



We send a fond farewell to one of our retiring engineers, Don Yeager. Don has been with the MNTC since its beginning and has been critical to the development and overall success of the facility. We thank Don for his 13 years of service with the MNTC and his overall 24 years of service with the University. All of us at the MNTC wish him the best of luck with his retirement!

2014 Annual Report

January 15, 2015

**University of Louisville Micro/Nano Technology Center
Annual Report
FY2014**

Dr. Kevin Walsh, Director
Dr. Shamus McNamara, Associate Director
Dr. Julia Aebersold, MNTC Cleanroom Manager
Wendy S. Metcalf, Administrative Associate
Don Yeager, Technical Staff and Facilities Coordinator
Dr. Xiaojin Wang, Senior Process Engineer
Curtis McKenna, Research Engineer Scientist and Outreach Coordinator
Dr. Evgeniya Moiseeva, Senior Process Engineer
Mary Watson, Administrative Assistant
Ana Sanchez Galiano, Nanotechnology Research Coordinator

INTRODUCTION

The University of Louisville's Micro/Nano Technology Center (MNTC) is a university-recognized recharge center officially established in 2004. The MNTC includes several state-of-the-art core facilities including a \$30M 10,000 ft² AGI-designed cleanroom for the micro/nanofabrication of novel materials and devices. It also includes a 1,000 ft² custom packaging and characterization lab, a 300 ft² design/layout/simulation lab for MEMS and IC devices, and a suite of offices to house its technical and administrative staff. This interdisciplinary multi-user center is utilized internally by several university departments and many faculty members for both research and educational training. The MNTC also provides valuable micro/nanofabrication services to external users ranging from industry and other academic institutions within the state of Kentucky, and well beyond its borders. This document serves as the MNTC's official annual report for the FY14 fiscal year ending June 30, 2014.

FINANCIAL SUMMARY

The MNTC ended FY14 with a deficit of \$75,178, as compared to a surplus of \$19,626 in FY13. Table 1 presents an itemized breakout of expenditures and income. Expenditures totaled \$314,985 and revenues totaled \$239,808, resulting in the end-of-year \$75,178 deficit. The three largest expenditures for the center were salaries and benefits (\$90k), equipment maintenance (\$67k) and liquid nitrogen (\$54k). The university continued to charge a 10% administrative fee on expenses, which came to \$16k for FY14. However, through negotiations, the University has agreed to discontinue that fee starting in FY15.

Special talent is required to safely and efficiently operate the MNTC. The MNTC technical staff members are responsible for training all users and maintaining over 100 complex fabrication tools of value well over \$20M - whereas, other comparable multi-user core facilities utilize maintenance contracts for equipment support. Tables 2 and 3 summarize the technical and administrative labor costs required to safely operate the MNTC. Table 2 presents a summary the funds provided by the Dean of the Speed School of Engineering (SSE), which are used to cover a large portion of the MNTC's staff support. These funds originate from Continued Annual Resources (CAR) supplied by the state of Kentucky and various SSE endowments. This support totals \$261K excluding fringe. The above financial support is not sufficient to cover the entirety of the required MNTC's staff salaries. Table 3 summarizes the remaining salary expenses which are the responsibility of the MNTC. This value was \$73K in FY14 excluding associated fringe costs.

Figure 1 shows the MNTC's quarterly revenue generated by internal and external users which totaled \$239,808 for FY14. Figure 2 shows internal income was \$184,302 (77%) and external income was \$55,505 (23%). A breakdown of internal revenue by faculty member is shown in Table 4 and Figure 3. For FY14, the MNTC had 25 faculty from 8 different departments using the facility. Figure 4 presents a percentage breakdown of internal revenue by department with the largest percentage from ECE faculty at 69%. Table 5 and Figure 5 list the 23 external clients using the MNTC in FY14 which generated \$55,505 of external revenue. Table 6 presents a comprehensive list of the 59 MNTC internal users for FY14, which consisted of 25 faculty, 33 students/post-doctoral researchers and 1 teaching assistant. This list excludes students who took academic classes which utilized the cleanroom and high school summer camps.

Figure 6 presents a comparison of MNTC internal and external income for the last 10 years from FY04 to FY14. In FY10 and FY11, MNTC revenues began to decline for the first time in part due to the difficulties of faculty users winning federal grants as government spending was reduced. In FY12, the MNTC hired a new cleanroom manager, Dr. Julia Aebersold, with the goal of increasing external business. Consequently, external revenues have increased by 222% (\$46,374) since FY11 and internal revenues have increased by 23% (\$30,748). The MNTC operational costs (salary and non-salary) for that same time period are presented in Figure 7. The dramatic increase in operational costs for FY14 is primarily due to three factors - 1) the unforeseen installation costs associated with the MRL Polysilicon tube furnace, 2) increased salary costs due to reclassification and in-range adjustments of two MNTC staff members and 3) additional salary expenses associated with cross-training an extra staff member due to the retirement of Don Yeager. Several of these factors are specific for this fiscal year, thus future operational costs in FY15 are expected to be much reduced.

Figure 8 presents accumulative income from FY04 to FY14 for internal clients (\$1,518,394). The top six faculty clients of the accumulative period were Dr. Walsh (ECE \$435k), Dr. Keynton (BE \$108k), Dr. Harnett (ECE \$106k), Dr. Cohn (ECE \$100k), Dr. Alphenaar (ECE \$88k) and Dr. McNamara (ECE \$87k). Figure 9 presents total internal income by department for the same time period. The dominant department continues to be ECE with \$881,231 (58%), followed by BE (12%), ME (11%), Physics (8%) and Chemical Engineering (4%).

Figure 10 shows the number of departments, faculty, students, post docs and researchers who have annually used the cleanroom since FY06. In the spring of 2012 a revised fee structure was implemented that charged clients per process along with a new cleanroom access fee. Previously, users were not charged to suit up and enter the cleanroom even though that activity resulted in real costs to the center. This, in part, caused the number of FY14 users to decrease from 45 students/post-doctoral researchers to 34, although there was an increase in faculty users from 21 to 25, and departments from 7 to 8.

Figure 11 shows the total number of U of L and Engineering grants (\$60M) to use the MNTC since its inception. Since 2001, 32% of these grants were funded by the Department of Defense, 22% from EPSCoR Program (i.e. University of Kentucky Research Foundation), and 14% from the National Science Foundation. This resulted an approximate annual average of \$6M of grant funding to use MNTC. In order to put this statistic in perspective, this corresponds to approximately half of SSE's entire annual research funding. A significant portion of this funding would not have been awarded to the University without leverage the availability of the cleanroom facility. Table 8 highlights the significance of the MNTC core facility where FY14 internal revenue of \$131,568 resulted from 23 grants totaling \$6.7M. This produced an outstanding multiplication factor to the University of 51 to 1 due to the MNTC.

