Asian Try Zero-G 2018

Elastic Force of Paper Springs

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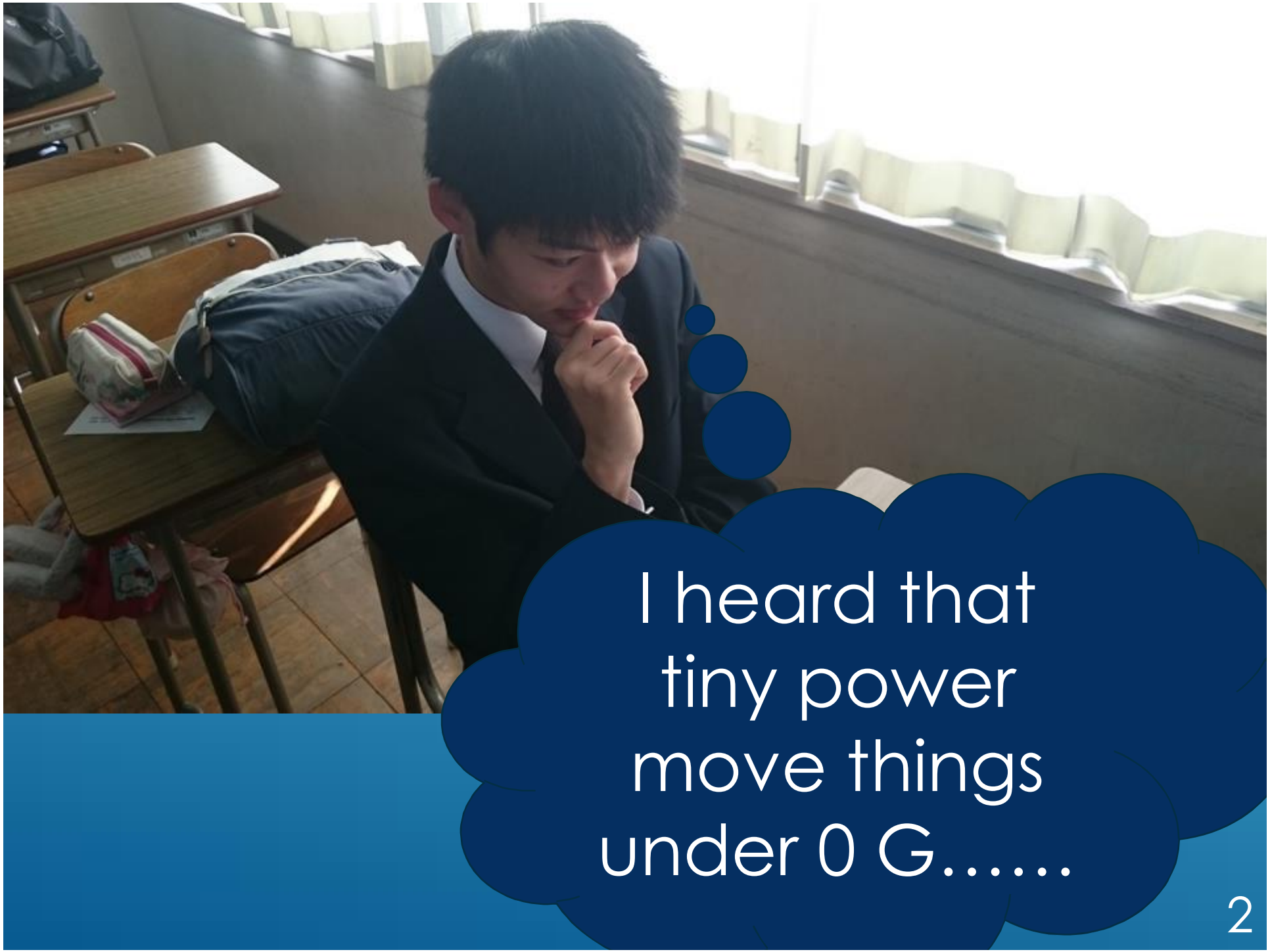
I heard that
tiny power
move things
under 0 G……

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TRY ZERO-G PERFORMED BY ASTRONAUT KOICHI WAKATA


0 G may enable us to observe elastic power of paper springs!

- 「elastic power of spring is in proportion to amount of deformation」
- Force = spring constant k × amount of deformation x
- It needs to be under maximum deformation of elastic limit

※elastic limit

The maximum deformation. Hooke's law is efficient under this limit.

