

Exercise worksheet

(a.k.a. how to get your hands dirty)

1. Measuring distances using angles

How do we measure the distance to astrophysical objects? We cannot stretch a tape measure between the Earth and the nearest star. But we can measure angles.

You have a short ruler and a protractor. Just like astronomers, you cannot move out of your corner of the Universe. Your task is to measure the distance to an object in the middle of the room.

2. Measuring distances using angles

At larger distances, the angles get smaller and smaller, and hard to measure. So astronomers must use other methods.

Your task is to measure the distance to a second object. The object in Experiment 1 is now replaced by a light source, with a 1/4 brightness filter. There is an identical source at twice the distance. Measure the distance to the second source.

3. Measuring the geometry of spacetime (or a slice through space)

Think again about Experiment 1. What principles did you use from geometry?

You now have a piece of string and a protractor. Prove that the floor of the room is flat. How would your results in Experiment 1 change if this wasn't true?

4. Measuring the relative strength of the fundamental forces of nature

Drop a coin to the floor. What makes it fall? Easy – it's gravity.

What makes it stop? Why didn't the coin break? Why didn't it go right through the floor?

5. Using randomness to measure constants

You have a circle inside a square. You also have a small coin. Your task is to measure Pi. How can you make your measurement more accurate?

6. How to test a principle of General Relativity without going to outer space

Build a simple pendulum. Time the period of the pendulum. Now imagine you were inside a spaceship travelling at 99% of the speed of light. Would the period of the pendulum change?