A New Intergalactic Distance Scale

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Introduction

It's difficult for us to really comprehend the immense scale and distances between galaxies, even those nearby – but there is a way. Let's use Centaurus A as an example:

2017-07-06 Centaurus A. Image: R. Powell.

It's not a member of the Local Group of galaxies but it's still relatively "close" to us at 12,000,000 light years (12 Mly) or as professional astronomers would prefer to say, 3.7 megaparsecs. So how can we process a sense of the distance of the galaxy, relative to our local environment and the

distances that we understand? Huge numbers like that can seem meaningless and don't give us much sense of scale.

It's true that intergalactic distances can make the human brain boggle. Reducing them to our "normal" every day units such as kilometres makes it even worse:

> Q. How many kilometres are travelled by light in 12 million years?
> A. 1.135×10^{20} km or 113,500,000,000,000,000,000 km.

How can we even begin to comprehend numbers like that? Let's step back to our own backyard.

The Solar System

We are familiar with using Astronomical Units to compare the distance of planet orbits from the Sun:

Object	Distance (Astronomical Units)
Mercury	0.4
Venus	0.7
Earth	1.0
Mars	1.5
Jupiter	5.2
Saturn	9.5
Uranus	19.2
Neptune	30.7
Pluto (yes, yes, I know.....)	39.7
Oort Cloud	3,800 to 410,000

Sometimes light travel time is used to measure a planet's distance from Earth:

Planet	Average Light Travel Time		
	Mins	Hours	Days
Earth	0		
Mars	14.1		
Jupiter	43.7		
Saturn		1.33	
Uranus		2.66	
Neptune		4.17	
Pluto		5.64	
Oort Cloud			21.5

Nearby Stars

With billions of stars in our galaxy, here's a list of three of them and their distances in astronomical units:

Star	Distance (Astronomical Units)
Proxima Centauri (nearest star)	266,940
Sirius (brightest star)	543,672
Betelgeuse (a red giant)	34,660,000

The numbers are getting unwieldy again, so we find it more convenient to measure the distance to the stars in light years:

Star	Light Travel Distance (LY)
Proxima Centauri (nearest star)	4.2
Sirius (brightest star)	8.6
Betelgeuse (a red giant)	548

The Milky Way is about 100,000 light years across* and so the use of light years is convenient within the galaxy.

Nearby Galaxies

When we reach the intergalactic scale, light travel years (or maybe parsecs) are still used and we end up with increasingly large numbers yet again. Even worse, they give little sense of comparison with our own reality, inside our Milky Way.

Galaxy	Light Travel Distance (LY)
Large Magellanic Cloud	163,000
M31 Andromeda	2,573,000
Centaurus A	12,000,000
Sombrero	35,410,000
Virgo Cluster	53,800,000

If only we could adopt a simpler distance method for galaxies, using smaller numbers, that relates to our galaxy! I use the Milky Way Diameter. It's an approximation but I've found it helps to visualise inter-galactic distances.

The Milky Way galaxy is roughly 100,000 light years* in diameter and if we can, by definition, call it one Milky Way Diameter (MWD), then using it as a rough 'measuring stick' for intergalactic space makes it easier to visualise the scale of the galactic distances involved. Using this approximation, these are the distances for the same galaxies:

Galaxy	Milky Way Diameters
Large Magellanic Cloud	1.6
M31 Andromeda	25
Centaurus A	120
Sombrero	354
Virgo Cluster	538

Conclusion

Quoting the distance of Centaurus A (for example) as 120 Milky Way Diameters gives a sense of intergalactic proportion that cannot be conveyed when using light years and it helps me to comprehend the scale of regional galactic distances in comparison with galaxy sizes.

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** I have read that the diameter of the Milky Way, long quoted as 100,000 light year, is now suspected of being larger than this - but for the sake of illustrating my point, I've stuck with it for this exercise.*
