



**Marvell  
Nanofabrication  
Laboratory**

## 2017 Principal Investigators Meeting

**Professor Ming C. Wu**

**Faculty Director**

**Dr. Bill Flounders**

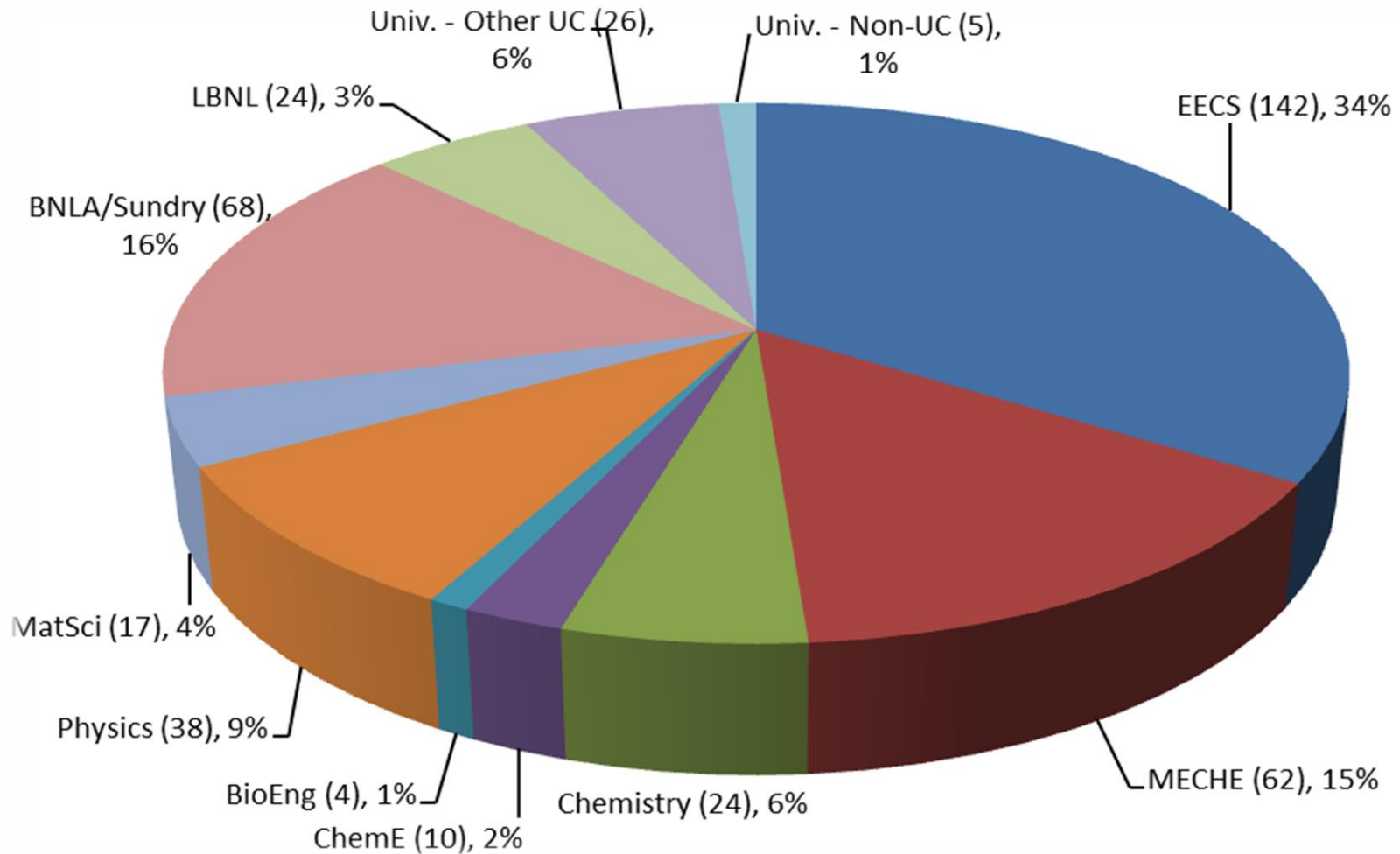
**Executive Director**



# Agenda

- ❖ Membership Status, Usage UCB Dept Trends
- ❖ Web Page Highlights
- ❖ New Equipment / Capabilities
- ❖ FY 16/17 Rates Overview
- ❖ Summary of Support from VCR's Office

