DIRECT Capstone Progress

April 19th

MECHANICAL ENGINEERING

UNIVERSITY of WASHINGTON

Curve Fitting

> Curve fitting using least square with trust region reflective optimization to rate dependency of electrode specific capacity for 3D lithium-ion batteries

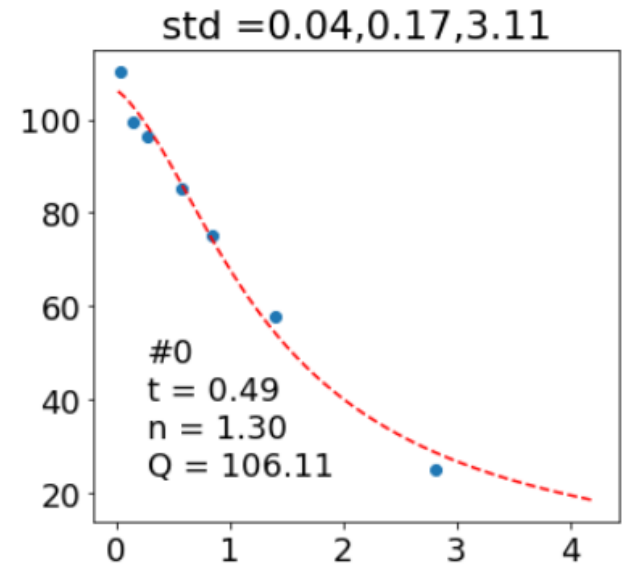
$$\frac{Q}{M} = Q_M[1-(R\tau)^n(1-e^{-(R\tau)^{-n}})]$$

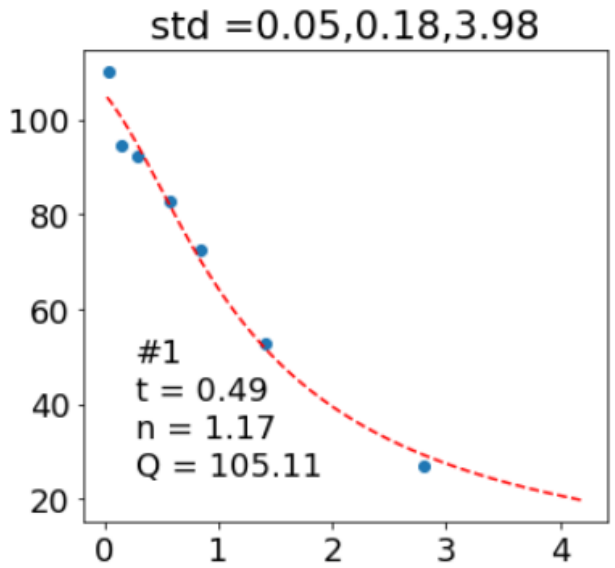
Inputs:

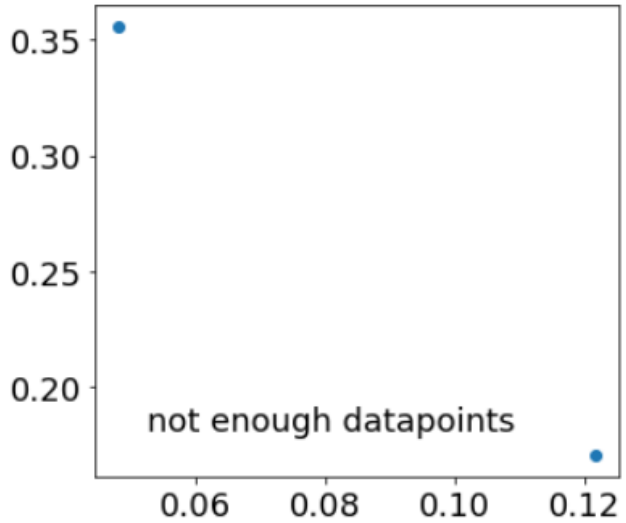
- Specific capacity $\frac{Q}{M}$
- C-rates R