- Kent paper (hard paper)

  ⇒spring motion

- copy paper (thin paper)

  ⇒non spring motion possibly over the elastic limit

EXPERIMENT ON THE EARTH

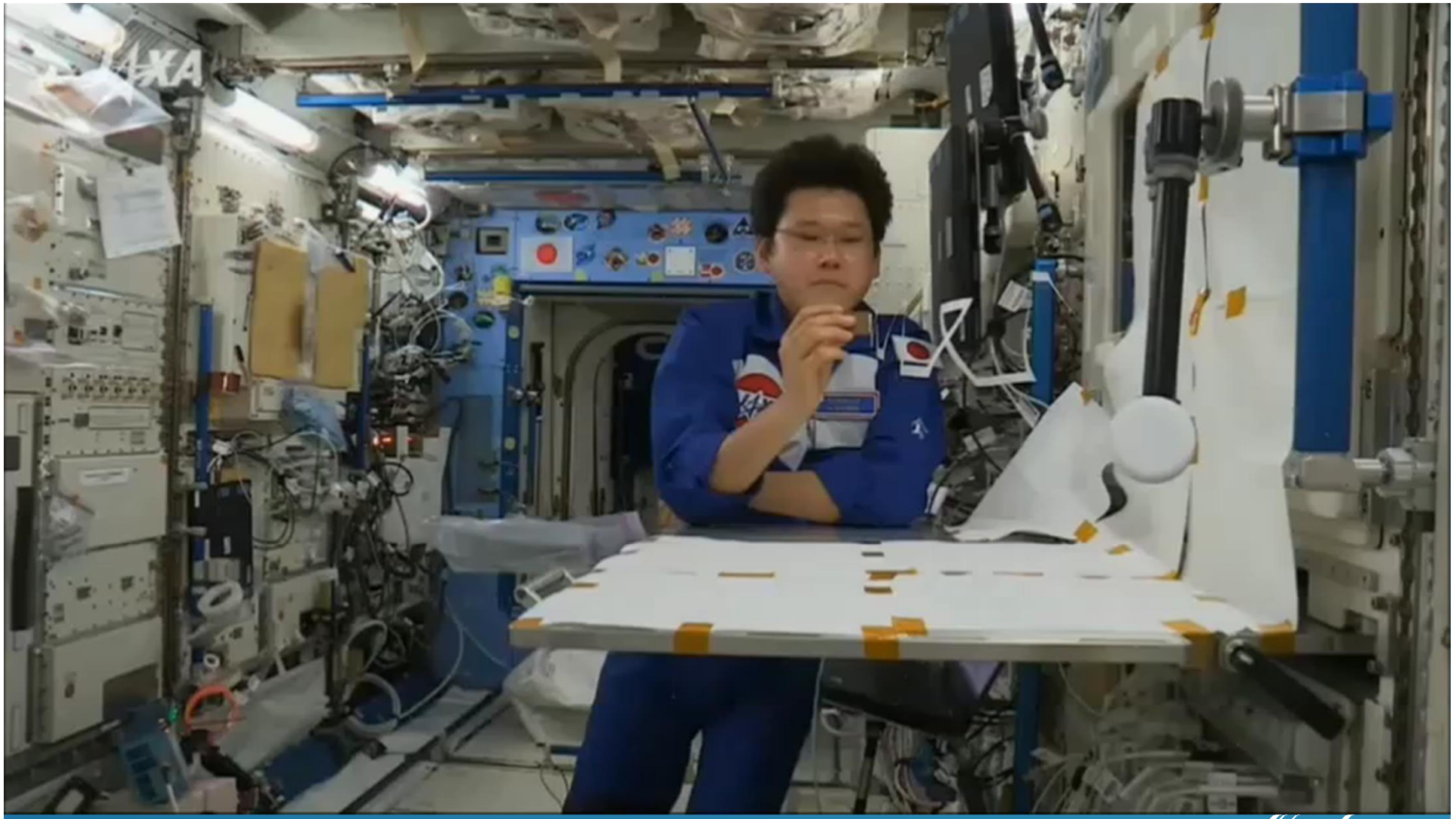
- problems :

  due to spring's own weight, spring possibly deform over elastic limit.