The staff of the MNTC wish to thank all internal and external clients who have supported the micro/nano initiative at the University of Louisville. Let us help make your research a success.

Table 1. MNTC balance sheet for FY14.

EXPENDITURES

SALARIES AND BENEFITS (S&B)		
	Prof and Administrative	54,754.11
	Classified	2,680.98
	Temp	15,223.07
	Health Insurance	12,084.36
	FICA	5,458.27
		<hr/>
		90,200.79
SUPPLIES AND EXPENSES (S&E)		
	Out -Of-State_Air	1,048.70
	Out -Of-State_Hotel	381.90
	Out-Of-State-Rental Car	181.15
	Out -Of-State_Misc	985.30
	Employee Recruitment	108.00
	Laboratory	17,388.55
	Chemicals	44,323.05
	Compressed Gas (cylinders)	997.81
	Liquid Nitrogen	53,864.26
	Demurrage	3,241.41
	Office Supplies	2,916.50
	Software	469.95
	Stockroom	286.94
	Meeting	303.30
	Computer	2,088.81
	PSC-Legal	1,000.00
	Security	10.00
	Criminal Background Checks	244.40
	Freight	469.29
	Overnight and Grant Mailings	1,036.22
	Postal Service	221.35
	Catering	231.00
	IT-Printing Svcs	210.00
	IT-Cellphone Charges	1,957.52
	IT-Pre Print Design	40.00
	Physical Plant Services	3,805.89
	IT-Network Base Infrastructure	1,989.96
	IT-Install -Network Base Infra	550.00
	Equipment Maint	67,388.18
	Subscription	99.00
	Processing Fees (Dept of Hom. Sec)	2,875.00
	Credit Card fee	12.00
	Parking	45.00
	Business Meals	590.36
	Publicity & Promotion	8,244.52
	Prizes & Awards	219.38
	Insurance Recovery	(11,007.00)
	UL Administrative Fee	15,952.01
	Cost Share Direct	14.67
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TOTAL EXPENDITURES		314,985.17

INCOME

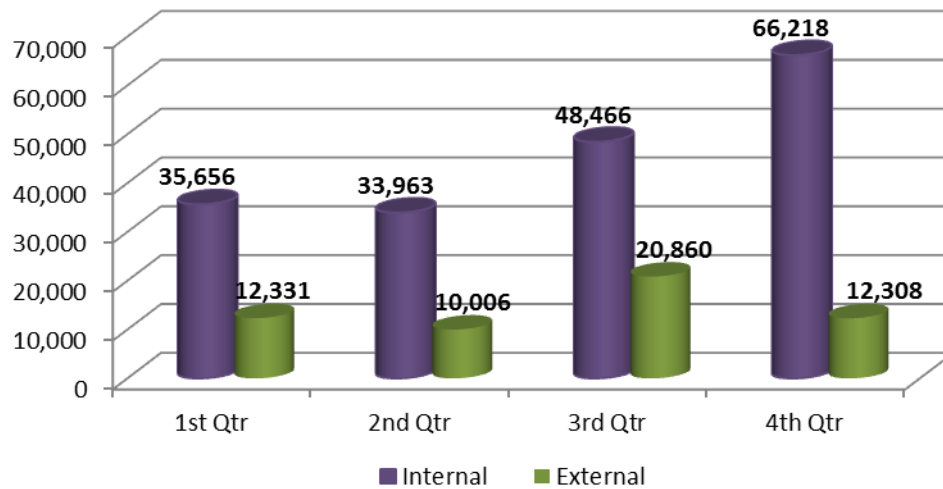
USER FEE		
	External	\$55,505.31
	Internal	\$184,302.27
		<hr/>
		\$239,807.58
	Deficit	(\$75,177.59)

Table 2. Salary expenses (excluding fringe) supported by the Speed School of Engineering for FY14.

Julia Aebersold	\$78,000
Curt McKenna	\$42,795
Wendy Metcalf	\$38,907
Xiaojin Wang	\$47,619
Mary Watson	\$3,859
Don Yeager	\$49,513
Salary Total	\$260,693

Table 3. Salary expenses supported by the MNTC for FY14.

MNTC Salary & Benefits Detail	Salary	Fringe	Total
Curt McKenna	8,087.38	2,929.53	11,016.91
Wendy Metcalf	1,666.73	719.26	2,385.99
Evgenia Moiseeva	55,517.31	12,235.40	67,752.71
Mary Watson	7,386.74	1,658.44	9,045.18
TOTAL	72,658.16	17,542.63	90,200.73



Total Amount of Internal Revenue = \$184,302
Total Amount of External Revenue = \$55,505
Total Amount of Revenue = \$239,808

Figure 1. Internal and external revenue generated by quarter for FY14.

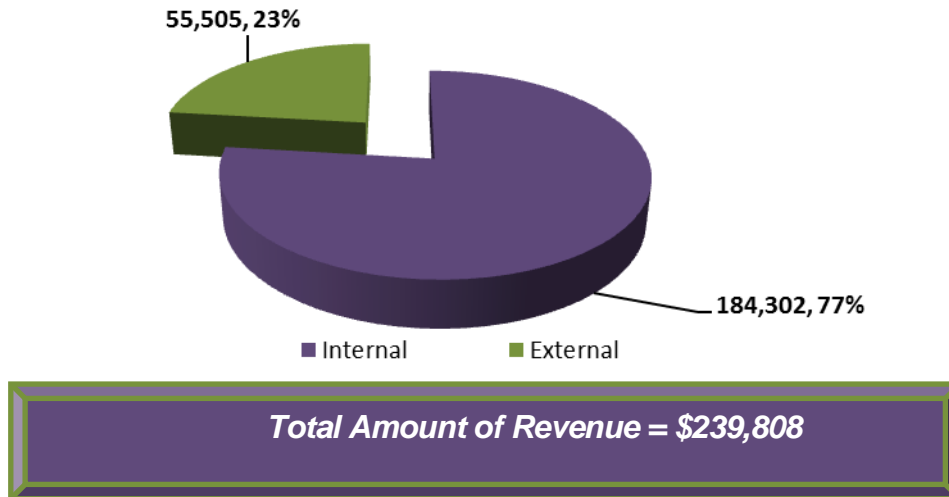


Figure 2. Total internal and external revenue generated for FY14.

Table 4. Internal faculty clients for FY14.

