DIRECT Capstone Progress

Meet with sponsor
May 5th

MECHANICAL ENGINEERING
UNIVERSITY of WASHINGTON

Reminder on Curve fitting Equation

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

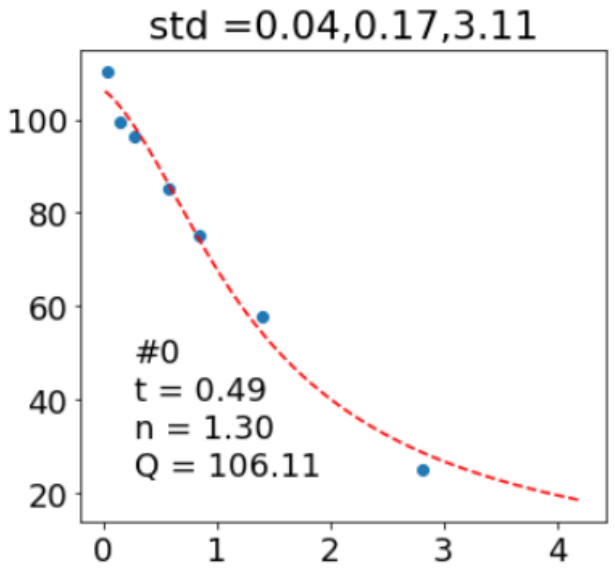
$$\frac{Q}{M} = Q_M[1-(R\tau)^n(1-e^{-(R\tau)^{-n}})]$$

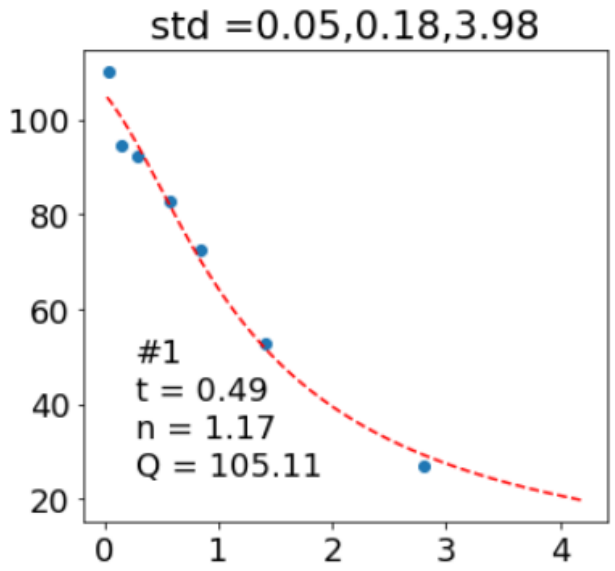
Inputs:

- 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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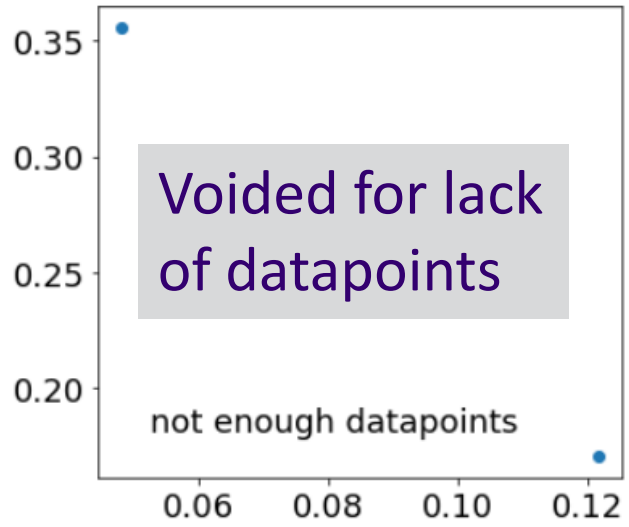
n = 1.17
Q = 105.11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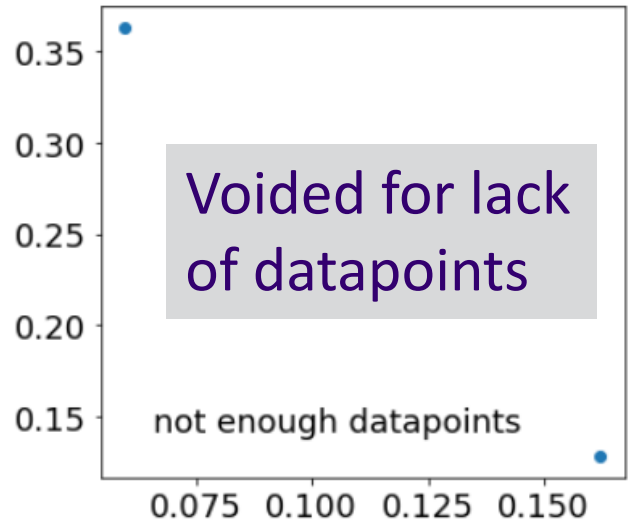
not enough datapoints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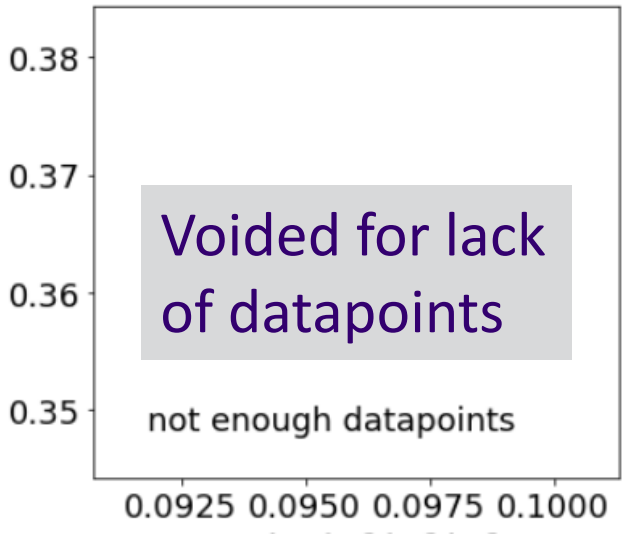
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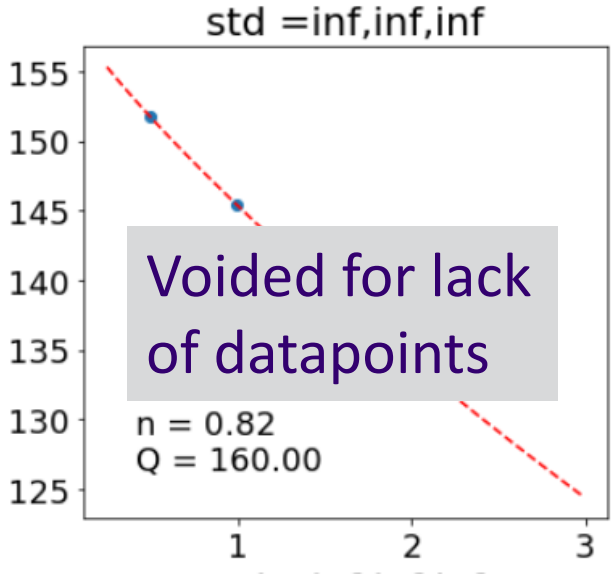
std =inf,inf,inf
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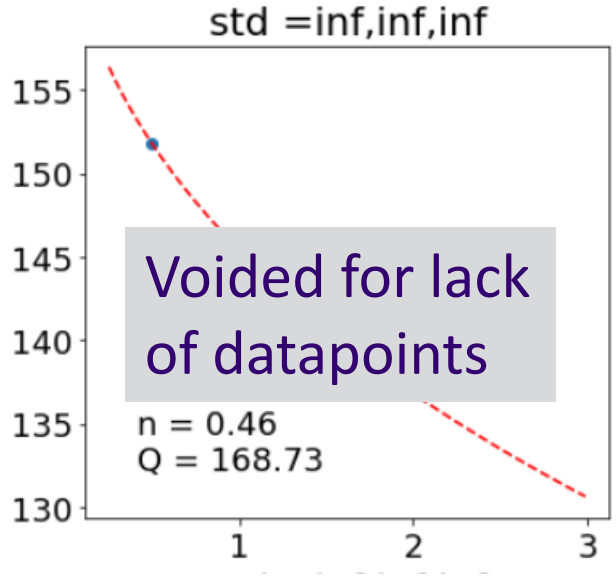
n = 0.82
Q = 160.00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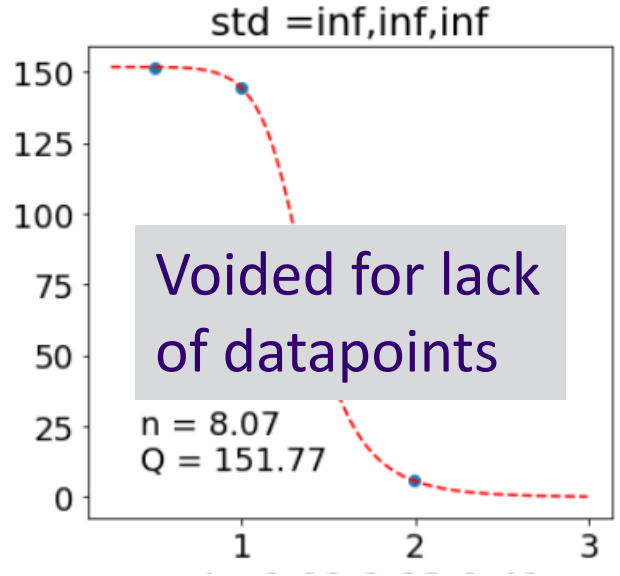
Q = 168.73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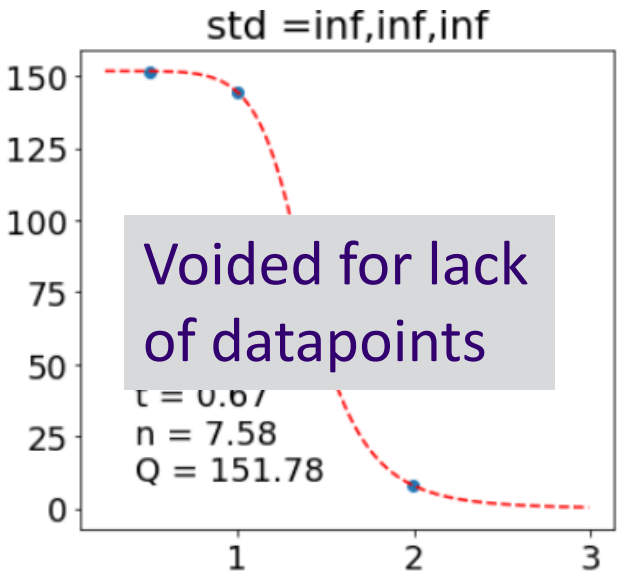
n = 8.07
Q = 151.77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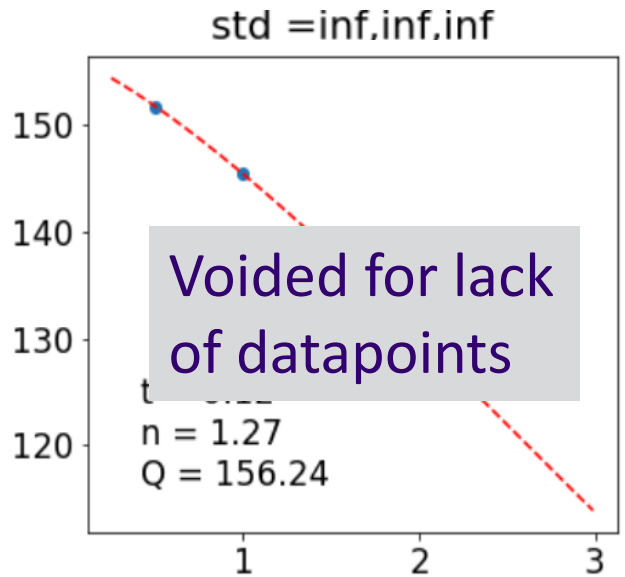
n = 7.58
Q = 151.78


