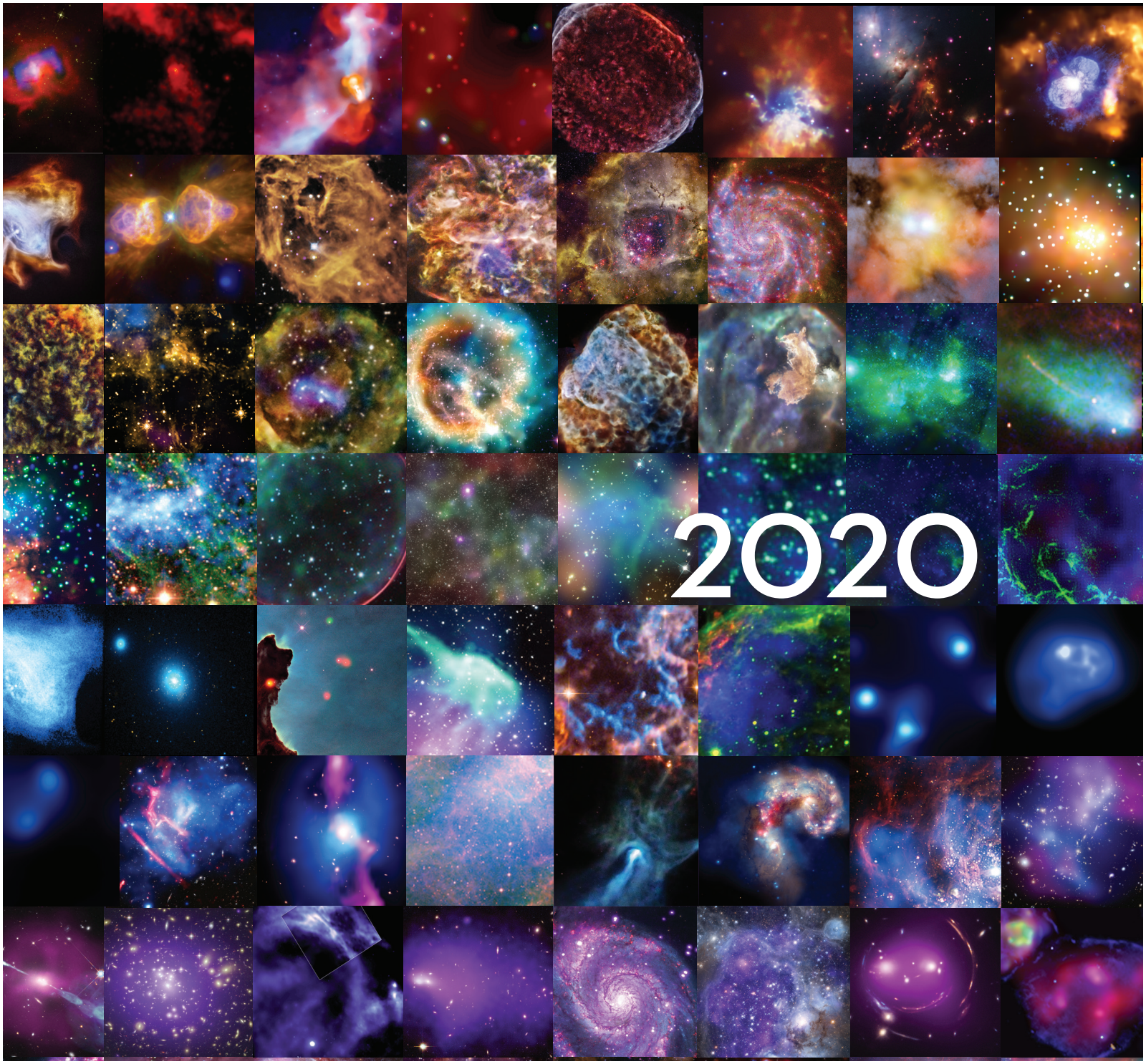