1	Alphenaar	ECE	\$2,495
2	Baldwin	CHEMISTRY	\$3,327
3	Berfield	ME	\$5,179
4	Cardio. Innov. Inst (Drs. Boyd, Hoying & Keller)	MED	\$6,574
5	Cohn	ECE	\$750
6	ECE	ECE	\$6,489
7	Fu	CHEM ENG	\$13,804
8	Giridharan	BE	\$1,555
9	Gutierrez	PHYSICS	\$538
10	Harnett	ECE	\$17,081
11	Keynton	BE	\$7,355
12	McNamara	ECE	\$7,781
13	Mendes	Physics	\$455
14	Naber	ECE	\$160
15	O'Toole	BE	\$5,101
*16	Panchapakesan	ME	\$5,628
*17	Sethu	BE	\$1,555
18	Smadici	Physics	\$735
19	Stucker	IE	\$420
20	Sunkara	CHEM ENG	\$1,281
21	Walsh	ECE	\$92,437
22	Williams	ME	\$1,200
23	Yang	IE	\$540
24	Zamborini	CHEM	\$1,512
25	Zhang	CHEM	\$350
	TOTAL		\$184,302

*Faculty users that left the University.

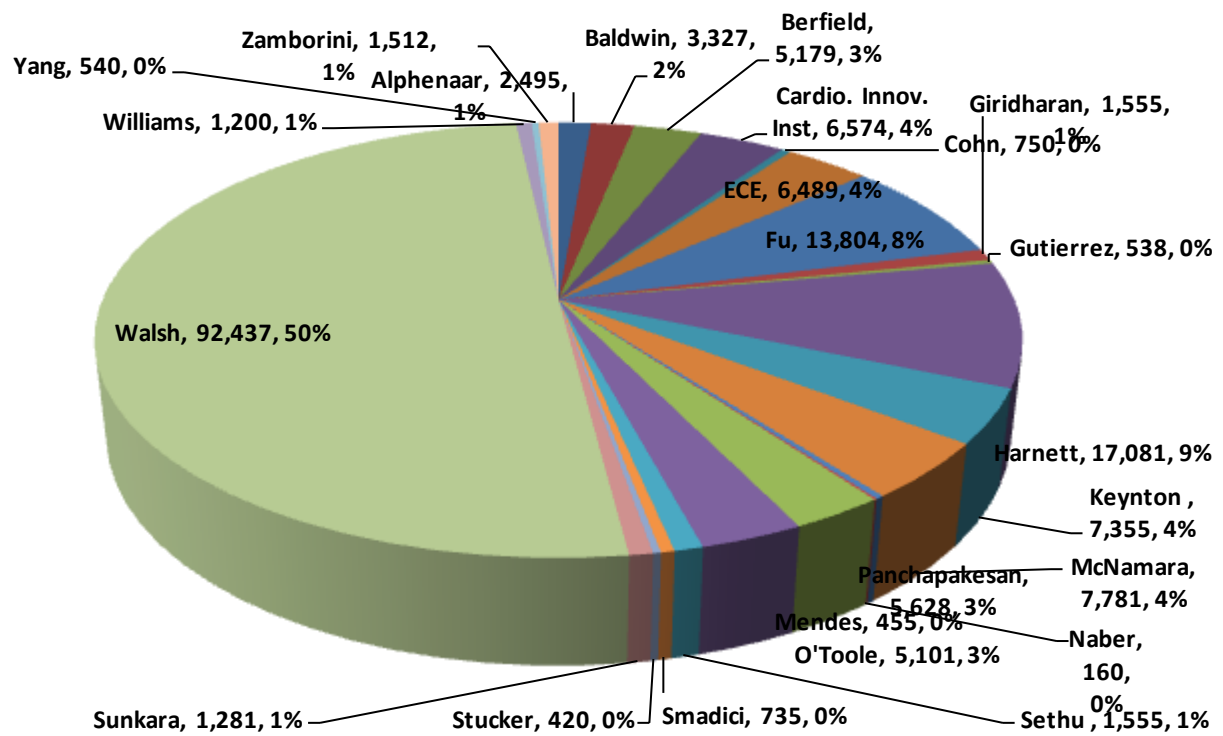


Figure 3. Internal clients by amount and percentage for FY14.