std =inf,inf,inf
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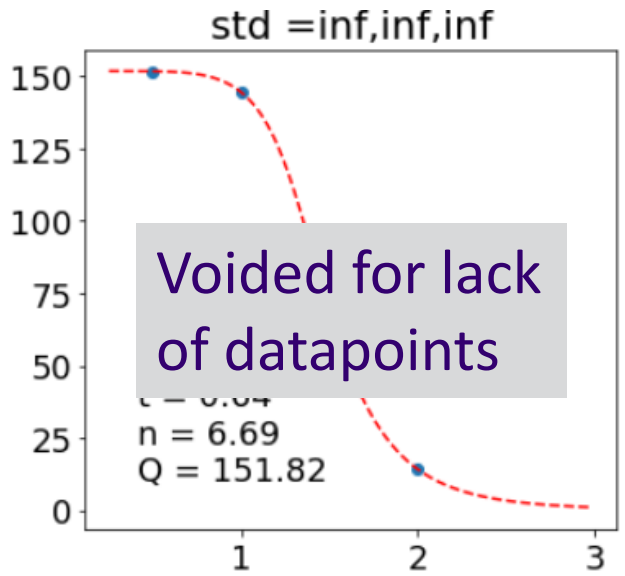
n = 1.27
Q = 156.24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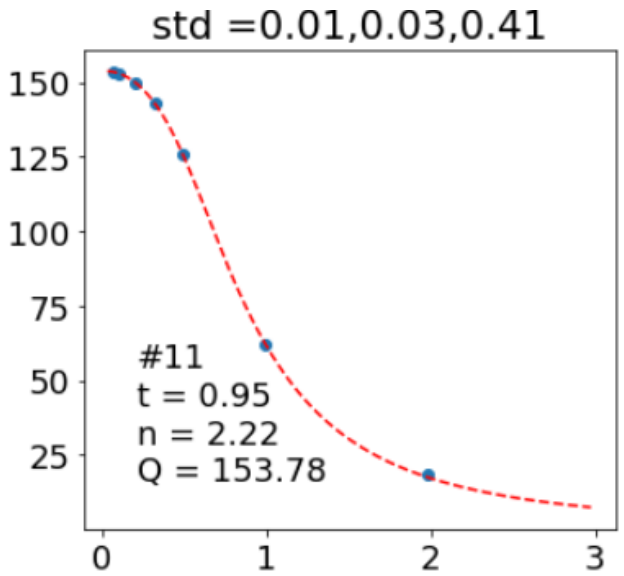
Q = 151.82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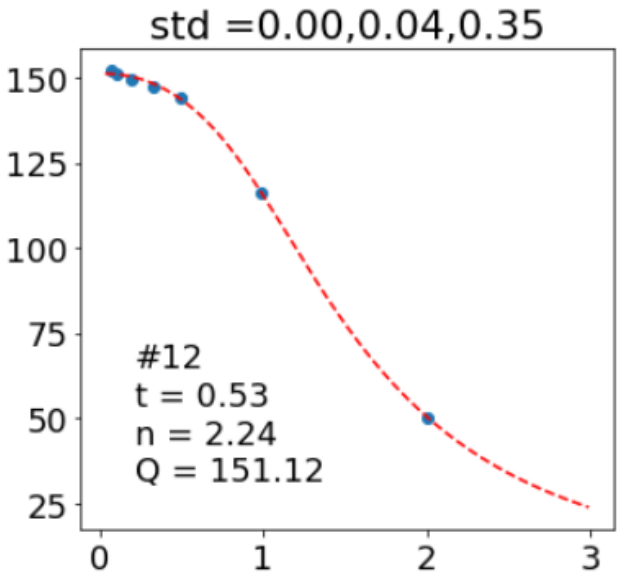
#11
t = 0.95
n = 2.22
Q = 153.78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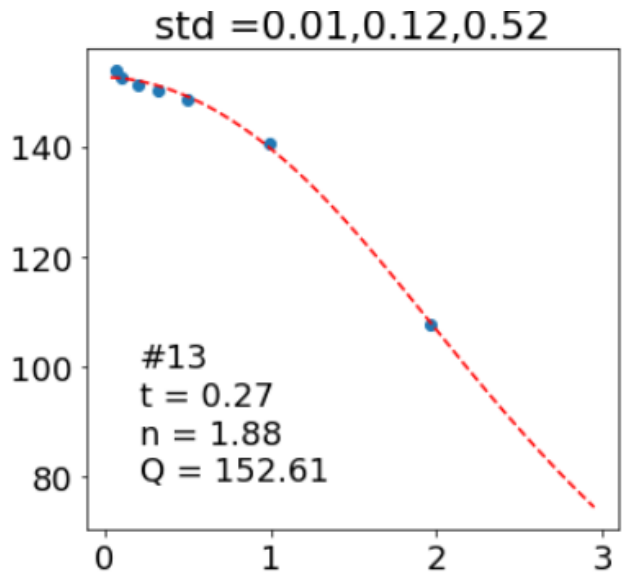
#12
t = 0.53
n = 2.24
Q = 151.12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#13
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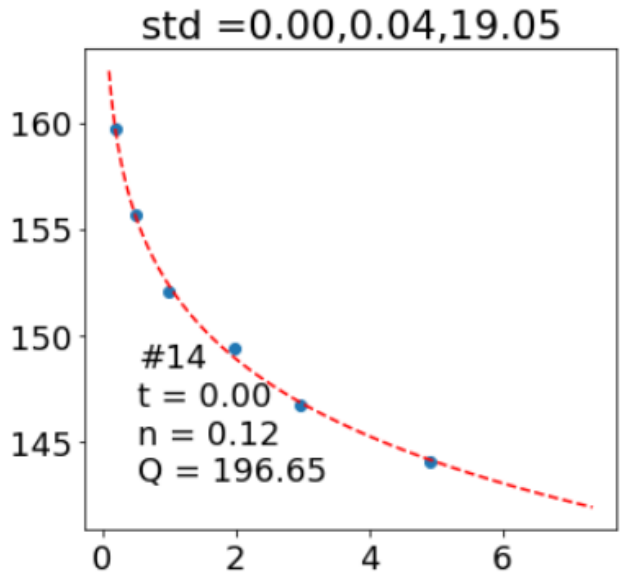
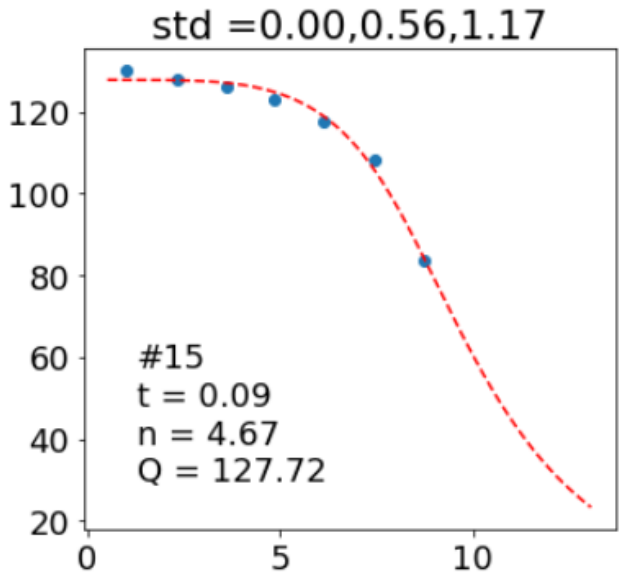
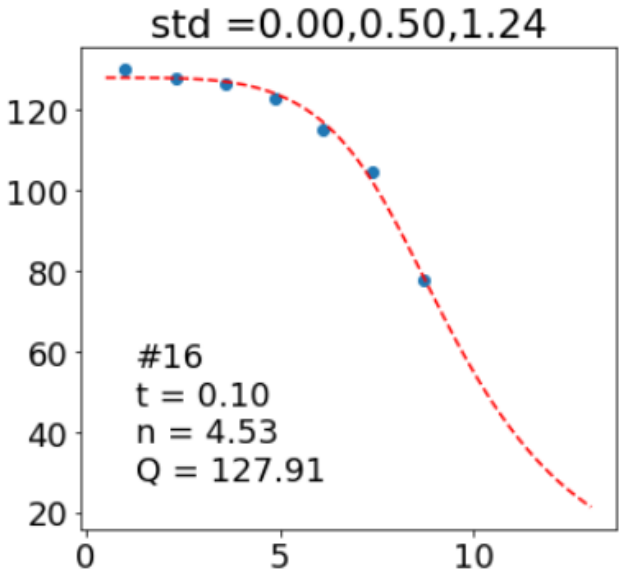
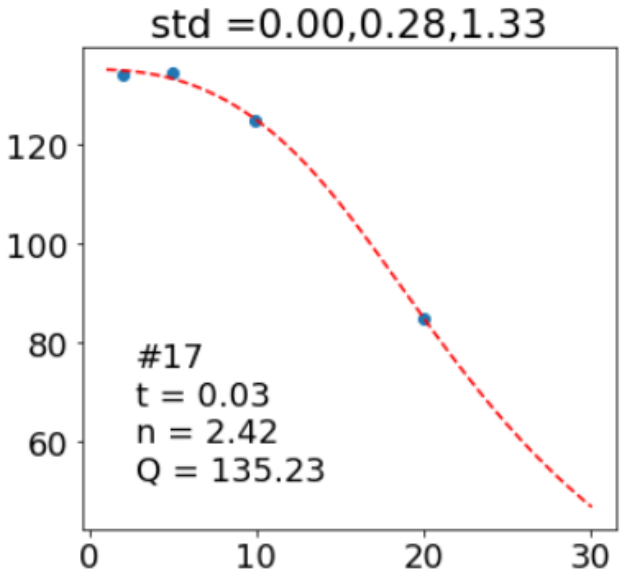
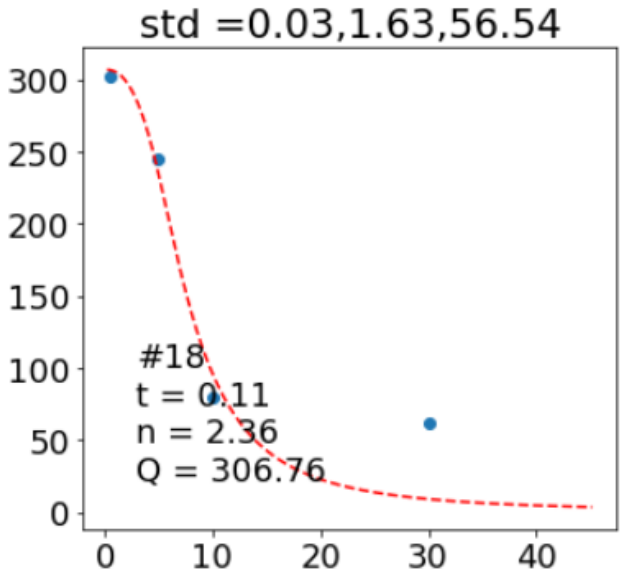
Q = 152.61

