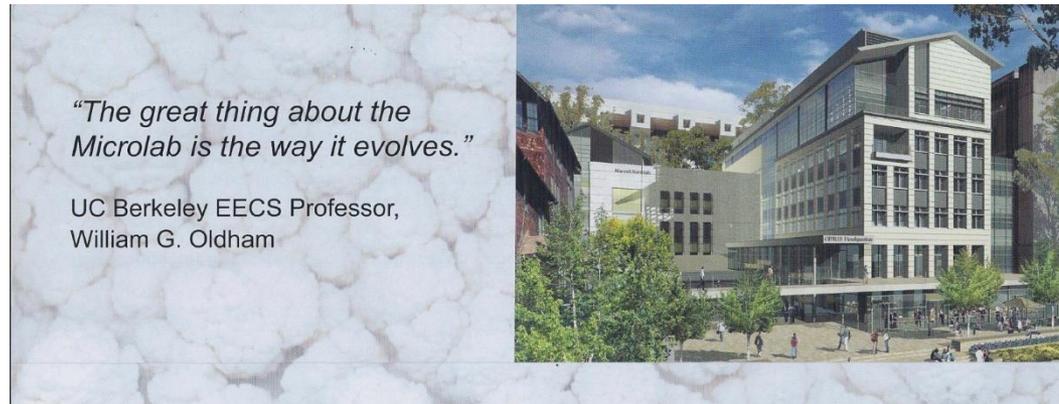




Marvell Nanofabrication Laboratory

2022 Principal Investigators Meeting



Professor Kris Pister

Faculty Director

Dr. Bill Flounders

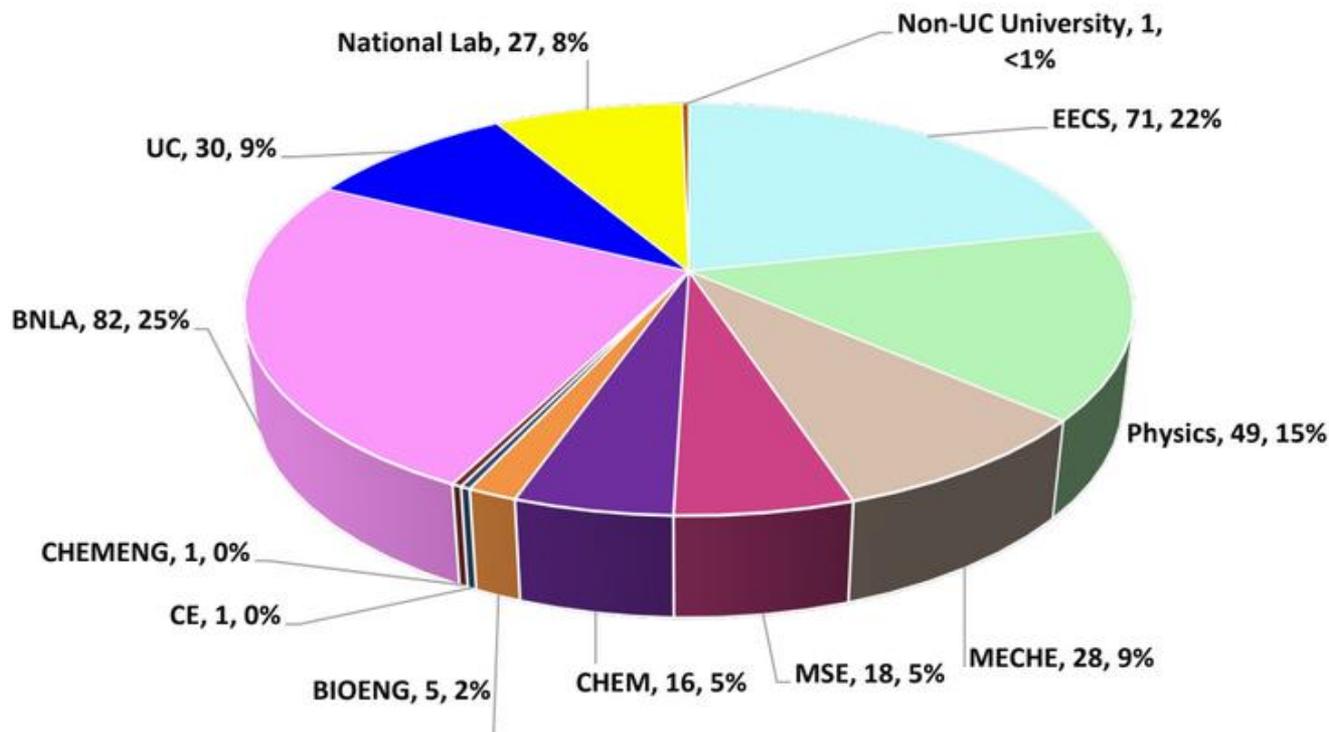
Executive Director



Agenda

- Membership / Financial Status / Pandemic Impact
 - FY 23 Recharge Rates
- Staffing Status – The Great Retirement Continues
- New Equipment / Capabilities
- Summary of NSF Proposal
 - Info removed per NSF requirements

Lab Members by Department FY 22 Total = 329



Fiscal Year	2018	2019	2020	2021	2022
Total	382	376	342	304	329
UCB	257	241	217	191	189
Commercial	73	84	73	72	82 (25%)
All Academic	309	292	269	232	247
External	125 (33%)	134 (36%)	125 (37%)	113 (37%)	140 (43%)

The NanoLab 2022

The Top 20 and Academic vs BNLA

Top 20 PI by Dept Δ '21			Financial		Δ '21
EECS	7	0	All Academic	\$1.86 M	+ \$205 K
Mech Eng	3	0	Top 20 Academic	\$1.42 M	+ \$ 84 K
Physics	3	0	All BNLA	\$1.63 M	+ \$ 70 K
MSE	2	↓1			
Chem/ChE	1	↓1	Top 10 Academic	> \$55K each	
UCD EE	3	↑2			
UCSF BioE	1	0	Top 10-20	> \$32K each	

