

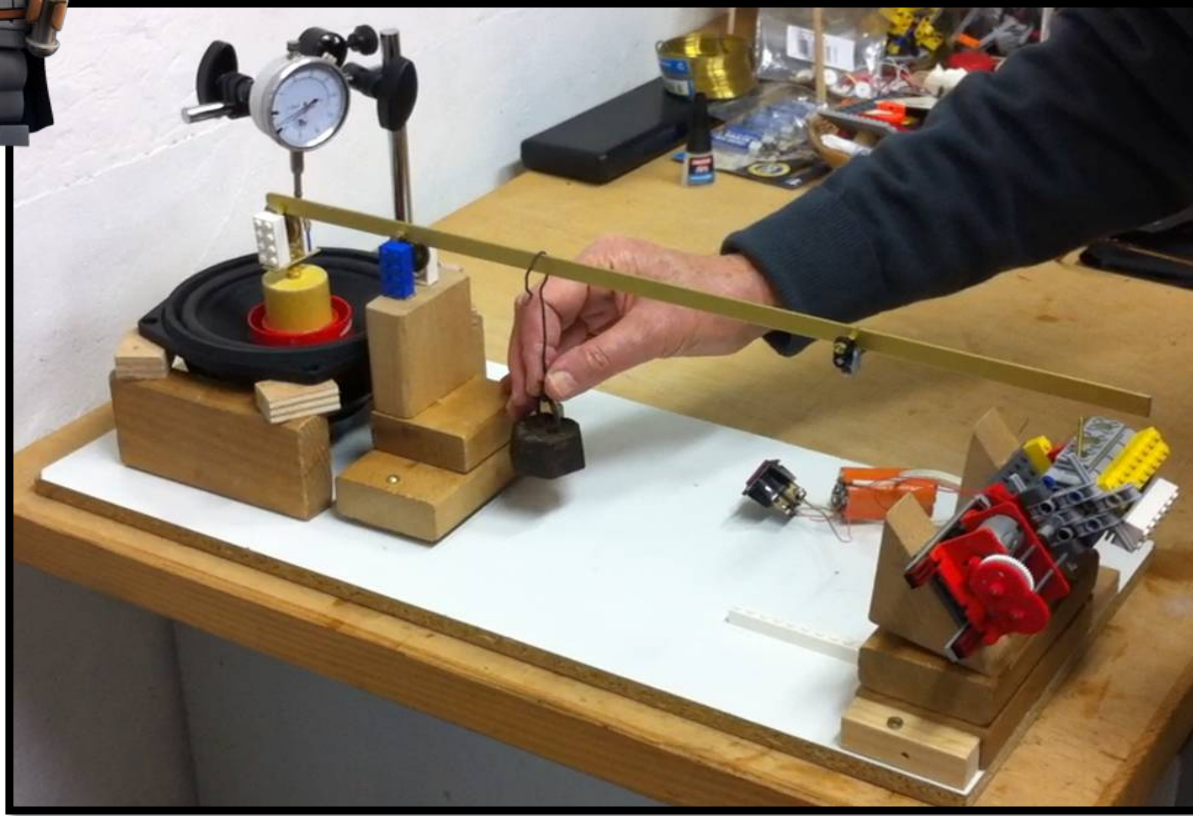
# The NIST LEGO® Watt Balance

CCM 2015



# The *Real* Pioneers

- ▶ Terry Quinn, Richard Davis, and Lucas Quinn (age 11!) blazed the path (THANK YOU)



- ▶ *Physics Education*, 2013, "A simple watt balance for the absolute determination of mass"