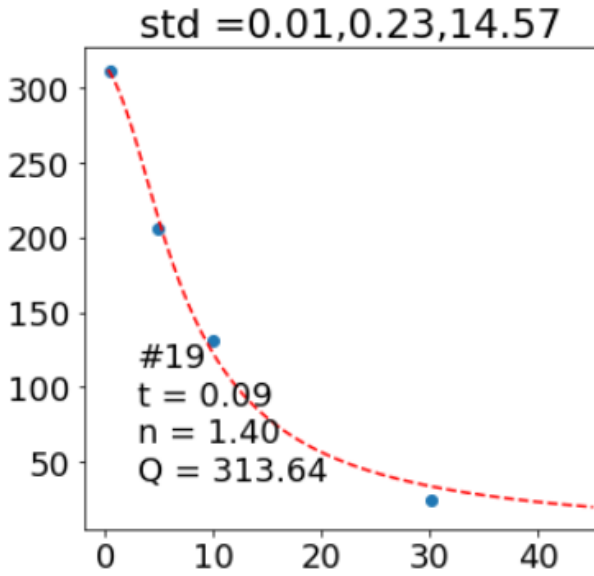

std =0.00,0.04,19.05
#14
t = 0.00
n = 0.12
Q = 196.65


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





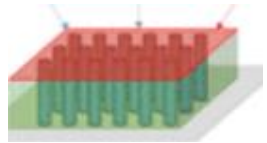


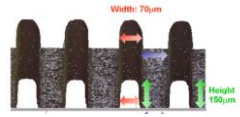


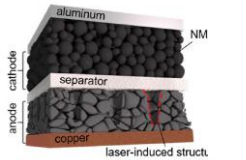
Cannot find a good fit for this one

3D Cases Examined

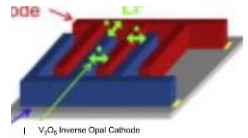
	Paper #	Set	Cathode Material	Anode Material
0	1	1	LiFePO4	Lithium
1	1	1	LiFePO4	Lithium
11	17	1	LiCoO2	Lithium
12	17	2	LiCoO2	Lithium
13	17	3	LiCoO2	Lithium
14	19	1	Li4Ti5O12	Lithium
15	23	1	NMC (1/11)	Graphite
16	23	2	NMC (1/11)	Graphite
17	27	1	LiCoO2	Li4Ti5O12
18	31	1	V2O5	Lithium
19	31	2	V2O5	Lithium