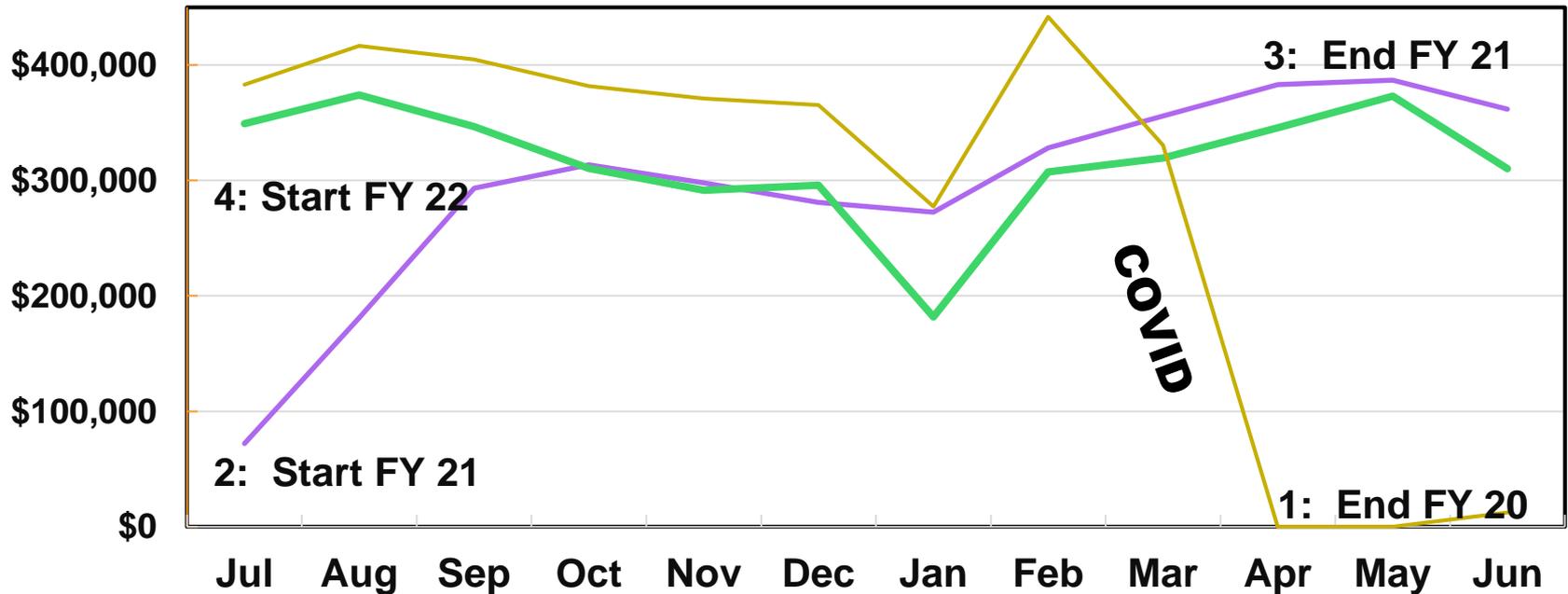
Lab Members Historical Analysis

FY	2017	2018	2019	2020	2021	2022	Δ '17	Δ '18	Δ '19	Δ '21
Total	370	382	376	342	304	329	-11%	-14%	-13%	8%
UCB	252	257	241	217	191	189	-25%	-26%	-22%	-1%
Ext Acad	49	52	51	52	41	58	18%	12%	14%	41%
BNLA	69	73	84	73	72	82	19%	12%	-2%	14%
EECS	125	114	111	94	79	71	-43%	-38%	-36%	-10%
Mech Eng	46	58	52	41	31	28	-39%	-52%	-46%	-10%