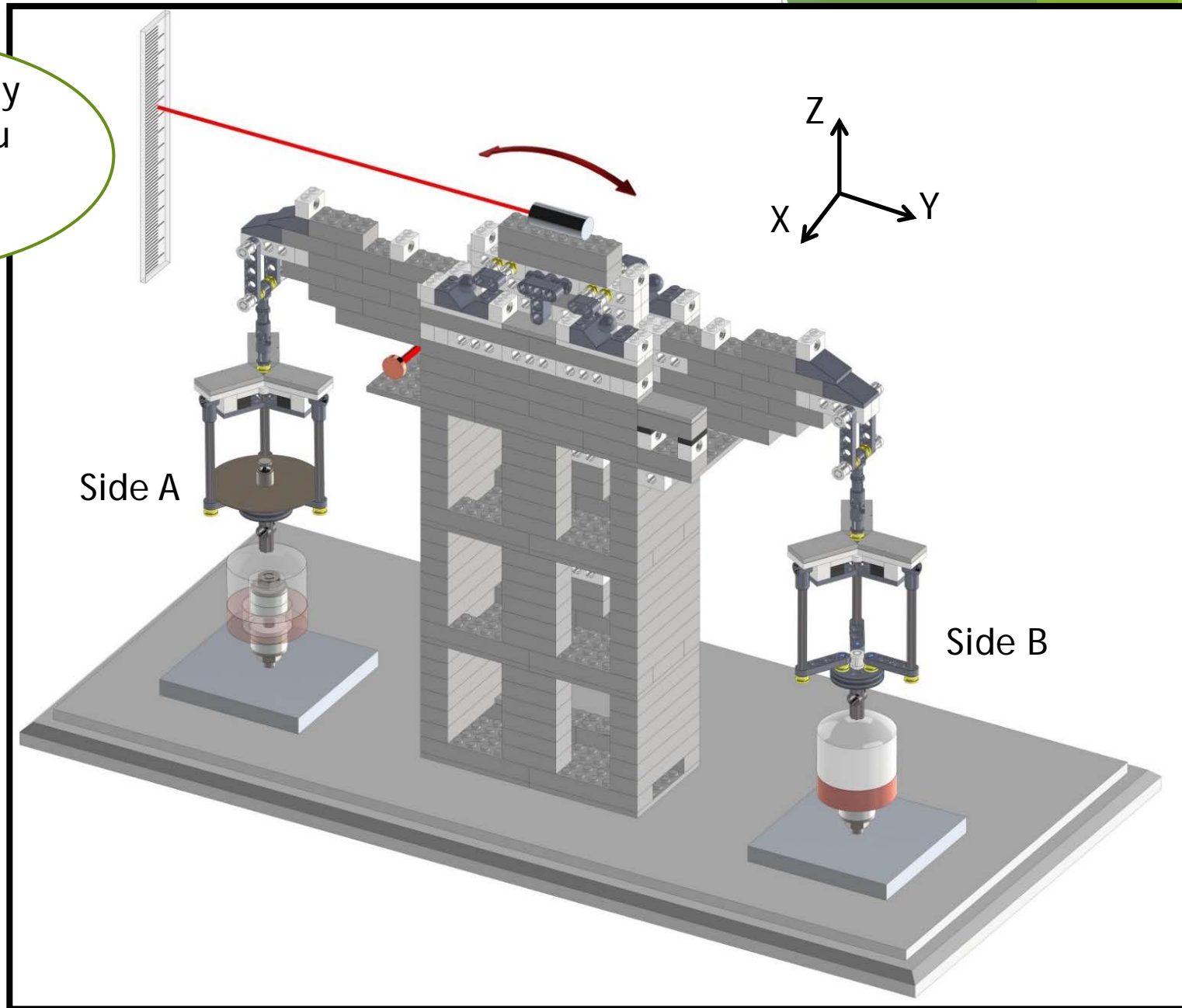


Pick a side. Any side. A? B? You can weigh on either side!

Striving towards that 1% uncertainty...