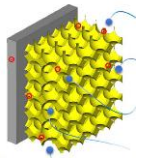




Electrolyte channel



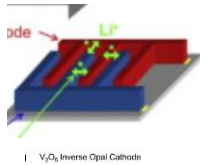
Interdigitated



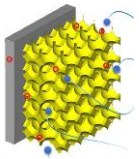
Network

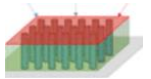
Characteristic time tau vs Lengths

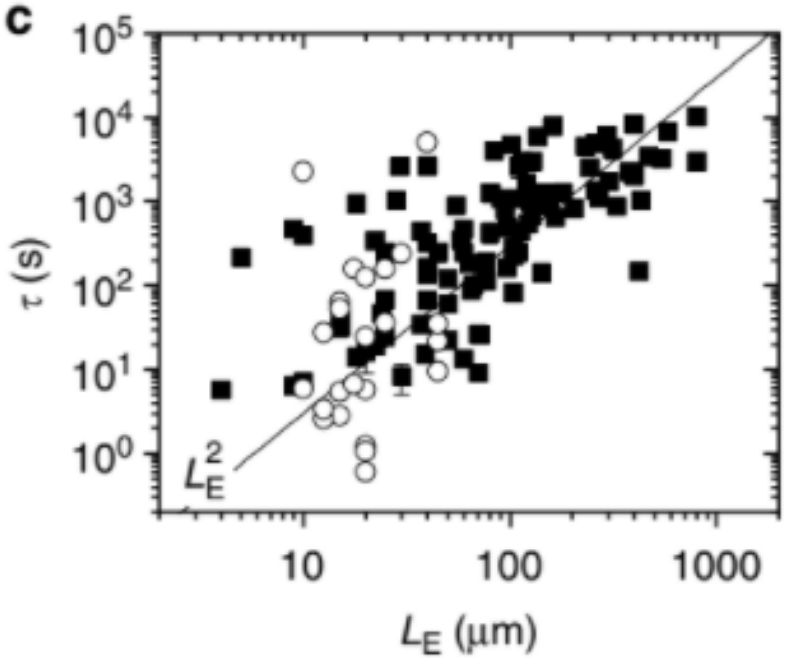
Interdigitated

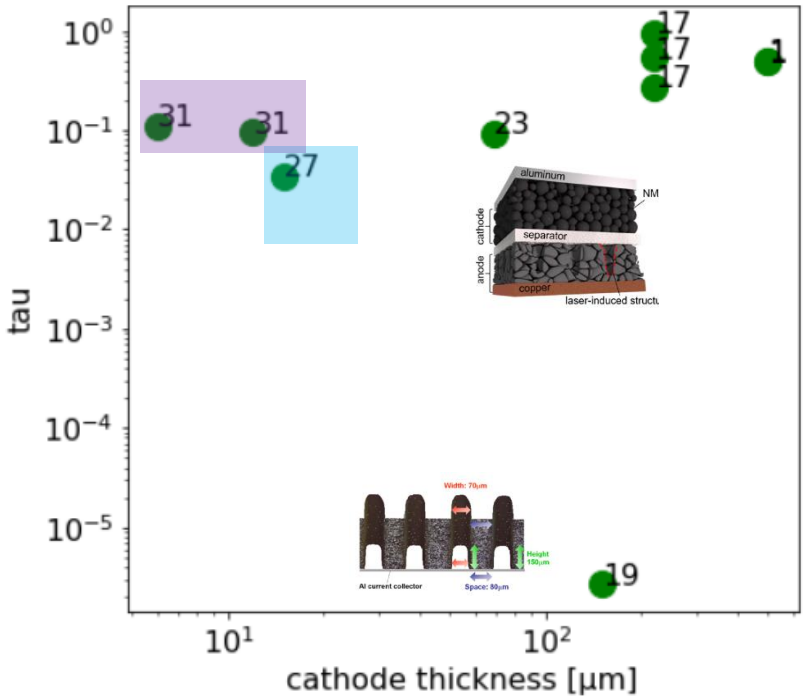


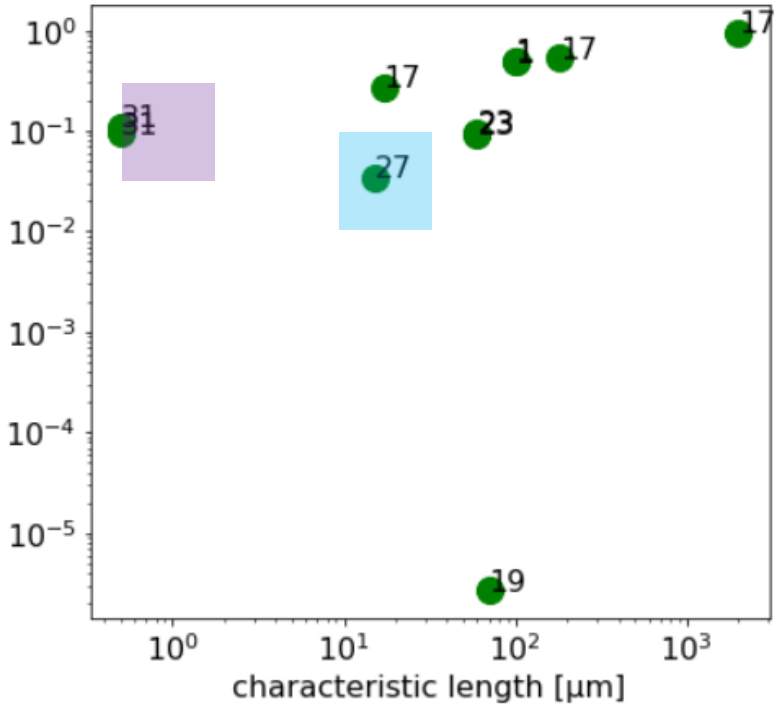
Network





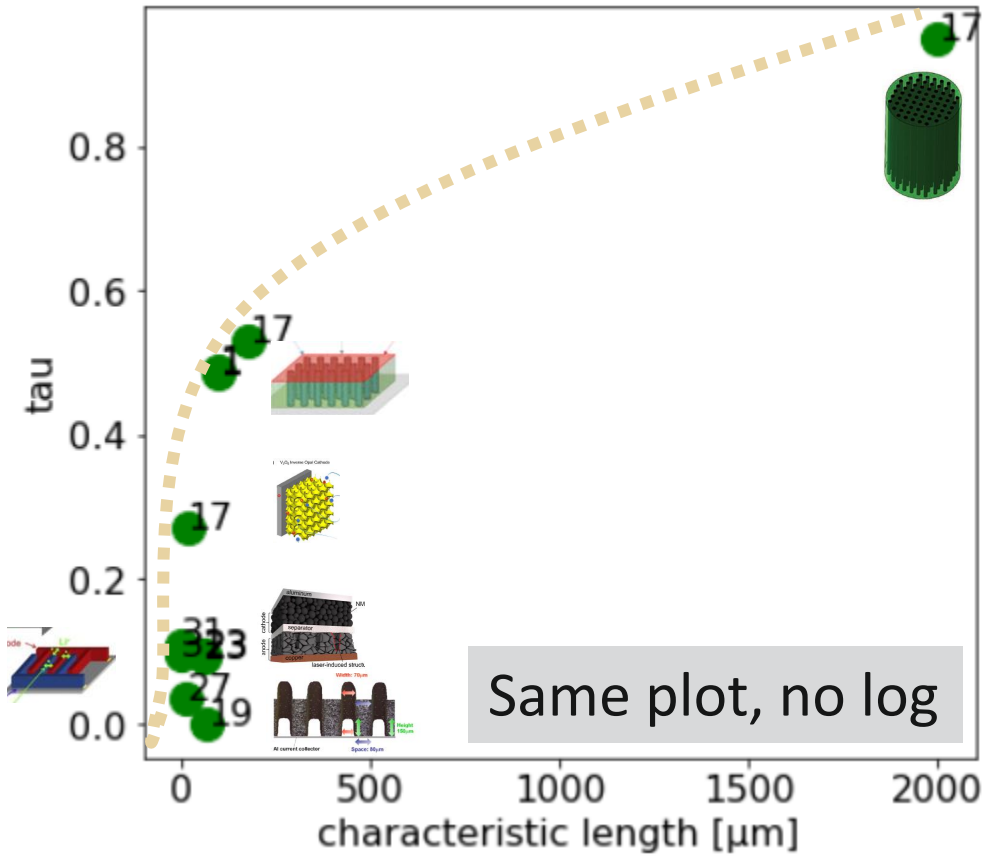


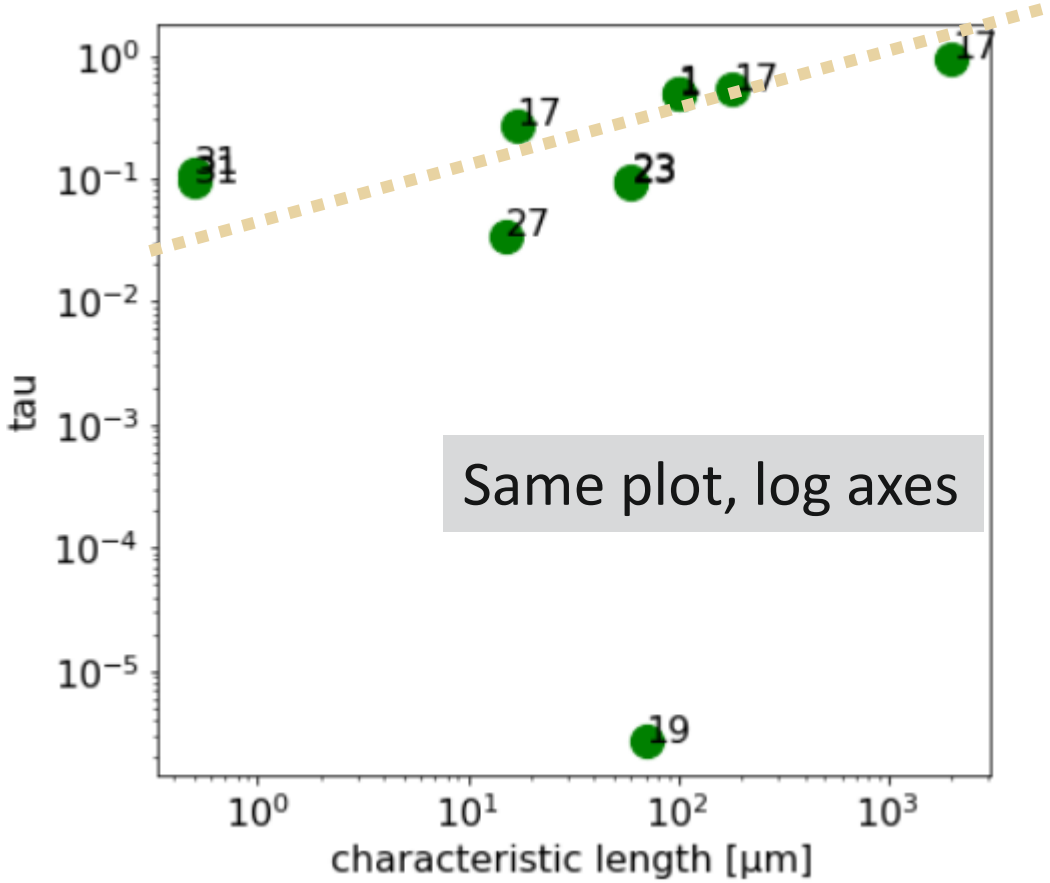




A Closer Look at Characteristic time vs Characteristic Lengths

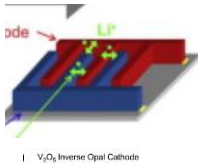
Is this an exponential relation or second-order function here?



