Liceo Classico “Gioacchino da Fiore” – Rende (CS)
Prof.ssa Fabiola Salerno – a.s. 20/21

GRAVITATIONAL WAVES

What is a gravitational wave? It’s a **1.**____________________ in the **2.**____________________ of space and time.

Imagine that space is a giant **3.**____________________ of **4.**____________________: things that have mass cause that **5.**____________________ **6.**____________________ to bend, like a bowling ball on a trampoline. The more mass, the more that space gets **7.**____________________ and distorted by gravity. For example, the reason the earth goes around the sun is that the sun is very **8.**____________________, causing a big **9.**____________________ of the space around it. If you just try to move in a **10.**____________________ line around such a big **11.**____________________, you will find yourself actually moving in a **12.**____________________.

That’s how **13.**____________________ work: there’s not an actual force pulling the planets around, just a **14.**____________________ of the space. Gravitational waves are produced whenever masses accelerate, changing the **15.**____________________ of space. Everything with mass and/or energy can make gravitational waves. If you and I started to dance around each other, we would also cause **16.**____________________ in the **17.**____________________ of space and time. But these would be extremely small. Practically **18.**____________________. Now gravity is very weak in the scale of the other forces in the Universe, so you need something really really **19.**____________________ moving very, very fast, to make the big **20.**____________________ that we can **21.**____________________. How would you observe a **22.**____________________ in the space? If the space between you and me **23.**____________________ or **24.**____________________, we wouldn’t have noticed if we had made marks on our metaphorical **25.**____________________ **26.**____________________, for example, using equally spaced rocks. Because these marks would also get **27.**____________________ further apart. But there is one ruler that doesn’t get **28.**____________________, one made using the speed of light. If the space between two points get **29.**____________________, then light will take longer to go from one point to the other. And if the space gets **30.**____________________, light takes less time to cross the two points. This is where the **31.**____________________ experiment comes in. It has 4 kilometer long **32.**____________________ and uses **33.**____________________ to measure the changes in the distance between the ends of the **34.**____________________. When a gravitational wave comes through, it **35.**____________________ space in one direction and **36.**____________________ space in the other direction. By measuring the interference of the **37.**____________________ as they bounce between the different points, physicists can measure very precisely whether the space in between has **38.**____________________ or **39.**____________________. And the precision needed is incredibile. To **40.**____________________ a gravitational wave, you need to be able to tell when something changes in length by a few parts in 10 to the 23. It is like being able to tell that a stick one **41.____________________** meters long has **42.____________________** by 5 mm. The effect of a gravitational wave is so minuscule and easily confused with random noise you need a smart data analysis technique. Scientists hope to identify the patterns of gravitational waves by comparing the **43.____________________** they measure in the experiment to the **44.____________________** they expect from the gravitational waves. That's like trying to identify a song being **45.____________________** at a noisy party. A very, very noisy party. Imagine that your whole life you had been **46.____________________** until one day your hearing was restored. You'd be able to explore the Universe in this whole new way. That's why **47.____________________** gravitational waves are so significant. It's a completely new way of studying the Universe. Anytime there's a new way to investigate the Universe we discover things that we didn't expect. It's really about looking for new things that we didn't know existed, examining the extreme edges of our knowledge of physics and testing our theories about how the Universe works.