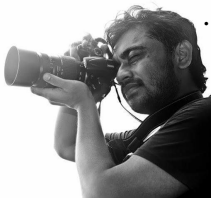
Astrophysics for Fun

Sushan Konar & Sourav Mitra

The Astronomy Module : Lodha Genius Program



Astronomical Measurements : Solar System

Similar to the *Zero Shadow Day*, another celestial event that we, the Astronomy enthusiasts, are in the habit of celebrating is the *transit* of a planet across the disc of the Sun. In 2012, we celebrated ***Venus Transit*** with a lot of pomp and grandeur. You can read all about it here.

Of course, the ancients handsomely beat us to it. Read about the use of *Venus Transit* to measure distances between solar system objects in the attached reading material (a 2019 blogpost). The basic principles are given in the material, but you need to work out the arguments yourself.

1. Consider the second paragraph of the blogpost. Mathematically establish that the *Venus Transits* occur in pairs that are eight years apart, each pair separated by 121.5 or 105.5 years and the entire pattern repeating every 243 years.
2. Set up the equations (a-la-Kepler) to calculate the distances to all the planets from the Sun, in terms of the Earth-Sun distance. What are the quantities that you'd require to perform such a calculation and find the distance to a particular planet from the Sun?
3. Set up the equations (a-la-Halley) to obtain the value of AU using *Venus Transit* (it is already given in the picture). Using the known values of various quantities involved, find the time required to travel from observer A to observer B by a Vande Bharat train (assuming you can comission a Vande Bharat to ply between any two arbitrary points on the globe, and that it can run at maximum speed all the time).
4. Do we observe the transits of all the other planets? If not, why not?

Teaching Assistants

Anantharaman S V & Umang Kumar

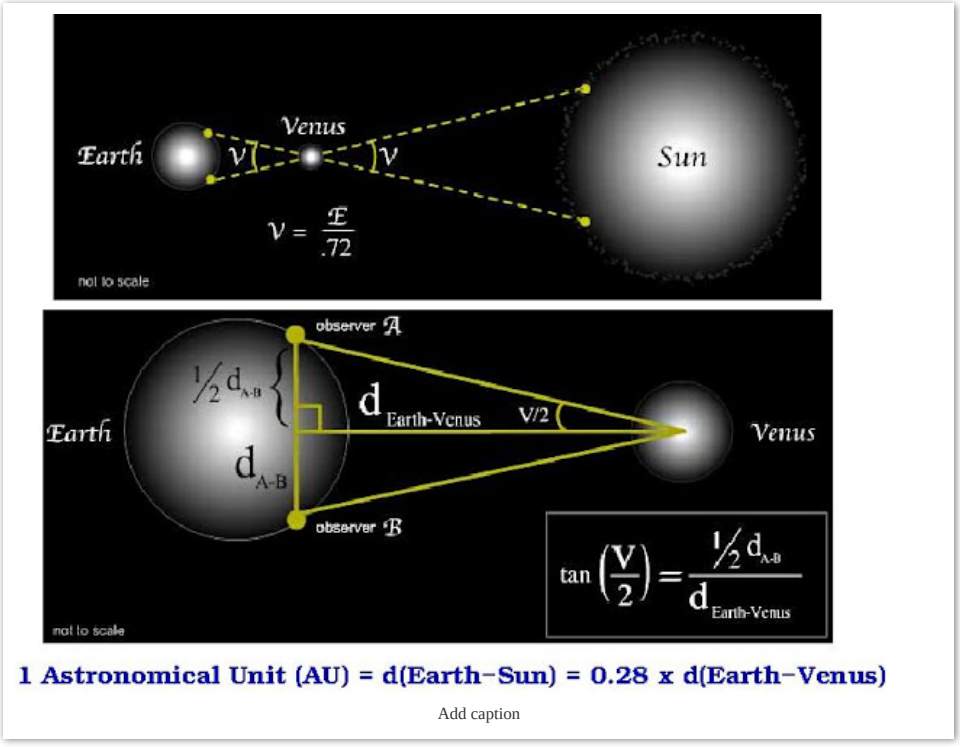
Monday Musings

Monday, 3 June 2019

03.06.2019 : The venus transit from 250 years ago..