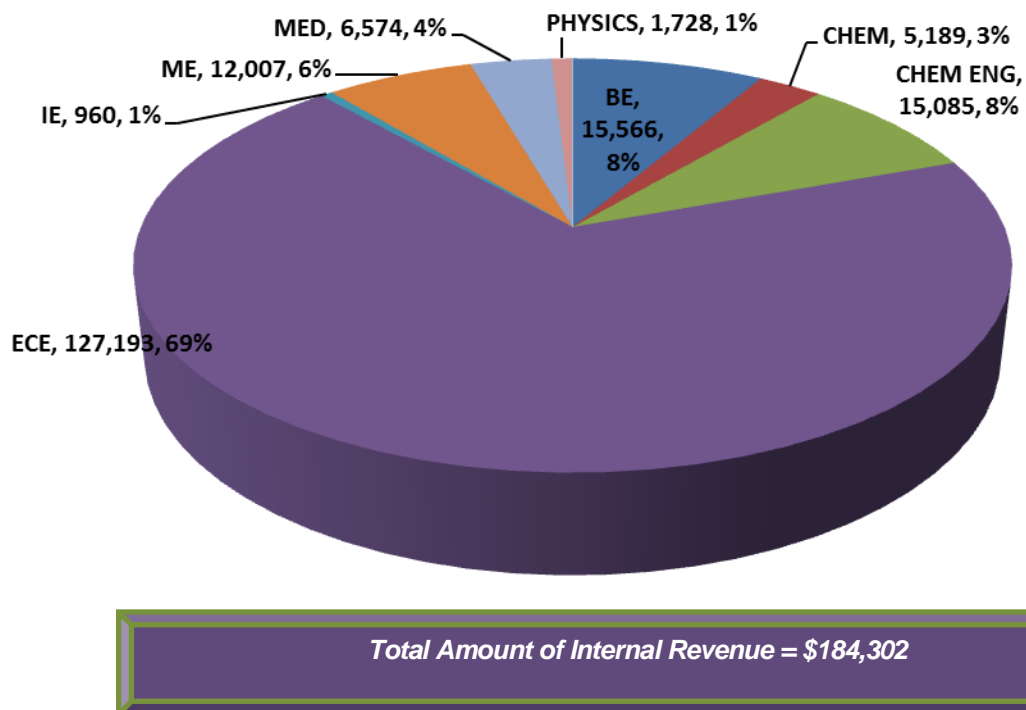
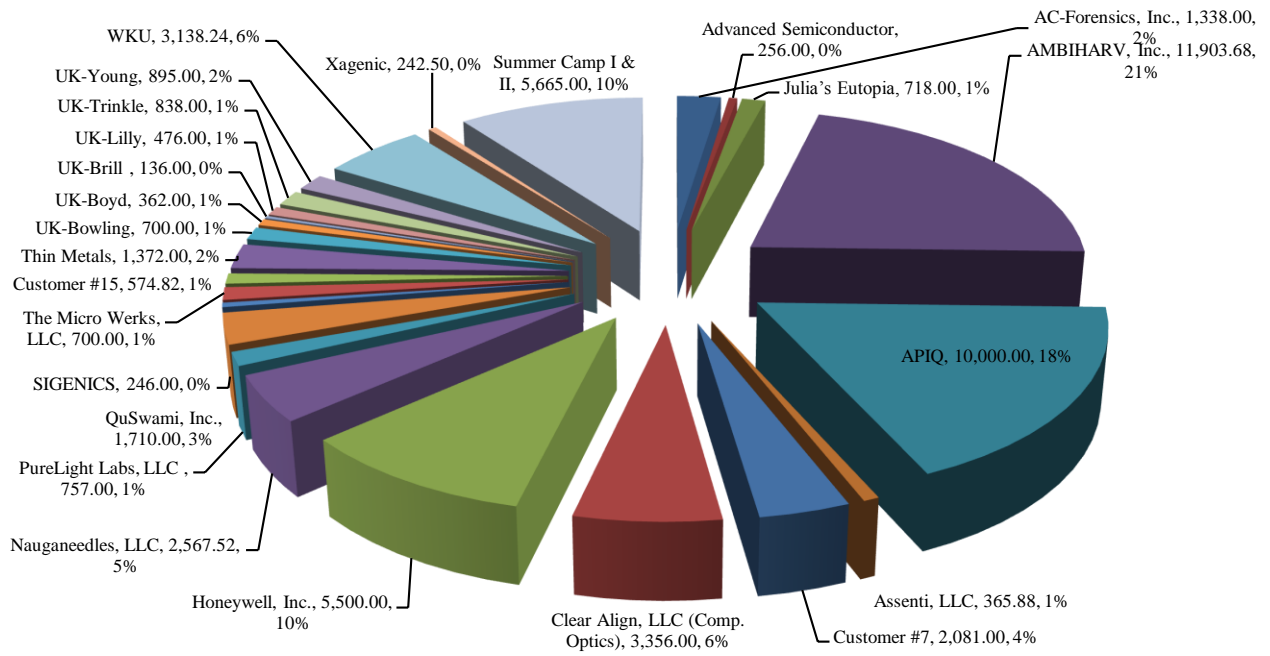


Figure 4. Internal revenue from departments by amount and percentage for FY14.

Table 5. External revenue for FY14.

1. AC-Forensics, Inc.	1,338.00
2. Advanced Semiconductor	256.00
3. Julia's Utopia	718.00
4. AMBIHARV, Inc.	11,903.68
5. APIQ	10,000.00
6. Assenti, LLC	365.88
7. Customer #7	2,081.00
8. Clear Align, LLC (Comp. Optics)	3,356.00
9. Honeywell, Inc.	5,500.00
10. Nauganeedles, LLC	2,567.52
11. PureLight Labs, LLC f	757.00
12. QuSwami, Inc.	1,710.00
13. SIGENICS	246.00
14. MicroWerks, LLC	700.00
15. Company #15	574.82
16. Thin Metals	1,372.00
17. UK-Bowling	700.00
18. UK-Boyd	362.00
19. UK-Brill	136.00
20. UK-Lilly	476.00
21. UK-Trinkle	838.00
22. UK-Young	895.00
23. WKU	3,138.24
24. Xagenic	242.50
25. Summer Camp I & II	5,665.00

Total Amount of External Revenue = \$55,505



Total Amount of External Revenue = \$55,505
(less credit card charges of \$393)

Figure 5. External clients by amount and percentage in FY14.

Table 6. A summary of internal users for FY14.

Faculty Advisors	Department	Students/Post Docs/Researchers	
Dr. Bruce Alphennar	ECE	Abeyweera	Buddika K
Dr. Richard Baldwin	CHEM	Beharic	Jasmin
Dr. Thomas Berfield	ME	Benken	Alex
Cardiovascular Innovation Institute	School of Med	Boden	Seth
Dr. Brad Keller		Chen	Jubin
Dr. Robert Cohn	ECE	Crain	Mark
Electrical & Computer Engineering	ECE	Cuba Garcia	Vasili
Dr. Xiaoan Fu	CHEM ENG	Faiz	Abderrazzak
Dr. Guru Giridharan	BE	Fan	Xiaoming
Dr. Humberto Gutierrez	PHYSICS	Gu	Hengfeng
Dr. Cindy Harnett	ECE	Hoveyda	Marashi Seyedeh
Dr. Angelique Johnson	ECE	Khosravi	Farhad
Dr. Robert Keynton	BE	King	Benjamin C.
Dr. Shamus McNamara	ECE	Larin	Alexander
Dr. Sergio Mendes	PHYSICS	Li	Mingxiao
Dr. John Naber	ECE	Lin	Ji-Tzuoh (George)
Dr. Martin O'Toole	BE	Loeian	Seyed Masoud
Dr. Balaji Panchapakesan	ME	Lucas	Thomas
Dr. Palaniappan Sethu	BE	Marei	Mohamed
Dr. Serban Smadici	PHYSICS	Martin	Michael D.
Dr. Brent Stucker	IE	Nguyen	Dung M.
Dr. Mahendra Sunkara	CHEM ENG	Ogunwale	Mumiye A,
Dr. Kevin M. Walsh	ECE	Porter	Daniel
Dr. Stuart Williams	ME	Ratnayake	Dilan
Dr. Li Yang	IE	Rinehart	Sean M
Dr. Francis Zamborini	CHEM	Schneider	Joseph
Dr. Xiang Zhang	CHEM	Senousy	Yehya
		Smith	Daniel
		Smith	Scott
		Sun	Xinghua
		Trada	Hiren V.
		Yuan	Hanwen
		Zhang	Shanshan
		Zhu	Li