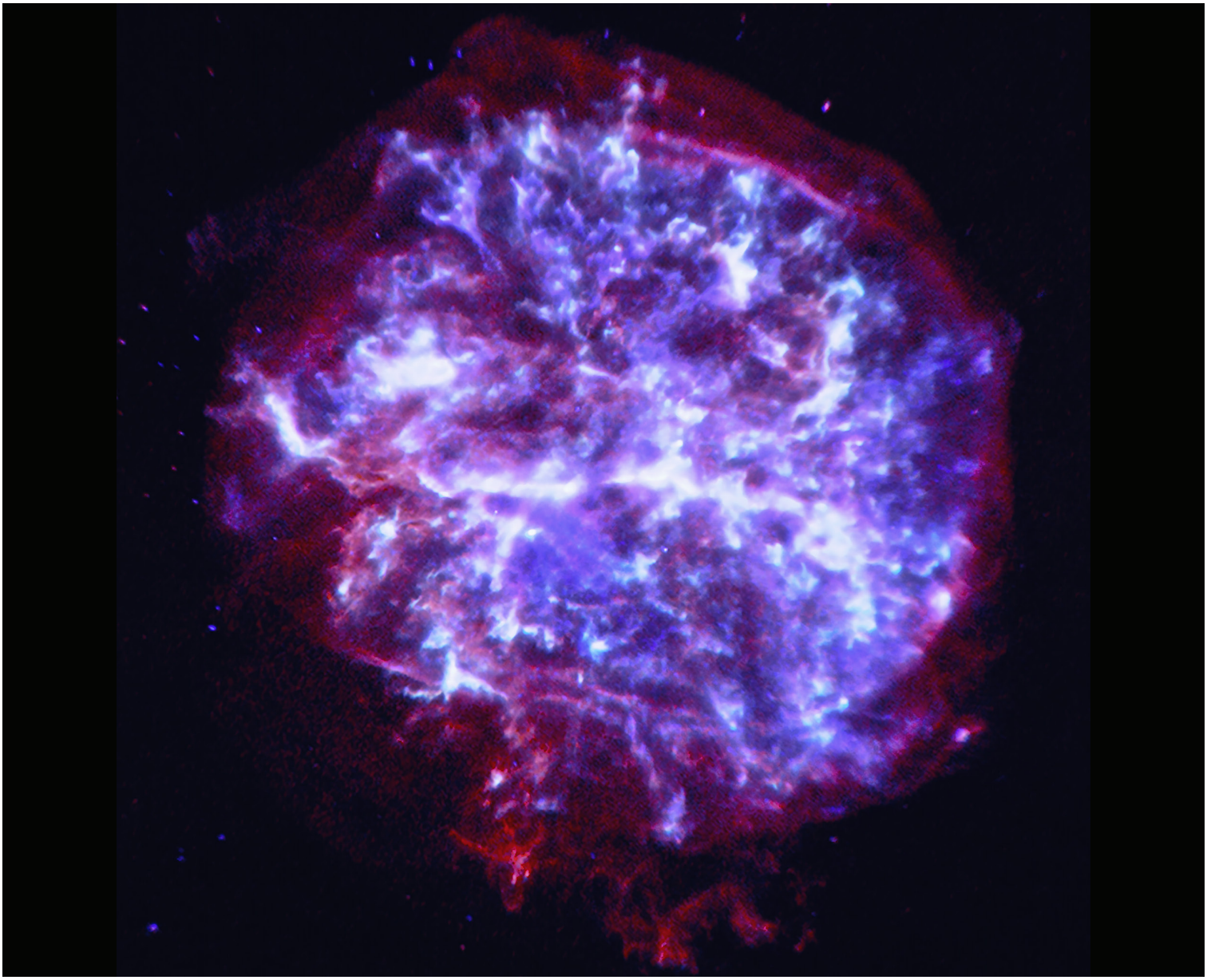
NASA'S

