Revealing the Mysteries of Deep Space

Dr Jenifer Millard
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Who am I?

- Cardiff University Alumna – undergraduate and postgraduate degree
  - “The Stuff Between The Stars – On the Evolution of the Interstellar Medium in the Real and Simulated Universe”
- Realised during my PhD that my true passion is talking about science and sharing my love of astronomy with the world
- Now Managing Editor for Fifth Star Labs ‘Sky Guide’ App
- BBC Space Expert (Radio and TV)
- TEDxCardiff /AI Decoded
- Fred Olsen cruises/Cardiff Uni lecturer
- Lego-builder and owned by a cat

I’m going to begin this talk by asking you a slightly strange question

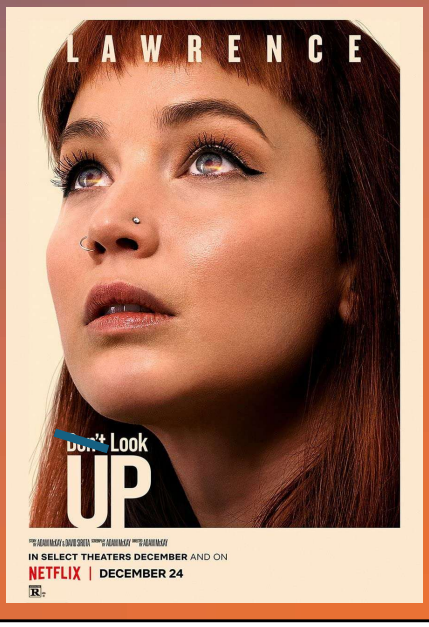
What do you do?

– what do you do when you get out of your car? Or hop off the bus, or train?

Audience Suggestions…

I wonder, if, perhaps, on occasion, you do as I do ...

To the Heavens

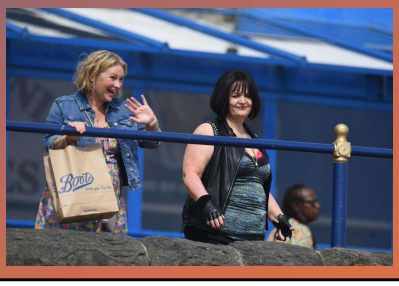


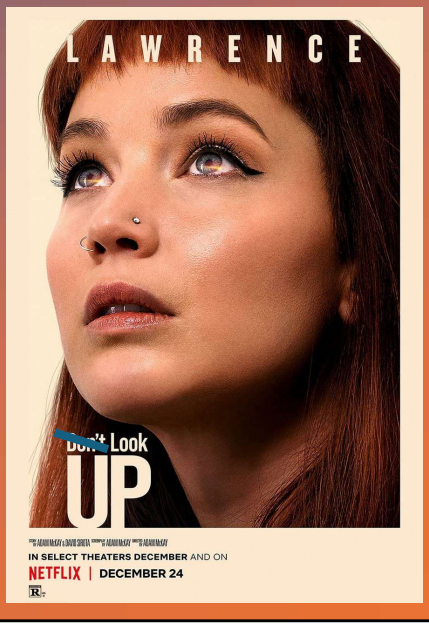
I wonder, if, perhaps, on occasion, you do as I do, and find yourself looking up.

It doesn't matter where I am, what city, what day of the week. If I find myself exiting a vehicle and I'm outside, I look up. I just can't help myself. My eyes are simply drawn to the heavens.

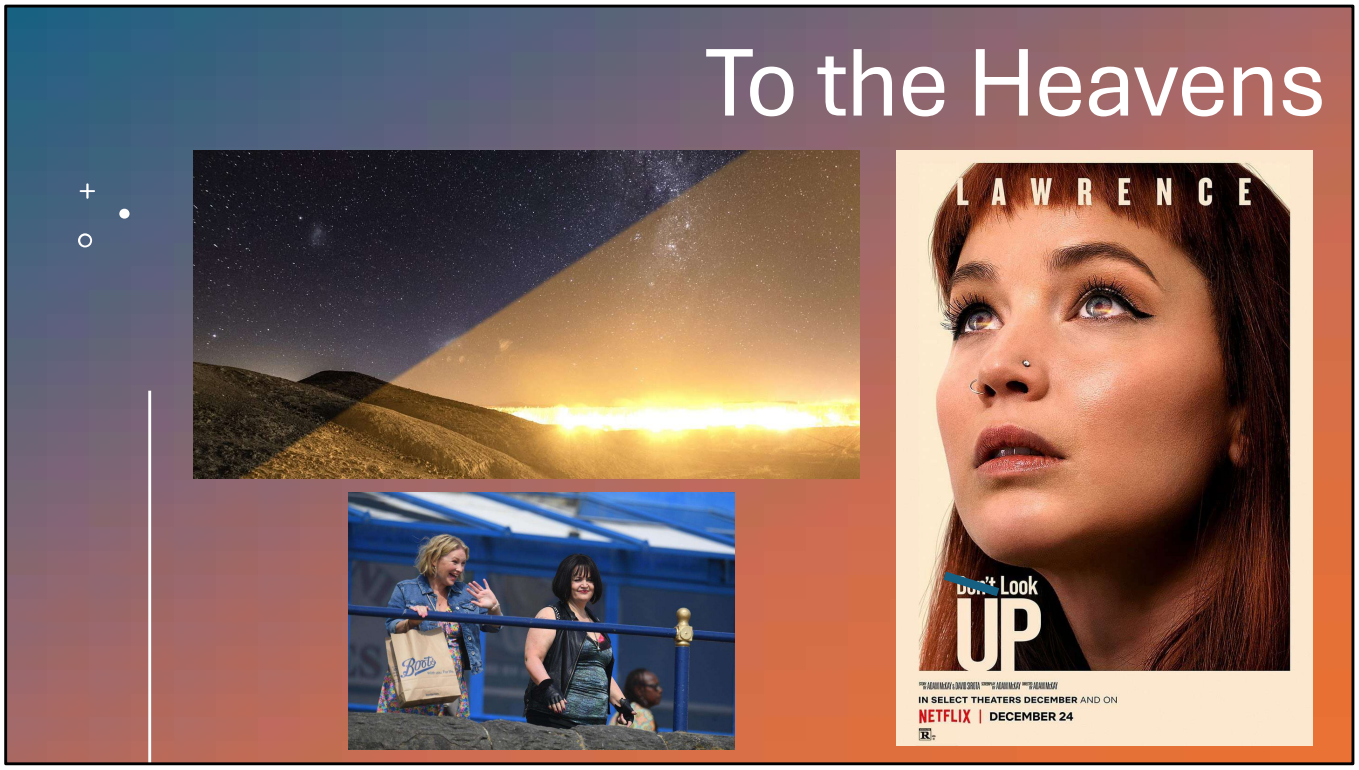
Oftentimes when I'm getting out of my car, it's because I'm finally home after a long day of adventures.

To the Heavens



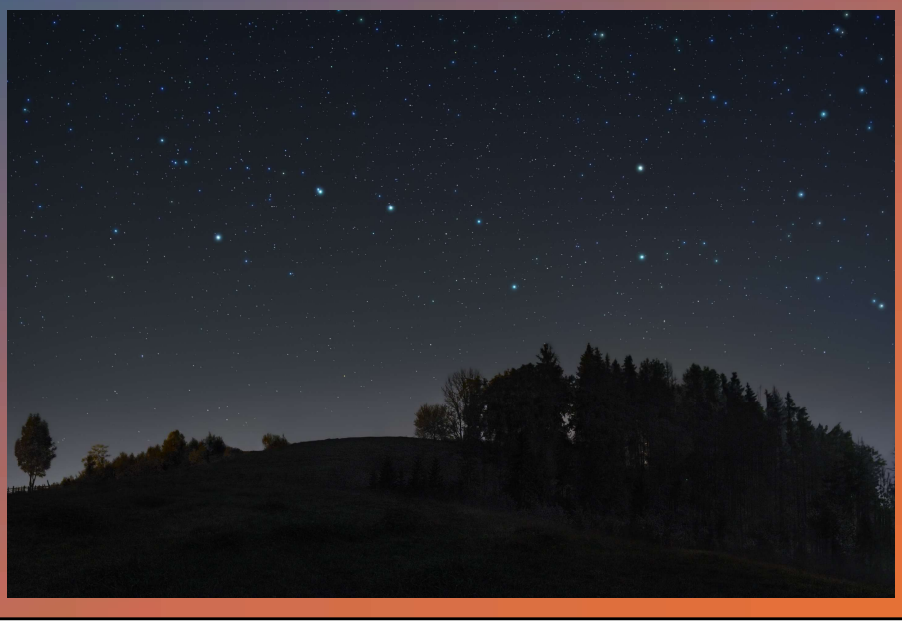


I live in a town, a town called Barry that some of you may have heard of – and that means I



do have a lot of light pollution. Possibly a strange choice for an astronomer but hey, it's my first house – and we all gotta start somewhere.

