National Aeronautics and
Space Administration

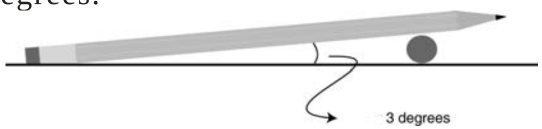
Measuring a Miniscule Angle

The success of Gravity Probe B entirely depends upon its ability to measure two incredibly small angles. The experiment must measure the predicted “geodetic effect” of 6600 milliarcseconds and the “frame-dragging” effect of 42 milliarcseconds. Each of these measurements must be accurate to within 0.5 milliarcseconds.

What is a “milliarcsecond”?
A one degree angle is broken down into arcminutes, arcseconds, and milliarcseconds.

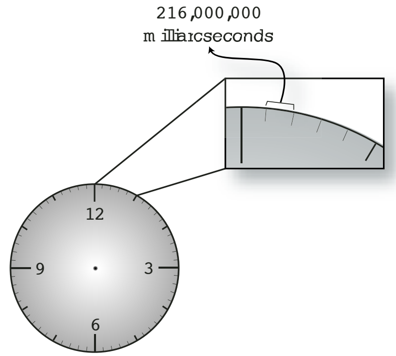
1 degree =	60 arcminutes 3600 arcseconds 3,600,000 milliarcseconds
1 milliarcsecond = 2.78 x 10^{-7} degrees *(three ten-millionths of a degree)*	

1. Lean a pencil across another pencil. Look at the angle between the leaning pencil and the table top. This angle is fairly small -- between two and four degrees.



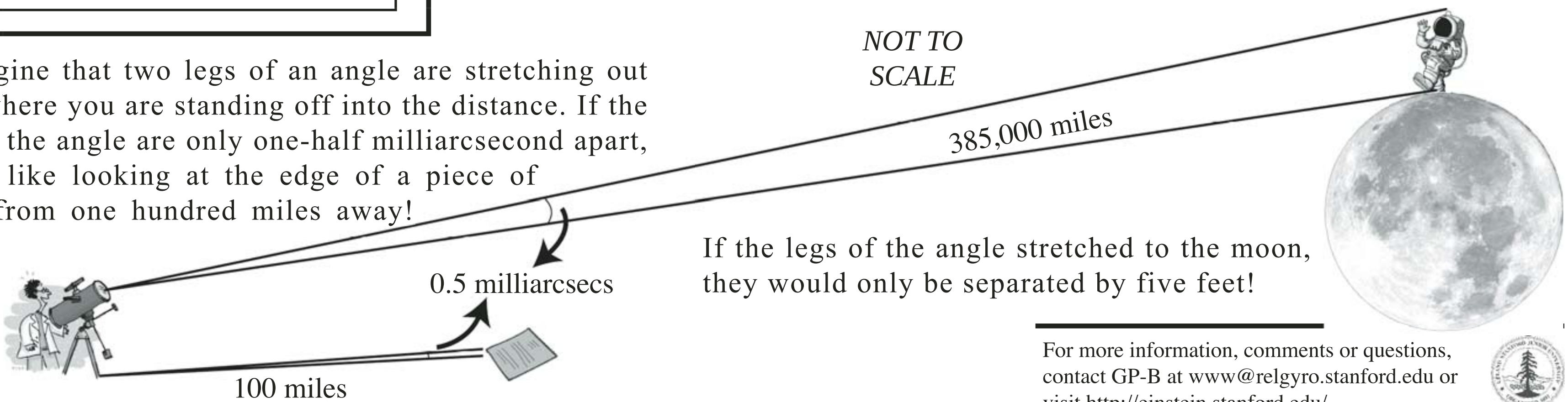
To imagine how small one-half of a milliarcsecond is, break this angle into about ten pieces, then ten more, then ten more, and ten more. Then break it into ten more pieces, then ten more, and finally ten more pieces. Then break it in half. Gravity Probe B must be precise enough to measure an angle approximately 20,000,000 times smaller than the angle between the pencil and the table top!

2. Look at a round clock with the minutes marked on it. Each minute mark is six degrees apart. In that space, there are 216 million milliarcseconds.



Gravity Probe B must be able to measure half of one of those milliarcseconds -- an angle nearly one five-hundred-millionth of the space between each minute mark!

3. Imagine that two legs of an angle are stretching out from where you are standing off into the distance. If the legs of the angle are only one-half milliarcsecond apart, this is like looking at the edge of a piece of paper from one hundred miles away!



If the legs of the angle stretched to the moon, they would only be separated by five feet!

For more information, comments or questions, contact GP-B at www@relgyro.stanford.edu or visit http://einstein.stanford.edu/

LTH3.1-1003

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