CHANDRA

X-RAY OBSERVATORY





G292

Supernova remnants are the debris from exploded stars. Because they are one of the primary sources of the heavy elements (that is, everything other than hydrogen and helium) necessary to form planets and people, supernova remnants are important to study. G292.0+1.8 is a rare type of supernova remnant observed to contain large amounts of oxygen. The X-ray image of G292.0+1.8 from NASA's Chandra X-ray Observatory (red, green, blue-green, and purple) shows a rapidly expanding, intricately structured field left behind by the shattered star.

JANUARY 2020

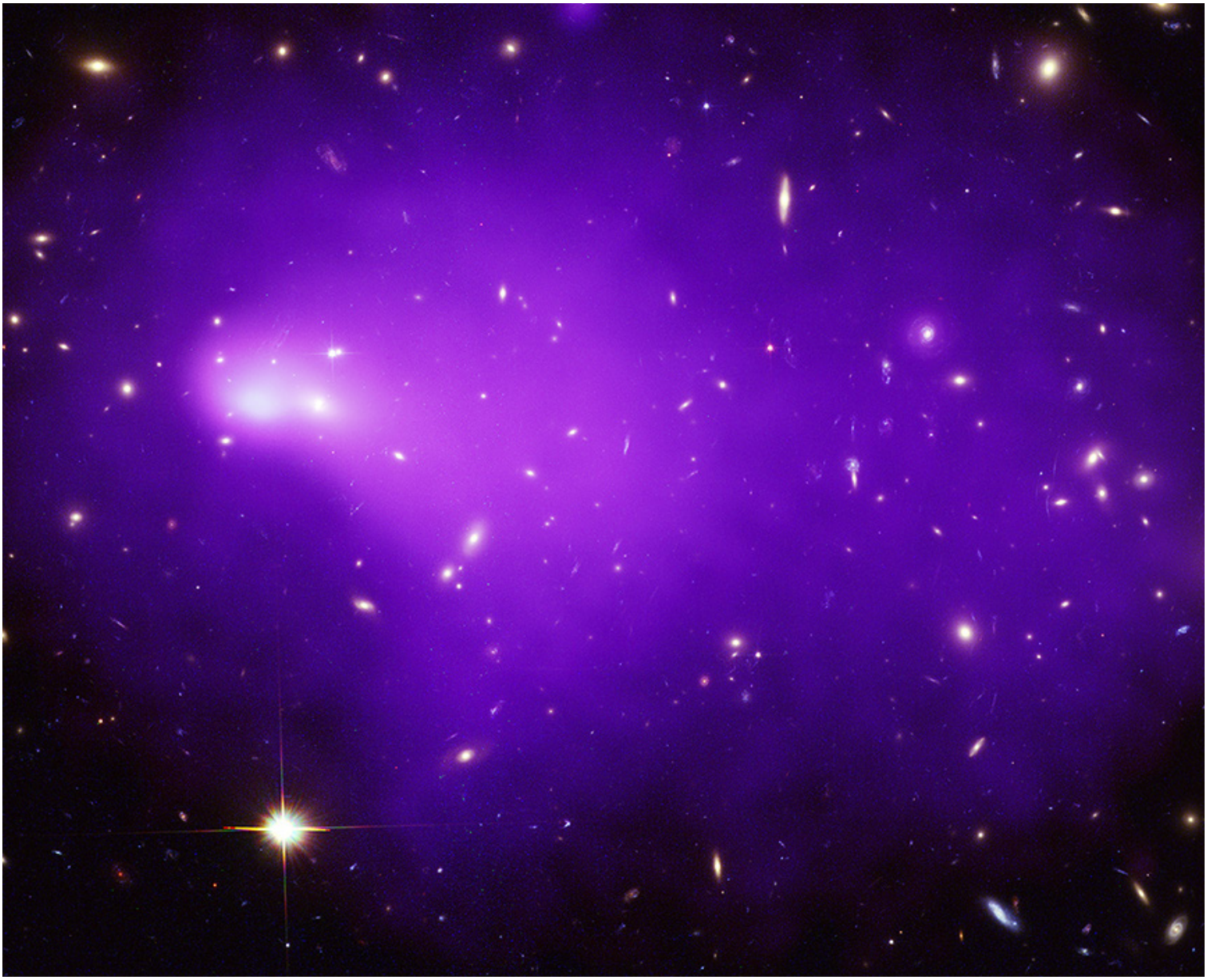
S	M	T	W	Th	F	Sa
			1 New Year's Day	2 ◖	3	4
5	6	7	8	9	10 ○	11
12	13	14	15	16	17 ◗	18
19	20 Martin Luther King, Jr.	21	22	23	24 ●	25
26	27	28	29	30	31	

NGC 604

The nearby galaxy Messier 33 contains a star-forming region called NGC 604 where some 200 hot, young, massive stars reside. The cool dust and warmer gas in this stellar nursery appear as the wispy structures in an optical image from NASA's Hubble Space Telescope (purple). In between these filaments are giant voids that are filled with hot, X-ray-emitting gas that Chandra observes (blue). Astronomers think these bubbles are being blown off the surfaces of the young and massive stars throughout NGC 604.