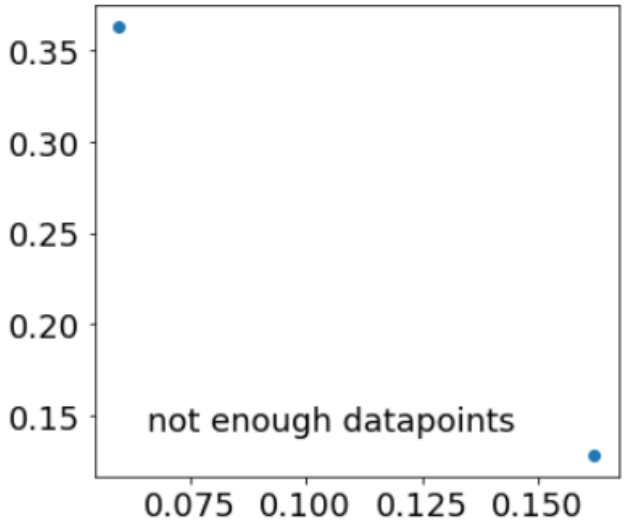
Outputs:

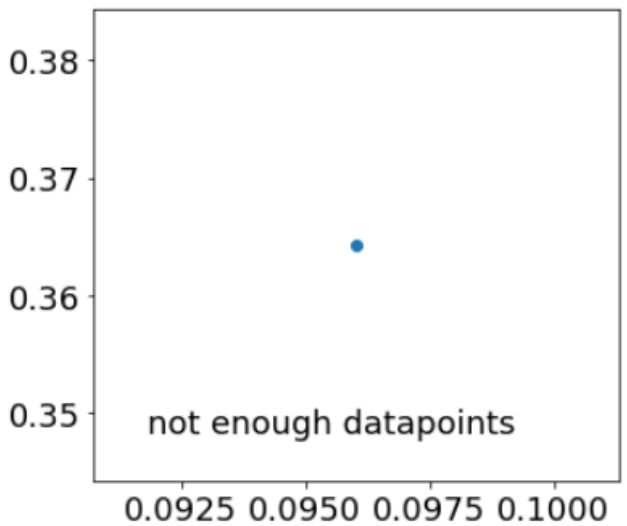
- Characteristic time τ ,
- Rate-limiting exponent n,
- Theoretical maximum capacity Q_M

