Update: Pump Control, Yale

WILLIAM HEIDORN
IOWA STATE UNIVERSITY
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Since last time…

- Yale thermal setup
- Found issues with CRC-16 (modbus) generation
  - The cyclic redundancy check (CRC) is to make certain that the commands that have been sent are not corrupted in transmission.
  - If the CRC is not correct it causes the command to fail… causing the system to shutdown instead of change to the correct pump value.
  - The CRC generation has been found not to work for pump settings of 12.8-15.9 and 38.4 and greater.
    - This is probably good, because these will be locations where the flowmeter will not usually go for 1l/min flow rates
- Comparing pump setting to flow and voltage measurements
  - Noticing problems with low temperature conversions

Yale Thermal Setup Requirements

1. Finish Setup
   - Install Arduino software
   - Install computer control software
   - Make certain all parts are together(pipes, alignment, etc)
2. Flow Meter Calibration
3. Vignetting measurements
4. Stave measurements with Yale Setup
   - #2R and #8
- T-probe test? Use one of our short pipes?

Booster Pump Commands

- In Hexadecimal
  - 0106002cRRRRyyyy

    = Set booster pump RPS to RRRR/10

    where yyyy is CRC code generated from 0106002cRRRR
  - Our current CRC generator has issues from 12.8-15.9 or 0080-009F in hex

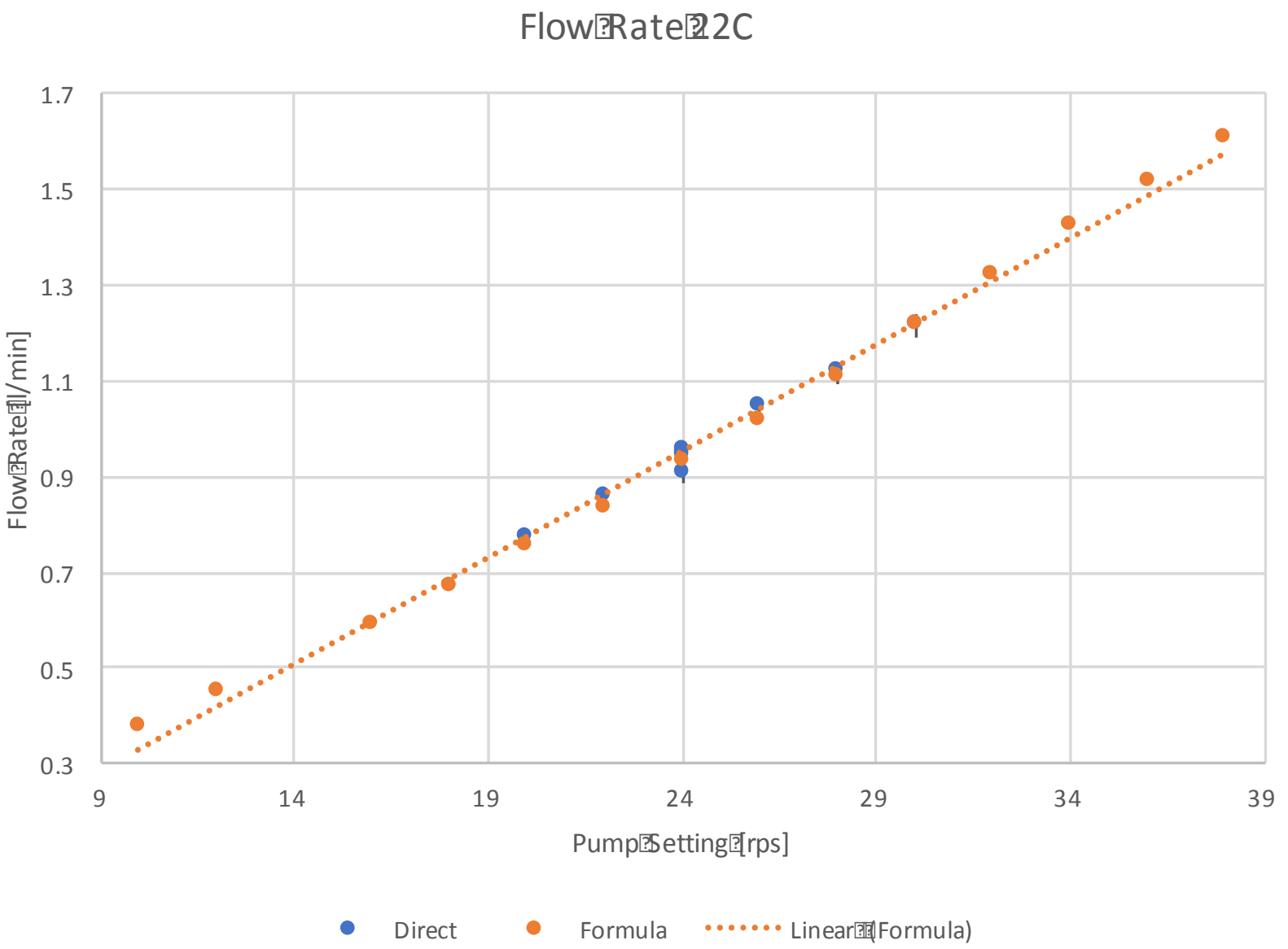
  - Why? I do not know. Roy's looking into it.