## Membership is strong and stable



# The NanoLab 2016

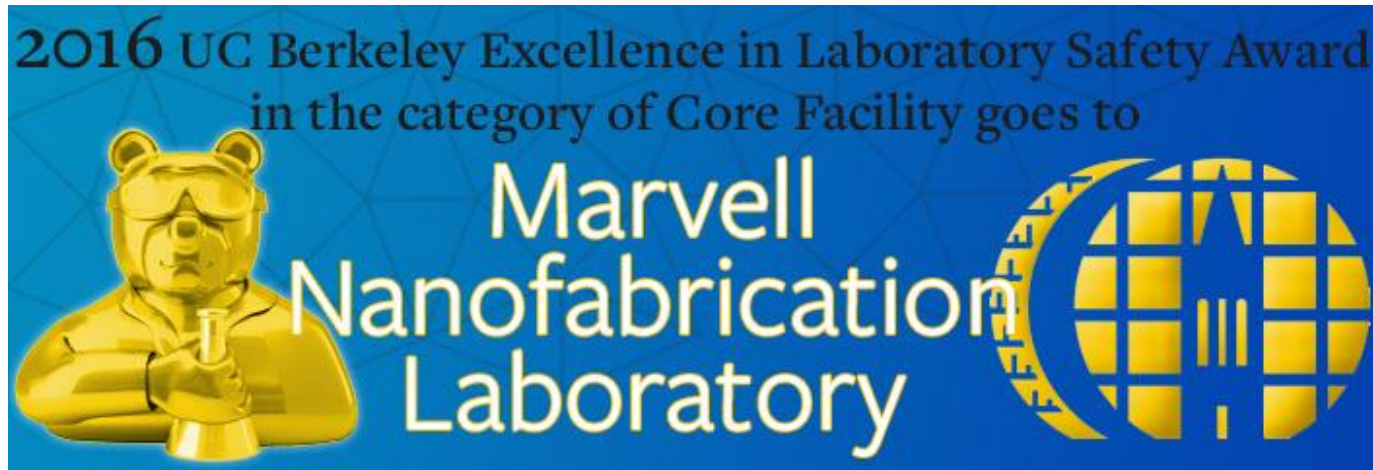
## Highlights of the Top 20

Top 20 by Department			Financial	
<b>EECS</b>	<b>11</b>		<b>All Academic</b>	<b>\$2.28 M total</b>
<b>Mech Eng</b>	<b>3</b>		<b>Top 20 Academic</b>	<b>\$1.86 M total</b>
<b>Chemistry</b>	<b>2</b>		<b>All BNLA</b>	<b>\$1.66 M total</b>
<b>Physics</b>	<b>2</b>			
<b>MSE</b>	<b>1</b>		<b>Top 10 Academic</b>	<b>&gt; \$75K each</b>
<b>UC Davis EE</b>	<b>1</b>		<b>Top 10-20</b>	<b>&gt; \$30K each</b>

# Lab Members Historical Analysis

<b>Fiscal Year</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>
<b>Total</b>	466	474	497	471	462	441	420
<b>UCB</b>	367	353	370	340	326	280	297
<b>Ext Academic</b>	48	67	68	59	66	87	55
<b>BNLA</b>	51	54	59	72	70	74	68
<b>EECS</b>	122	132	138	126	139	135	142
<b>Physics</b>	42	36	45	39	35	31	38
<b>MSE</b>	21	27	31	23	21	23	17
<b>Mech Eng</b>	102	99	106	95	87	59	62
<b>BioEng</b>	12	10	7	8	4	4	4
<b>Chem/ChemE</b>	65	47	42	49	30	28	34