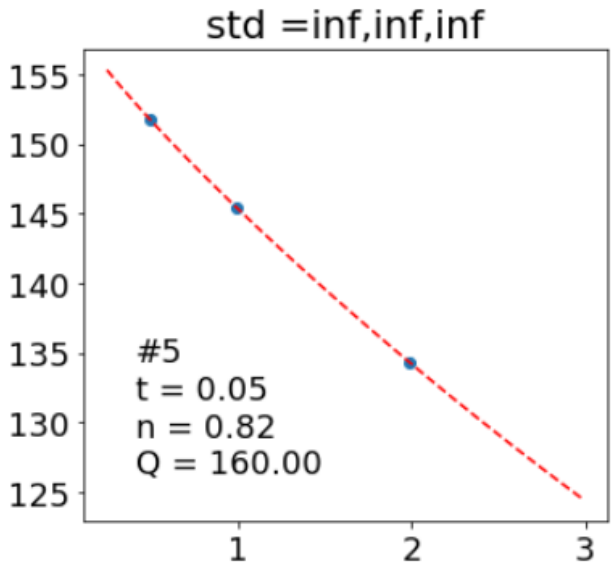

std =0.04,0.17,3.11
#0
t = 0.49
n = 1.30
Q = 106.11

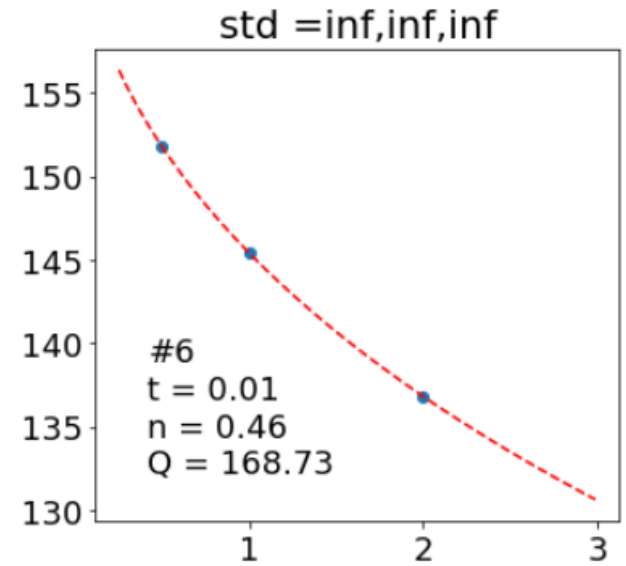

std =0.05,0.18,3.98
#1
t = 0.49
n = 1.17
Q = 105.11

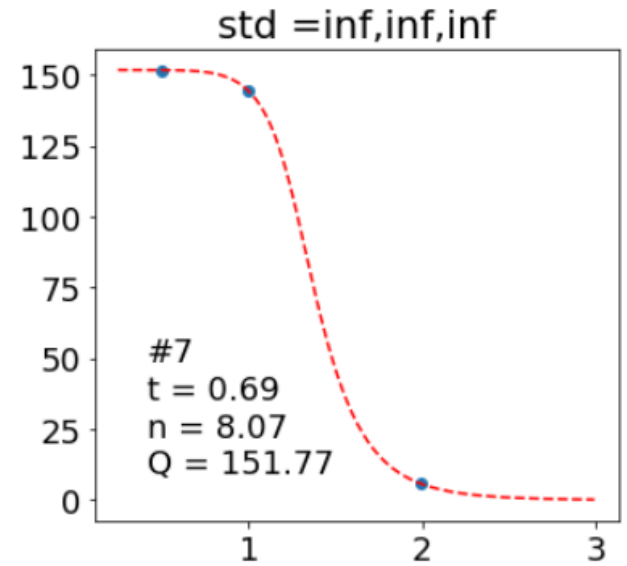

not enough datapoints

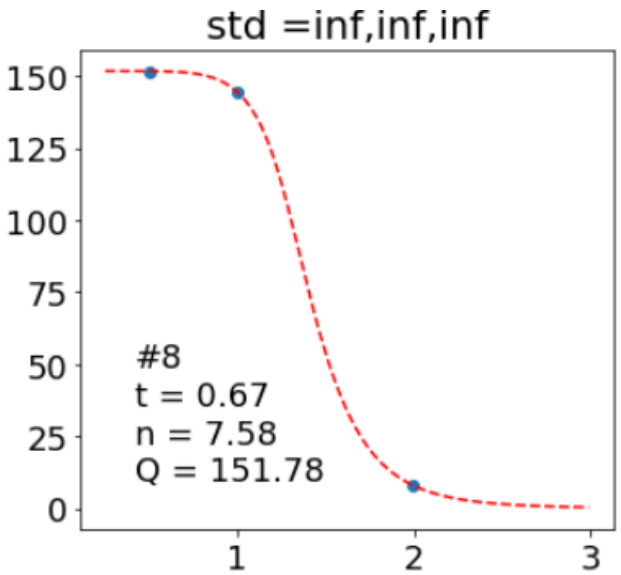

not enough datapoints

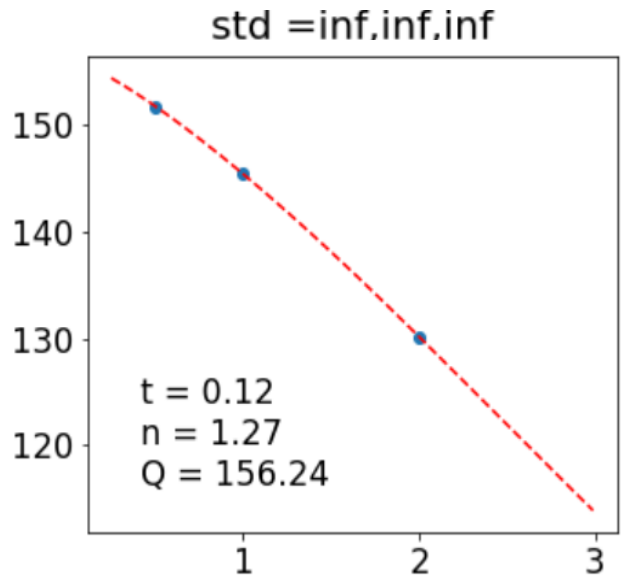

not enough datapoints