Asterisms & Constellations



Even so, there are things I can see. The bright stars making up asterisms and constellations – those shine through the street lamps. Perhaps the Big Dipper, an asterism making up part of the much larger constellation of ursa major, the Great Bear. You'll currently find the Plough, or the Sospan, as we say in Wales, low on the Northern Horizon.

Ursa Major

Follow the Pointers up across the sky, you'll come to Polaris, the North Star. Not the brightest star in the sky by far – abut magnitude 2, so visible under reasonable amounts of light pollution.

Polaris & Ursa Minor

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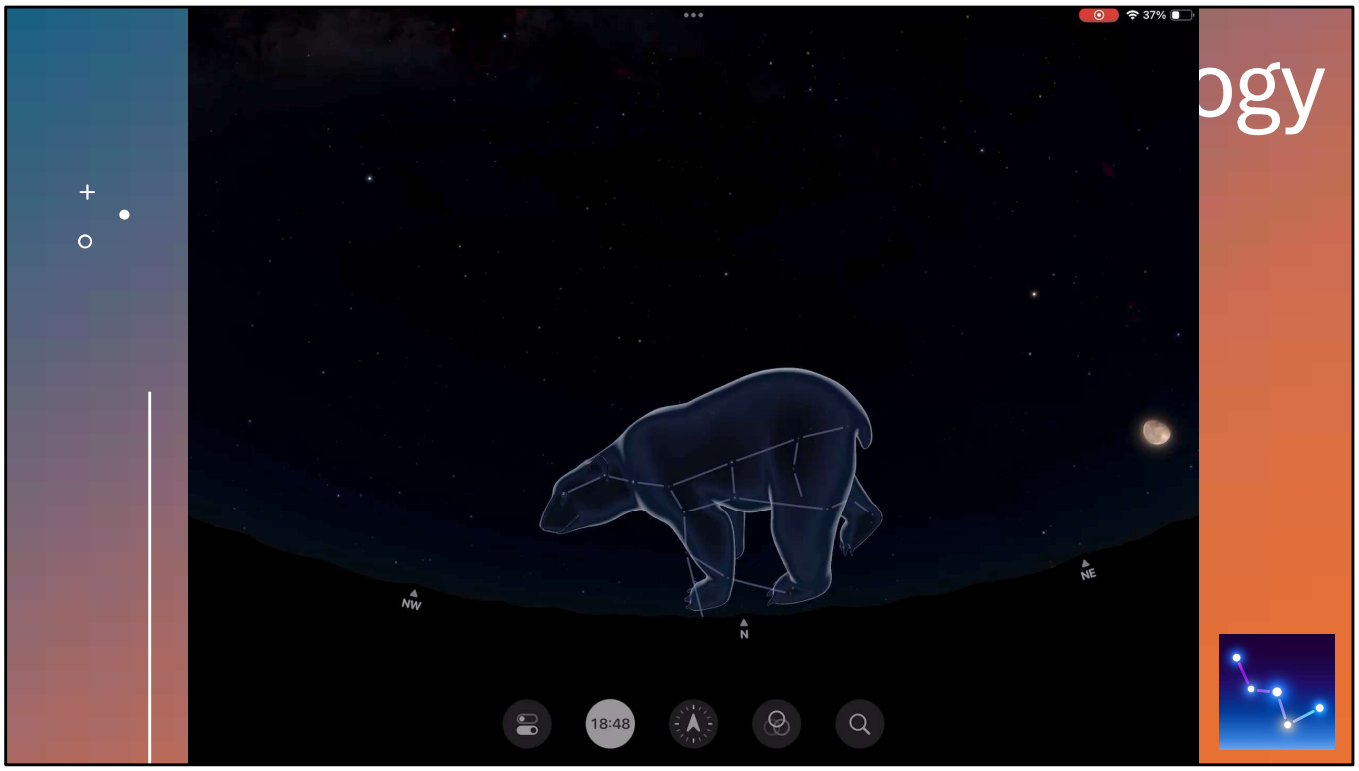
Greek Mythology



Track eastwards. Mythology around Cassiopeia etc

Greek Mythology

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A Little Later – Orion and His Gang

Few hours after sunset, more fantastic winter constellations rising – Taurus and the Hyades and Pleiades. Orion – will become better and better over the coming months

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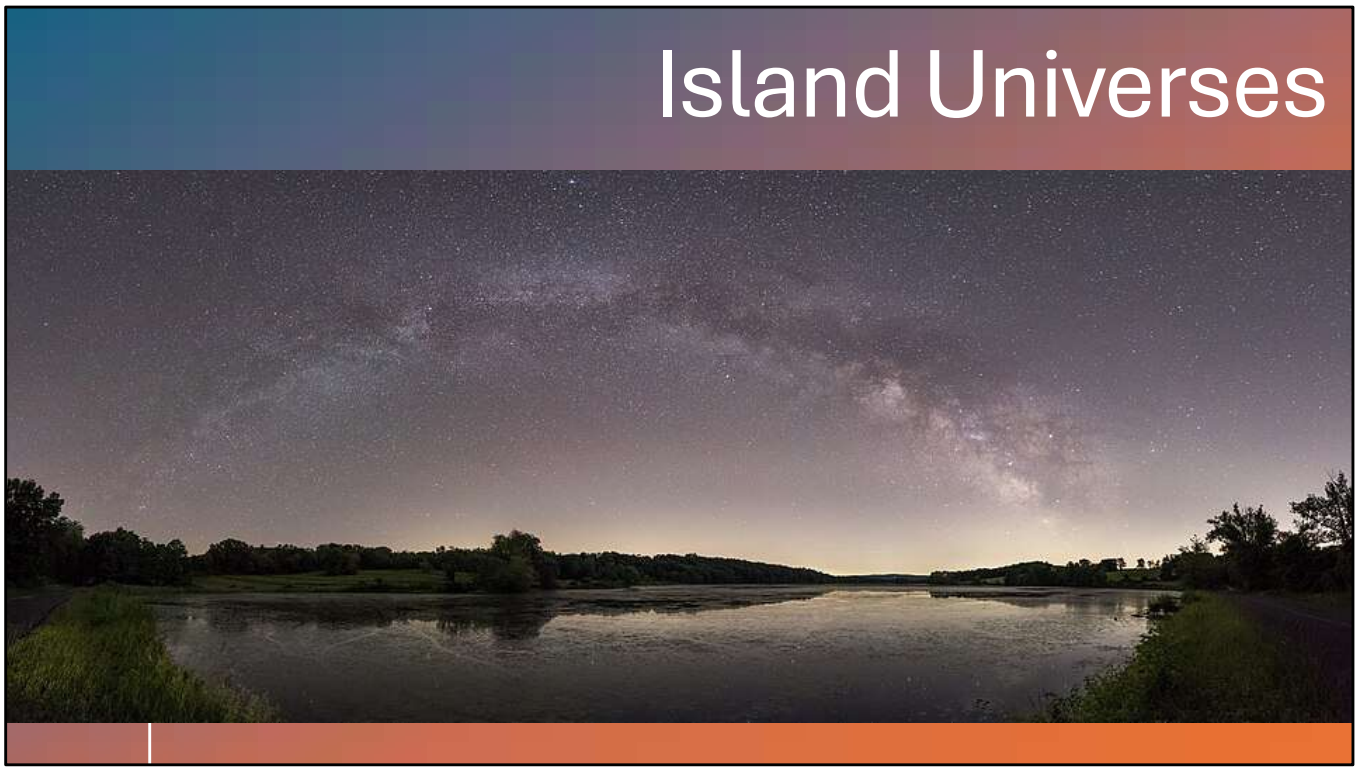
But this is all under light polluted skies.