FEBRUARY 2020

S	M	T	W	Th	F	Sa
						1 ◖
2	3	4	5	6	7	8
9 ○	10	11	12	13	14 Valentine's Day	15 ◗
16	17 Presidents' Day	18	19	20	21	22
23 ●	24	25	26	27	28	29

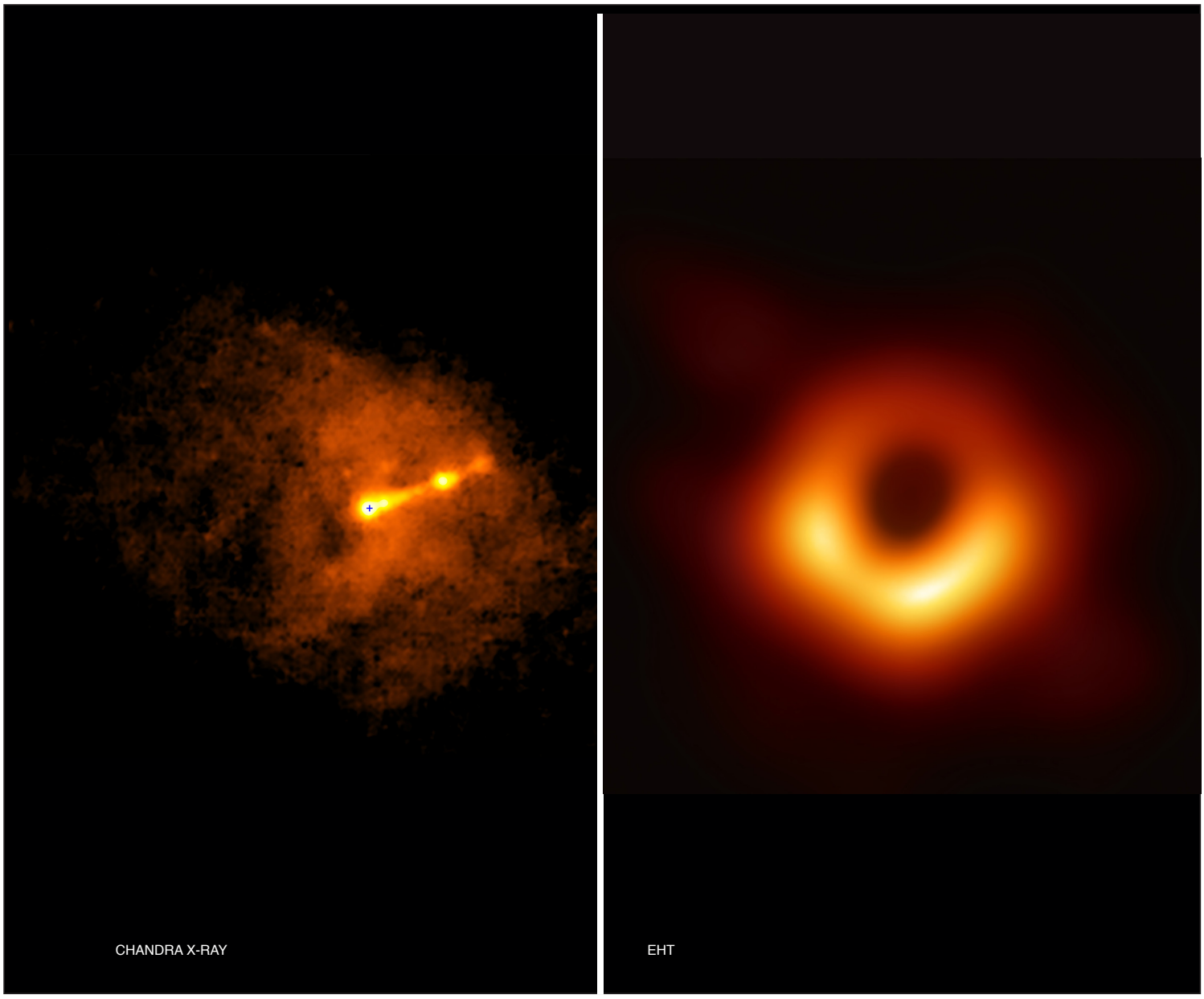


ABELL 2146

The colossal system Abell 2146 is the result of a collision and merger between two galaxy clusters. This composite image shows hot gas revealed by Chandra (purple) and a Hubble image of the stars and galaxies in the field of view. Astronomers think that galaxy clusters, the largest structures in the Universe held together by gravity, grow by colliding and merging with one another. Chandra has observed many galaxy cluster mergers, giving scientists insight into how these mega-structures came to be.

MARCH 2020

S	M	T	W	Th	F	Sa
1	2 ◖	3	4	5	6	7
8	9 ○	10	11	12	13	14
15	16 ◗	17	18	19	20	21
22	23	24 ●	25	26	27	28
29	30	31				