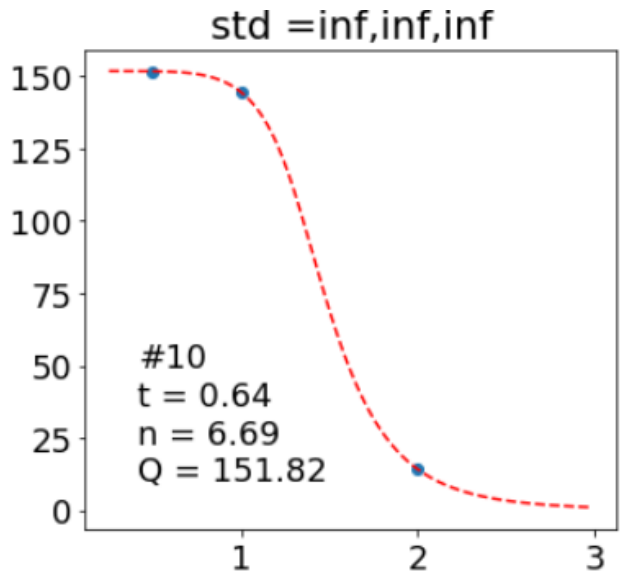

std =inf,inf,inf
#5
t = 0.05
n = 0.82
Q = 160.00

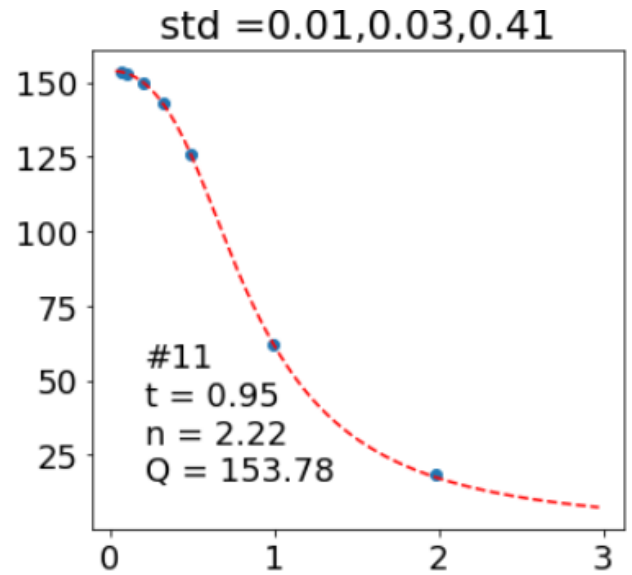

std =inf,inf,inf
#6
t = 0.01
n = 0.46
Q = 168.73

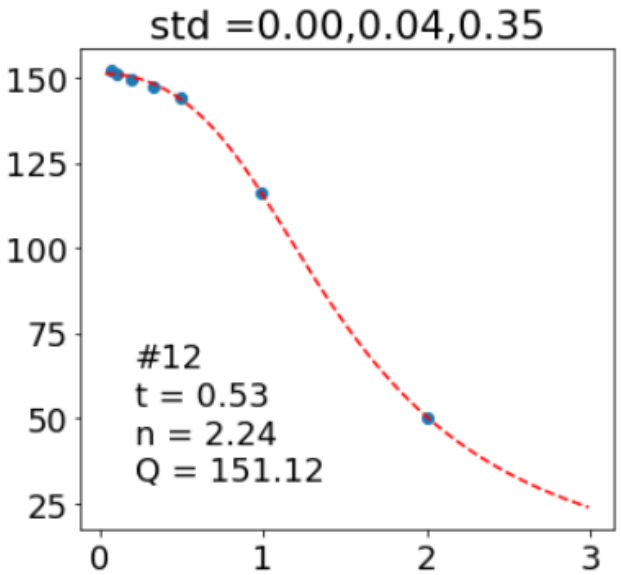

std =inf,inf,inf
#7
t = 0.69
n = 8.07
Q = 151.77

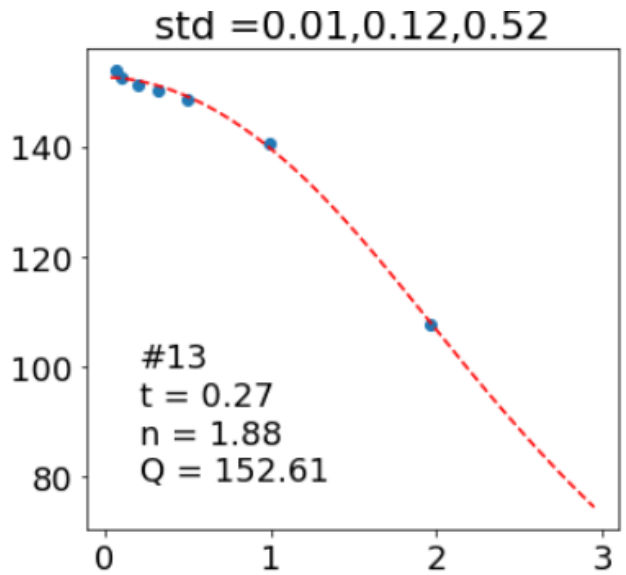

std =inf,inf,inf
#8
t = 0.67
n = 7.58
Q = 151.78