Head to darker skies, find Cassiopeia again

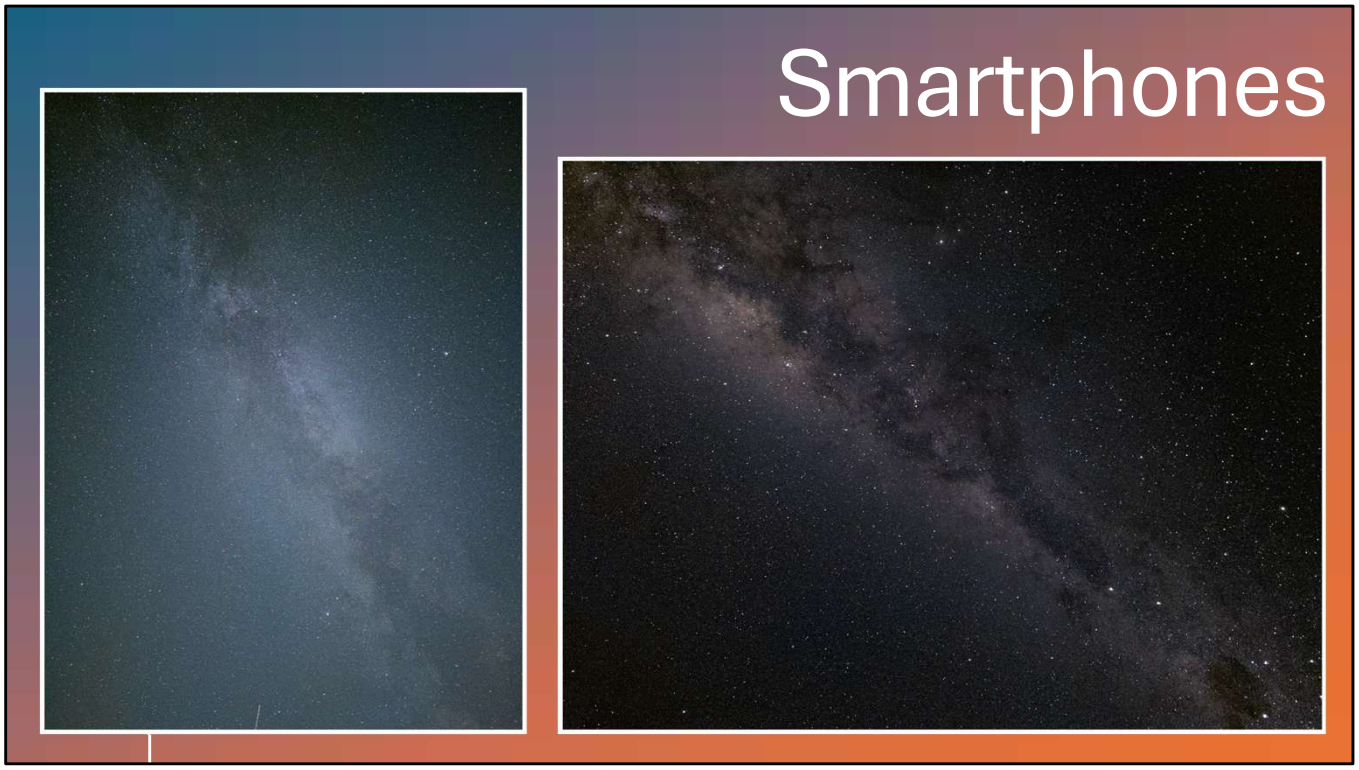
Track across the sky to the wester horizon, where three bright stars make a large triangle – summer triangle – may notice a fuzzy spill of light. This is the Milky Way – mythology there with Zeus.



mythology there with Zeus.

Staring across thousands of light years of space – highlight distance to some stars maybe

Smartphones



Even with the naked eye, you can see stars tens, hundreds, thousands of light years away – you can see across the vast Island Universe that is our Galaxy. You can also even see our neighbouring Island Universe, that faint smudge of the Andromeda Galaxy – a trillion stars in its own right. Details that you don't need any fancy equipment to capture – here are two example of short exposures using an iPhone – the darkness of your skies matter, but it's clear as day!

Smartphones

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Crank up the Magnification

But this is just using our eyes. For over 400 years, we've been able to study the skies with magnifying tools, thanks to the Dutch Eyeglas makers than inspired Galileo Galilei.

Crank up the Magnification

- Comet Hunter, 18th century
- Inspired by Great Comet of 1744 to pursue astronomy
- Messier Catalogue – 110 objects of not-comets
- 4-inch telescope – but 18th century optics!

One of the most remarkable lists of objects comes from Charles Messier, a comet hunter – now if he could see these with 18th century optics, you definitely can with a small telescope. Story of messier

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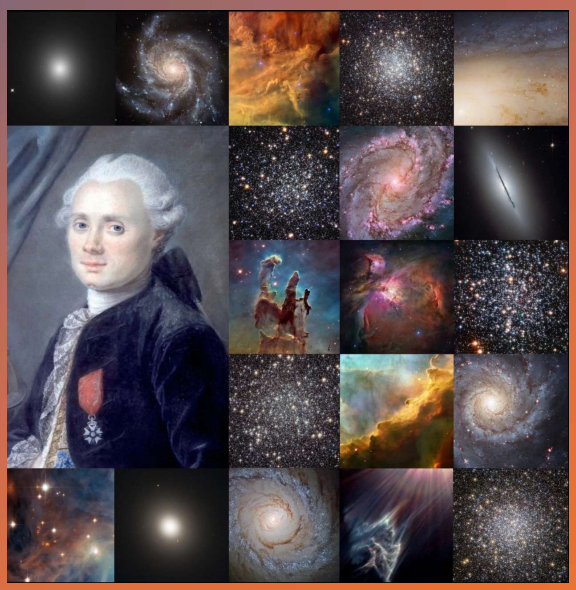

