COLLEGE OF
COMPUTER, MATHEMATICAL,
& NATURAL SCIENCES

Imaging Core Annual Report FY2019

Dr. Charles Delwiche and Amy Beaven

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Executive Summary

The Imaging Core (IC) plays a key role in research, training, and education in the life sciences at UMD. In FY19 alone, 57 laboratories from 14 departments in 4 colleges (CMNS, AGNR, ENGR, BSOS), plus 2 off-campus users (Weinberg Medical Physics and the Geneva Foundation) used the facility's high-end light microscopes, as did students in the undergraduate course BSCI421 and the FIRE program. During the past year, the director trained 55 new researchers to independently operate the IC's microscopes, bringing the total number of trained users since FY05 to 854. Access to the facility's microscopes and high-quality training has directly resulted in at least 167 publications (see Appendix 4).

In FY19, total income collected via charge-backs from all microscopes exceeded facility expenses by $25,576. This surplus is due to a number of factors, including: 1) the Advisory Committee directed the IC to purchase a lower-cost ($9,180 versus $17,461) service contract on the DeltaVision starting in FY18 (a savings of $8,281), 3), the director negotiated with Leica to lower the service contract cost by $2,781, 4) the IC raised hourly rates by $2 on the confocal and DeltaVision and by $5 on the AxioObserver and Nikon scopes beginning February 1, 2018 (again, as per the Advisory Committee) and 5) use of the IC's instruments remains just below FY18's historically high level (Figure 1). FY19 marks the second year in a row that the Leica SP5x collected enough income from charge-backs to pay for both the microscope service contract and the (exceedingly expensive) contract on the white light laser.

If rates remain unchanged and microscope use stays at FY19 levels, the IC account balance will slowly increase. However, as the instruments continue to age, we predict expenses will increase beyond current average levels due to wear and tear on parts and instruments that are not covered under service contracts, including all the various heavily-used objective lenses and, on the Deltavision, the light source and sCMOS camera, which are not covered under the less expensive service contract. In addition, if the IC receives funding to purchase a new confocal (see #2 below), the IC will need to purchase a number of peripheral items for the system including network attached storage, a computer table, and an uninterrupted power supply.

Looking to the future, the IC's two confocals (purchased in 2008 and 2009) will soon become obsolete. Meanwhile, the number of new, high-end microscopes on campus has steadily been increasing, in part due to the IC director's involvement in the acquisition, management, and installation of the PerkinElmer spinning disk, ASI diSPIM lightsheet, and JPK AFM systems for the Imaging Incubator. If the IC is to remain competitive, solvent, and self-sustaining, the director suggests we take the following actions:

1. Maintain current rates in FY20, in spite of the surplus in FY19.
2. Obtain funding for a new, state-of-the-art, confocal microscope. The director started this process in May 2017 by submitting an NIH S10 Shared Instrumentation Grant for a Zeiss LSM 880 Airyscan fast laser scanning confocal microscope. The proposal was not funded, but was resubmitted in May 2018. It received a score of 20, with positive reviews including, "all the reviewers had outstanding enthusiasm for this application, with the instrument expected to have high impact on the users' research productivity". It was recommended for funding by the Program Official in March 2019 and is currently pending administrative review.

Implementing some or all of these recommendations will ensure the IC remains a valuable imaging resource for years to come.