≈



# Capabilities

## LEGO WATT BALANCE (NIST-5L)

Graphs | Measurement | Settings | Experimental

Balance position  Voltage across coils

Coil velocities  Current in Coils

CurrentMeter

Choose Mode

- Constant on Coil A
- Sine driven on Coil A
- Constant on Coil B
- Sine driven on Coil B

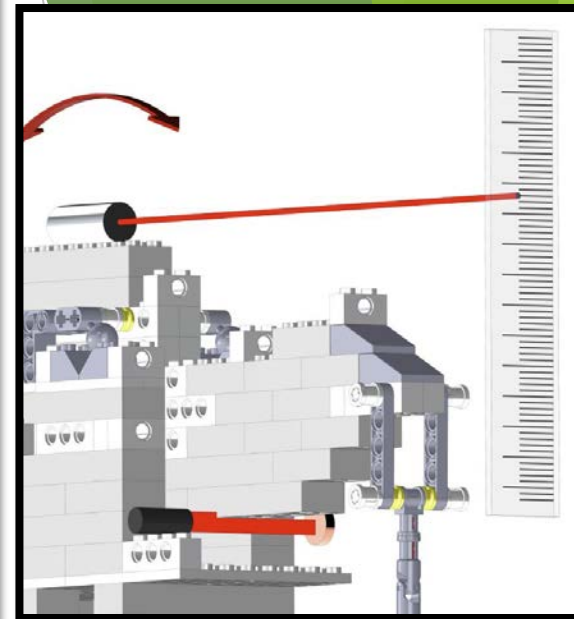
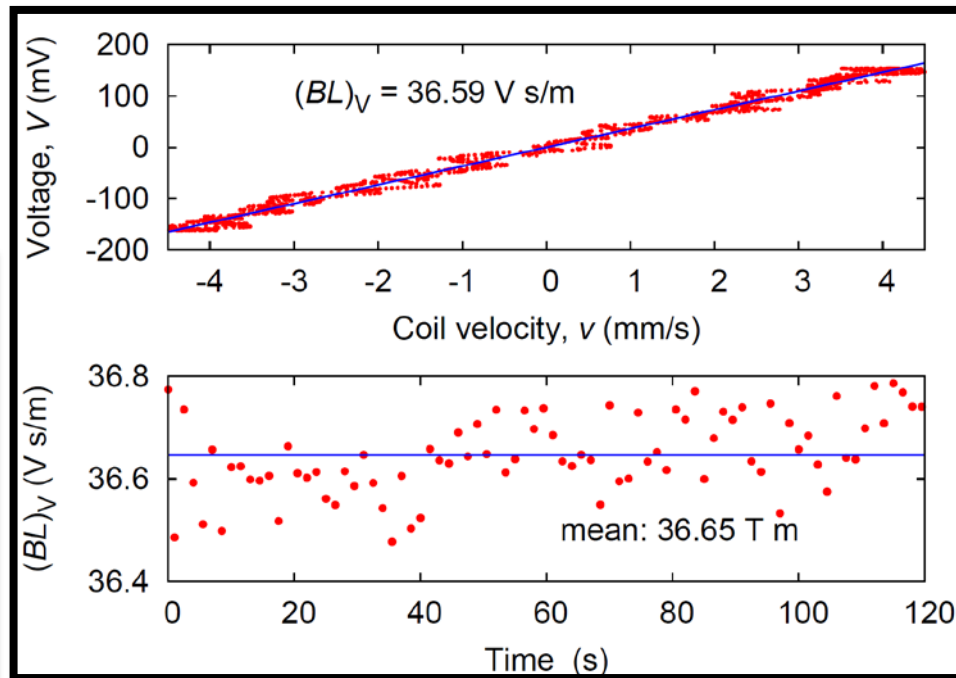
Current in Coil A  
 Current in Coil B