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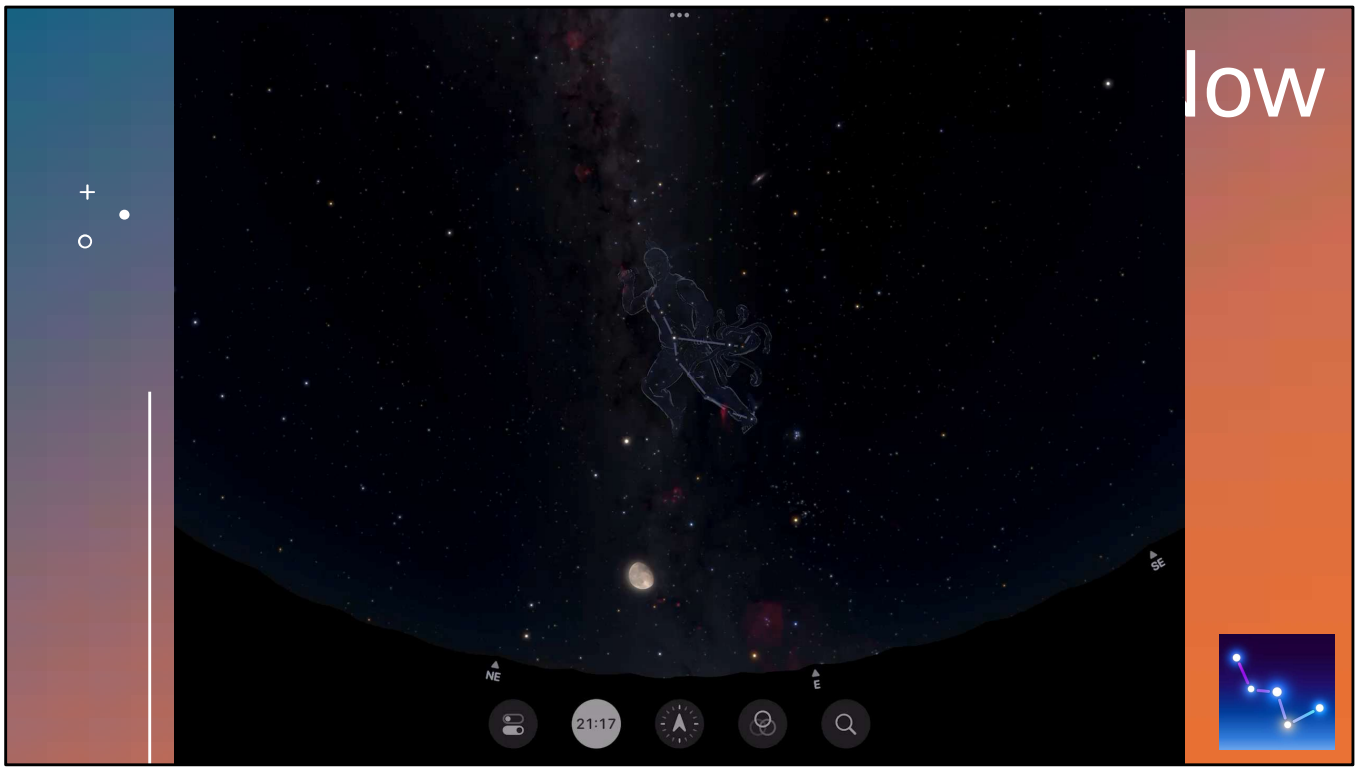
Point out some Messier objects – but realistic views of them to begin with for small backyard telescopes.



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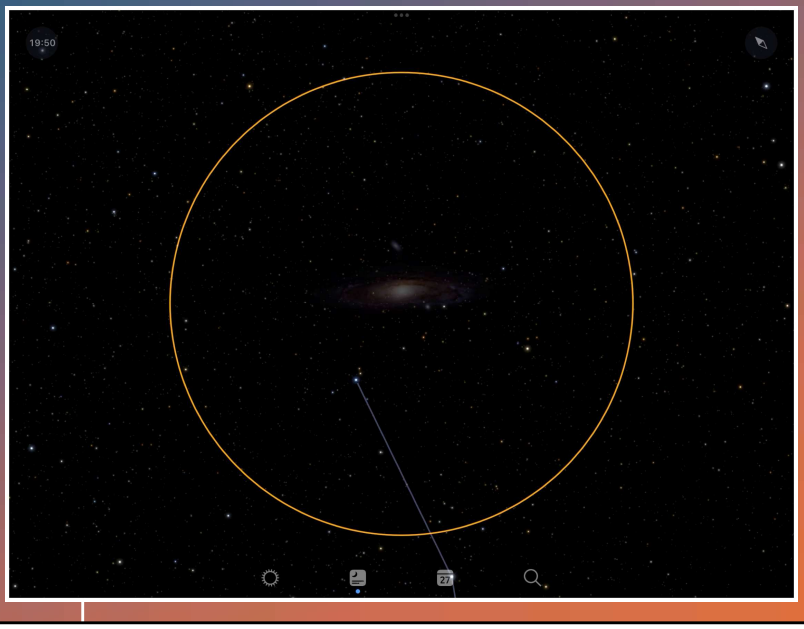
Realistic: Small Telescope/SeeStar



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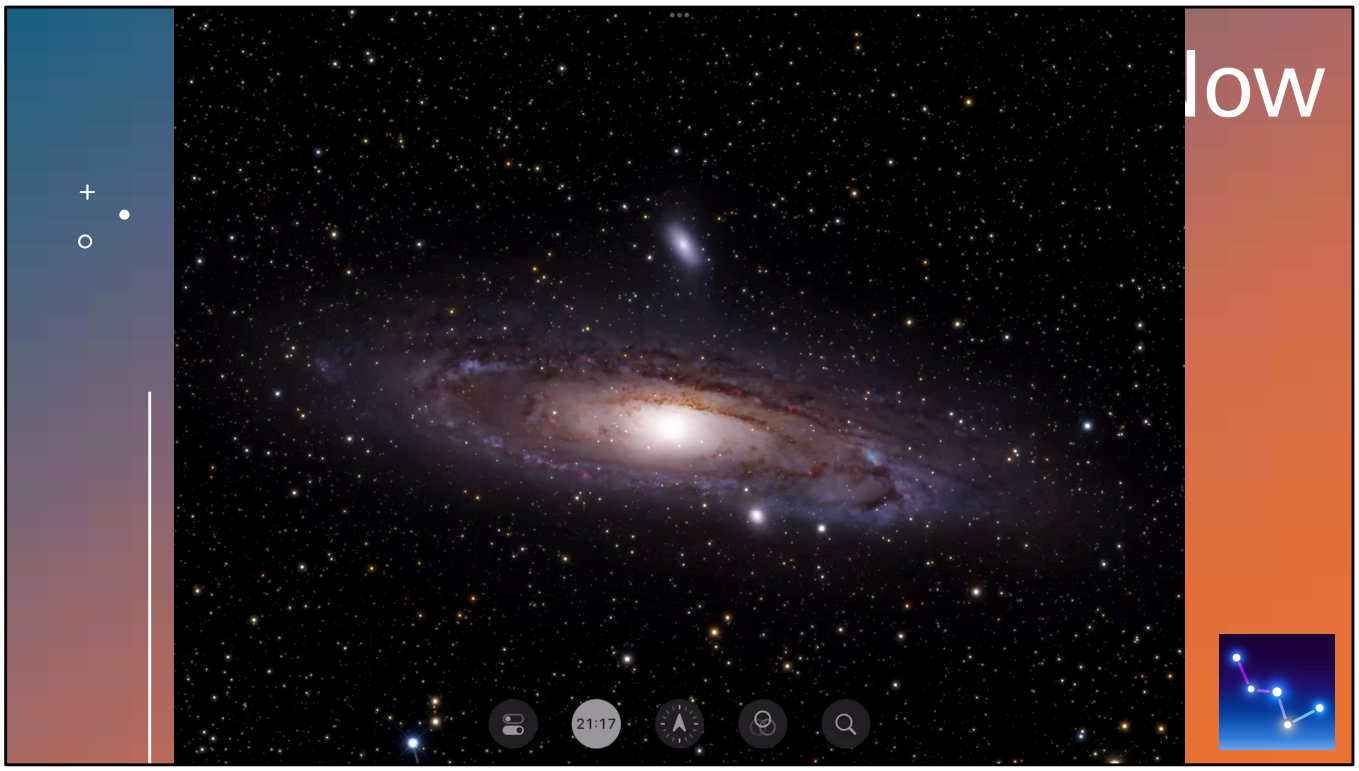

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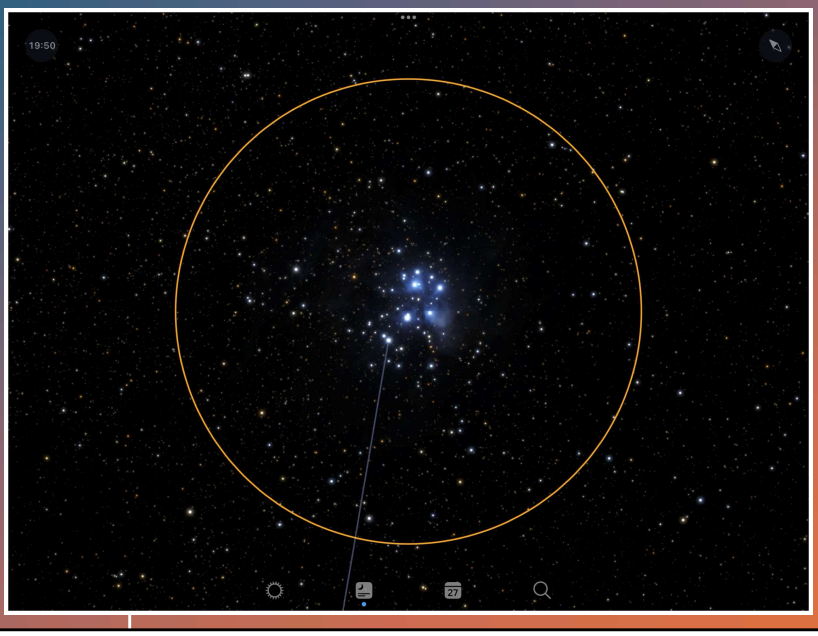


