Do it yourself: Disk angle of Vega or Jupiter:

Motivation: Measuring the distance to stars is a fundamental problem in astronomy. Galileo could somewhat safely discuss this topic because his opponents had used both the size of the Sun and the distance to the Sun as length scales. He implicitly made the assumption that stars have the same disk diameter as the Sun, which is as close as he ever got to stating publically that the Sun is a star. This assumption that all stars have the same diameter is incorrect but better than assuming they all have the same luminosity. The real disk angle of Vega is too small to measure in this manner. The method may work for getting the disk angle of a planet. This year Jupiter is in the eastern evening sky and on SEP 23 to right of Moon. It is noticeably yellow and the brightest object in the night sky other than the Moon.

Project: This is Galileo's method of measuring the disk angle of the star Vega. The disk angle of the star is the angle from a projection point behind your eye through the eyeball and the rope. The distance between your eye and the rope is X, which you can measure by pacing it off. See the Figure on the next page. You will need to close or cover one eye.

The rope/wire diameter is R. Use the wires near the parking structure on Panama Street if convenient. Their diameter is 2.1 centimeter (0.021 m), use this as generic diameter if you work somewhere else and use inaccessible wires. The diameter of your pupil is E. (Use 0.5 centimeter (0.005 m) if you cannot measure it easily.) With a little algebra, the disk angle is (R-E)/X

ANSWER = (Rope - Eye) / distance

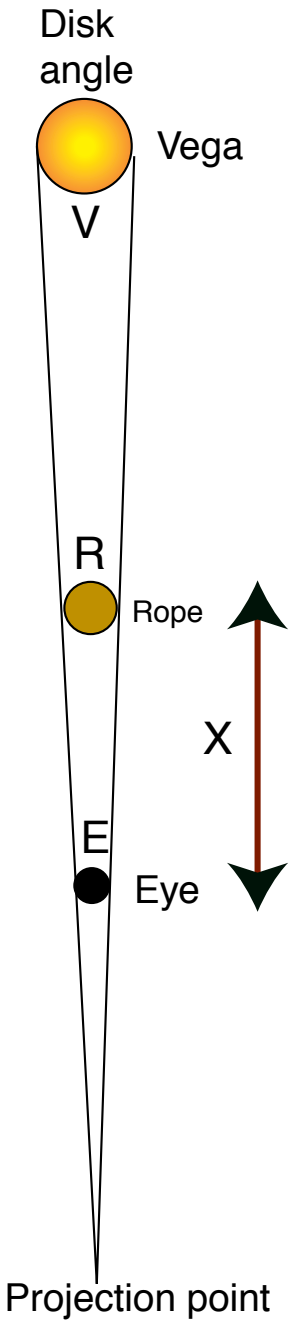
(___0.021m_____ - _____) / _____

Put R, E, and X in common units, like meters. This gives the disk angle in radians. Multiply by 3438 to convert to arc minutes.

As you did this with a planet, you will get an actual estimate. The disks of stars are too small to actually measure in this way so we get an upper limit. Measure your pupil (if have a helper) after have you have been in the dark for a while. A taut rope works but a moving one will not. So does railing on a building if it is in the right place. A phone wire will work if you just want to see the effect. Walk back until you just see light on both sides of the rope. You can use a right triangle to measure X if the wire is well off the ground and you want a more precise answer, but pacing will be OK. Jupiter will be low enough that you do not need to do this.

Get planet and sun rise and set times from here. http://www.almanac.com/rise/index.php
Fall 2010 was excellent for watching Jupiter.

If you have access to binoculars or small telescope, look at Jupiter. Can you see it as disk? Do you see any of the moons? If you do they will lie on a line through the center of Jupiter. You will also be able to see features on the Earth's Moon. Sketch Jupiter and its moons and note time and day. Check the next few days and replot. You may also bring in Uranus (who will need to know where to look), which will be noticeably green. Then try to see it will the naked eye. To see Venus in west, you will be to be out at sunset. It may be lost in glare of twilight or be behind mountains. Check planet tables for Mercury, Saturn, and Neptune. A small telescope will bring in Neptune but you may need tripod. Galileo recorded Neptune but did not recognize it as a planet.


Disk
angle
Vega
V
R
Rope
X
E
Eye
Projection point