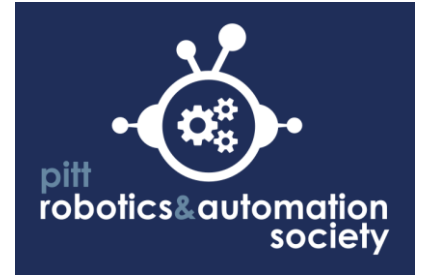


# General Lipo Usage

Original slides by Levi Burner for Pitt's RAS Fall 2017

Adapted by Andrew Saba for CMU's Air Lab Fall 2019

Adapted by Levi for UMD's ENEE408I Fall 2020 – Spring 2021



**Carnegie Mellon University**  
The Robotics Institute



# Outline

- What's a LiPo?
- Storage
- Safe voltages
- Charging
- LiPo fire

# What is a LiPo

- Lithium Polymer battery
  - Lithium means super reactive
- High discharge rates
  - 100's of amps possible
- Relatively high specific energy
  - Theoretically, 4081 batteries can deliver 900 watts for 2 minutes



# LiPo's are used for

- RC Cars
- RC Planes
- RC Drones



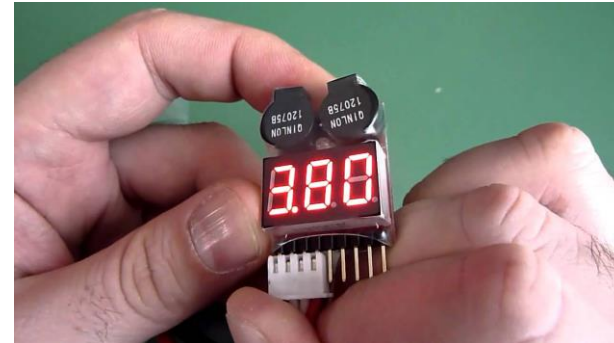
# LiPo Storage and Charging

- Store and charge your batteries in LiPo Bag
  - Ok for smaller batteries like those used in 408l
  - You have 3 cell (11.1V), ~2650 mAh batteries
- Larger batteries should go in fire resistant box
  - You don't have any that big
- Do not put bad batteries in trash
  - Special disposal required (contact us)



# Safe/functional voltages

- 4.2V per cell when charged - 3.7V Nominal
  - 25.2V, 22.2V for 6S
  - 16.8V, 14.8V for 4S
  - 12.6V, 11.1V for 3S
- Charging above or discharging below shortens lifespan
- **Below 3V per cell can be dangerous**
- **Inconsistent cell voltage can be dangerous**
- When running robot, **use a battery monitor**
  - It beeps loudly with a programmable setpoint





# Charging for ENEE 408I

- Simple chargers provided
- Charges at a fixed current
  - Well under your batteries current rating
  - About 3 hours to charge



- 100-240V  
AC Input Voltage
- 3\*800 mA  
Max Current
- Balance Charge
- 2-3 cells  
LiPo Cells