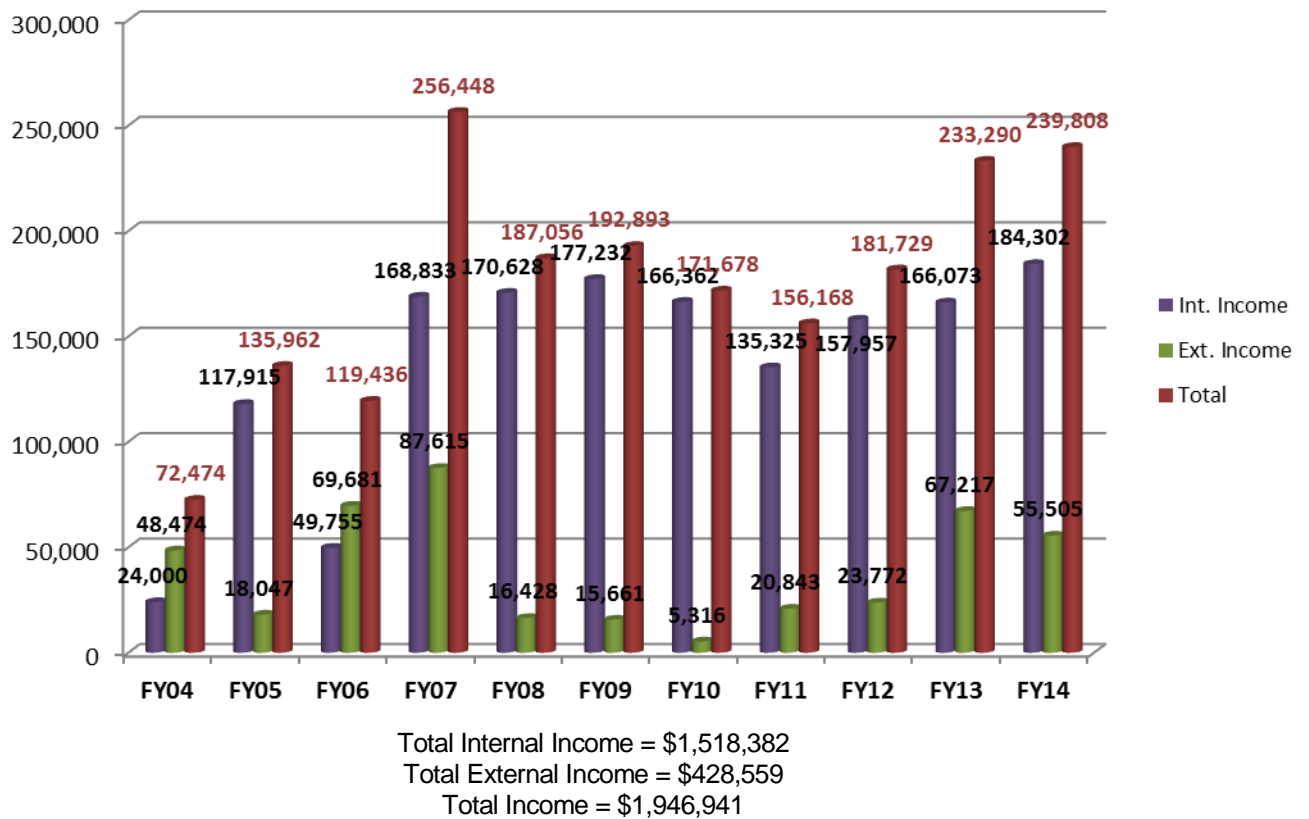


Figure 6. Annual comparison of internal and external income from FY04 through FY14.

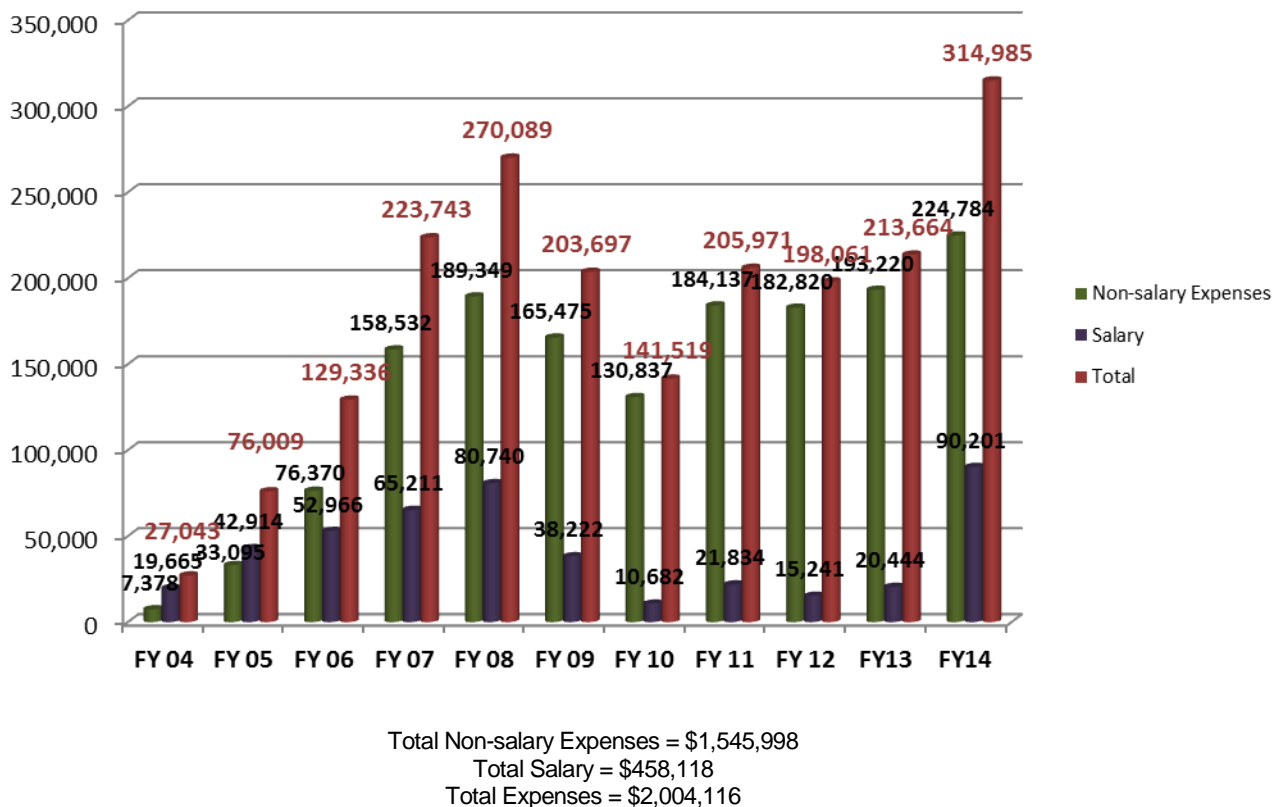


Figure 7. Annual comparison of operational and salary expenses for FY04 through FY14.