Facility Mission

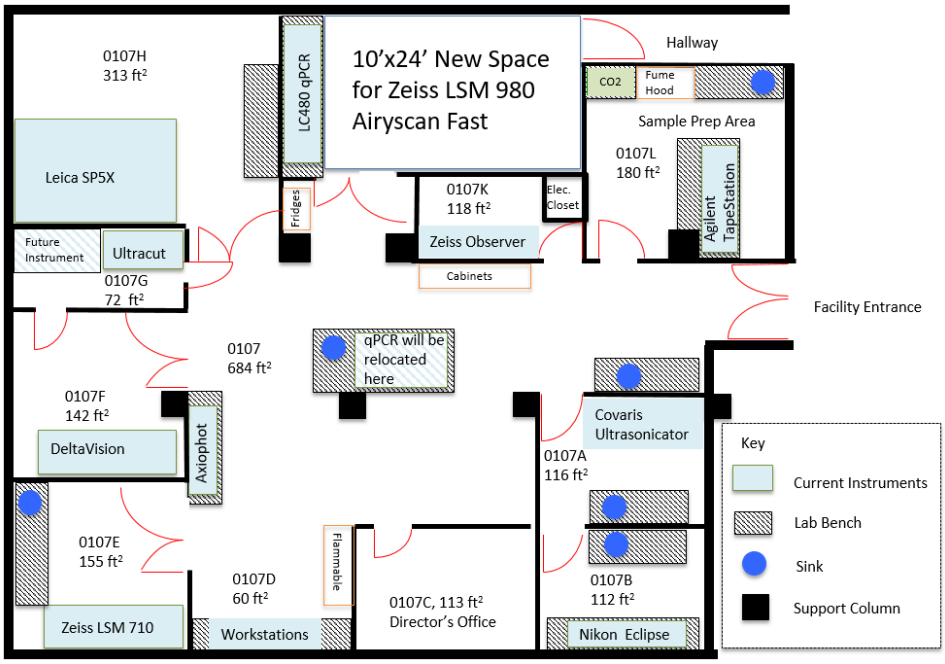
The mission of the Imaging Core (IC) is to enhance research and education by:

1. Providing access to state-of-the-art light microscopy and imaging instrumentation.
2. Offering detailed training opportunities and support in basic and advanced light microscopy techniques.
3. Keeping researchers up to date with the latest technology and innovations in light microscopy.

Introduction/History

The Imaging Core (IC) was established in the year 2000 by the Department of Cell Biology and Molecular Genetics in order to enhance research and education at the University of Maryland. It provides students and faculty members with access to sophisticated light microscopes and imaging instrumentation whose purchase and maintenance costs far exceed the budgets of individual investigators.

The IC facility is located in 0107 Microbiology building, and includes 10 rooms, five of which are dedicated microscope space, office space for the Director, and a wet-bench lab space with fume hood. When first established, the IC contained a single confocal microscope and a deconvolution microscope. Over the years, demand for time on the instruments increased dramatically, necessitating the purchase of a second confocal in 2008. At present, the IC contains 2 laser scanning confocal microscopes (a Zeiss LSM710 and Leica SP5X), a DeltaVision deconvolution/TIRF microscope (installed in March 2014), a Zeiss AxioObserver fluorescence microscope (acquired in February FY14), a Zeiss Axiophot brightfield microscope, and a Nikon Eclipse upright microscope with color camera (transferred to the facility in October 2016).



In December 2014, a PerkinElmer spinning disk confocal microscope was purchased and installed in the Physical Sciences Complex, and became the first instrument in the new Imaging Incubator facility.

Following that, an ASI diSPIM was installed in April 2017, and a JPK NanoWizard 4a BioAFM in October 2017. The Director of the IC managed these instruments until transferring all responsibilities to the new Director of the IC, Stephan Brenowitz (hired in July 2017). Dr. Brenowitz left the position in April 2019. A search is open for a Lab Manager position to replace him.

The Director of the IC, Amy Beaven, oversees the routine operation of the IC and is available during normal business hours to provide training on all equipment, guidance on experimental design, assistance with image analysis, and technician-assisted microscope operation. Since taking over operation of the IC in November 2005, Ms. Beaven has trained over 799 researchers from at least 13 different departments in six colleges and three different campuses (UMCP, UMB, Shady Grove, Salisbury) of the University of Maryland.

The IC is used by a diverse group of investigators, including undergraduates, graduate students, post-docs, technicians and faculty. In addition, students enrolled in the annual 2-credit class CBMG688W/BSCI427, Principles of Microscopy, gained hands-on experience in the operation of the IC's brightfield, DeltaVision and Leica SP5X confocal microscopes until the fall of 2017, when Professor Stephen Wolniak retired. The course trained an average of fifteen students each year for over eleven years.

In the past, funding for the IC came from a combination of user fees and support from the University of Maryland. In an effort to become self-sustaining, trends in facility income, expenses and instrument usage were analyzed over time (the details of which are published in IC's FY10-18 Annual Reports). The analysis showed that a gradual increase in hourly instrument rates were necessary in order for the facility to become financially independent. As such, user fees were incrementally increased over several years in the hopes that the IC would be able to cover all maintenance and service contract costs through user fees alone. It should be noted that current instrument fees are priced competitively and still below the average rates charged at similar institutions with equivalent instrumentation (see Appendix 5).