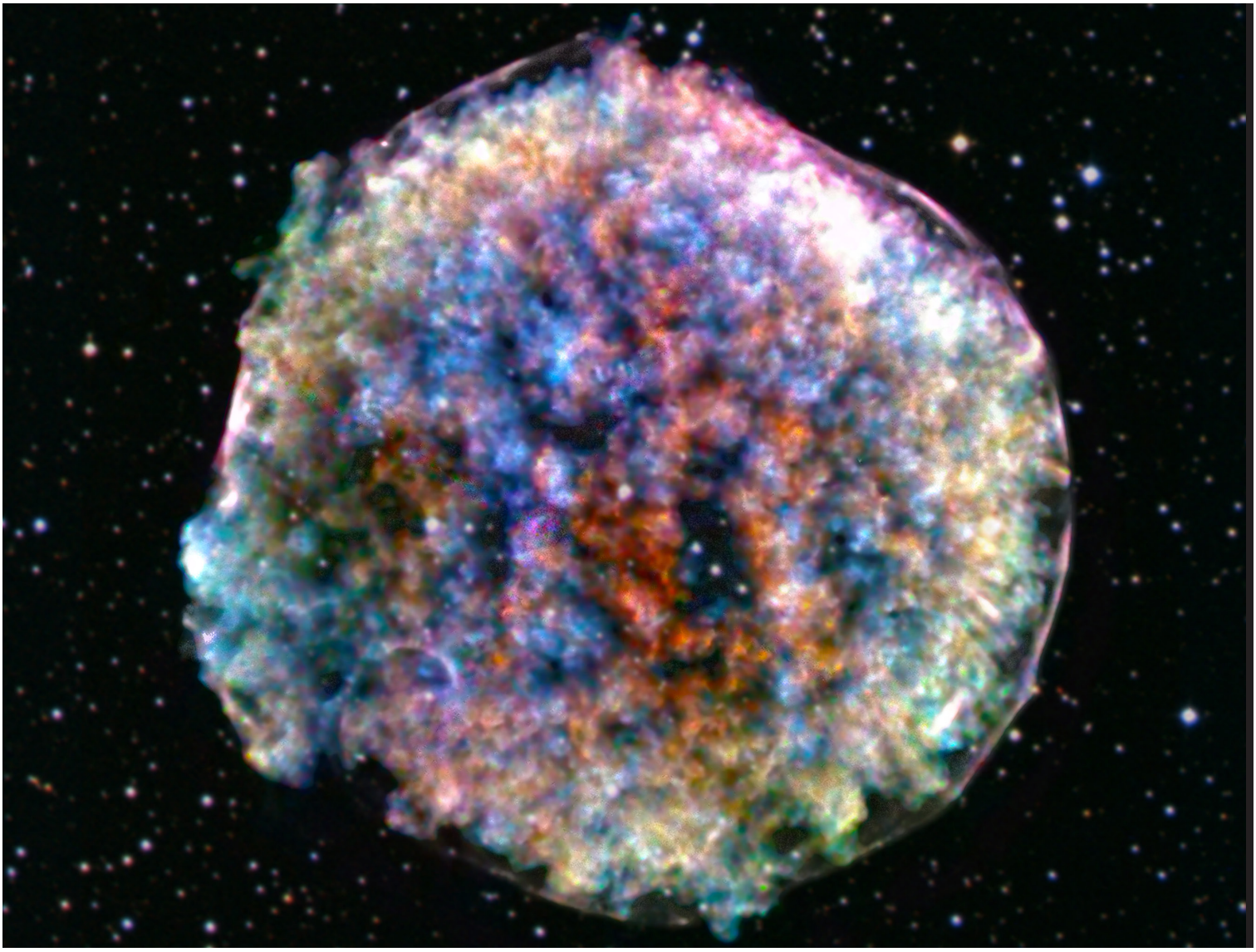
IMAGES NOT TO SAME SCALE

M87

Astronomers used Chandra to observe Messier 87, or M87, during the April 2017 observing run by the Event Horizon Telescope (EHT), which captured the first direct image of a black hole. The X-ray data from Chandra, in combination with the radio image from the EHT and other observations, will help scientists learn more about high-energy emission and the physics of accretion and ejection at the event horizon, the boundary between what can and cannot escape the gravitational boundary of a black hole. Chandra has studied M87 many times over its over 20-year mission and sees a much wider field of view than the EHT.

APRIL 2020

S	M	T	W	Th	F	Sa
			1 ◖	2	3	4
5	6	7 ○	8	9	10	11
12	13	14 ◗	15	16	17	18
19	20	21	22 ●	23	24	25
26	27	28	28	30		



TYCHO'S SUPERNOVA REMNANT

This Chandra image of the Tycho supernova remnant reveals an intriguing pattern of bright clumps and fainter holes giving clues about its origin. To emphasize these features, two narrow ranges of X-ray energies were selected to isolate material (silicon, colored red) moving away from Earth, and moving towards us (also silicon, colored blue). The other colors in the image (yellow, green, blue-green, orange and purple) show a broad range of different energies and elements, and a mixture of directions of motion. Chandra's X-ray data have been combined with an optical image of the stars in the same field of view from the Digitized Sky Survey.

MAY 2020