# NanoLab Awarded EH&S Safety Recognition



# New NanoLab Website Highlights

- New (last year) 2min NanoLab Video  
On the home page or at news and events  
<https://www.youtube.com/embed/EwfChuacUCg>
- NanoLab Awarded EH&S 2016 Core Facility  
Excellence in Laboratory Safety Award
- Evap Class – Now On Line Video  
[https://drive.google.com/file/d/0Bwt\\_-WcNo6O-T041ZmROWUFEUG8/view](https://drive.google.com/file/d/0Bwt_-WcNo6O-T041ZmROWUFEUG8/view)
- Etch Class – On Line Video Coming Soon
- On Line Process Specifications  
Modeled on TDSI Process Specification Charts  
[https://nanolab.berkeley.edu/public/manuals/process\\_specifications.shtml](https://nanolab.berkeley.edu/public/manuals/process_specifications.shtml)



# New ebeam writer installed

**Delivery: Nov28, 2016**

**Released: Dec 20, 2016**

## CABL-UH130

UH110 (110 kV), UH90 (90 kV)

PRICING INFO CONFIDENTIAL  
See Lab Management for details

***THANK YOU !***

**CRESTED**

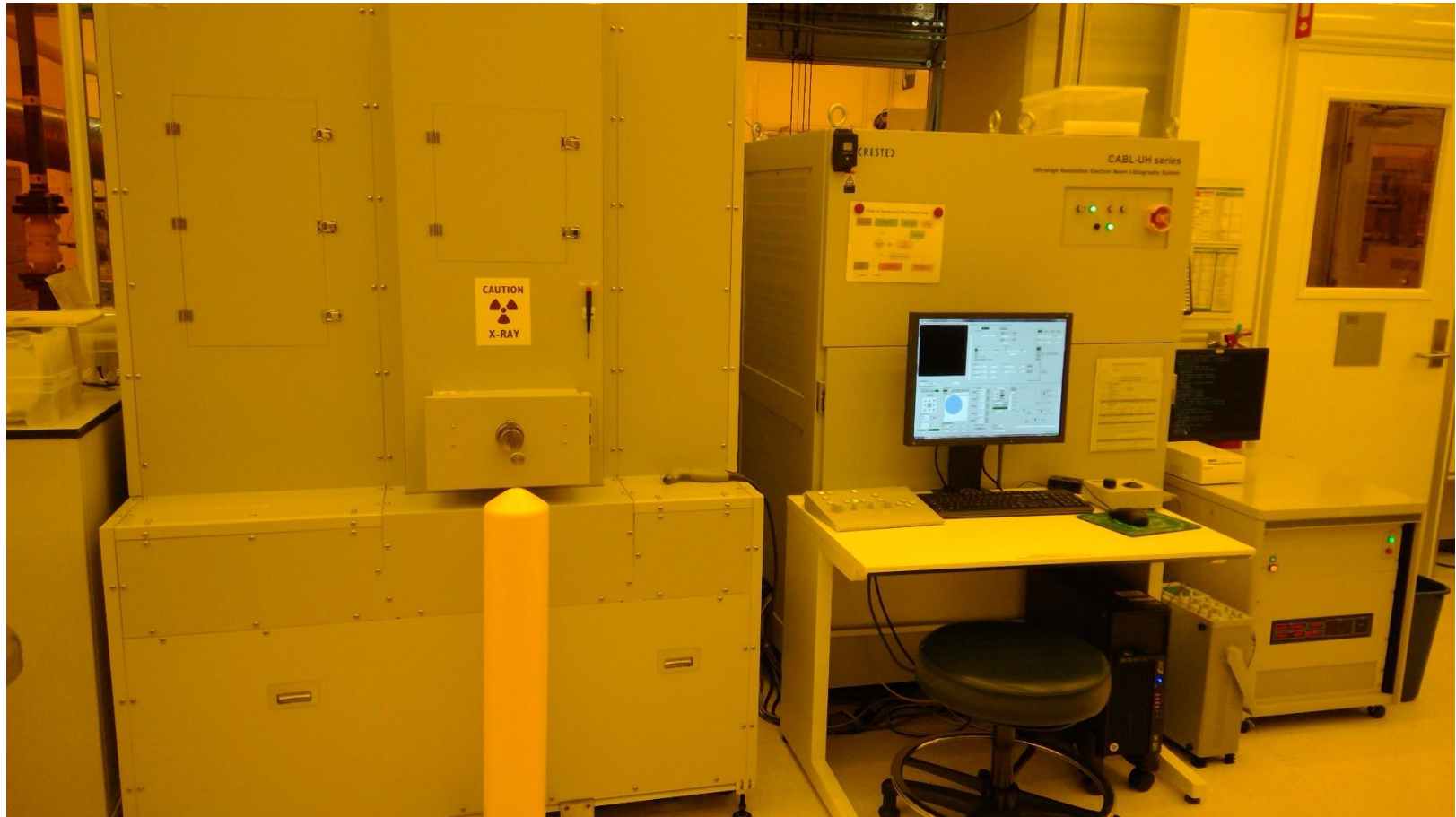
- **Vacc: 130 kV Max** (25-130 kV, 5 kV steps)
- **Single-Stage Acceleration Electron Gun up to 130 kV**
- **Micro-Discharge Free Electron Optical Column**
- **Beam Diameter: < 1.6 nm**
- **Fine Line: < 7 nm**
- **Ultra-stable write capability with dual thermal controller**
- **Pattern Generator: 100MHz**