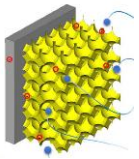


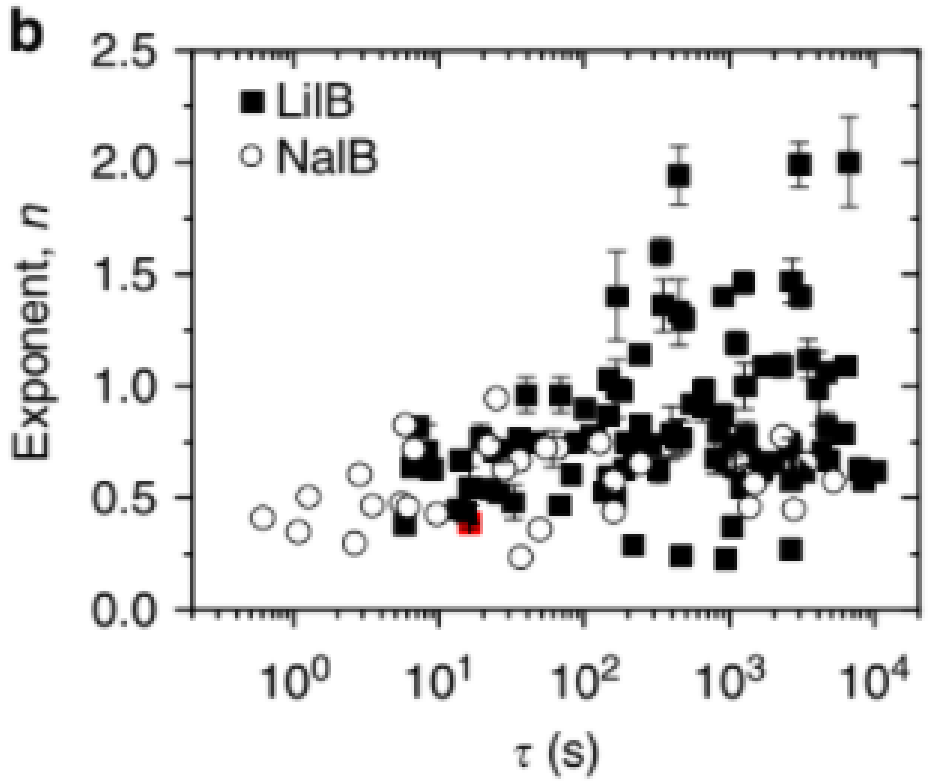
N values vs Characteristic time, tau

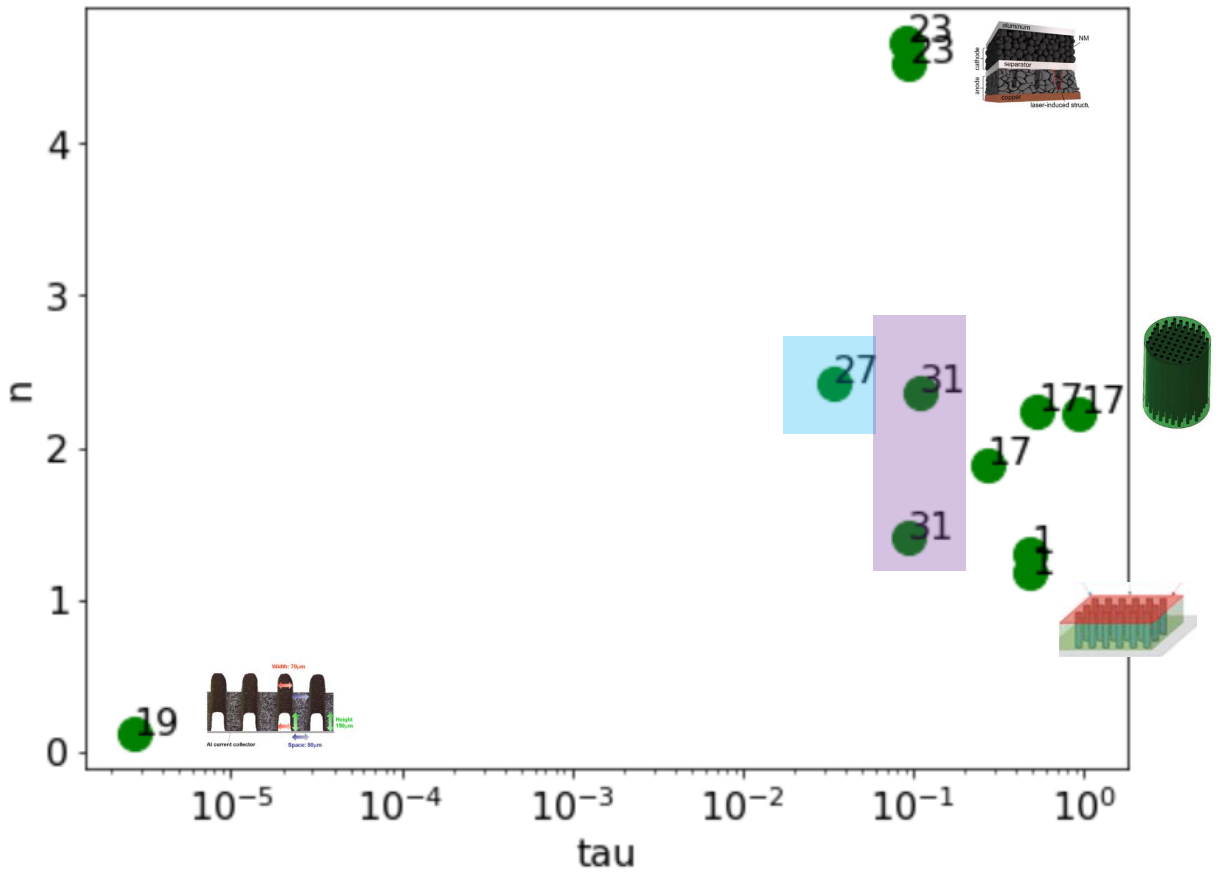
Interdigitated



Network

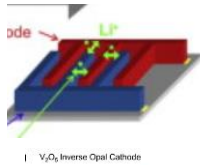




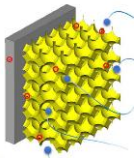


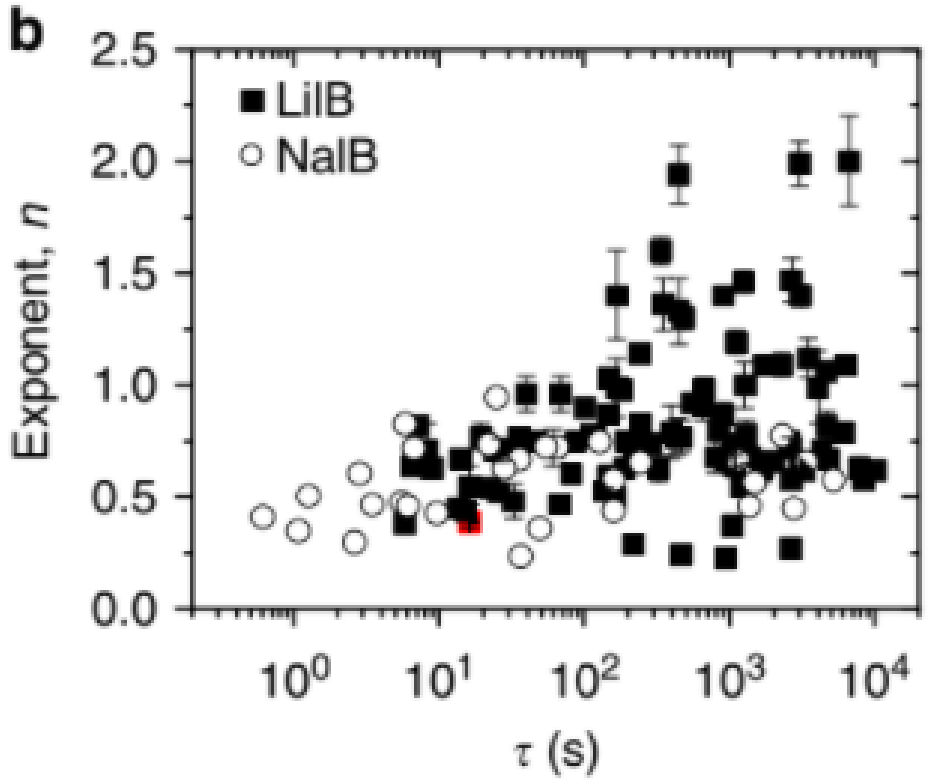
Same plot as last slide, not log

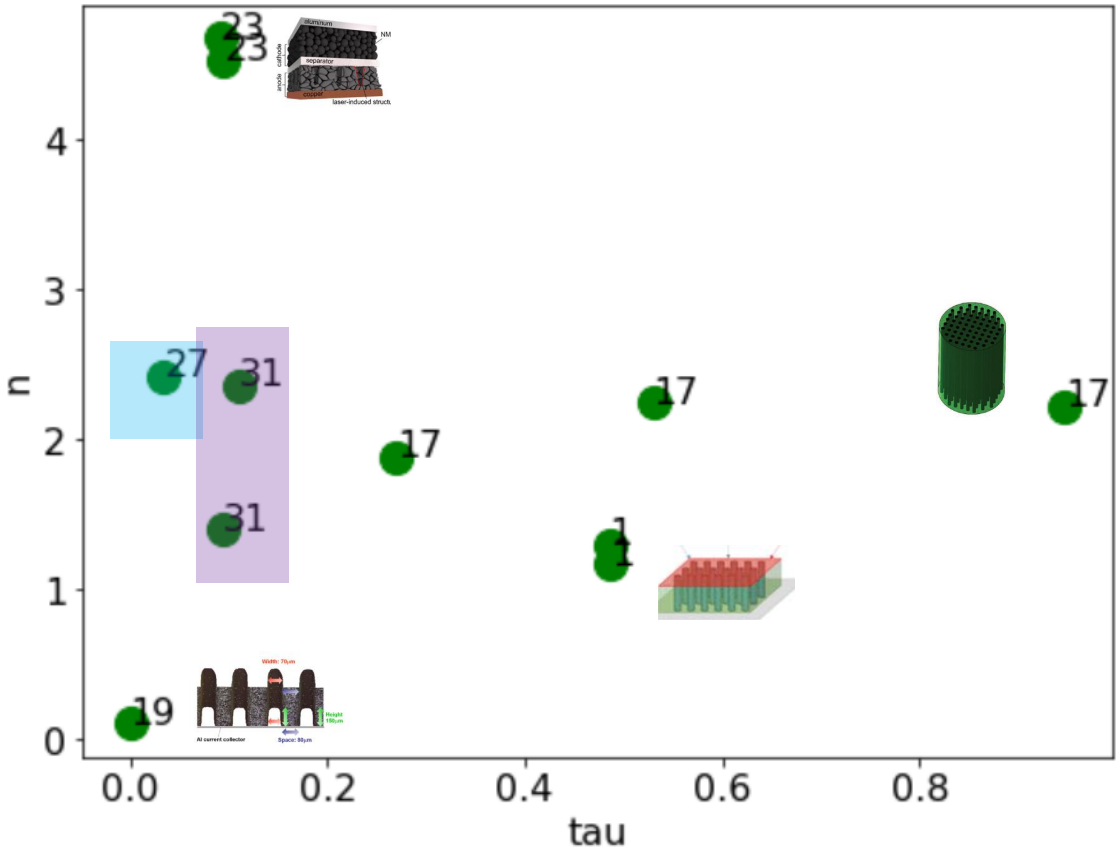
Interdigitated



Network

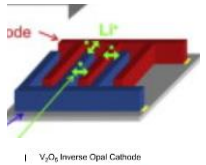