Pump Check

- Measurements of the flow rate from the arduino were taken with varying pump settings from around 10 rps to 38 rps
- Compared with direct flow rate measurements that were used to make the voltage conversion formula
- FlowRate = A*__Volt__+ B + C*__Temp__+ D*__Temp__^{2}
  - **Volt**: Voltage from flow meter
  - **Temp**: Used Tres value (this is a problem at low temperatures)

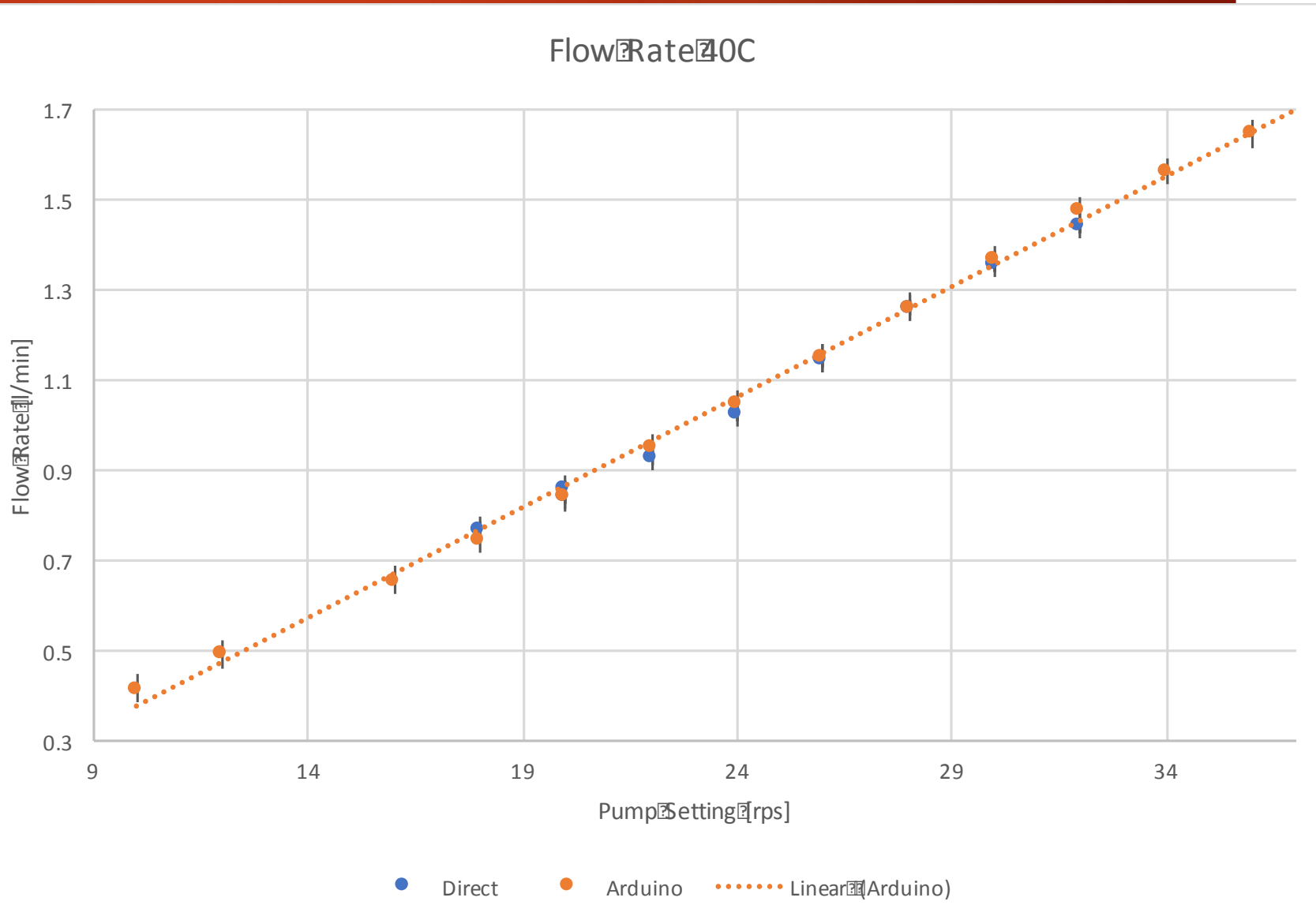
Room Temp

- Flow comparison between early direct flow measurements and flow rates measured from the voltage, using the formula
- Both are within uncertainty