CHOOSE YOUR CONTROL  
 MANUAL  AUTO

Manual Difficulty

Newbie | Rookie | Beginner | Talented | Skilled | Proficient | Metrologist

STOP

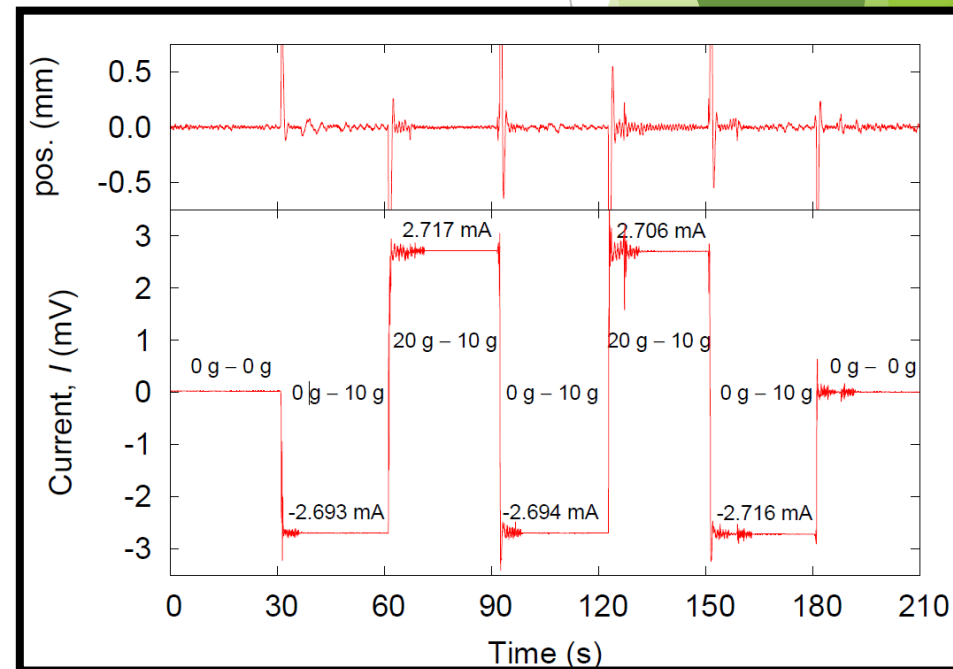


## Velocity Mode

Uses a calibrated optical interrupter to measure real time displacements.

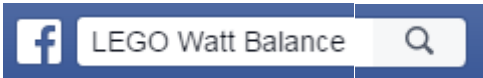
## Force Mode

Control loops adjust the current to null the balance during a series of mass on and mass off measurements.



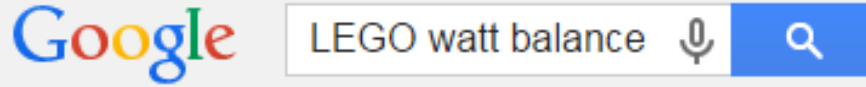


# We are aspiring to grow a community

- ▶ Submitted to *American Journal of Physics*, 2015:
  - ▶ "A LEGO Watt Balance: An apparatus to demonstrate the definition of mass based on the new SI"
  - ▶ <http://arxiv.org/abs/1412.1699>
- ▶ New Facebook page: 
  - ▶ [www.facebook.com/LEGOwattbalance](http://www.facebook.com/LEGOwattbalance)
- ▶ New NIST Redefining the Kilogram webpage
  - ▶ [http://www.nist.gov/pml/si-redef/kg\\_redefinition.cfm](http://www.nist.gov/pml/si-redef/kg_redefinition.cfm)
- ▶ **You Tube** video on the way...



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Bricked-up watt balance is 99 per cent accurate

**These Scientists... Of Legos -- And It**

Ria Misra  
Filed to: MEASUREMENT 12/10/14 11:49

**NIST** NIST Shows You How Watt Balance... With LEGO

And that is just... AWESOME

**IEEE SPECTRUM**

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**Measure Planck's Constant and Define the Kilogram with LEGOs**

# What are you waiting for?!

- ▶ There's a LEGO watt balance community sprouting right now. Don't get left out!
- ▶ We encourage everyone to build their own table-top sized watt balances.
- ▶ Build your own version and keep improving the concept!!!

- ▶ Contact: Leon Chao
- ▶ [leon.chao@nist.gov](mailto:leon.chao@nist.gov)