S	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7 ○	8	9
10	11	12	13	14 ◗	15	16
17	18	19	20	21	22 ●	23
24	25 Memorial Day	26	27	28	29 ◖	30
31						

30 DORADUS

At the center of 30 Doradus, one of the largest star-forming regions located close to the Milky Way, thousands of massive stars are blowing off material and producing intense radiation along with powerful winds. Chandra detects gas that has been heated to millions of degrees by these stellar winds and also by supernova explosions that mark the end of some giant stars' lives. The X-rays come from shock fronts, similar to sonic booms produced by super-sonic airplanes, that rumble through the system. This image of 30 Doradus contains Chandra data (red, green, and purple) from several long observations totaling almost 24 days of observing spread out over about 700 days.

JUNE 2020

S	M	T	W	Th	F	Sa
	1	2	3	4	5 ○	6
7	8	9	10	11	12	13 ◗
14	15	16	17	18	19	20
21 ●	22	23	24	25	26	27
28 ◖	29	30				

GALACTIC CENTER

The central region of our Milky Way galaxy contains an exotic collection of objects, including a supermassive black hole weighing about 4 million times the mass of the Sun (called Sagittarius A*), clouds of gas at temperatures of millions of degrees, neutron stars and white dwarf stars tearing material from companion stars, and beautiful tendrils of radio emission. The region around Sagittarius A* is shown in this new composite image with Chandra data (green and blue) combined with radio data (red) from the MeerKAT telescope in South Africa.