Physics	36	41	35	36	41	49	36%	20%	40%	20%
MSE	16	20	23	22	18	18	13%	-10%	-22%	0%
BioEng	1	1	0	3	2	5	400%	400%		150%
Chem/ChE	27	23	20	21	18	17	-37%	-26%	-15%	-6%

For the Dean to Consider:

Chang-Hasnain	5 → 25
Subramanian	10 → 0
Xiang	5 → 4 !
Javey	8 → 42
King-Liu	10 → 46

NanoLab Monthly Operations Income: FY 20, 21, 22

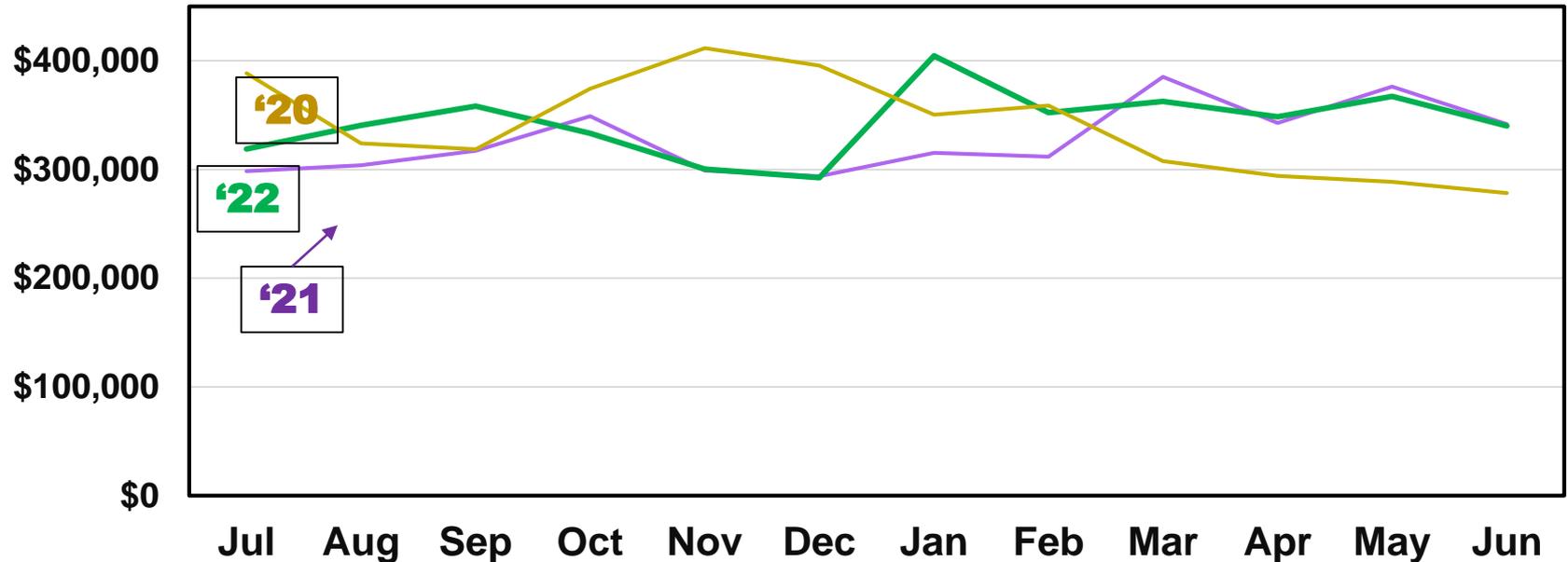


Zero Activity for ~ 15 weeks...