  ⇒impossible on the earth.

WHY IT HAD TO BE CARRIED OUT IN ISS

EXPERIMENT 1



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SPRING REALLY MOVED !

EXPERIMENT 2

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- 1 period 27 s
- Move with rotation in both Z axis and Y axis
- Cube go through the center with rotation under 90 degree
- First 180 degree rotation happened near the center of spring, While it happened in outer side for the second time we observe

RESULT

- 1 period 27 s
- Spring constant kent paper

  2.961*10 ^ (-2) (N/m)

  copy paper

  6.037*10 ^ (-4) (N/m)

PERIOD

- Define Z axis as the axis of moving and X axis as an axis which is perpendicular to the connection line of spring and cube.
- The rotation with Z axis seems to happen because of characteristics of coil spring. Coil spring made rotation toward the direction to unfold the spring.
- The rotation with X axis is due to the construction of spring, which is connected with cube by only one point.

ROTATION

- Spring pressured
- More pressure are put on the place of 180 degree deform
- More stronger distortion happened, causing more elastic force
- This relativity strong force rotate the cube when it come the center

THE RECOVERY NEAR THE CENTER

- The moment caused by moving up rotated the cube, so the deformation happened mainly near the center

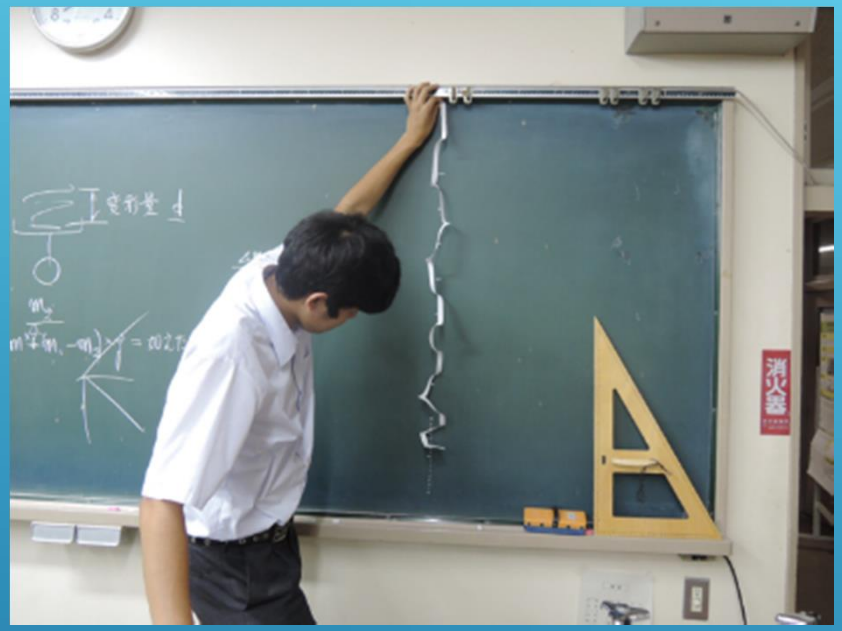
THE FIRST 180 DEGREE DEFORMATION

- The collision or friction caused it, so the deformation happened where it collided, or the weakest point.