JULY 2020

S	M	T	W	Th	F	Sa
			1	2	3	4 Independence Day
5 ○	6	7	8	9	10	11
12 ◗	13	14	15	16	17	18
19	20 ●	21	22	23	24	25
26	27 ◖	28	29	30	31	

NGC 3079

NGC 3079 contains two “superbubbles” — structures blown by powerful winds from massive stars and supernova explosions — that stretch out on opposite sides of the center of the galaxy. One superbubble is 4,900 light years across and the other is only slightly smaller with a diameter of about 3,600 light years. In this composite, X-rays from Chandra (pink) have been combined with optical data from Hubble (orange and blue). Chandra observations show that a cosmic particle accelerator in NGC 3079 is producing ultra-energetic particles in the rims of the superbubbles.

AUGUST 2020

S	M	T	W	Th	F	Sa
						1
2	3 ○	4	5	6	7	8
9	10	11 ◗	12	13	14	15
16	17	18 ●	19	20	21	22
23	24	25 ◖	26	27	28	29
30	31					

CYGNUS OB2

Our Sun is an average-sized star that will have a lifespan of some 10 billion years. More massive stars, like those found in Cygnus OB2, only last a few million years. During their lifetimes, these bigger stars blast large amounts of high-energy winds that can collide to produce shocks in the gas and dust around the stars, generating X-ray emission detected by Chandra. In this image of Cygnus OB2, X-rays from Chandra (red and blue) are shown with optical data from the Isaac Newton Telescope (light blue) and infrared data from NASA's Spitzer Space Telescope (orange).

SEPTEMBER 2020

S	M	T	W	Th	F	Sa
		1	2 ○	3	4	5
6	7 Labor Day	8	9	10 ◗	11	12
13	14	15	16	17 ●	18	19
20	21	22	23 ◖	24	25	26
27	28	29	30			

DEM L238

This supernova remnant is the result of an explosion that obliterated a white dwarf star. This occurs after the white dwarf pulls too much material onto its surface from an orbiting companion star or merges with another white dwarf, triggering a thermonuclear explosion. The aftermath of this violent event is revealed in this image of DEM L238, also known as SNR J0534.2-7033. The Chandra image (yellow, green, and bright red) shows multimillion-degree gas while Hubble data reveal cooler gas in the system, near the outer border of the remnant (red).

OCTOBER 2020

S	M	T	W	Th	F	Sa
				1 ○	2	3
4	5	6	7	8	9 ◗	10
11	12 Columbus Day	13	14	15	16 ●	17
18	19	20	21	22	23 ◖	24
25	26	27	28	29	30	31 ○

LMC N63A

After a massive star exploded in the Large Magellanic Cloud (LMC), a small satellite galaxy to our Milky Way, it left behind a supernova remnant observed by Chandra and Hubble. The Chandra data (red, green, and blue) show multi-million-degree gas and the blast wave from the supernova. The light brown region in the upper right of the remnant is a dense cloud of gas and dust that reflects optical light detected by Hubble.

NOVEMBER 2020

S	M	T	W	Th	F	Sa
1	2	3	4	5	6	7
8 ◗	9	10	11 Veterans Day	12	13	14
15 ●	16	17	18	19	20	21 ◖
22	23	24	25	26 Thanksgiving Day	27	28
29	30 ○					

LHA 120-N44

This region of star formation in the Large Magellanic Cloud features a superbubble that is blowing out from the middle of this image similar to the ones in NGC 3079. In these stellar nurseries, young massive stars produce intense radiation, expel matter at high speeds, and race through their evolution to explode as supernovas. Under some circumstances, these processes lead to superbubbles. In this composite image of LHA 120-N44, Chandra data (purple and pink) reveal a superbubble of hot gas, while a Hubble image (orange and light blue) shows the gas and dust in the system.