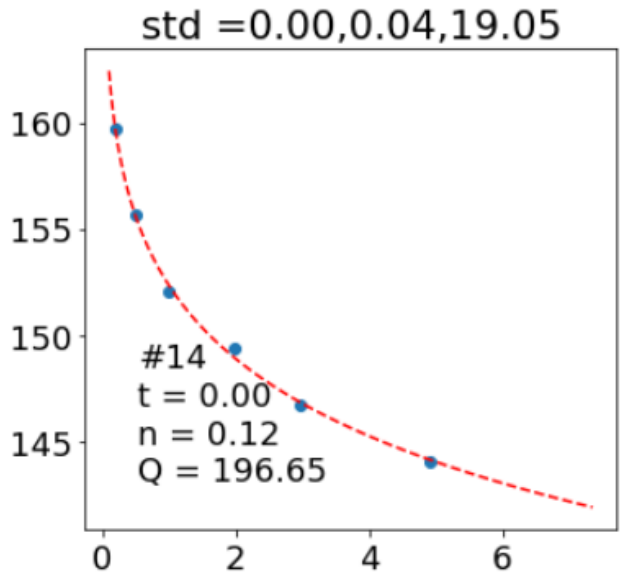

std =inf,inf,inf
t = 0.12
n = 1.27
Q = 156.24

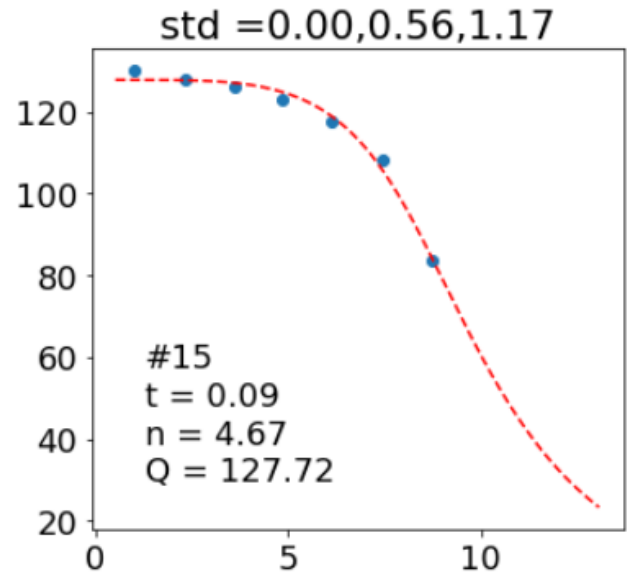

std =inf,inf,inf
#10
t = 0.64
n = 6.69
Q = 151.82

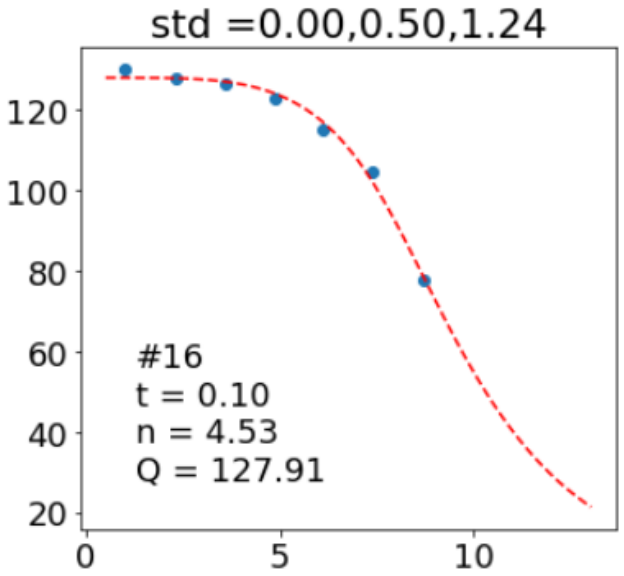

std =0.01,0.03,0.41
#11
t = 0.95
n = 2.22
Q = 153.78

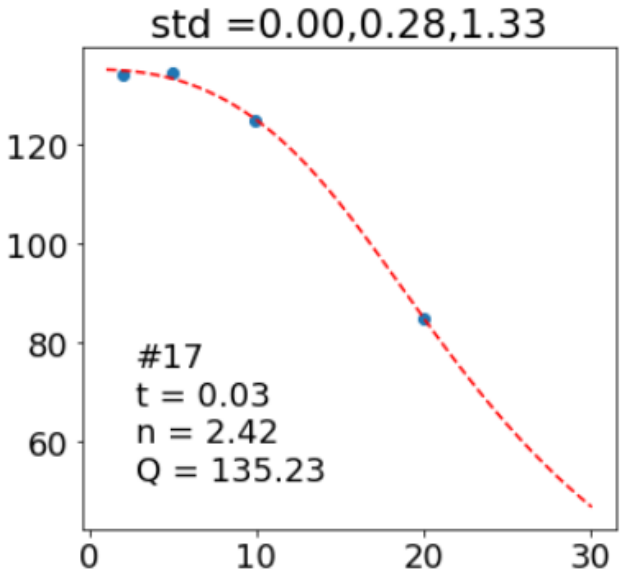

std =0.00,0.04,0.35
#12
t = 0.53
n = 2.24
Q = 151.12