<50% Activity for ~10 weeks...

~75% Activity for ~24 weeks

NanoLab Monthly Expenses: FY 20, 21, 22

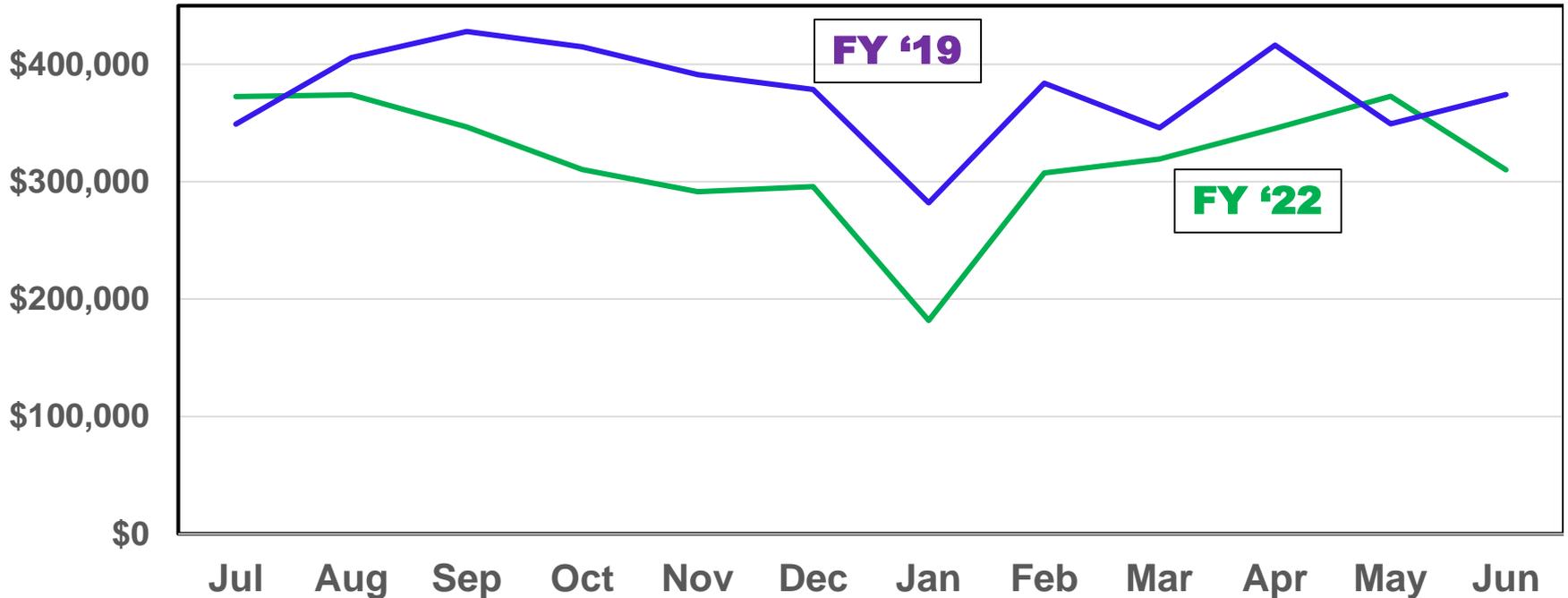


Expenses Don't Change Much...

House utilities never shut down...

Expanded Leave funded by each unit

NanoLab Monthly Operations Income: FY 22 vs FY 19



Situation has stabilized...

Now the recovery continues...