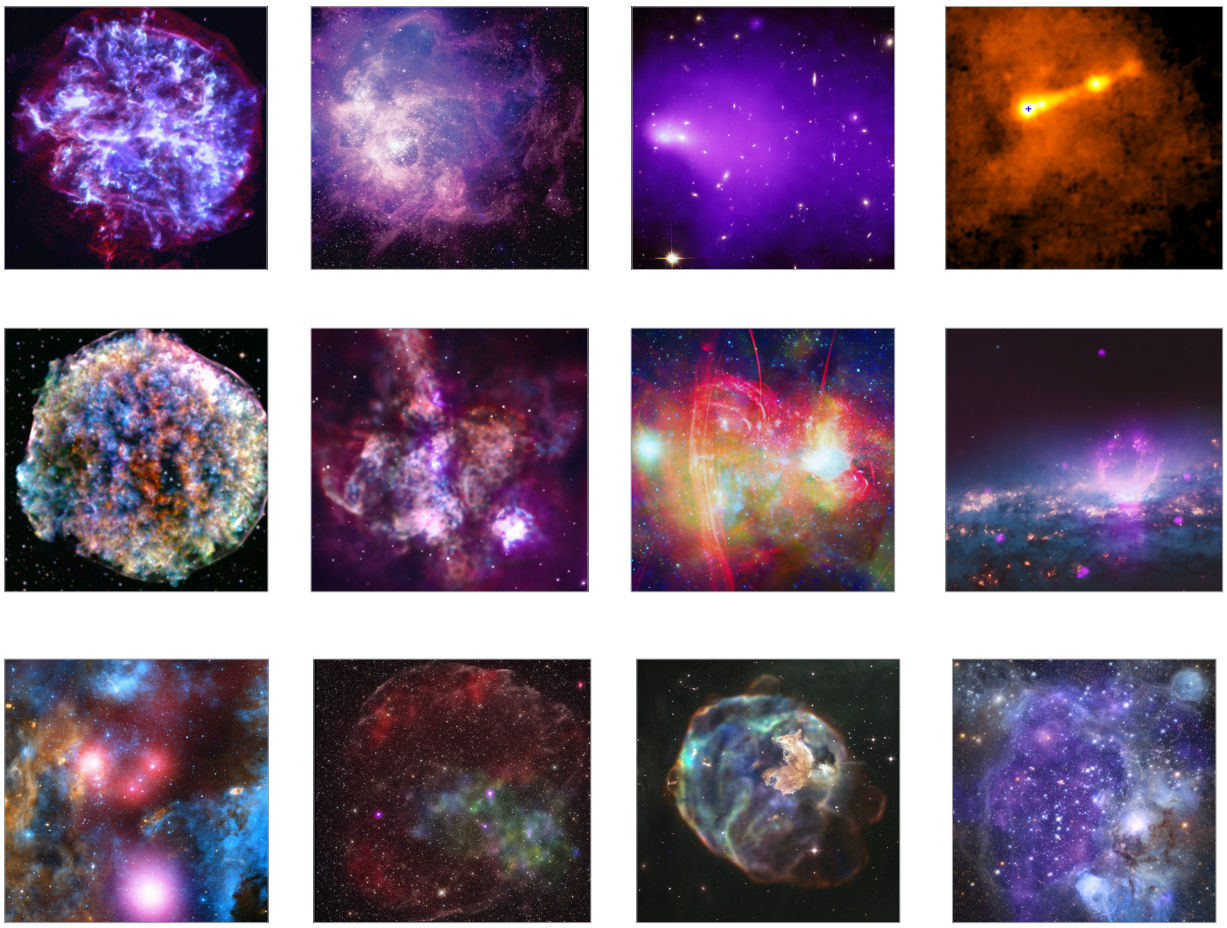
DECEMBER 2020

S	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7 ◗	8	9	10	11	12
13	14 ●	15	16	17	18	19
20	21 ◖	22	23	24	25 Christmas Day	26
27	28	29 ○	30	31		

Since its launch in 1999, Chandra has made profound discoveries and contributed invaluable information about the cosmos and the wondrous objects within it.

As part of NASA's "Great Observatories" program, Chandra was designed and built to observe X-rays alongside the Hubble Space Telescope in ultraviolet, visible and infrared light, the Spitzer Space Telescope in infrared light, and the Compton Gamma-ray Observatory in gamma rays. Today, the quest to explore the Universe is both multiwavelength and multimessenger in nature, with many of the very significant and exciting discoveries requiring information from different types of light as well as gravitational waves and particle physics.

In its more than 20 years of operation, Chandra and X-ray astronomy as a whole have played a pivotal role in uncovering and solving the mysteries of the Universe.



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