Please see Appendix 3 for a complete list of current instrumentation, and Appendix 2 for changes in IC instrumentation since FY05.

Organizational Structure and Governance

- Director of the Facility: Amy Beaven
- Faculty supervisor: Dr. Charles Delwiche, Professor
- Advisory Committee: Kevin McIver, Professor (Chair), Charles Delwiche, Professor (CBMG), Jose Feijo, Professor (CBMG), Antony Jose, Professor (CBMG), Iqbal Hamza, Professor (ANSC), Wolfgang Losert, Professor (PHYS/IPST), Olscan Hollister (CMNS Dean's Office).

Personnel

The Director of the Facility, Amy Beaven, is the only full-time staff member within the facility. She was hired in 2005 to manage the Imaging and Genomics Core facilities and was promoted to Director in 2010. Ms. Beaven received her Master's degree in Biology in 1999 and has over 15 years of intensive experience in imaging techniques, including laser scanning confocal, spinning disk confocal, deconvolution, and TIRF. She is available during the hours of 8am-4:30pm to provide guidance in experimental design, training on all equipment, technician-assisted confocal operation and assistance with image analysis.

Outreach Activities During FY19

1. July, 2019: the director of the IC continued to assist BioENGR/IBBR with their Zeiss LSM 700 system by training students how to use the scope, including proper use of an objective lens inverter.
2. October 2018: the director of the IC organized and hosted a SyGlass virtual reality software demo.
3. October 2018: the director represented the IC by participating in a meeting with the VPR's office to explore Agilent iLab Core Management software.
4. October-December 2018: the IC director completed 7 classes of the LDI Foundations of Leadership and Development.
5. November 2019: the IC took over management of a Covaris Ultra-sonicator, which was relocated to the IC from the IBBR Sequencing Core.
6. January 18, 2019: the IC director participated in an ASI diSPIM alignment session with members of the Losert lab and Drs. Hari Shroff and Harsh Vishwasrao.
7. January 30- February 6, 2019: The IC organized and hosted a Leica SP8 confocal with Lightning super resolution demo.
8. February 2019: the IC director gave members of MRI Global a tour of the IC and participated in a discussion regarding possible collaborations with the campus.
9. February 11-14: The IC organized and hosted a Zeiss AxioScan Z.1 automated slide scanner demo.
10. February-March 2019: the IC director submitted JIT for the NIH S10 Zeiss LSM 880 Airyscan Fast proposal, which was subsequently recommended for funding by the Program Officer. Because NIH would not fund the offline computer workstation, the IC director worked with the Chairs of CBMG and Biology, the assistant Dean of CMNS, and the VPR's office to obtain a Letter of Support for matching funds, which was submitted with the JIT.
11. March 2019: the IC director participated in several troubleshooting sessions with Baltimore Precision Instruments to assist Dr. Stephan Brenowitz (director of the Imaging Incubator) with problems related to the PerkinElmer system.
12. March 2019: the director of the IC trained teaching assistants in BSCI421 (Cell Biology) to use Zeiss AxioObserver and Nikon Eclipse so that they could assist undergraduate students to take images for their laboratory experiments. The director also gave the class a tour of the facility.
13. March 4-14, 2019: The IC organized and hosted a Nikon CSU-W1 spinning disk confocal SoRa superresolution demo.
14. March 22, 2019: the IC director took back over management of the Imaging Incubator from Dr. Stephan Brenowitz.
1. May 31, 2019: The director coordinated with NIH-funded faculty in CBMG, Biology, ANSC, and Physics to resubmit an NIH S10 Shared Instrumentation Grant for the purchase of a new Zeiss LSM 980 Airyscan Fast as a backup plan in case the 2018 proposal is not funded.
15. May 28, 2019: the IC director coordinated installation/training of a new Agilent TapeStation instrument.

Summary of Facility Usage

Starting in FY18, the director began tracking both the billable hours for each instrument, as well as the actual hours each instrument was scheduled/booked and therefore unavailable to other users in order to collect more accurate usage data (Tables 1-2).