Over Voltage Protection



Over-Current Protection



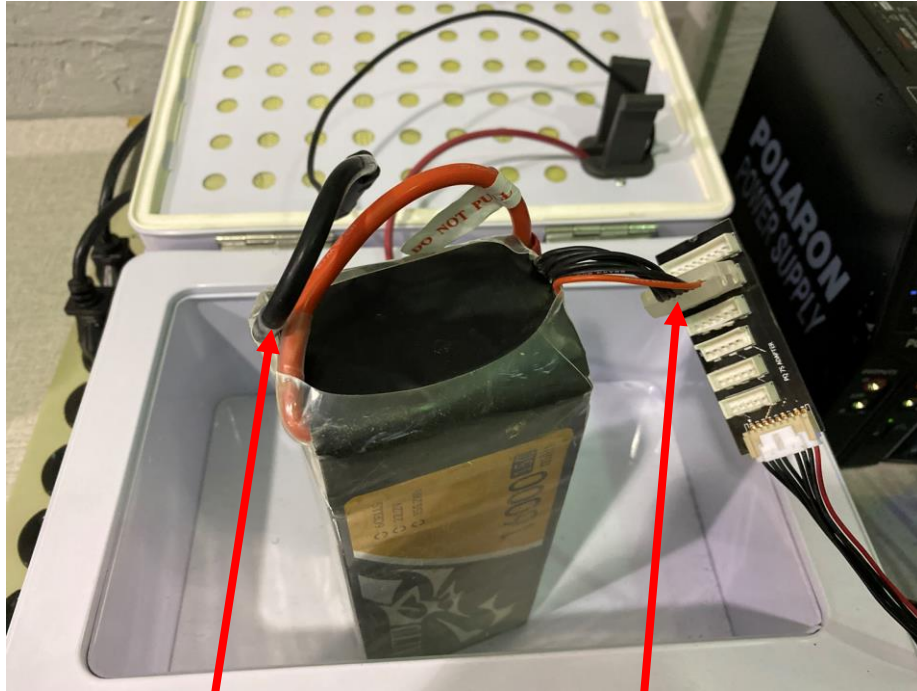
Over-Temperature Protection



Short-Circuit Protection

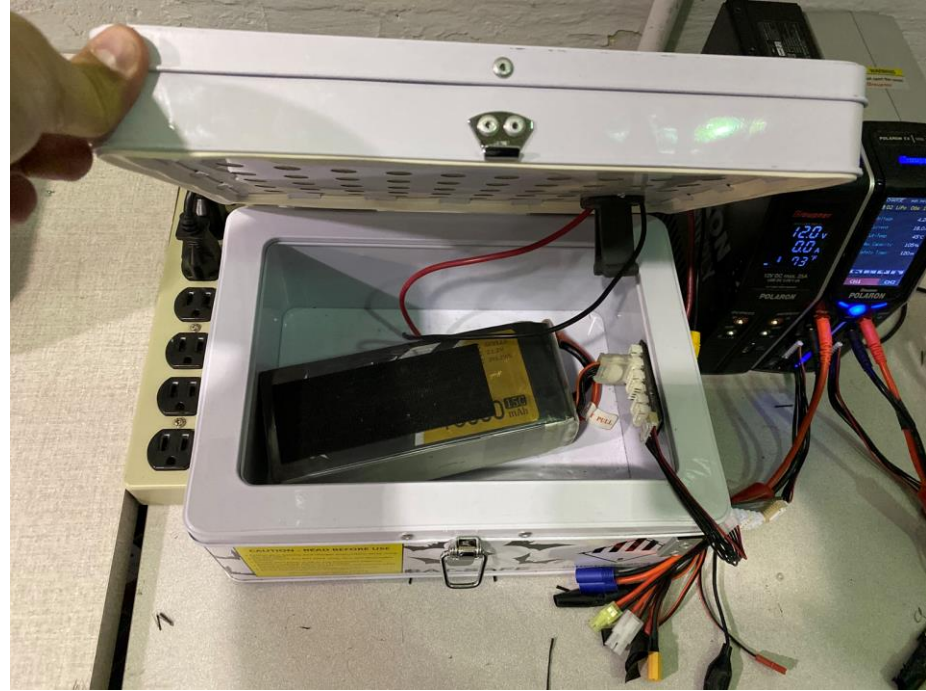
What's wrong with this photo?

# How to charge a battery



Power Leads

Balancing Port



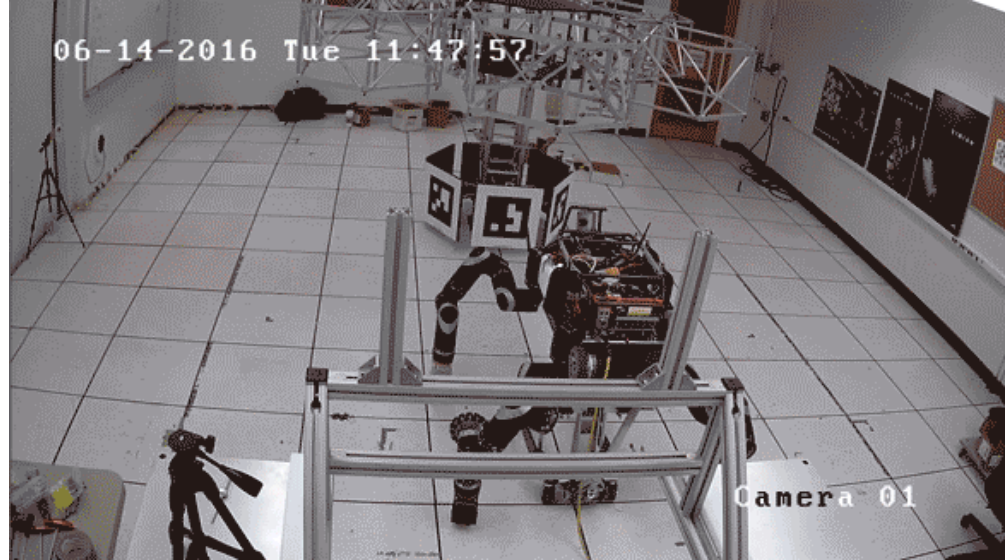




Mind the  
latch!

# LiPo Fires

- Puncture = Fire
- Over discharge + charge = Fire



Questions?

# Good videos and reads

- LiPo burn tests in various containers
  - <https://www.youtube.com/watch?v=CnNld0mDnBo>
- General LiPo Guide
  - <https://rogershobbycenter.com/lipoguide/>
- Bat Safe box test
  - <https://www.youtube.com/watch?v=pzIXcv5ONSY>

# General Charging (if you had configurable charger)

- C-rating: how much current you can pull in relation to Ah rating
  - 20C 5Ah battery means:  $20C \times 5Ah = 100A$  discharge
- Recommended to charge batteries at 1C
  - 1Ah battery gets charged at  $1C \times 1Ah = 1A$ .
- Charging too fast can cause fire
- Charging at wrong voltage can cause fire
- **Unsupervised charging can cause fire**