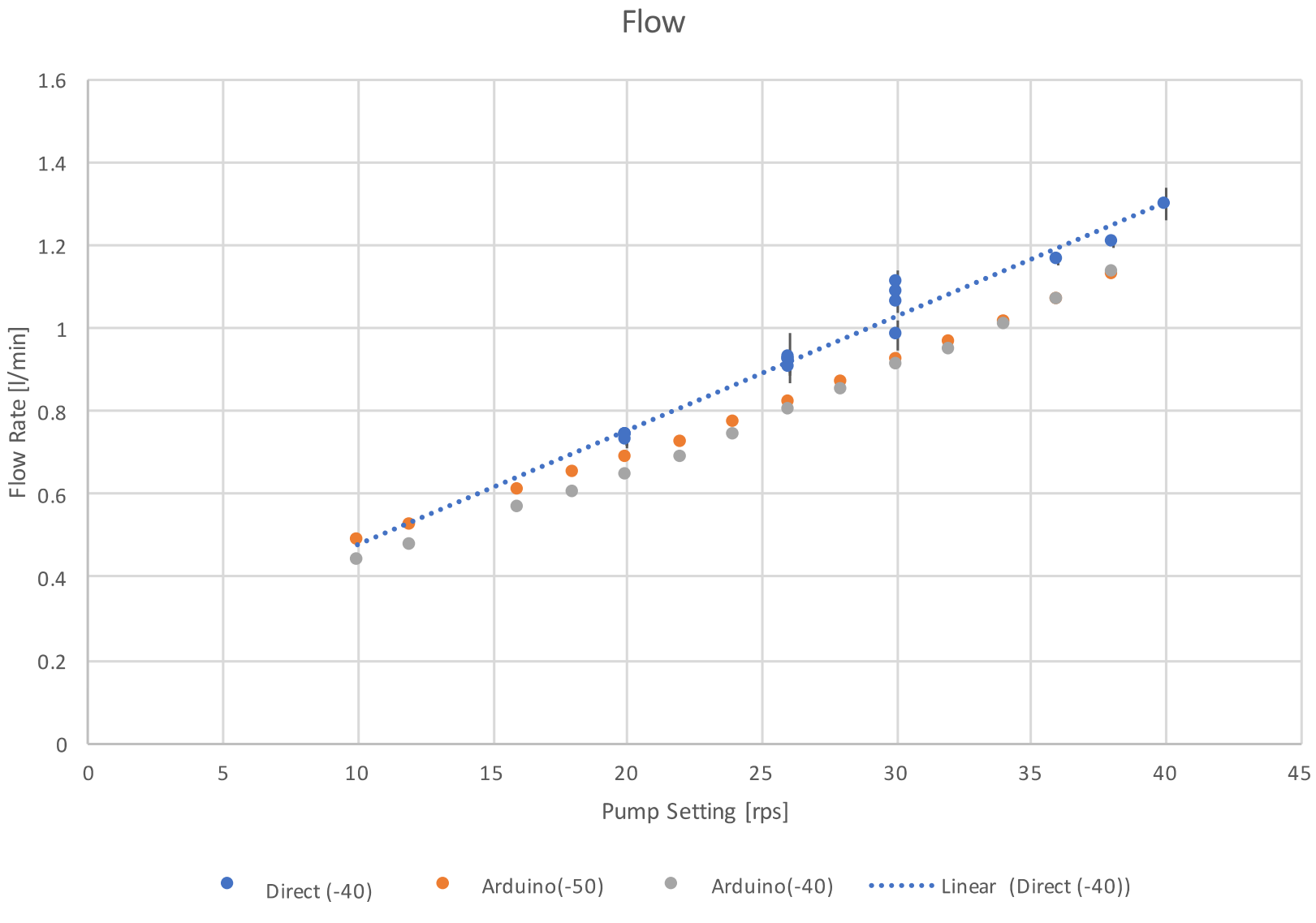
Hot Temp

- Flow comparison between early direct flow measurements and flow rates measured from the voltage, using the formula
- Again both are within uncertainty