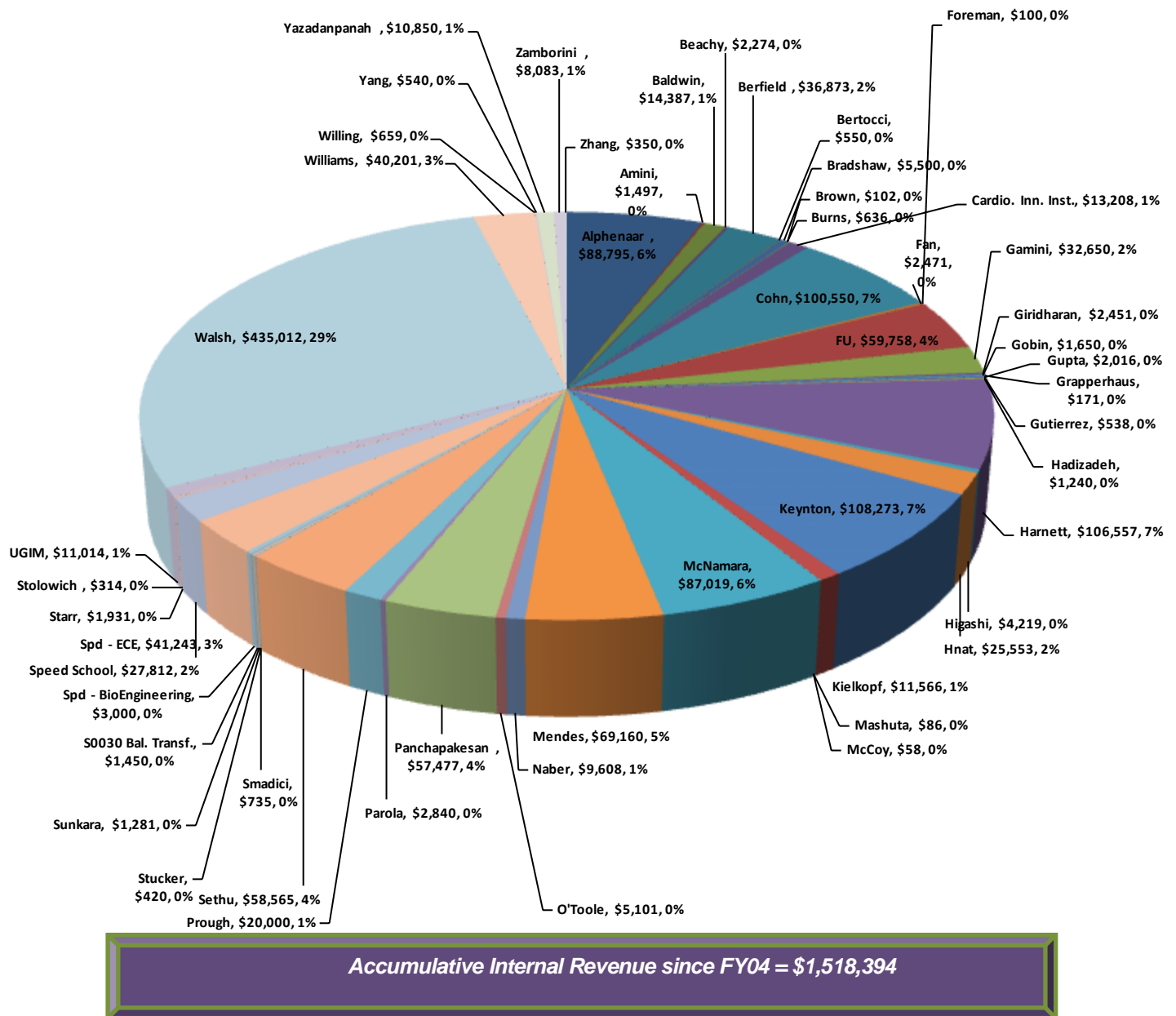
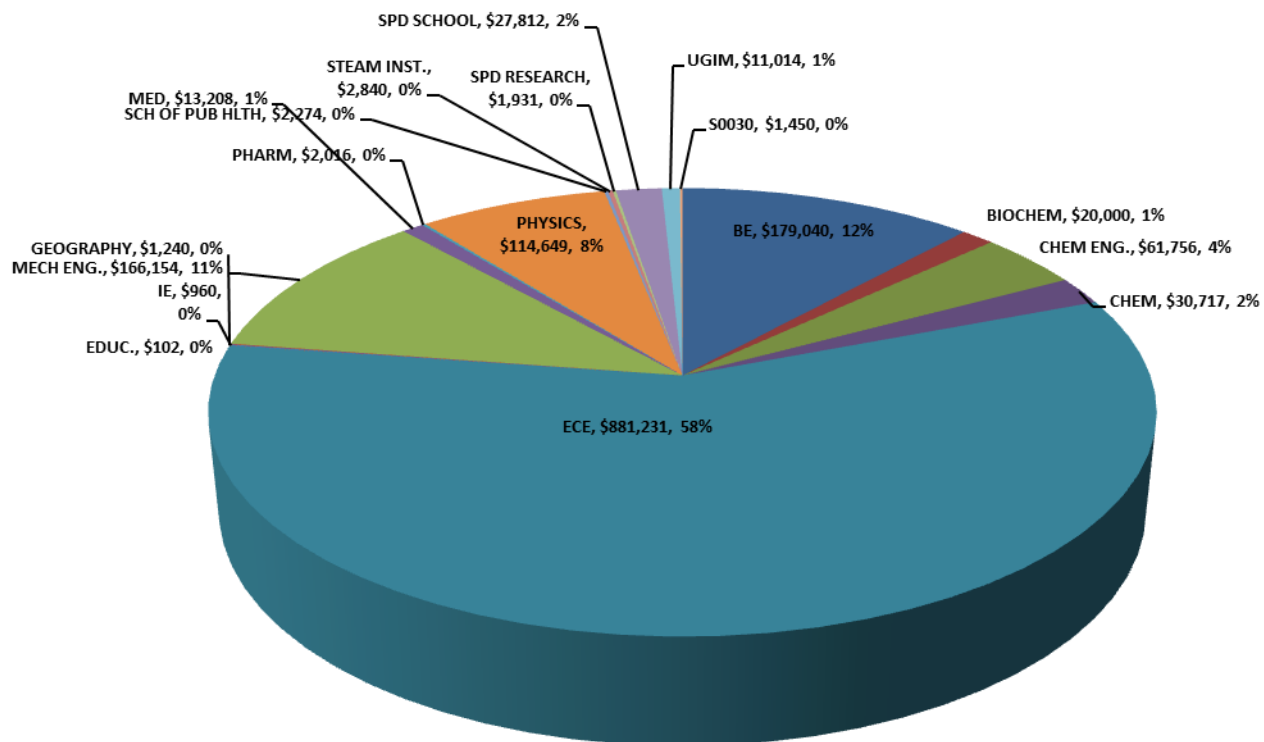


Figure 8. Accumulative income from internal clients from FY04 through FY14.