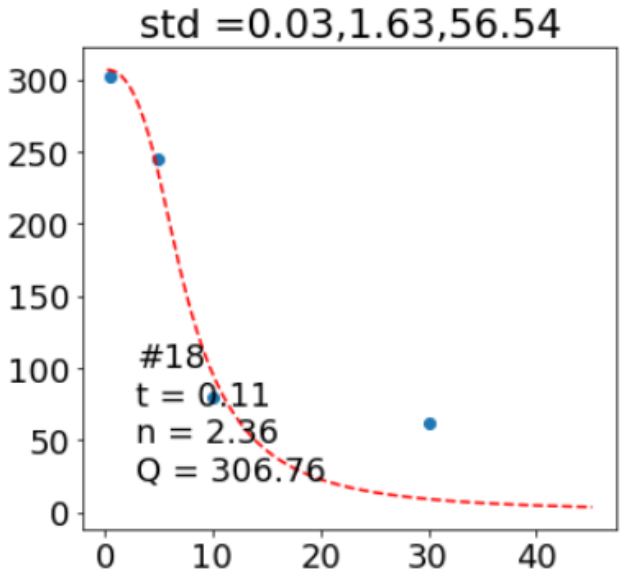

std =0.01,0.12,0.52
#13
t = 0.27
n = 1.88
Q = 152.61

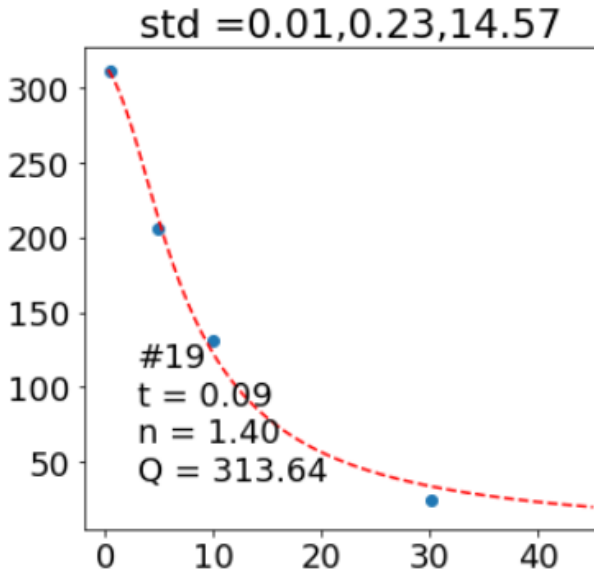

std =0.00,0.04,19.05
#14
t = 0.00
n = 0.12
Q = 196.65


std =0.00,0.56,1.17
#15
t = 0.09
n = 4.67
Q = 127.72







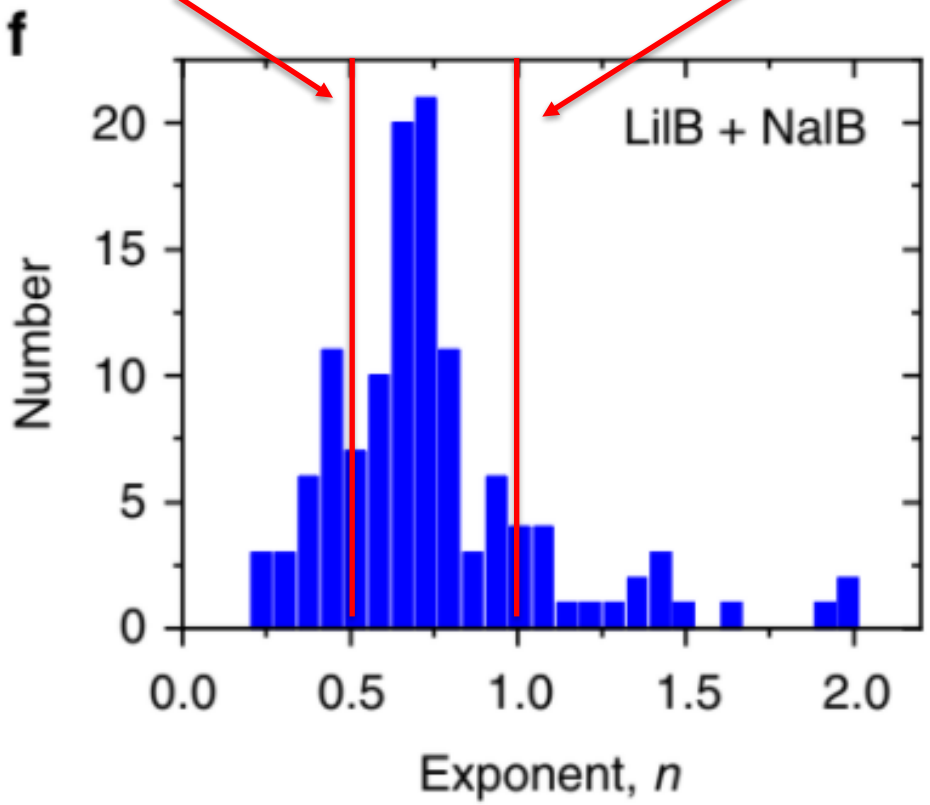


Cannot find a good fit for this one

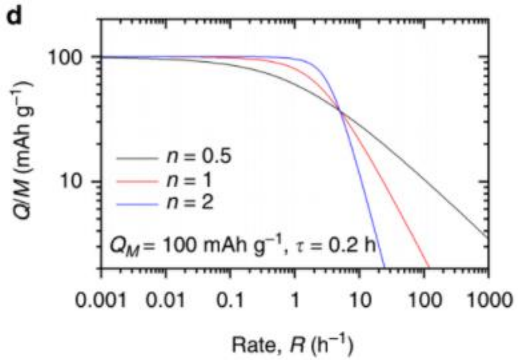