# Crestec130kv In The NanoLab

Includes Beamer Proximity Effect Correction SW



# New PR Coat and Develop System

## Thank you TEL



Donated Nov 2008  
Prior to new lab  
completion

Vacuum sealed/stored  
at RFS. Thank you COE

Approved for sale  
March 2015

Repurchased by TEL  
via approved high bid  
process

TEL ACT12: >12' x 7', 11 crates, >\$4M list

# Picotrack PR Coat and Develop System

## Thank you TEL

Sited in NanoLab April 2017



Fully automated coat R&D scale dual 6" and 8" coat and develop track.

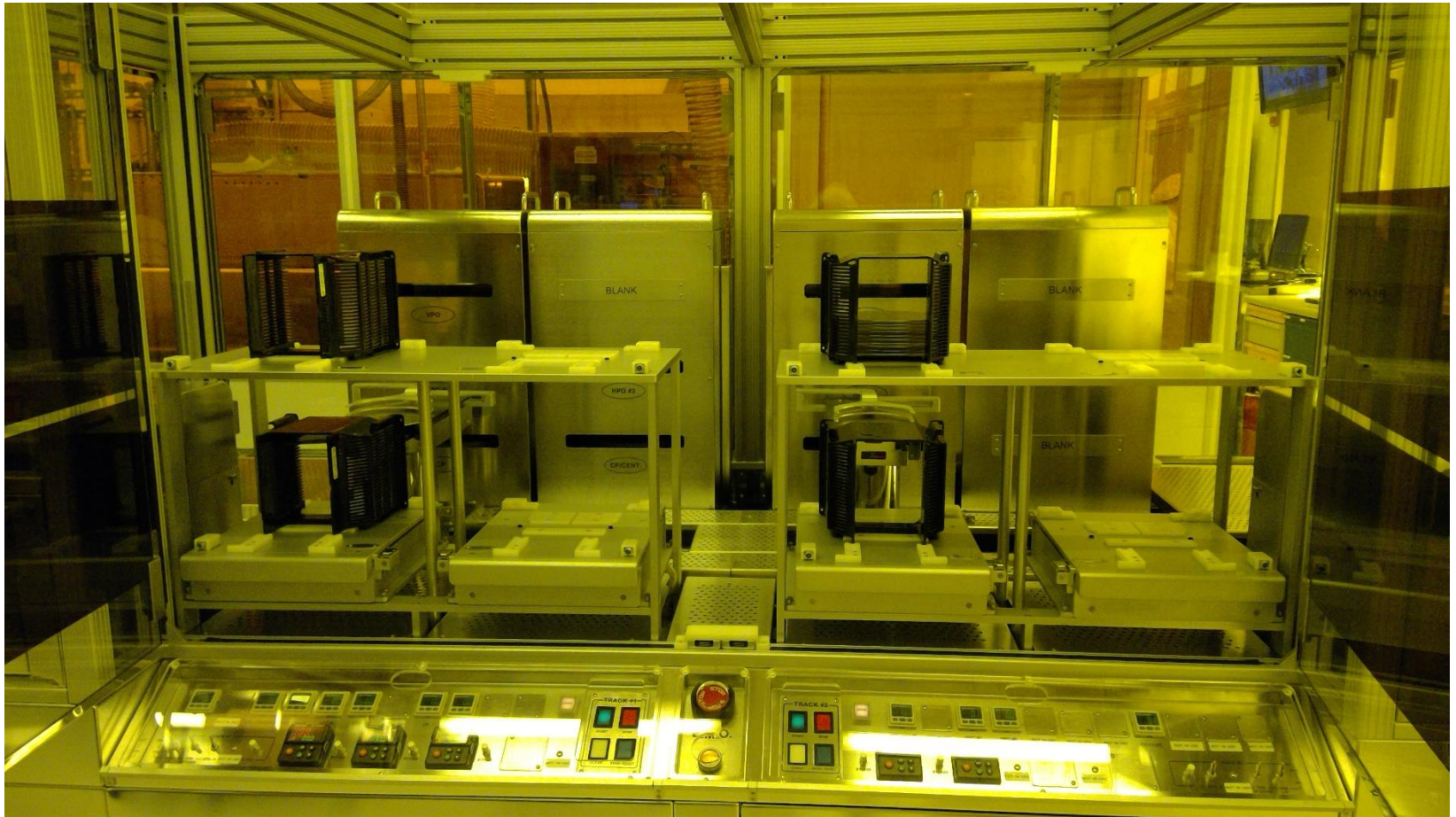
Local support, consistent use of generic access pumps, motors, controllers