THE SECOND 180 DEGREE DEFORMATION

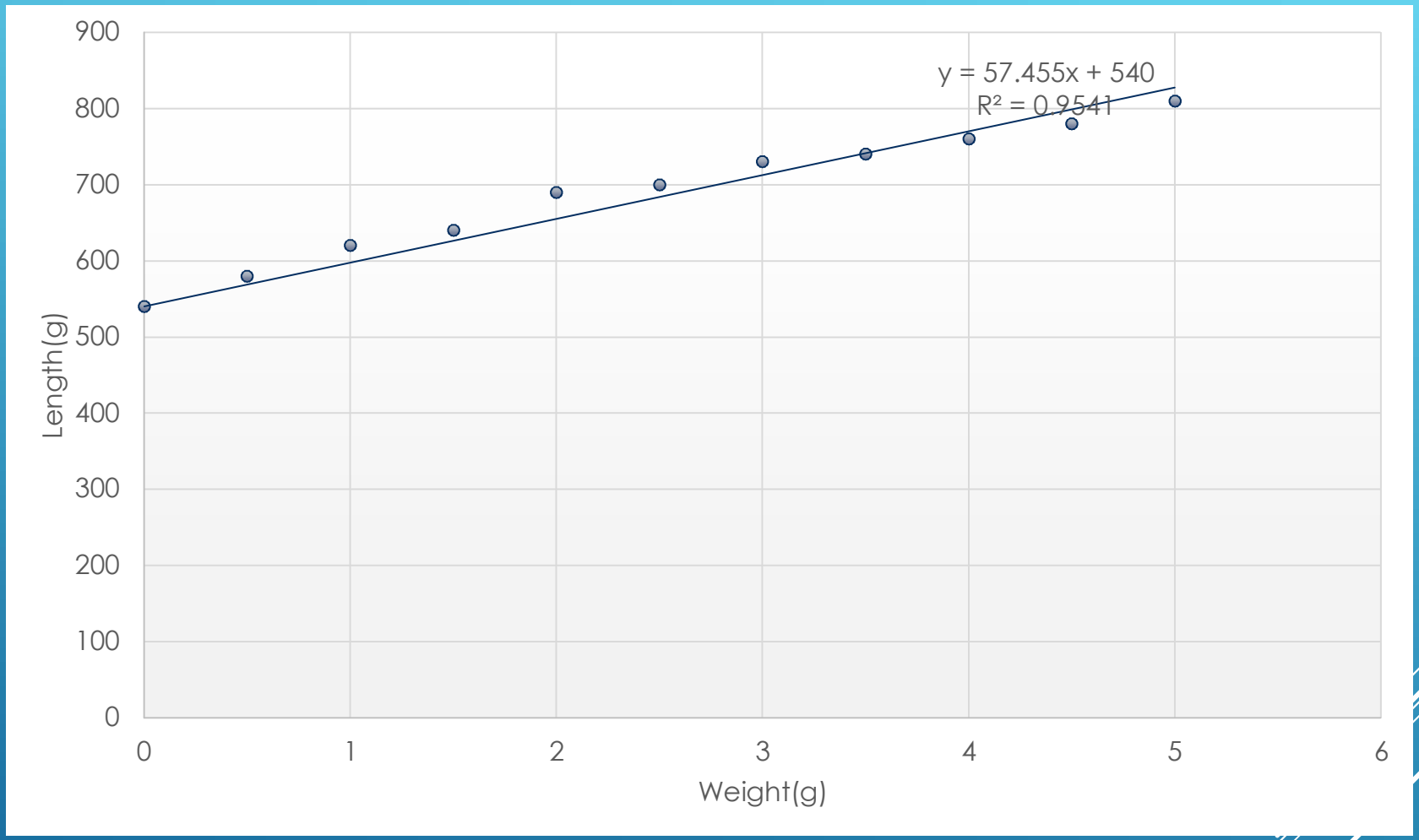
- Hung one side of paper spring and put weight in the other side.
- Measure the change of length of paper spring.