Total Accumulative Internal Revenue since FY04 = \$1,518,394

Figure 9. Accumulative internal income by department from FY04 through FY14.

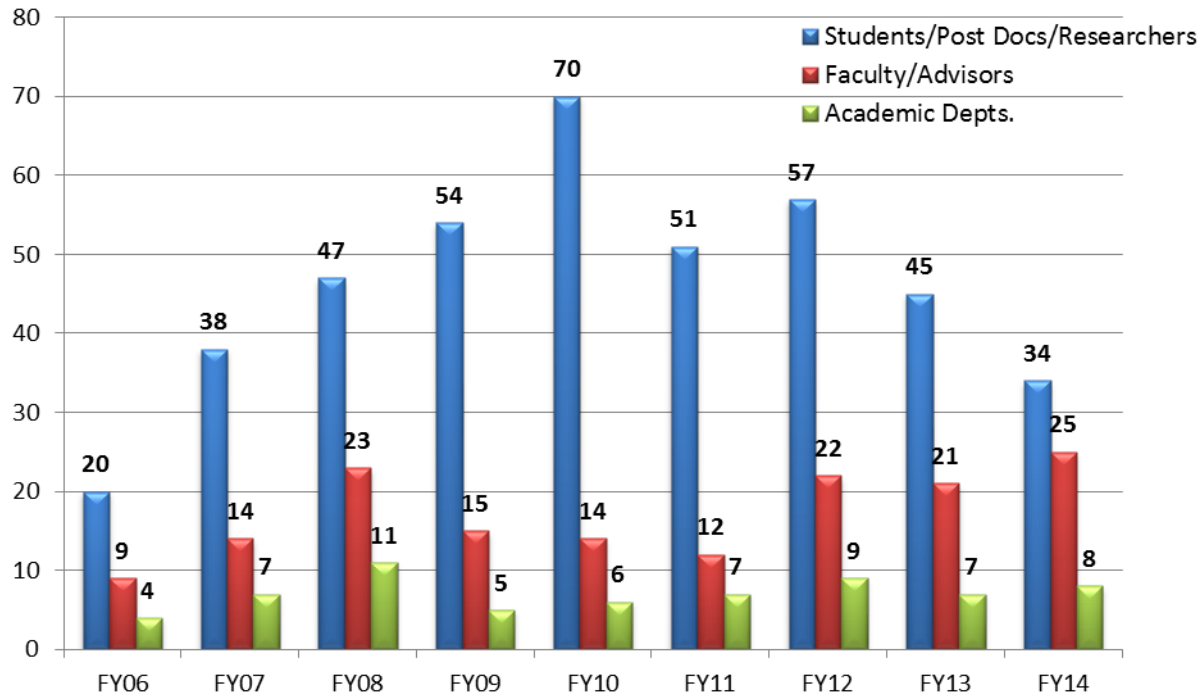
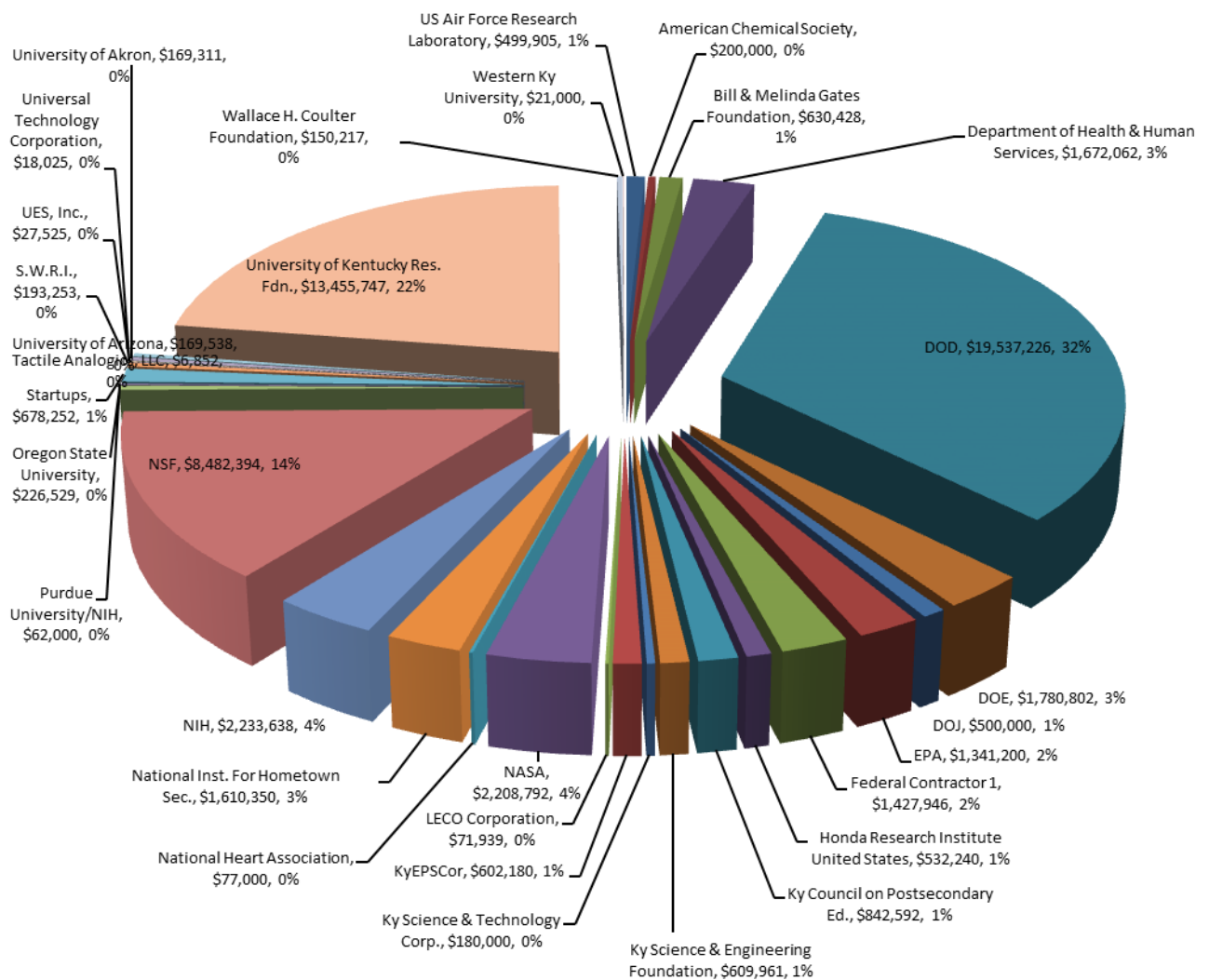


Figure 10. Cleanroom access from FY06 through FY14.