PCT-200: ~8' x 4', 3 crates, >\$300K list



# Another view of the New Picotrack

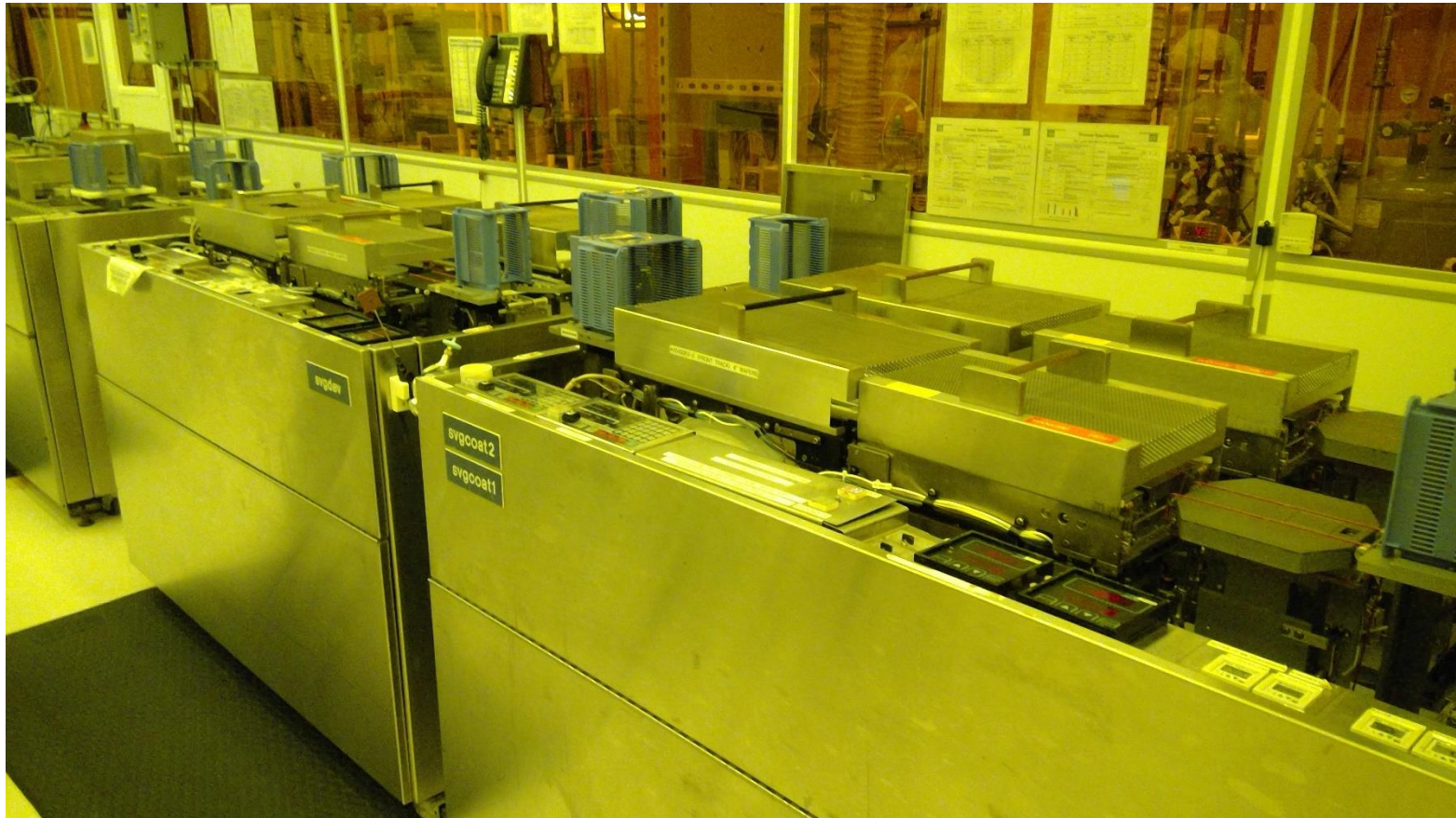
## Coat and Develop Compliment to the DUV Stepper



3 DUV resists and back up i-line resist

# Picotrack Retires 2 1990 Legacy SVG Tools

## Declining Reliability and Difficult to support





# Recent Donation/Purchase from Toshiba

5 Evaps: 1<sup>st</sup> Contact 4/21/16... Delivered 5/23/16

3 old bell jars:  
good cryos  
Eguns/parts

2 recent  
box coaters





# Recent Donation from Toshiba

Box coater with new e-gun dedicated for oxides  
Released May 4, 2017



2<sup>nd</sup> system being rebuilt as 3 target sputter chamber - 2018

# Academic Recharge Rates

Fiscal Year	2016/17	2017/18	
Access Fee per month	\$91.20	\$89.00	- 2%
General Laboratory Rate	\$45.00/hr <i>Cap: \$1,400.00/month</i>	\$43.20/hr <i>Cap: \$1,400.00/month</i>	- 4% ----