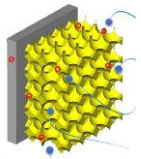


N values vs Lengths

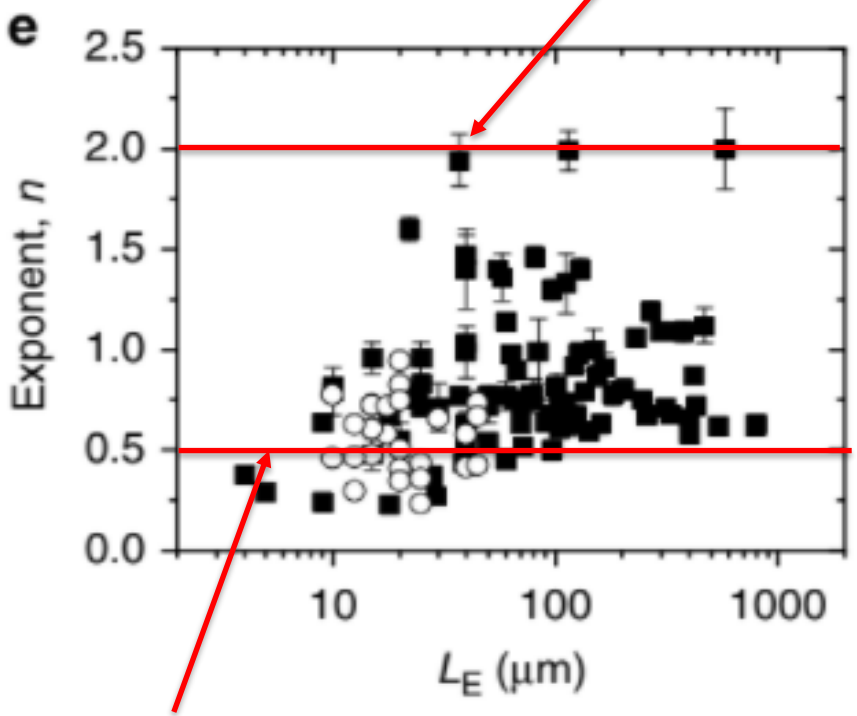
Interdigitated



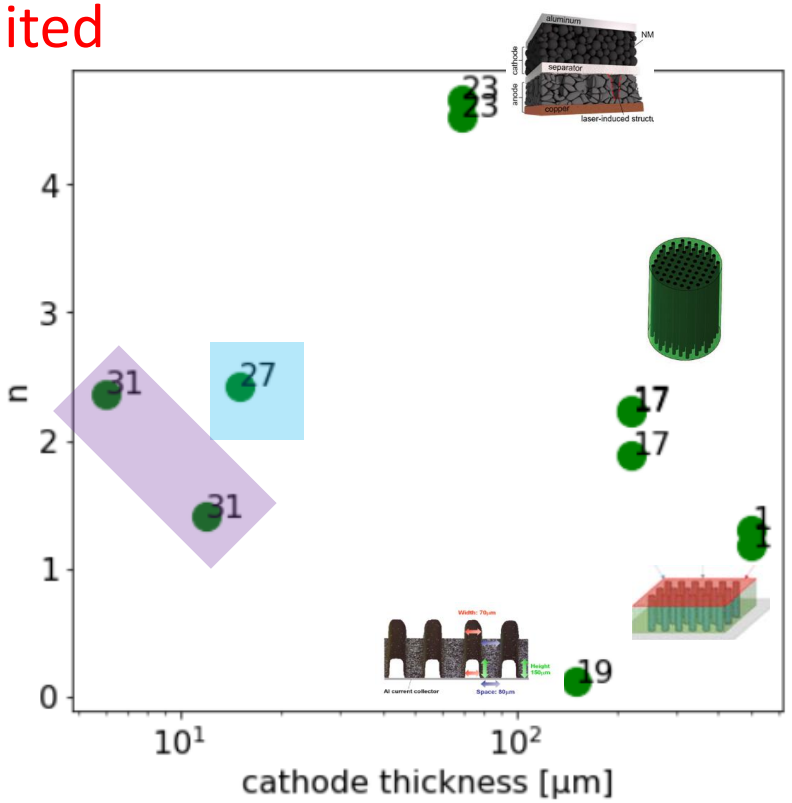
Network

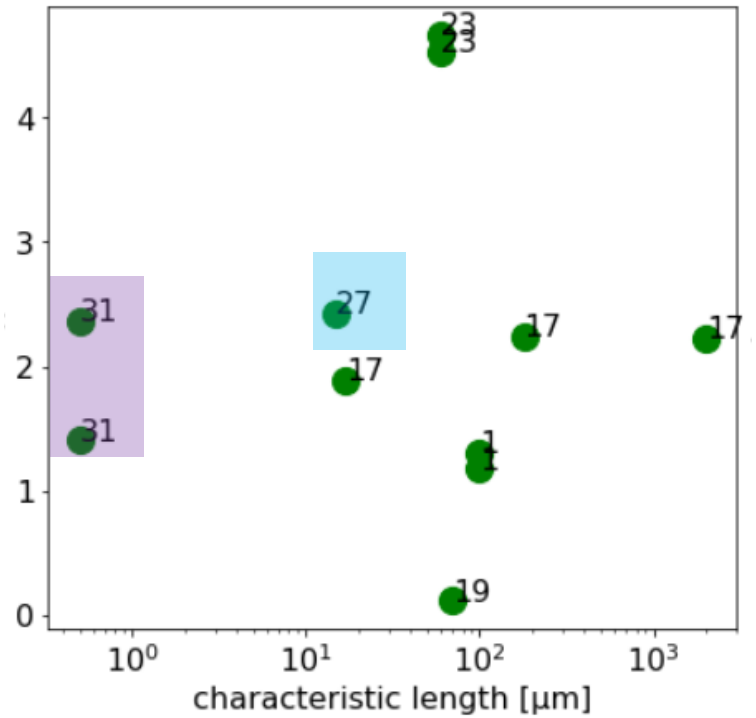


Purely conduction-limited



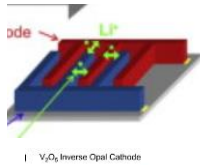
Purely diffusion-limited



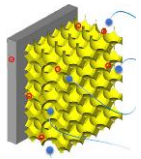


Same plots as the last slide, no log

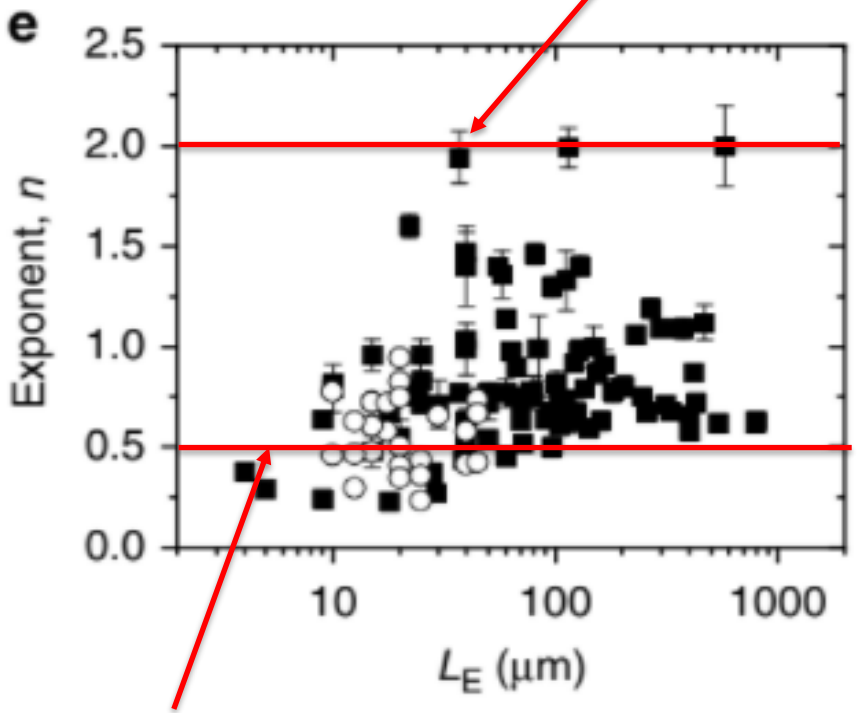
Interdigitated