EXPERIMENT ON THE EARTH



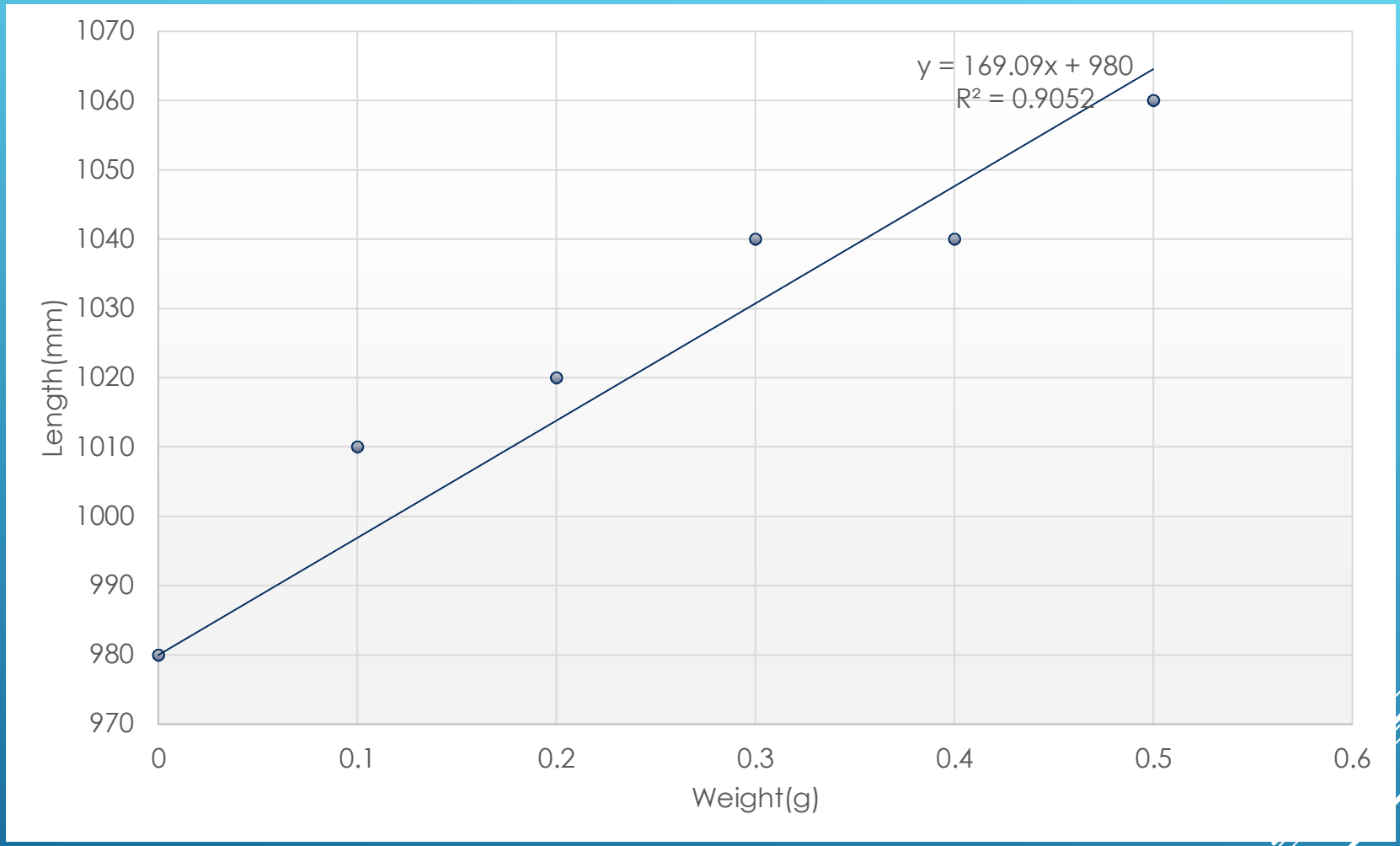
THE STATE OF THE EXPERIMENT

KENT PAPER



DISCUSSION

COPY PAPER



DISCUSSION

- Kent's length changed according to the change of weight.
- Copy showed less correlations between weight and length

DISCUSSION

- Under the 0 G situation, paper spring showed elastic forces and moved accordingly.
- Under the 1 G situation, paper spring`s elastic forces appeared less obviously, though it had certain regularity in experiment one.
- More data might let us discover more accurate conclusion.

CREDITS AND SPECIAL THANKS

- JAXA
- Dr. Kanai