Special Equip Rate Tier 1 <i>wire bonder, HF vapor, polymer, metrology</i>	<b>Tier 1: \$21.00/hr</b> <i>Tier 1 cap: \$200.00 / month Rate over Tier 1 Cap: \$0/hr</i>	<b>Tier 1: \$21.00/hr</b> <i>Tier 1 cap: \$200.00 / month Rate over Tier 1 Cap: \$0/hr</i>	---- - 1% ----
Special Equip Rate Tier 2 <i>LPCVD, PECVD, DRIE, general purpose SEM</i>	<b>Tier 2: \$44.40/hr</b> <i>Tier 2 cap: \$1,400.00/month Rate over Tier 2 cap: \$6.15/hour</i>	<b>Tier 2: \$43.80/hr</b> <i>Tier 2 cap: \$1,400.00/month Rate over Tier 2 cap: \$5.70/hour</i>	- 1% ---- - 7%
Special Equip Rate Tier 3 <i>DUV, 50kV ebeam litho SEM, epi-SiGe</i>	<b>Tier 3: \$63.60/hr</b> <i>Tier 3 cap: \$1,500.00/month Rate over Tier 3 cap: \$19.60/hour</i>	<b>Tier 3: \$60.00/hr</b> <i>Tier 3 cap: \$1,500.00/month Rate over Tier 3 cap: \$19.20/hour</i>	- 6% ---- - 2%
Special Equip Rate Tier 4 <i>130 kV ebeam litho</i>	NA	<b>Tier 4: \$101.40</b>	NA
Staff Services	\$84.00	\$84.60	+ 1%