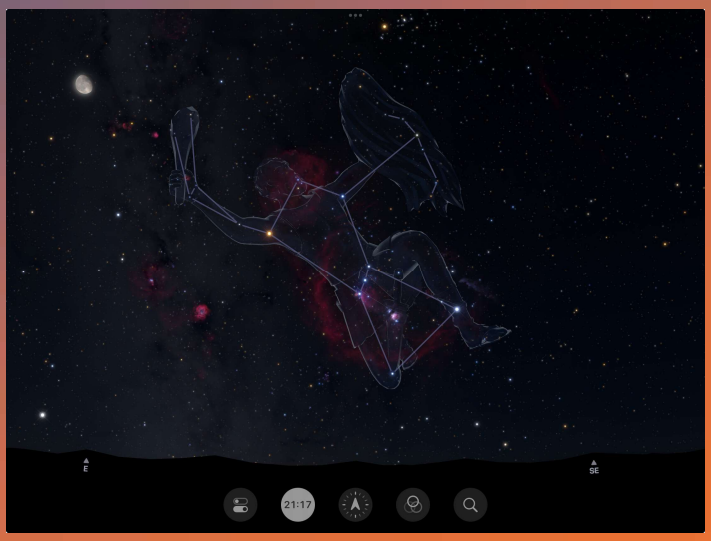
The photons of light from these faint fuzzies have travelled hundreds, up to millions of miles across space and time to make their way through Earth's atmosphere, strike *your retina*, and change your brain chemisty *forever*.

Make the point that even though these are just small fuzzies, the light has travelled for hundreds of light years, thousands, even millions across space to enter your eyes, change your brain chemistry, forever.

Messier with the Big Boys

M42 – the Orion Nebula

1500ly – nearest star forming region

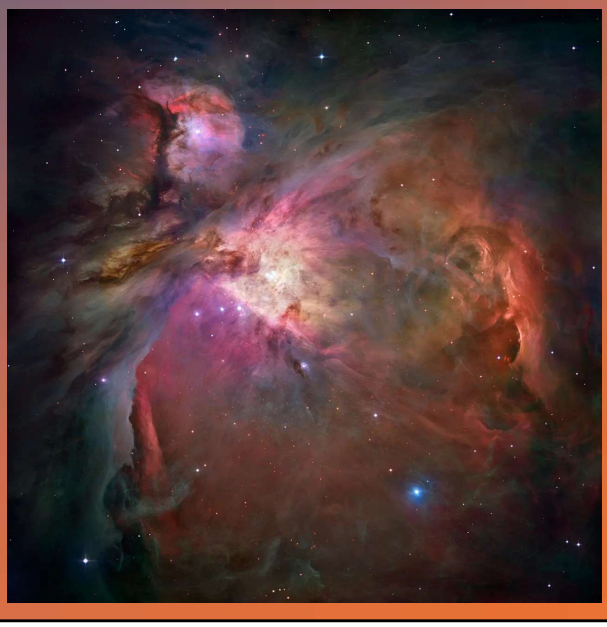


Stellar Birth

M42 – the Orion Nebula

1500ly – nearest star forming region

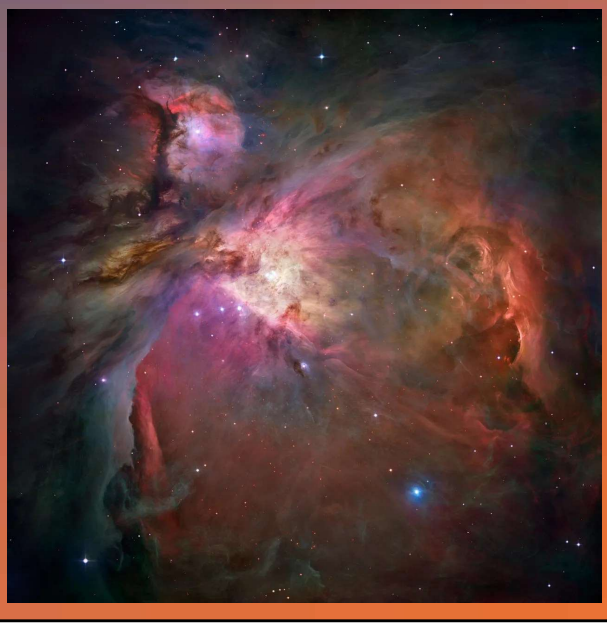
24ly across – nearest star to the Sun is 4ly away



Hubble view

Stellar Birth

- Extraordinary opportunity to understand star-formation



Hubble view

Stellar Birth

- Actual planetary systems in the process of forming! Protoplanetary disk of gas and dust, like a frisbee hiding their host star – this was us 4.5 billion years ago

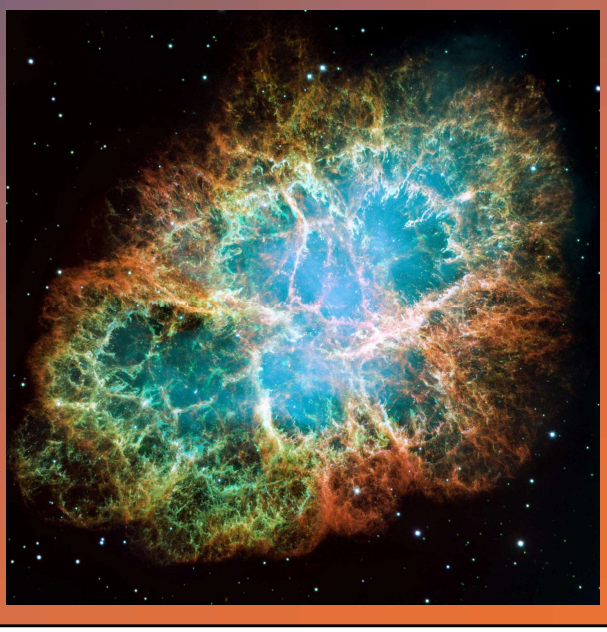
Hubble view

Stellar Death

Venture near the horns of the Bull – M1, the Crab Nebula

Stellar Death

- In 1054, Chinese astronomers saw a “guest star” for nearly a month – so bright it was visible in the day!
- Supernova – explosive death of a massive star, enriches the Universe
- 6ly wide

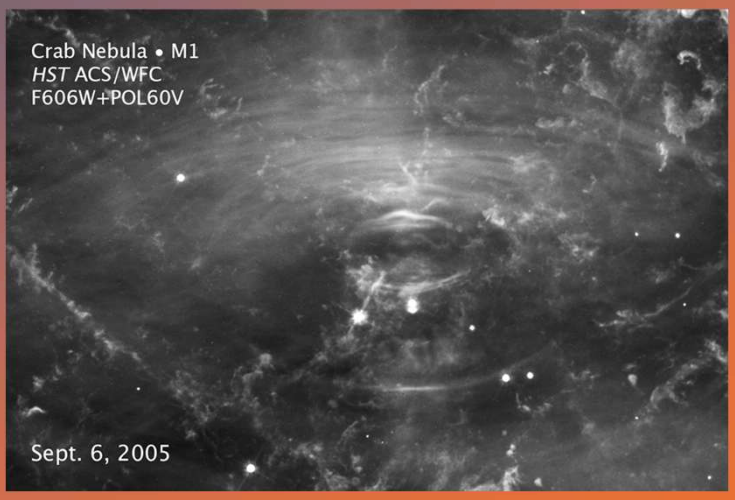


Mostly hubble

Stellar Death

Left behind – a rapidly spinning pulsar, the densest and most exotic star in the Universe