Compared to Tian et al.

n=0.5
Purely diffusion-limited

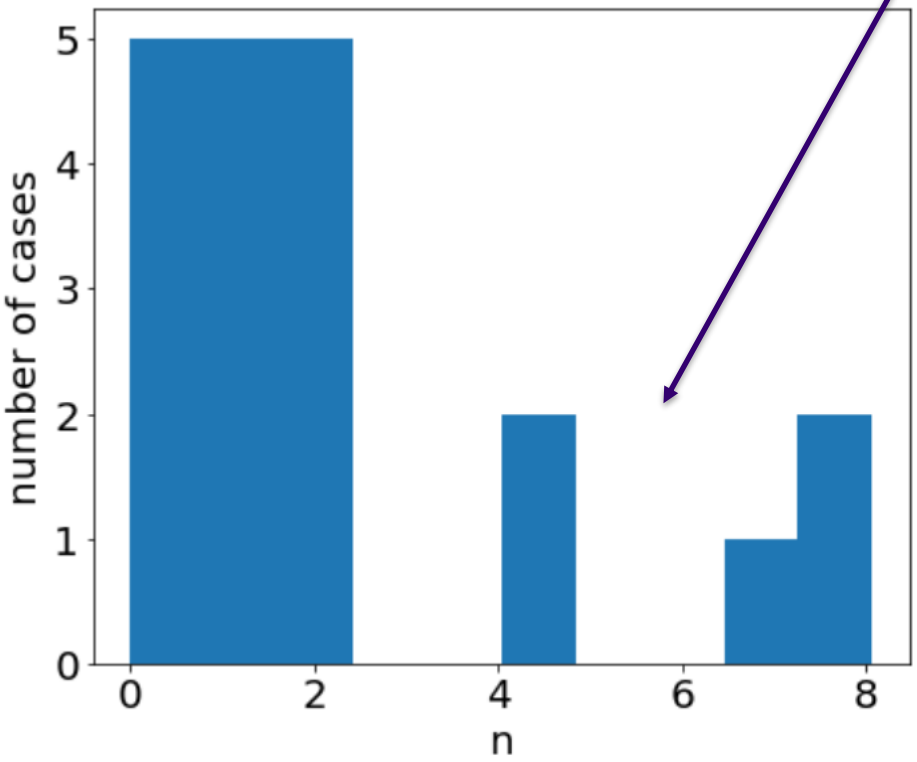
n=1
Purely electric-limited



Tian et al.



n has a wider spread, suggesting a different limiting mechanism



Our Results

Progress Updates

- Curve fitting is going well, with a few issues:
  - Covariance/uncertainties of the fitting parameters cannot be determined
  - One case cannot be fitted well
- We are now moving on to visualizing relationship between found fitting parameters and geometric/material parameters following Tian's procedure

Title and Space for Pictures

insert images

Divider Slide 1

Divider Slide 2

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Thank you

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