# BNLA Recharge Rates

Fiscal Year	2016/17	2017/18		Academic
Access Fee per month	\$116.00	\$123.60	+ 7%	\$89
General Laboratory Rate	\$49.20/hr <i>Cap: \$2,450.00/month</i>	\$47.40/hr <i>Cap: \$2,500.00/month</i>	- 4% + 2%	43.20 \$1,400
Special Equip Rate Tier 1 <i>wire bonder, HF vapor, polymer, metrology</i>	<i>Tier 1: \$21.00/hr Tier 1 cap: NA</i>	<i>Tier 1: \$21.00/hr Tier 1 cap: NA</i>	---- ----	\$21.00 \$200
Special Equip Rate Tier 2 <i>LPCVD, PECVD, DRIE, general purpose SEM</i>	<i>Tier 2: \$51.00/hr Tier 2 cap: NA</i>	<i>Tier 2: \$52.20/hr Tier 2 cap: NA</i>	+ 2% ----	\$43.80 \$1,400
Special Equip Rate Tier 3 <i>DUV, 50kV ebeam litho SEM, epi-SiGe</i>	<i>Tier 3: \$80.40/hr Tier 3 cap: NA</i>	<i>Tier 3: \$84.60/hr Tier 3 cap: NA</i>	+ 5% ----	\$60.00 \$1,500
Special Equip Rate Tier 4 <i>130 kV ebeam litho</i>	NA	Tier 4: \$214.80	NA	\$101.40
Staff Services	\$84.00	\$84.60	+ 1%	\$84.60

# BNLA Annual Membership Fees

FY 16/17		FY 17/18	
Lab Members Per Company	Annual Rates	Lab Members Per Company	Annual Rates
1	\$18,500	1	\$18,500
2	\$28,500	2	\$28,500
3	\$38,500	3	\$38,500
4	\$42,500	4	\$42,500
5	\$55,000	5	\$55,000
6	Cancelled	6 **	\$65,000

**\*\* Non-Core Access Program**

- 6<sup>th</sup> member = restricted access
- max 20hours/month 10am – 8pm
- unlimited non-core 8pm – 10am

# VCR Investment in the NanoLab

## ➤ FY15 \$250K

- NanoLab obtains \$650K Gift In Kind as match for 2year VCR Investment
- Purchased 2chamber PECVD and 2chamber PVD for \$300K

## ➤ FY16 \$250K

- \$100K to new ebeam down payment
- \$100K to new aligned wafer bonder

## ➤ FY17 \$100K; NanoLab to Match

- Investment to support AFM purchase; \$100K VCR / \$100K BNLA
- AFM review underway – Bruker, Park, Nanosurf
- Tool selection to emphasize robust instrument to meet heavy use by wide range of NanoLab members

# Summary

- Academic Rates kept flat or decreased
  - Overall membership modest decrease
  - EECS, Physics, MSE Dept use steady
  - Mech Eng, Bio Eng, Chem Dept use decline
  
- Modest increases to BNLA
  - New non-core hour access program under test
  
- NanoLab continues to expand services and capabilities
  - On line video workshops for new member training
  - On line base line process specification and monitoring
  - 130kV ebeam
  - 6"/8" new PR coat and develop
  - New ebeam dedicated to oxides
  
- VCR investment in NanoLab to support AFM purchase





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

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



*"The great thing about the  
Microlab is the way it evolves."*

UC Berkeley EECS Professor,  
William G. Oldham



**Thank you**