We can see wave-like rings as the pulsar disturbs the surrounding gas



hubble

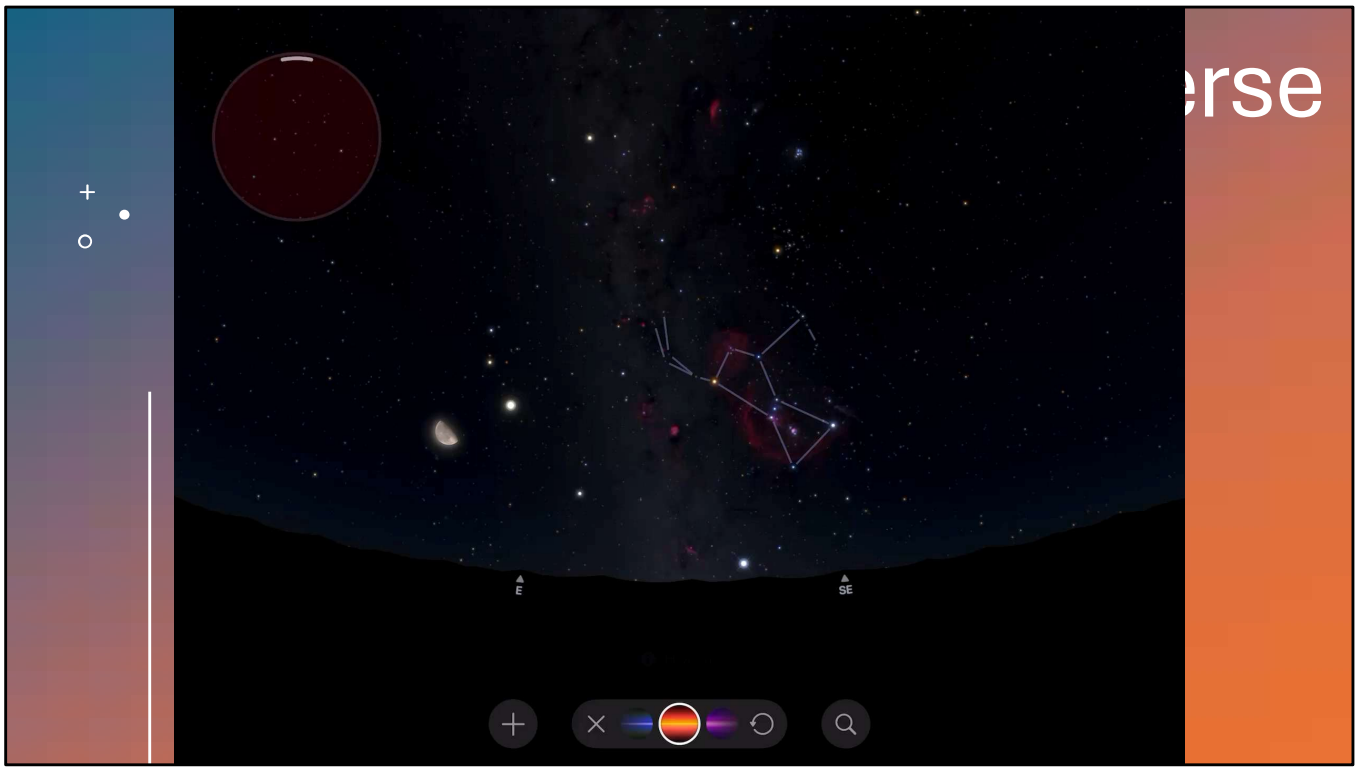
Ancient Stars

- M15 - Near the nose of Pegasus, a globular cluster

Ancient Stars

- M15 - Near the nose of Pegasus, a globular cluster
- Dense sphere of ancient stars left from the Milky Way's formation
- Contains an intermediate mass black hole

But this is all with light we can see with our eyes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The Invisible Universe

Comet C/2025 R2 (SWAN) near the Eagle Nebula (comet found by amateur studying space-based solar data)

M16 – Serpens (low on horizon, evening)

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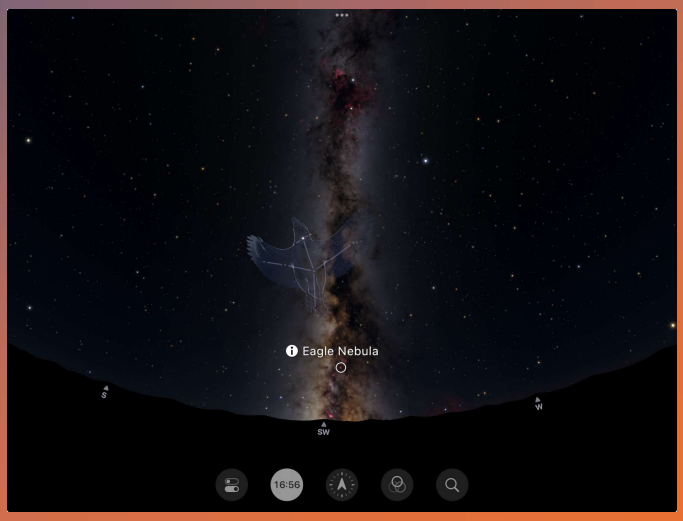
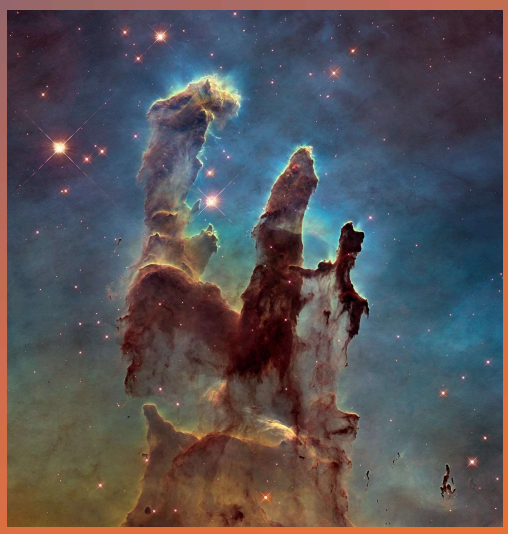


The Invisible Universe

Pillars of Creation



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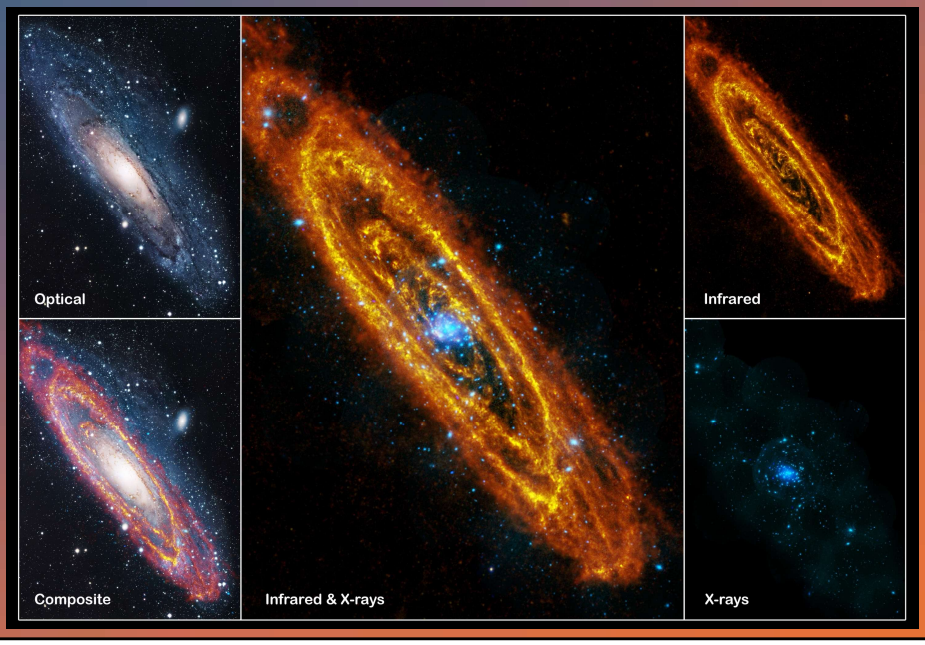