In FY19, the Zeiss LSM710 was scheduled an average 27 hours/week and Leica SP5X was used 26 hours/week. The combined average usage of 53 hours/week is a 5% decrease from FY18.

A total of 57 laboratories from 14 departments in 4 colleges (CMNS, AGNR, ENGR, BSOS), plus 2 off-campus users (Weinberg Medical Physics and the Geneva Foundation) used the facility's high-end light microscopes, as did students in the undergraduate course BSCI421 and the FIRE program. During the past year, the director trained 55 new researchers to independently operate the IC's microscopes, bringing the total number of trained users since FY05 to 854.

Table 1: Leica SP5X Summary Data:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2009	$5,091	346	N/A	0	39
2010	$18,363	1283	N/A	71	43
2011	$24,290	1325	N/A	56	35
2012	$21,882	1021	N/A	63	29
2013	$21,922	932	N/A	91	35
2014	$25,161	886	N/A	71	34
2015	$25,576	1206	N/A	39	27
2016	$35,865	1602	N/A	36	17
2017	$31,802	1153	N/A	6	20
2018	$49,599	1569	1720	0	28
2019	$39,378	1212	1346	0	9
Total	**$259,552**	**12534**	**N/A**	**433**	**316**

Table 2: Zeiss LSM710 Summary Data:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2010	$12,370	804	N/A	0	44
2011	$33,448	1762	N/A	0	33
2012	$27,895	1244	N/A	0	20
2013	$33,889	1248	N/A	0	26
2014	$31,471	1174	N/A	1.5	17
2015	$27,655	964	N/A	6.5	22
2016	$32,847	1021	N/A	7	20
2017	$26,055	688	N/A	29	30
2018	$35,400	1091	1192	0	13
2019	$42,551	1280	1398	0	18
Total	**$303,581**	**11452**	**N/A**	**44**	**243**

Table 3: DeltaVision Summary Data:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2014	$317	32	N/A	0	12
2015	$6472	376	N/A	24	13
2016	$6,824	270	N/A	33	20
2017	$7267	270	N/A	20	21
2018	$12,674	423	486	0	6
2019	$8,611	281	338	0	3
Total	**$33,554**	**1649**	**N/A**	**77**	**75**

Table 4: AxioObserver Fluorescence Microscope Data:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2014	$113	23	N/A	0	0
2015	$790	155	N/A	0	1
2016	$1,086	198	N/A	0	5
2017	$2066	319	N/A	0	22
2018	$975	117	130	36	8
2019	$1,338	113	141	57	9
Total	**$5,030**	**812**	**N/A**	**85**	**45**

Table 5: Nikon Eclipse Microscope Data:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2017	$103	16	N/A	0	1
2018	$1025	90	101	7	7
2019	$2045	168	196	9	8
Total	**$1128**	**106**	**N/A**	**16**	**16**

Table 6: Combined Microscope Data by Fiscal Year:

Fiscal Year	Income	Total # Hours Charged	Total # Hours Booked	Hours used for UMCP Courses	Total # Training Sessions
2009	$5,091	346	N/A	0	39
2010	$30,733	2,086	N/A	71	87
2011	$57,739	3,088	N/A	56	68
2012	$49,778	2,265	N/A	63	49
2013	$55,811	2,180	N/A	91	61
2014	$57,061	2,114	N/A	73	63
2015	$60,175	2,700	N/A	70	63
2016	$76,622	3,090	N/A	76	62
2017	$67,194	2,636	N/A	83	93
2018	$100,126	3290	3630	36	62
2019	$90,540	2772	3082	0	30
Total	**$560,330**	**3290**	**N/A**	**619**	**702***