Table 7. Cleanroom access from FY06 through FY14

	Students/Post Docs/Researchers	Faculty/Advisors	Academic Depts.
FY 06	20	9	4
FY 07	38	14	7
FY 08	47	23	11
FY 09	54	15	5
FY 10	70	14	6
FY 11	51	12	7
FY 12	57	22	9
FY 13	45	21	7
FY 14	34	25	8



Total Grant Dollars: \$60,218,905

Figure 11. Accumulative grant funding utilizing the MNTC from October 2001 through FY14.

Table 8. U of L sponsored research utilizing the MNTC in FY14.

FY14	Speedtype	Funding Source	Grant Agency	Fac.	PI	Dept	Title	Start Date	End Date	Total Grant Dollar Amount	Total Amt to the MNTC
Alphenaar	GB090532	Grant	NSF	Alphenaar	Alphenaar	ECE	Enhancement of Exciton Dissociation in Organic Solar Cell	9/1/2009	8/31/2013	339,048.00	2,425.00
Berfield	GB110924	Grant	NSF	Berfield	Berfield	ME	Micro-Patterning Through Mechanics and Cracking of Drying	9/1/2011	8/31/2014	250,000.00	3,864.00
Cohn	GB110749B1	Sub-Cont	Wallace H Coulter Foundation	Cohn	Cohn	ECE	Shape Adaptive Therapy to Treat Tumors	7/1/2013	10/31/2014	150,216.75	750.00
Fu	GB111304	Grant	Bill & Melinda Gates Foundation	Fu	Graham	Microbiology	Disposable sampling plate andf breath test to identify	10/13/2011	4/15/2014	480,210.89	1,736.00
Fu	GB111304B	Grant	Bill & Melinda Gates Foundation	Fu	Graham	Microbiology	Disposable sampling plate andf breath test to patients	10/13/2011	12/31/2013	48,400.00	10,293.00
Fu	GB120302	Grant	NSF	Fu	Fu	Chemical Eng.	A Chemoselective Microreactor Device for Trace Carbonyl	8/15/2012	7/31/2015	299,952.00	1,775.00
Harnett	GB101062	Grant	Oregon State University	Harnett	Harnett	ECE	Characterizing the Phytoplankton Component of Oceanic Pa	9/1/2010	7/31/2013	226,529.00	1,091.00
Harnett	GB110782	Grant	Kentucky Science & Engineering Fdn.	Harnett	Harnett	ECE	Emerging Ideas: Light-Powered Hybrid Microactuators for	7/1/2011	9/30/2014	90,000.00	5,641.00
Harnett	GB120654A	Grant	University of KY Res Fdn	Harnett	Gobin	BE	Engineering Platforms for Exploring Cellular (State)	9/3/2011	8/31/2013	196,062.00	3,713.00
McNamara	GB111027	Grant	NSF	McNamara	McNamara	ECE	Nano-Porous Thermoelectric Based Knudsen Gas P	9/1/2011	8/31/2014	289,249.00	2,535.00
McNamara	GB120654A	Grant	University of KY Res Fdn	McNamara	Gobin	BE	Engineering Platforms for Exploring Cellular (State)	9/3/2011	8/31/2013	196,062.00	2,399.00
McNamara	CS140883	Cost Share	Tactile Analogics, LLC	McNamara	McNamara	ECE	Pneumatic Valve Array	4/1/2014	6/30/2014	2,284.00	675.00
McNamara	IB140883	Contract	Tactile Analogics, LLC	McNamara	McNamara	ECE	Pneumatic Valve Array	4/1/2014	6/30/2014	6,852.00	1,875.00
Panchapakesan	GB110376	Grant	NIH	Panchapakesan	Panchapakesan	ME	Nanotube Antibody for Profiling Circulating Disease	8/9/2011	7/31/2014	422,722.00	1,120.00
Panchapakesan	GB120456	Grant	NSF	Panchapakesan	Panchapakesan	ME	GOAL 1: High Aspect Ration Nano-Needle Integrated Standin	6/1/2012	5/31/2015	353,004.00	1,660.00
Panchapakesan	GB121045	Grant	NSF	Panchapakesan	Panchapakesan	ME	Scalable Nanomanufacturing of nano-carbon based composite	9/1/2012	8/31/2016	353,054.00	946.00
Stucker	GB121051	Grant	NSF	Stucker	Stucker	IE	Collaborative Research: Modeling and Characterization	8/1/2012	7/31/2015	249,735.00	420.00
Walsh	GB120662	Grant	University of KY Res Fdn	Walsh	Walsh	ECE	(FEDERAL) KY nanoNet: A Statewide Integrative Micro/Nano	9/1/2008	8/31/2014	782,482.00	7,479.00
Walsh	IB111308	Contract	Federal Contractor 1	Walsh	Walsh	ECE	MEMS Sensor Research	1/9/2012	9/9/2014	1,427,946.00	70,093.50
Walsh	IB130440	Contract	Universal Technology Corporation	Walsh	Walsh	ECE	Photonic Heterodyne Detector	11/16/2012	8/15/2013	18,025.00	6,822.16
Walsh	IB140697	Contract	UES, Inc	Walsh	Walsh	ECE	Investigation of Germanium-on-Silicon Photonics	2/5/2014	2/4/2015	27,525.00	2,743.11
Zamborini	GB110497	Grant	American Chemical Society	Zamborini	Zamborini	Chemistry	Electrochemically Controlled Alkene Binding Affinity Of	8/1/2011	8/31/2014	100,000.00	642.00
Zamborini	GB130558	Grant	NSF	Zamborini	Zamborini	Chemistry	Exploring the Unique Electrochemical Reactivity of Metal	9/15/2013	8/31/2016	390,000.00	870.00
										6,699,358.64	131,567.77