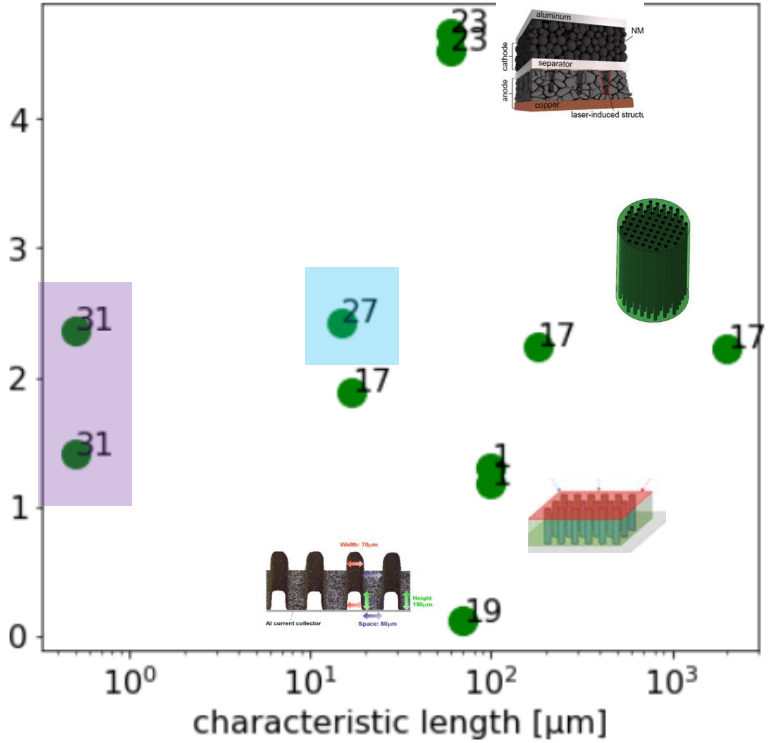


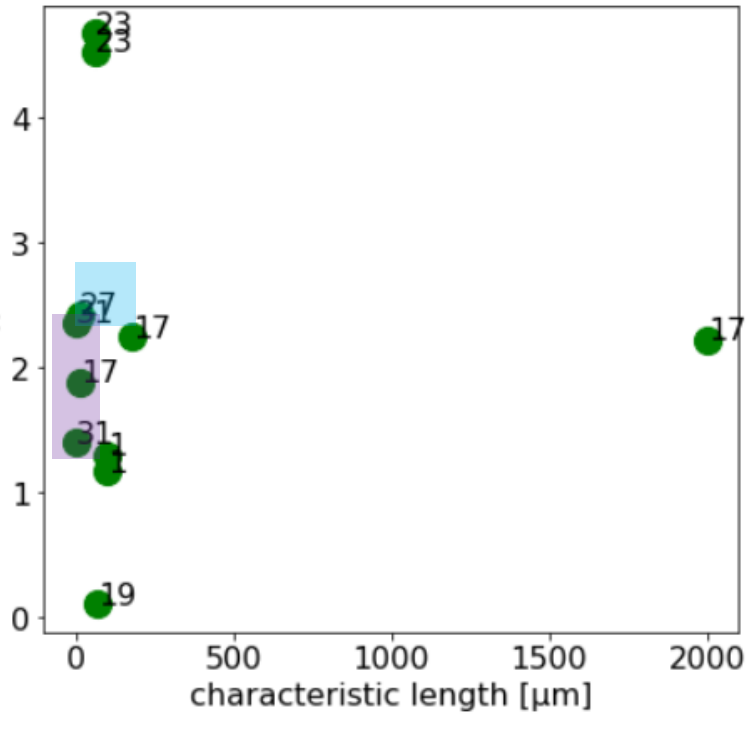
Network



Purely conduction-limited





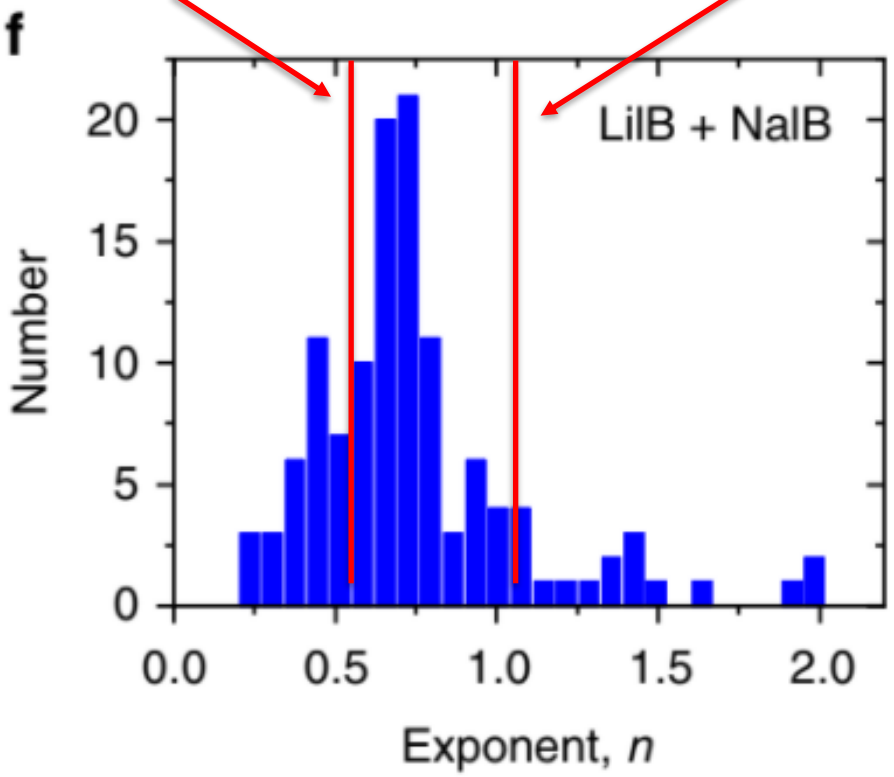


Purely diffusion-limited

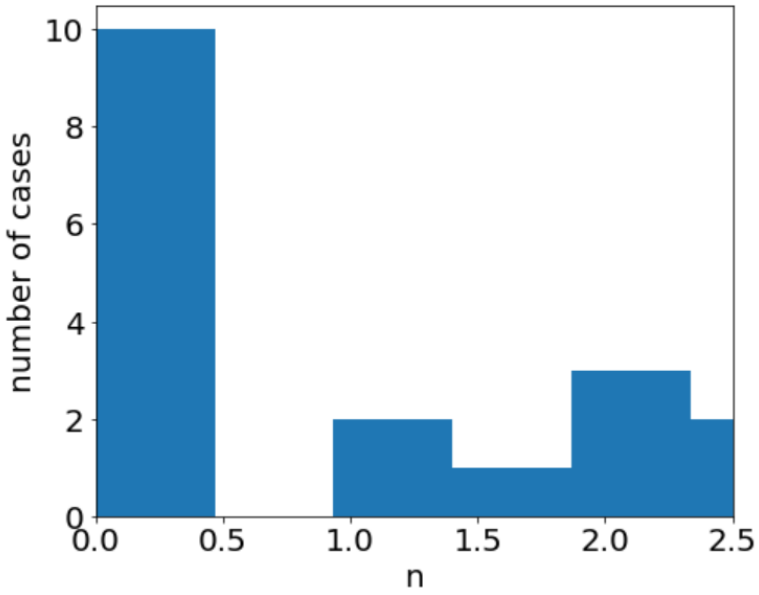
Distribution of n's

n=0.5
Purely diffusion-limited

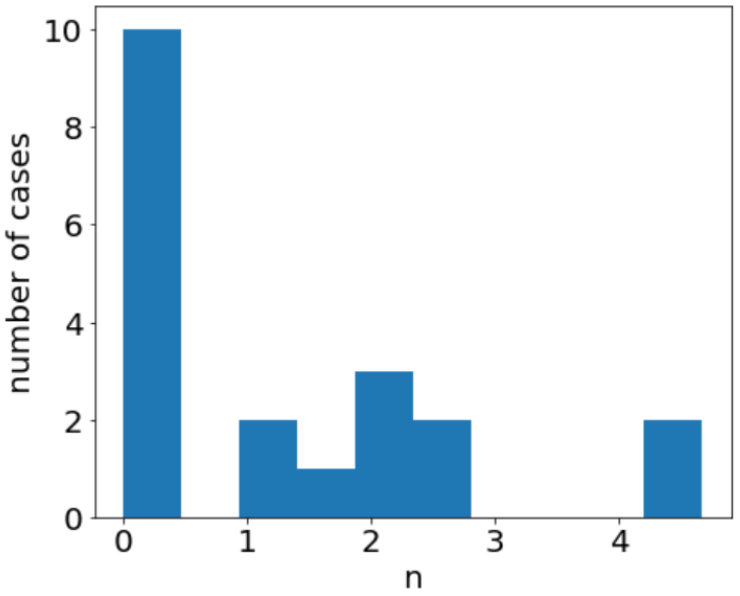
n=1
Purely conduction-limited



n has a wider spread, suggesting a different limiting mechanism



Our results with the same x-axis range



Our results with extended x-axis range

Progress Updates

- We are currently working on writing the curve-fitting script and visualization script into python packages/modules for future use
- Perhaps do correlation testing between variables?

Title and Space for Pictures

insert images

Divider Slide 1

Divider Slide 2

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Thank you

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