FY22 has reached FY19 activity level

NanoLab FY '23 Recharge Rates Effective July 2022 – June 2023

Charge Class	Academic		Affiliate	
	Rate	Δ	Rate	Δ
Monthly Access Fee	\$94.00	4%	\$172.00	8%
General Lab (Sinks etc)	\$49.20	4%	\$61.80	5%
General Lab Max/Month	\$1,400.00	0%	\$2,700.00	8%
Tier 1 (Metrology / Bond)	\$25.20	5%	\$28.20	18%
Tier 1 Cap	\$200.00	0%	NA	
Tier 1 over cap	\$0.00	0%	NA	
Tier 2 (LPCVD / Etch)	\$54.00	5%	\$64.80	5%
Tier 2 Cap	\$1,400.00	0%	NA	
Tier 2 over cap	\$5.90	0%	NA	
Tier 3 (DUV / Ebeam)	\$65.40	5%	\$103.20	6%
Tier 3 Cap	\$1,500.00	0%	NA	
Tier 3 over cap	\$19.50	0%	NA	
Staff Services	\$106.20	4%	\$106.20	4%

Recharge Rate Increases FY '20 → FY '23

	UNIV	BNLA	
	FY '23 vs FY '20	FY '23 vs FY '20	FY '23 Univ vs BNLA
Monthly Access Fee	11%	39%	83%
General Lab (Sinks / Simple)	15%	20%	26%
General Lab Max/Month	0%	13%	93%
Tier 1 (Metrology / Bond)	20%	34%	12%
Tier 1 Cap	0%		
Tier 1 over cap	0%		
Tier 2 (LPCVD / Etch)	23%	20%	20%
Tier 2 Cap	0%		
Tier 2 over cap	4%		
Tier 3 (DUV / Ebeam)	9%	15%	58%
Tier 3 Cap	0%		
Tier 3 over cap	3%		
Staff Services	22%	22%	0%

