather than isolating a single named object.



NGC 7822



Jellyfish Nebula (IC 443)



Heart and Fishhead Nebulae (IC 1805/IC 1795)



Cocoon Nebula (IC 5146) and B168

At still greater Galactic distances, the Pacman and Lion nebulae continue the journey. The Lion, more than ten thousand light-years away, won the astronomy category of the 2023 International Wiki Science Competition. By this point, the light recorded by the camera began its trip toward Earth thousands of years before any telescope existed.



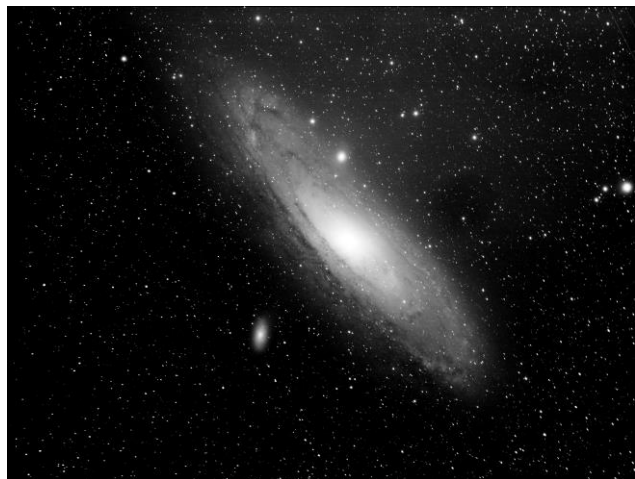
Pacman Nebula (NGC 281)



Lion Nebula (Sh2-132)

Beyond the Milky Way

Then the scale changes again. Andromeda is about 2.5 million light-years away. I have included two images deliberately: an early monochrome attempt and a later color image. They show the same galaxy, but also my own progression in equipment, acquisition, and processing. The Triangulum Galaxy, M33, is another member of our Local Group and one of my favorite color galaxy images.



Andromeda Galaxy (M31), Monochrome



Andromeda Galaxy (M31), Color



Triangulum Galaxy (M33)

NGC 891 is the endpoint of this particular journey. Seen almost perfectly edge-on, its dark dust lane divides the luminous disk. It lies roughly 30 million light-years away. The photons in this image therefore began traveling toward us tens of millions of years ago, yet their appearing is now.



The intimate cosmos

Astrophotography constantly moves between extremes. A camera records photons; software calibrates, aligns, combines, stretches, and maps them; an image emerges from choices that are simultaneously technical and aesthetic. Keeping the optical path clean is part of that process as well. I have used [First Contact Polymer](#) to clean astronomical optics and filters without repeatedly wiping delicate optical surfaces. Dust is mundane compared with a nebula, but faint-signal imaging makes mundane details matter.

What stays with me most, though, is the odd relationship between distance and intimacy. From an aurora overhead to a galaxy roughly 30 million light-years away, the intellectual distances become enormous. Yet standing under the sky, none of those objects is experienced 30 million light-years away. There is the telescope, the night, the photons, the seeing; and the distant structure simply appearing here.

There are distinctions everywhere: Earth and sky, Sun and Moon, star and nebula, observer and observed. But where is the fundamental boundary between them that can actually be found? The farther outward the camera travels, the more striking that inquiry becomes. Thirty million light-years can be unimaginably far away and, at the same time, astonishingly intimate.

Full-resolution images, technical details, equipment information, and further information about my astrophotography are available at: <http://ram.org/ramblings/cosmos/>