*Including the old Zeiss LSM510, the total # training sessions increases to 854

Figure 1: Total number of hours used on Imaging Core instruments by fiscal year

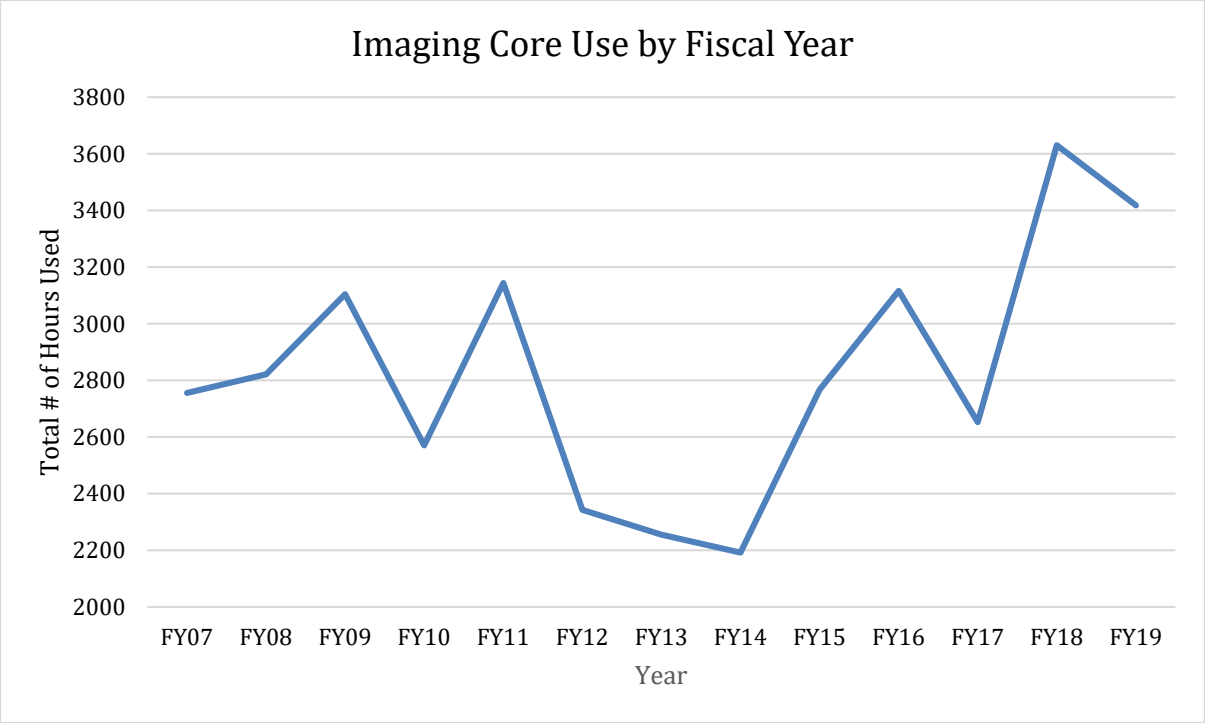


Figure 2: Top Microscope Users by Department FY19

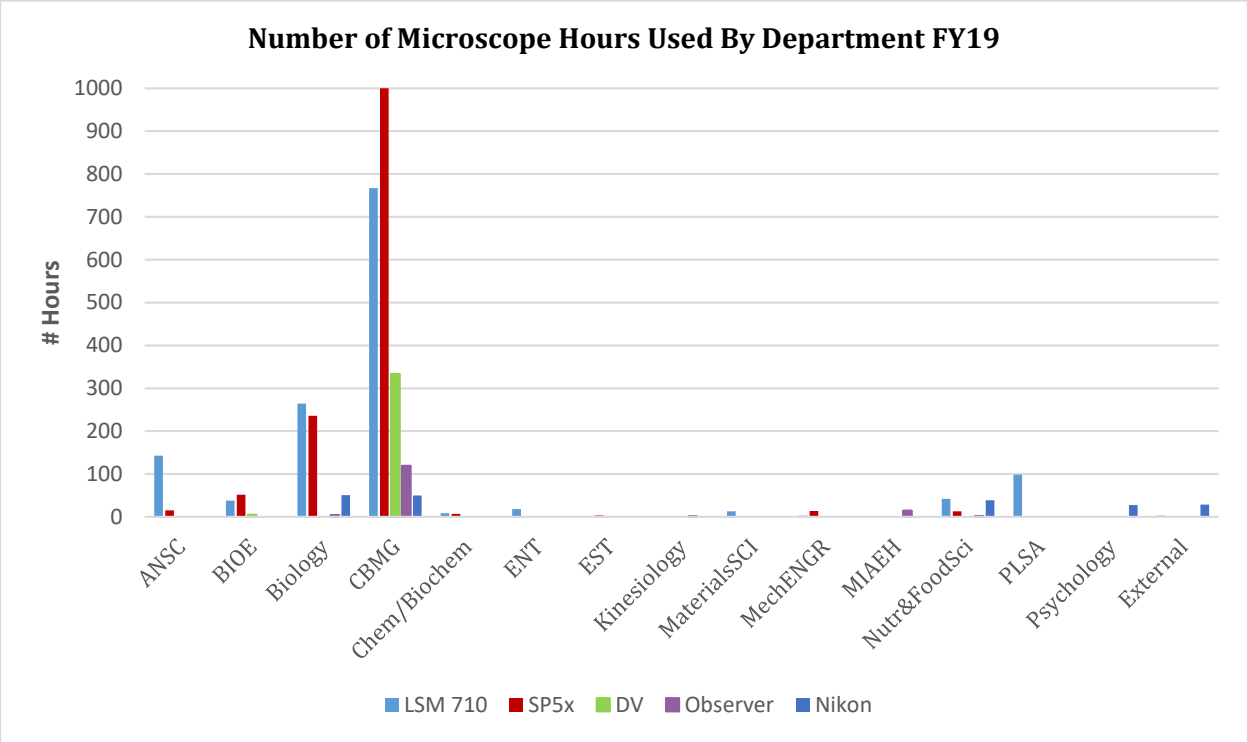


Figure 3: Top Microscope Users FY19