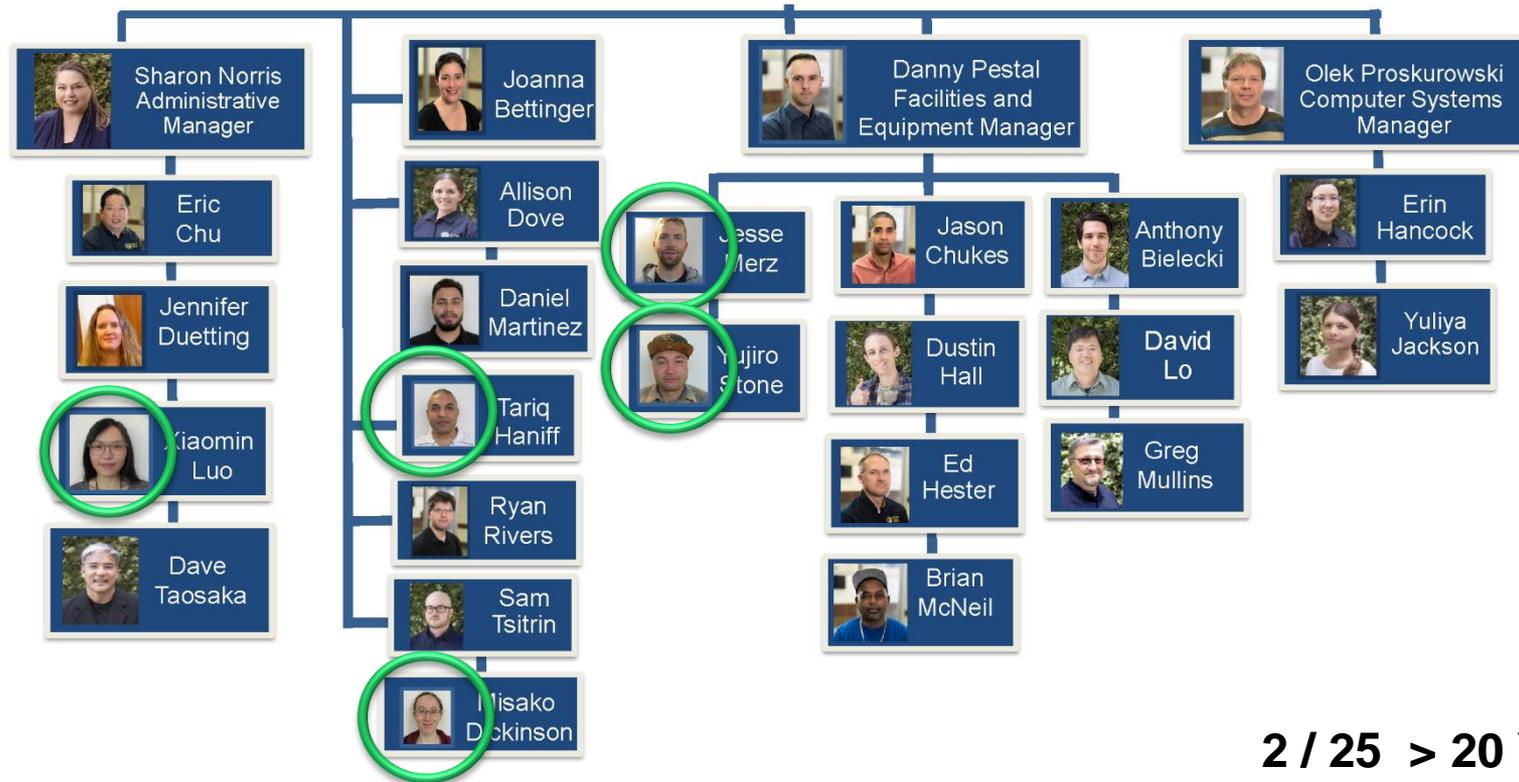
Current Staff Organizational Chart

Admin

Process

Equip/Facilities

Computer



In the past ten years,

17 staff have retired,

14 with >25 years of service.

2 / 25 > 20 Years

8 / 25 < 5 Years

5 < 1 year

Equipment Additions, Upgrades, Anecdotes

ASML DUV Stepper Now Backside Align Capable

ASML uses UCB lab for fabrication of 2D reference wafers

- use DUV stepper and we provide Si etch
- ASML provides tool review and PM prior to fab

ASML wants to fab 3D reference wafers using our tool

- they have donated the backside alignment option
- \$275K upgrade provided at no cost
- install 90% complete

Awaiting final parts. ETA 1st Q 2023

Equipment Additions, Upgrades, Anecdotes

2nd Zeiss Inspection SEM

Used Zeiss offered by 3rd party reseller since it is a match to our existing. ~2005 vintage. \$25K as is, operable.

Offers back up, shared parts, engineer already familiar with supporting the same tool, members trained on 2 tools for one.

CITRIS offers slab on grade room (~400 ft²) and NanoLab expands the 1st floor metrology center. One in the lab and a second in 1st floor SDH metrology room.

Significant rebuild, ~8month effort, release 1stQ 2023

Equipment Additions, Upgrades, Anecdotes

LPCVD Upgrade - 200mm, SiN, SiO₂, polySi

UCB requested quote for 200mm upgrade 2017, 2018

Pandemic results in cancelled order, March 2020

System offered to UCB at ~\$180 K savings (\$507K total)

NanoLab: \$ 459K

COE: \$ 48K

PO out April 2020, Delivery Nov 2020

Release to members March 2021

We've got some history with Tystar



There's a lot to an LPCVD furnace At vendor after build



Load station, controller, hotzone

Pump cabinet



**Gas shelf for each tube:
N₂, O₂, DCS, N₂O, NH₃,
SiH₄, PH₃.**

Another custom NanoLab Installation



Equipment Additions, Upgrades, Anecdotes

PVD: 2 chamber sputter, LL, 7target, 200mm

Renasas development lab retiring the tool and offered donation to Stanford, June 2022.

Stanford declined, tool too big, introduced donor to UCB.
Thank You to our colleagues at SNF!

NanoLab pays for appraisal to get donor tax recognition
Orig purchase 2010, \$750K. Appraisal as is \$275K

NanoLab staff decommission. NanoLab pays to move \$5K
Install underway, release 1st Q 2023