Last week, the world celebrated one hundred years of a total solar eclipse that verified Einstein's general theory of relativity. A total solar eclipse is an example of a remarkable cosmic coincidence, of the equality of the apparent sizes of the Sun and the Moon in our sky (despite hugely different real sizes). However, objects with much smaller apparent sizes (than the Sun) too can give rise to astronomically important events, like the `transit of Venus', when Venus moves across the disc of the Sun (visible as a small black dot). (The diameter of Venus is actually more than three times that of the Moon but appears much smaller because it is at a much larger distance.)

Venus transits occur in pairs that are eight years apart, each pair separated by 121.5 or 105.5 years and the entire pattern repeating every 243 years - arising from the fact that the orbital periods of the Earth and the Venus are close to the ratios 8:13 and 243:395. Such transits are of great astronomical importance as they can be used to measure distances within the solar system (long before the advent of modern technology like radio telemetry or radar interference).



Add caption

By 1619, Johannes Kepler had calculated the distances of all the planets from the Sun, in terms of the Earth-Sun distance (which is one of the important distance units of modern Astronomy, commonly known as the Astronomical unit or AU). The AU itself still needed to be measured, though.

In 1716, Edmond Halley proposed a method for calculating the AU using the transit of Venus - observed from different points on Earth's surface (see picture). The measurements directly yielded the Earth-Venus distance, from which the Earth-Sun distance could be easily calculated using Kepler's laws of planetary motion. Unfortunately, Halley was dead before he could witness his calculations bearing fruit from measurements taken during the 1769 transit (3 June 1769) when a reasonably accurate value of AU was obtained for the first time.

Sushan Konar

Theoretical Astrophysicist, Science Writer (of sorts) and the perennially hassled mom of a terrific (her words!) teen..

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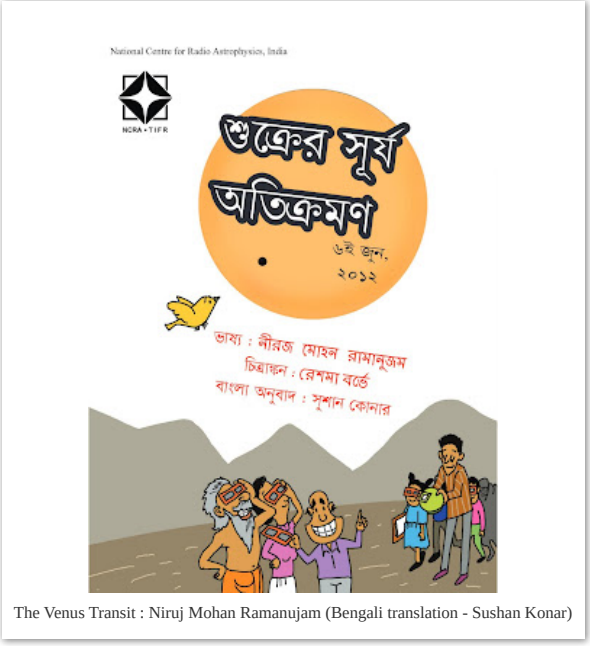
Though we no longer need transits for solar system distance measurements, they can provide us with great opportunities to refine our detection techniques for terrestrial (Earth-like) exo-planets. Scientists took advantage of this opportunity at the 2012 (5, 6 June) transit of Venus (also the last of the 21st century). Such a celestial event also provides us, the members of the Astronomical community, with an opportunity to share the excitement of our work with the general public.

To this end, my friend Niruj Mohan (Niruj Astropage) brought out a graphic novel (I am told the old-fashioned word 'comic book' is, well old-fashioned) on Venus Transit and got it translated in a number of languages. Gentle readers, you may not have a chance of witnessing a Venus Transit in your lifetime but you can surely enjoy the history of this exciting adventure here - http://mutha.ncra.tifr.res.in/ncra/outreach/transit-of-venus-1/comics-on-the-transit-of-venus-in-14-languages



The Venus Transit : Niruj Mohan Ramanujam (Bengali translation - Sushan Konar)

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at June 03, 2019

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