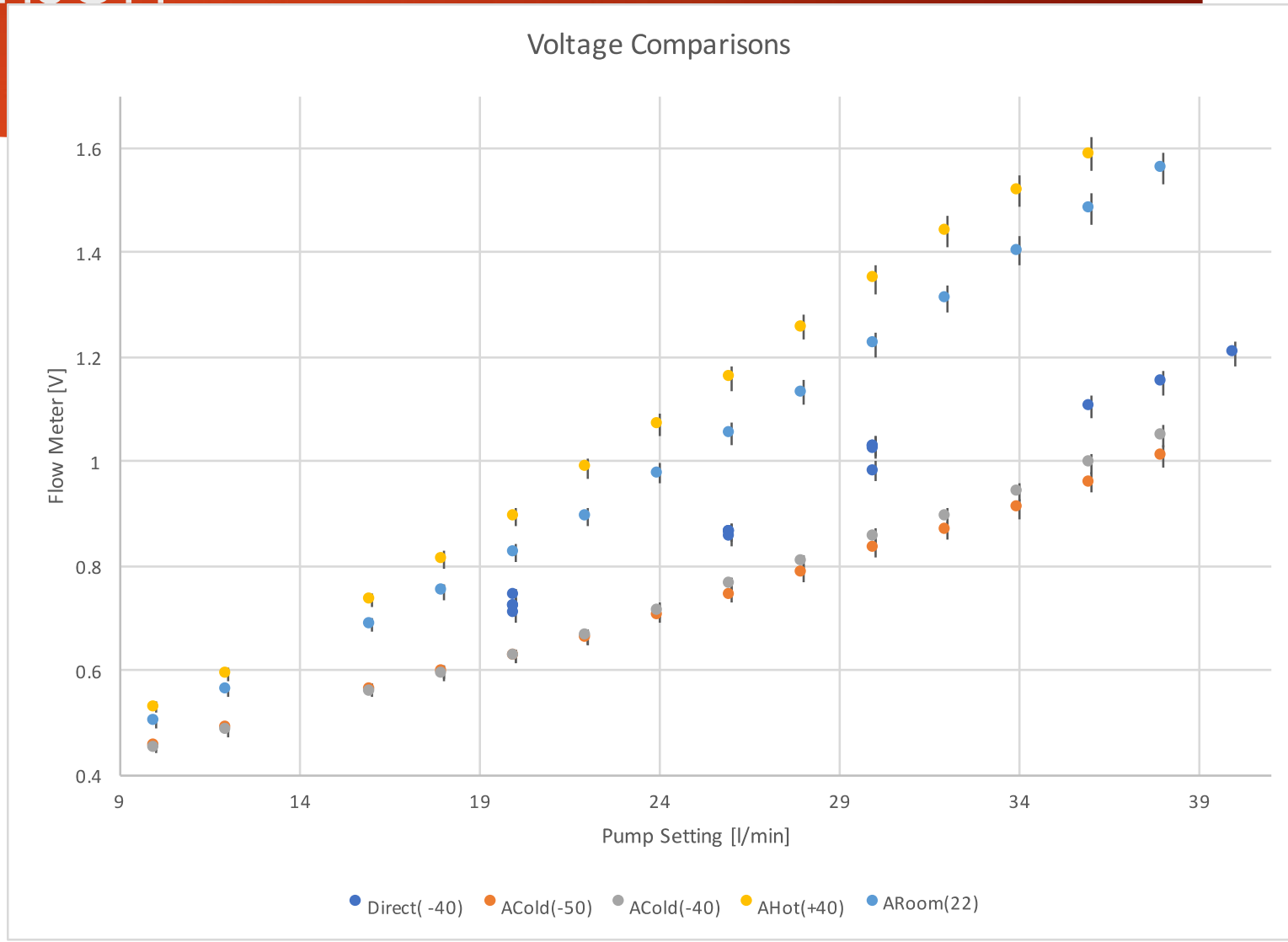
Cold Temps

- The flow rate that was measured using the formula was much lower than what was measured directly
- Direct measurement did not have the fluid flow through long enough to cool off the stave.
- Fluid in the Arduino measurements was much colder than the direct measurements.
  - Problem: No logger was used during these measurements… so no temperature data was recorded
  - Could redo measurements using similar technique and see what kind of results we end up with