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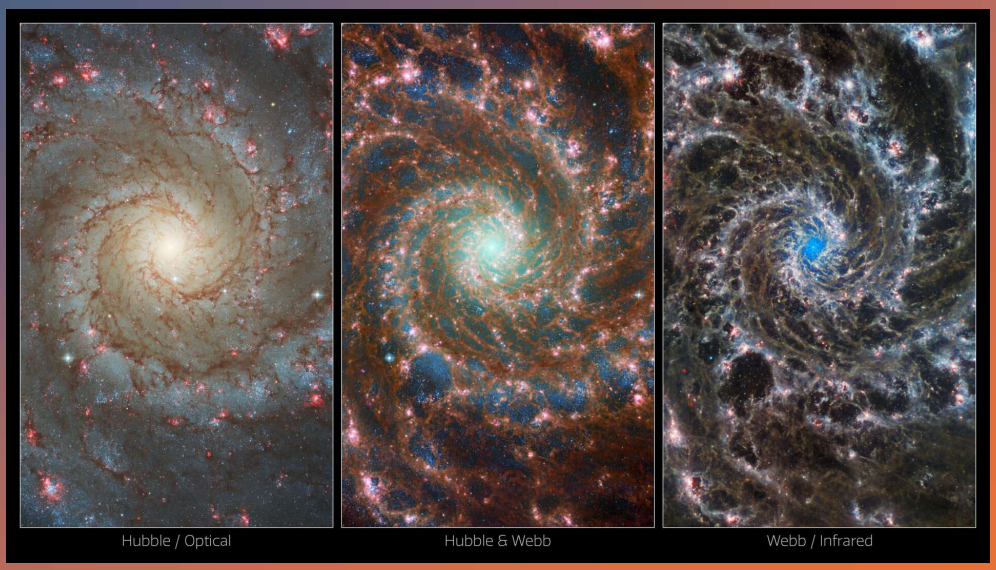
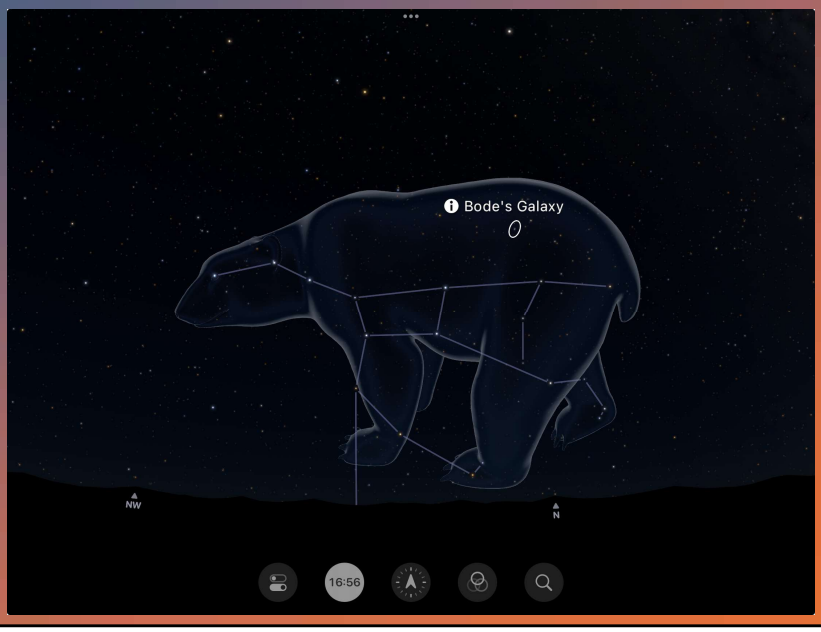


M74 – Pisces (Hubble+JWST)

The Invisible Universe

M81 (Bode's) – Visible + IR (Spitzer)

Fall Into Time



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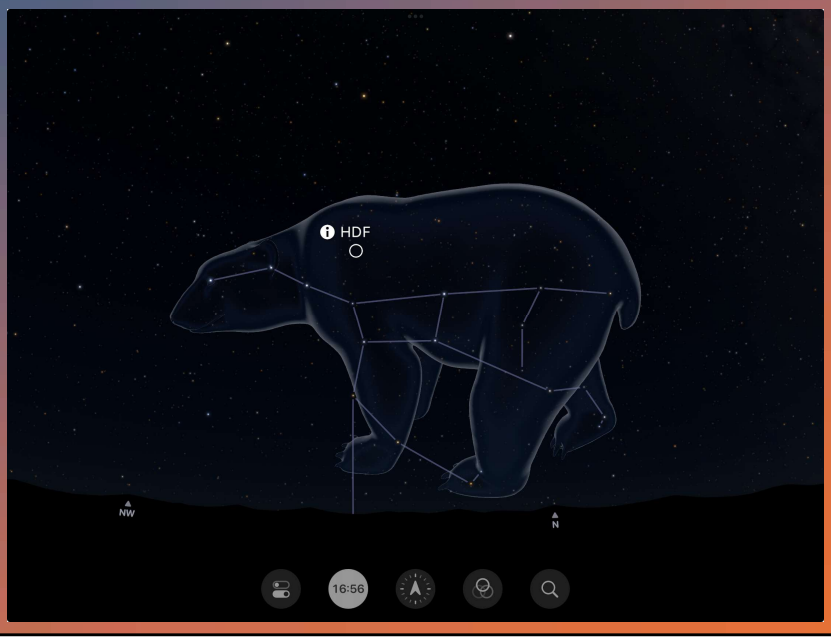