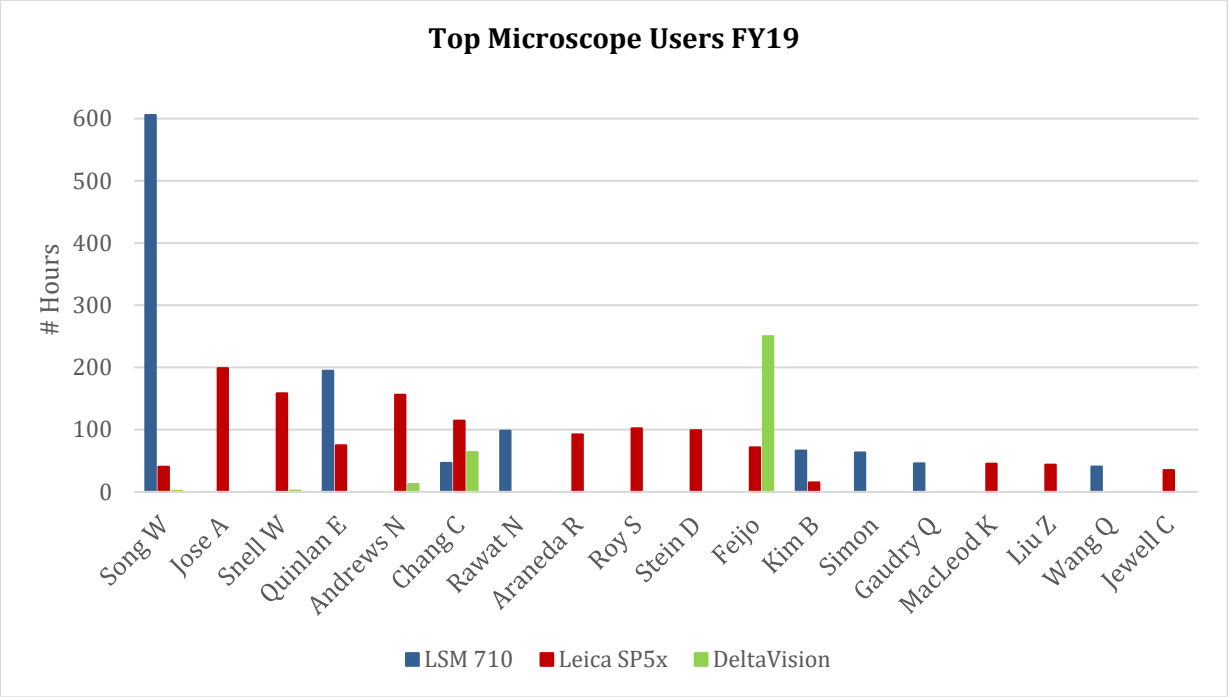


Figure 4: CBMG versus non-CBMG Use of Microscopes FY19

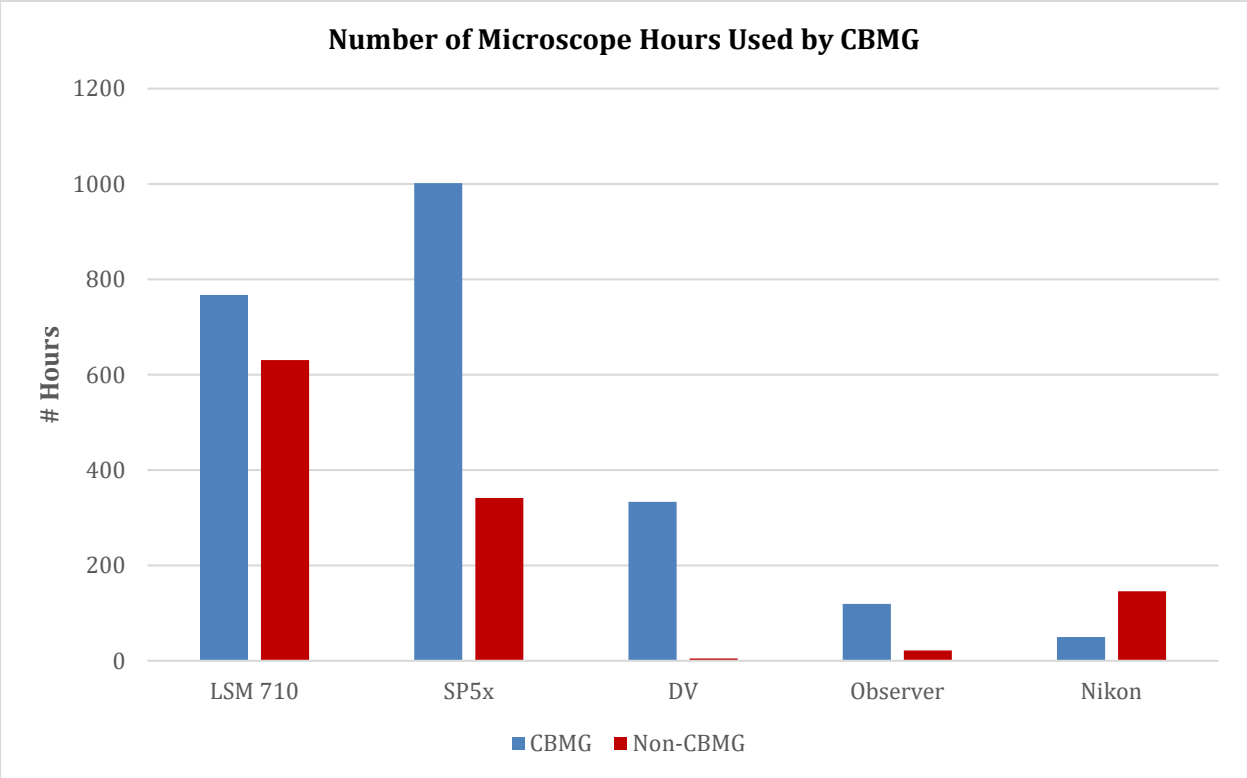
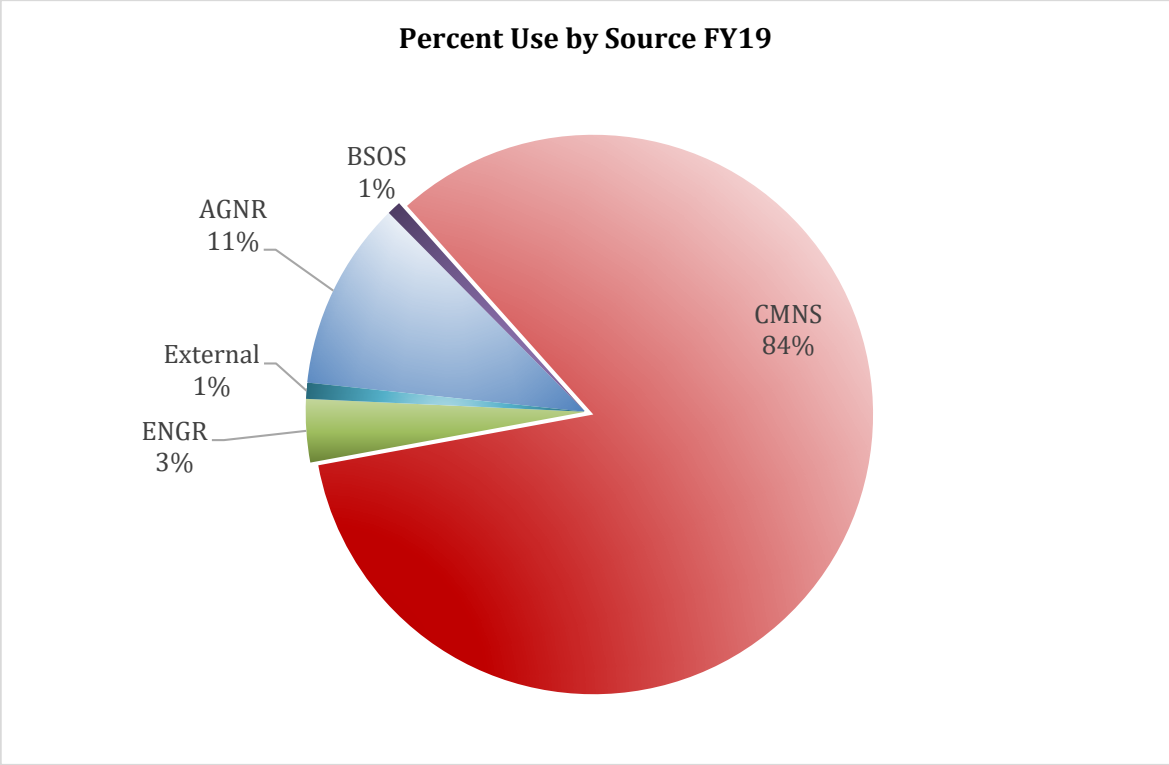