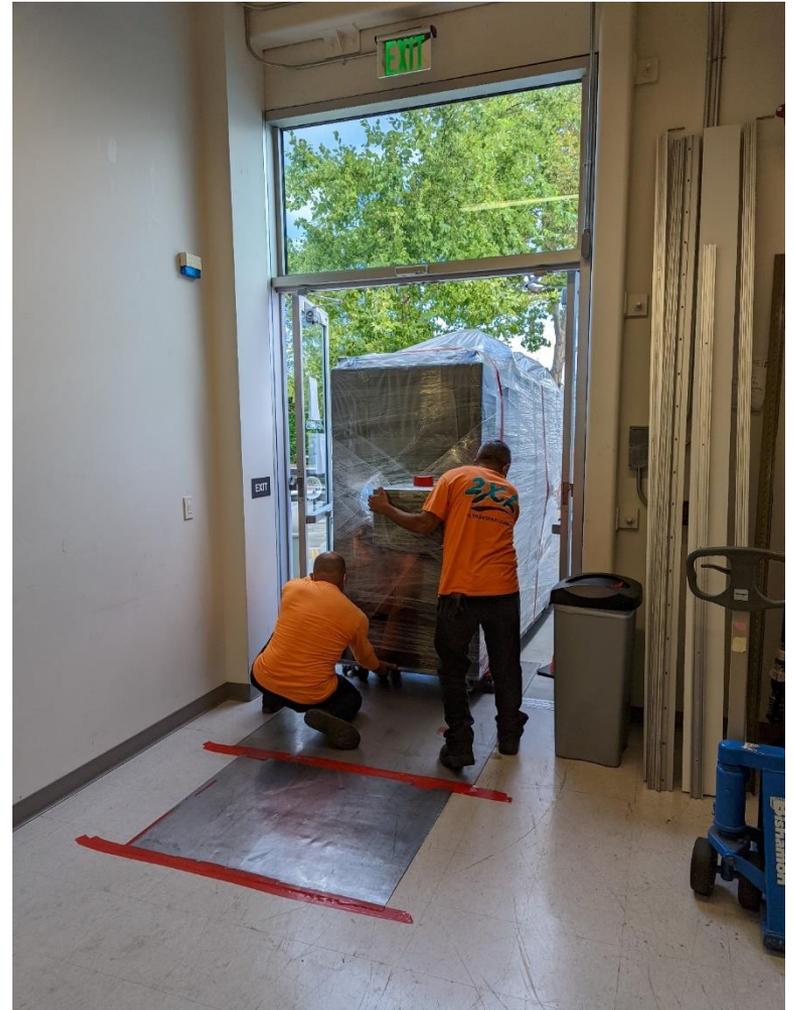
Stanford wasn't kidding – it's a Big Tool – 16'



Professional riggers (2XL) deliver to UCB



Just Wrap and Roll



Flatbed not Fed Ex



Don't Move the Tool...

Move the truck Under the tool



Ready To Travel



Staging at Davis Hall South – Thank you CEE



We'll take it from here...



We've got rigging equipment too...



Cut and Fold along dotted line...



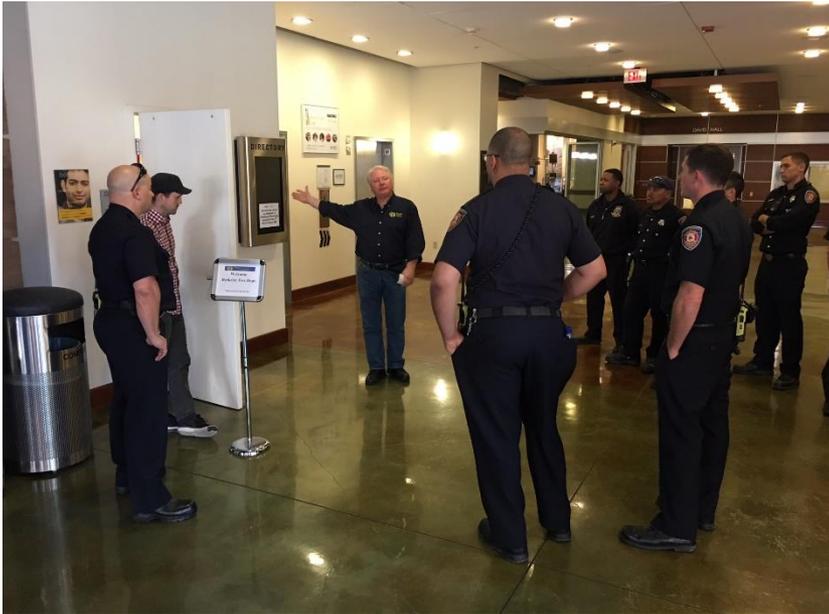
Reassembled and parked in the NanoLab



Summary

- Pandemic has created a significant deficit
 - Rates moderated and recovery allowed over several years
- Staff turnover has been steadily addressed
- NanoLab continues to expand services and capabilities
 - Maskless litho tool installed in 2019 is most popular tool
 - Transition to 200mm continues with or without BASI
- NSF MRI Proposal could be a game changer
 - Watch this space

The NanoLab responds to your issues and works to control your costs.



Berkeley Fire Department Annual Tour

The shared lab model is alive and well thanks to your support.

Thank you