How to:
Estimate quantities accurately

Q1

- The Pinwheel Galaxy (M101) is one of the most well-known nearby spiral galaxies.
- Bearing in mind the definition of a parsec, what would be the parallax of M101? Leave your answers in arcseconds

Q2

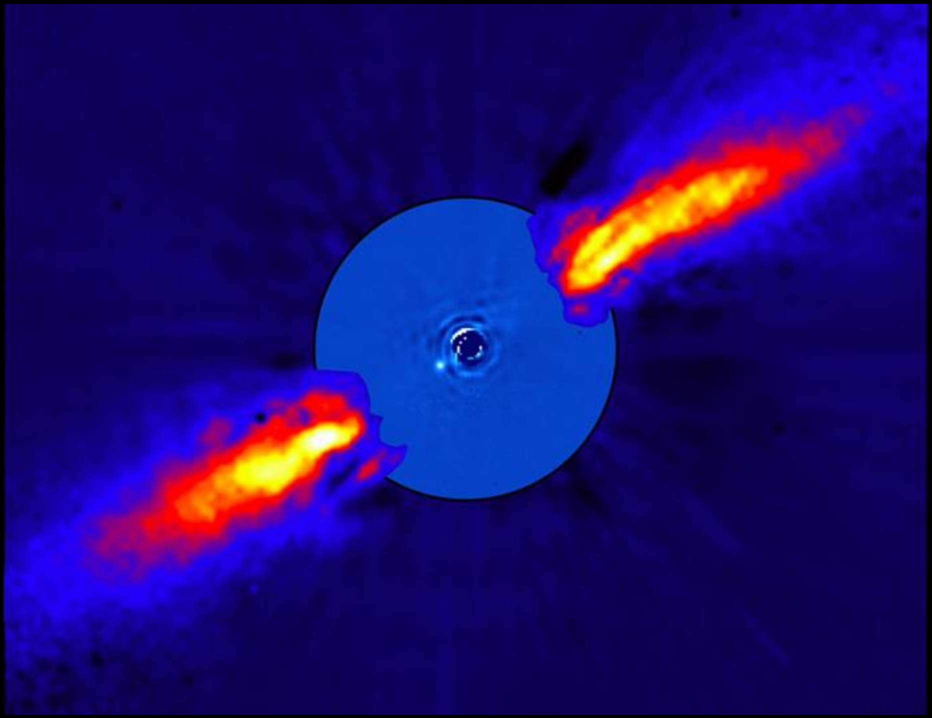
- Recall that ω Centauri is the most massive and luminous globular cluster in the Milky Way.

- Estimate the luminosity of ω Centauri, in terms of solar luminosities.

Q3

The young star Beta Pictoris is famously known for its debris disk, which contains at least 1 planet.

Estimate the diameter of this disk, in AU.



Key Principles

- DON’T: Toss whatever pops up in your mind.

Rather:

- Break down the problem into doable steps

- Apply prior knowledge/concepts to the question

- Check your answer! Is it obviously wrong?

Bonus technique

The wisdom of crowds (might) work

Q1

- I think the distance to Andromeda is around 3 million ly. That's around 1 million parsecs.

- Andromeda is part of the Local Group: M101 isn't. Since its nearby, lets increase its distance by an order of magnitude (10 million parsecs)

- This gives $10^{-7}\ arcseconds$, which is tiny. Given that we can't see parallax for galaxies, this doesn't seem wrong.

- ANS: $1.56 \times 10^{-7}\ arcseconds$

Q2-METHOD 1

- I recall that ω Centauri was mistaken as a faint star in Centaurus: it probably has a visual magnitude of around 4
- I just need its distance and then I can get its luminosity. Since its in the Milky Way, its probably no further than the Milky Way core to us (20,000 ly)

Q2-METHOD 1

- Plugging in, I get $7.5 \times 10^5\ L_\odot$
- The answer doesn't seem obviously wrong: I should expect a much higher luminosity than the Sun
- ANS: $4.0 \times 10^6\ L_\odot$

Q2-METHOD 2

- I know that ω Centauri is a globular cluster, and globular clusters have millions of stars

- Since it’s the most massive globular cluster in the MW, we are probably looking at around 10 million stars

Q2-METHOD 2

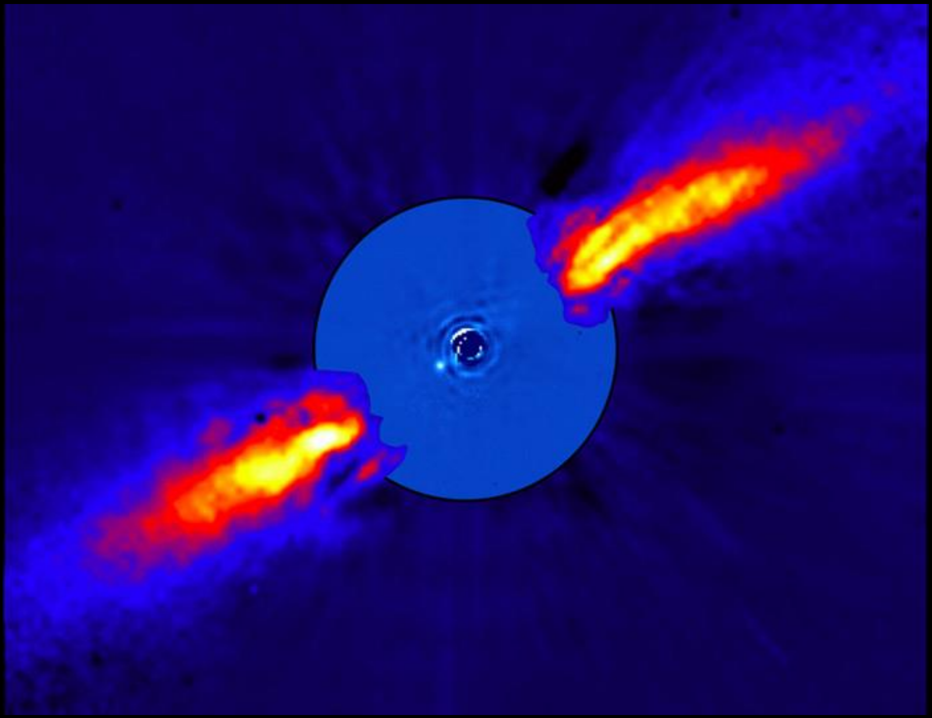
- Globular clusters are old, so the stars that remain are older than our Sun (and thus slightly less luminous). Lets say each star has half the luminosity of the Sun.

- This gives us $5.0 \times 10^6\ L_\odot$

- ANS: $4.0 \times 10^6\ L_\odot$

Q3-METHOD 1

- The disk radius seems to be around 50x the planet's orbital distance.
- I have no idea what the planet's orbital distance is, but lets say its like Jupiter.



Q3-METHOD 1

- With some simple multiplication, we get 520 AU ($5.2 \times 10^2\ AU$).

- This doesn't seem obviously wrong: protoplanetary disks are big, and planets only form in the inner regions of these disks.

- ANS: $3.29 \times 10^3\ AU$

Q3-METHOD 2

- Bodies in the Kuiper Belt/scattered disk formed in the inner region of the solar nebula, and was then scattered out.

- I think the aphelion of the furthest KBOs lies around 200 AU. This gives me a disk diameter of at least $4 \times 10^2\ AU$

- ANS: $3.29 \times 10^3\ AU$

Potentially helpful…