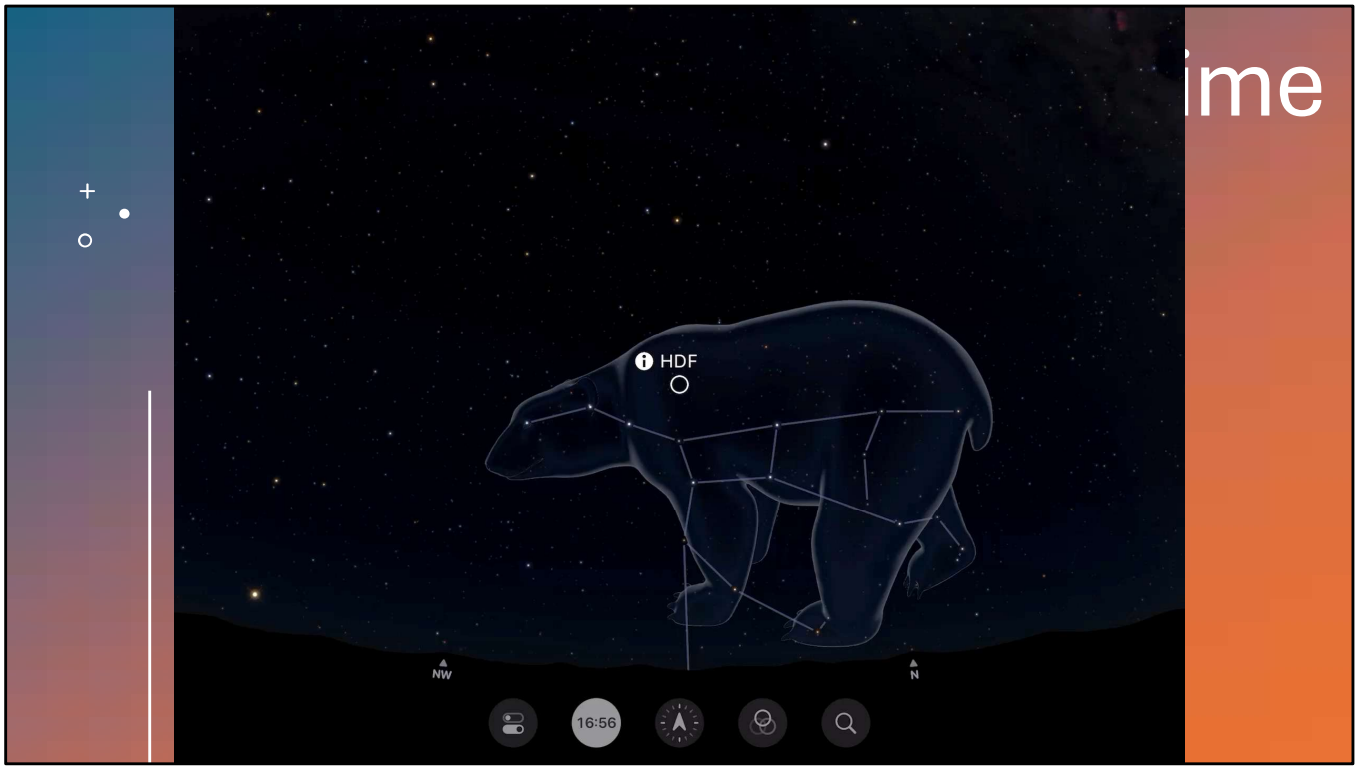
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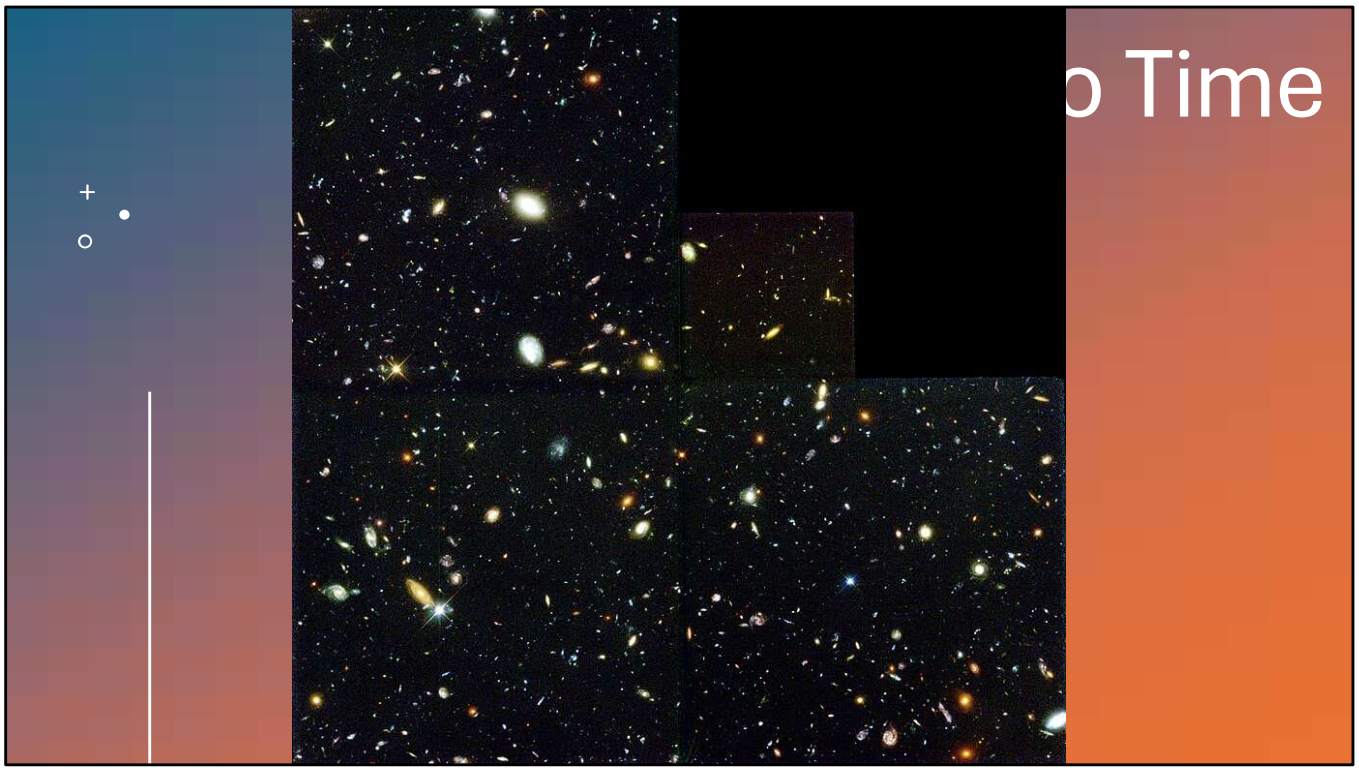
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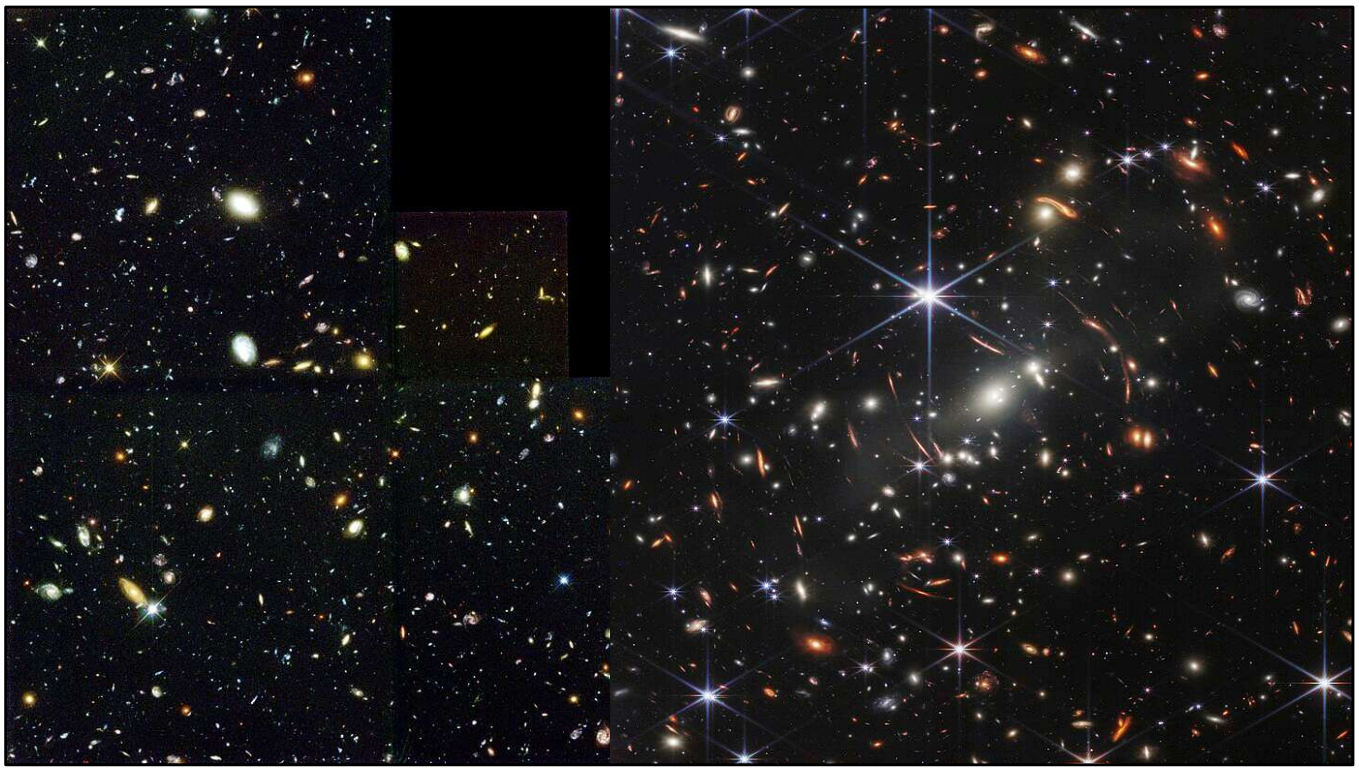


There’s an entire Universe out there, visible from your backyard
Naked eye
Smartphone
Binoculars
Telescopes
Just get out there, and capture the cosmos!