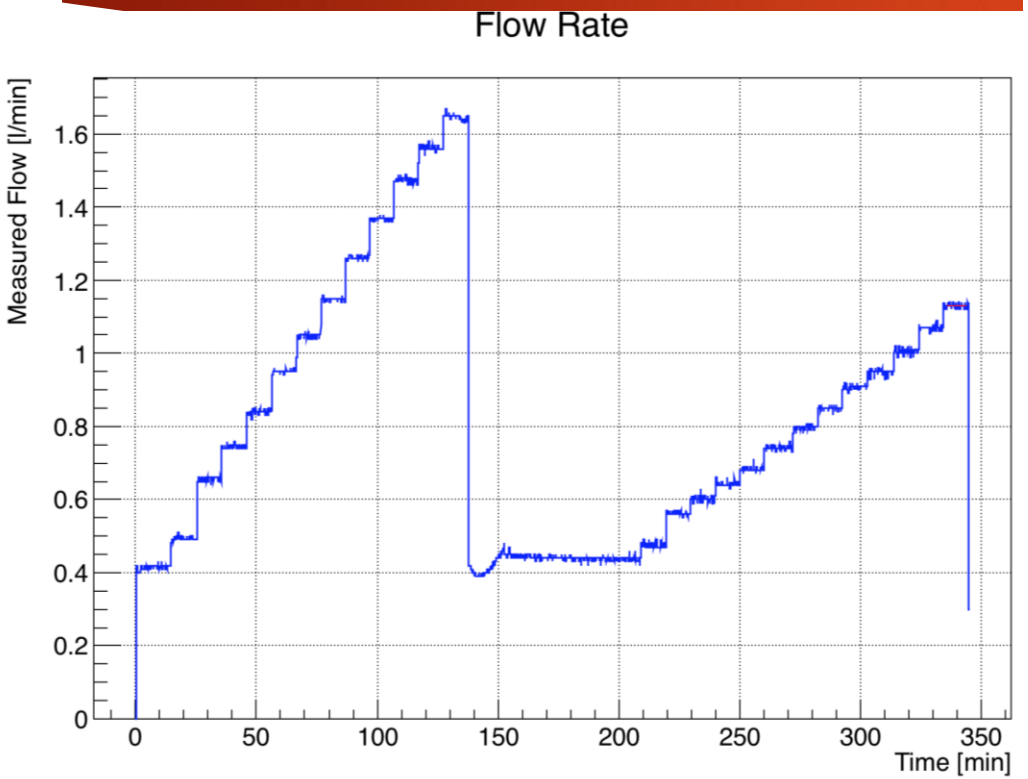


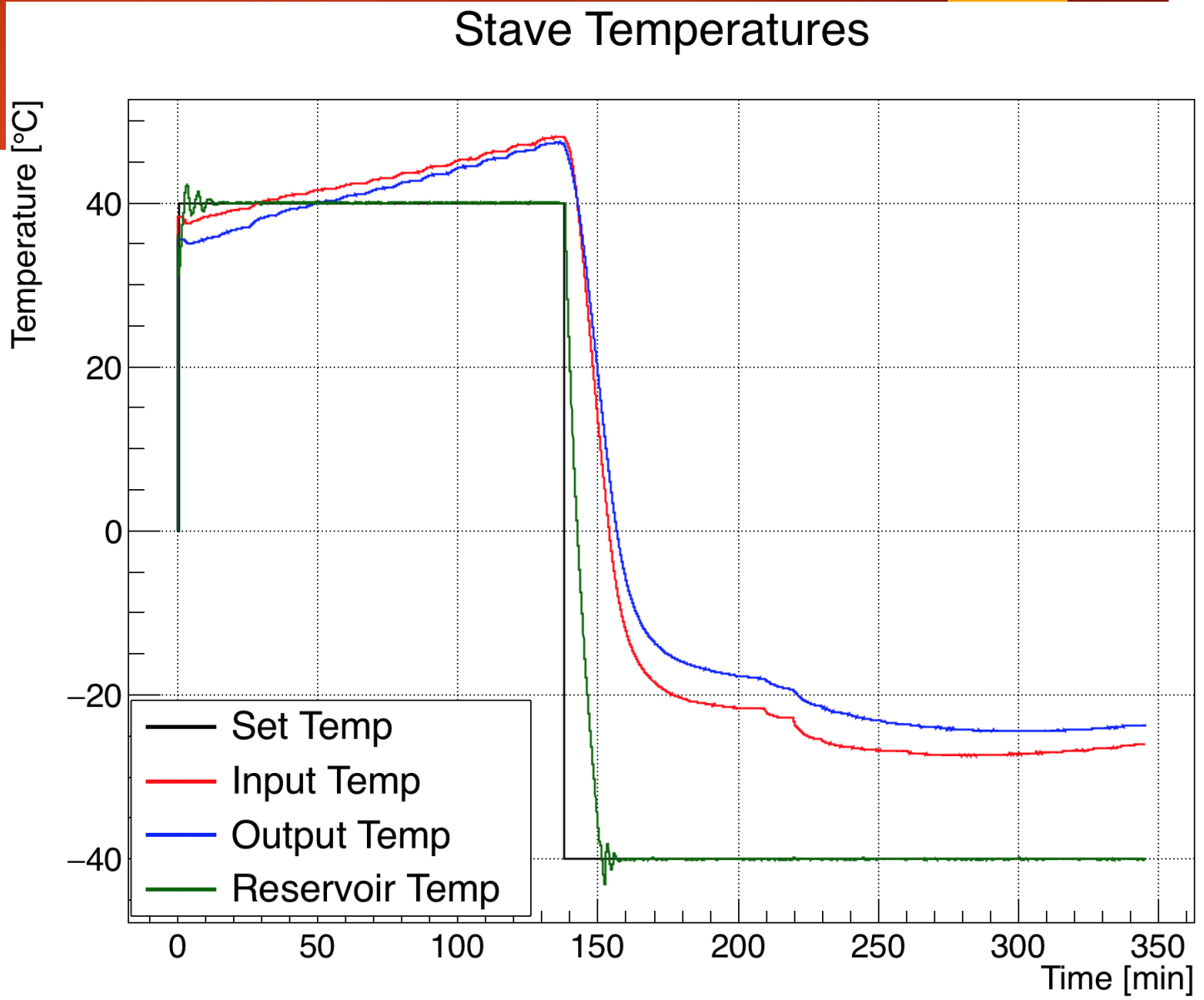
Voltage Comparison

- This is a comparison between all of the voltage measurements from the arduino and the direct measurement at -40C.
- The direct at -40C had a different fluid temperature than the other low temperature measurements



Some Plots


Flow Rate
Measured Flow [l/min]
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
0
50
100
150
200
250
300
350
Time [min]


Stave Temperatures
Temperature [°C]
40
20
0
−20
−40
Set Temp
Input Temp
Output Temp
Reservoir Temp
0
50
100
150
200
250
300
350
Time [min]

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