Figure 5: Percent Use by Source FY19



Operating Cost Analysis

In both FY18 and FY19, total income collected via charge-backs exceeded facility expenses. T This surplus is due to a number of factors, including: 1) the Advisory Committee directed the IC to purchase a lower-cost ($9,180 versus $17,461) service contract on the DeltaVision starting in FY18 (a savings of $8,281), 3), the director negotiated with Leica to lower the service contract cost by $2,781, 4) the IC raised hourly rates by $2 on the confocal and DeltaVision and by $5 on the AxioObserver and Nikon scopes beginning February 1, 2018 (again, as per the Advisory Committee) and 5) use of the IC's instruments remains just below FY18's historically high level (Figure 1).

Table 7: FY19 Income and Expenses by Microscope

Instrument/ Source Income	Service contract cost	Consumable Cost	Total Expenses	Income	Income - Expenses
Zeiss LSM 710	$19,969	$707	$20,066	$35,400	$21,874
Leica SP5 X	$36,849	$707	$39,726	$49,600	$1,821
DeltaVision	$9,450	$707	$9,276	$12,674	($1,546)
Zeiss Observer	$0	$707	$96	$975	$631
Nikon Eclipse	$0	$707	$96	$1,025	$1338
LSM700 IBBR	N/A	N/A	N/A	$750	$750
Total	$68,491	$2,828	$69,097	$94,673	$25,576

Table 8: Total Imaging Core Facility Income and Expenses from FY09-FY19

Year	Total Income from Charge-backs*	Total Imaging Core Expenses	Net Balance*
FY2009	$5,091	$6,113	($1,023)
FY2010	$30,732	$29,564	$1,169
FY2011	$57,738	$55,525	$2,214
FY2012	$49,778	$76,562	($26,685)
FY2013	$55,810	$59,673	($3,862)
FY2014	$57,184	$59,876	($2,692)
FY2015	$60,303	$73,955	($13,652)
FY2016	$79,028	$75,544	$3,484
FY2017	$71,458	$80,234	($8,784)
FY2018	$100,126	$69,261	$30,864
FY2019	$94,673	$69,097	$25,967
Total	**$774,423**	**$655,412**	**$6,510.74**

* If instrument income from subsidies associated with the Leica SP5x NSF MRI grant ($37,500 a year in FY10, FY11, and FY12) is included, the net balance for all instrument at the end of FY19 is $119,010. The actual account balance in June of 2019 was $150,660.

Table 9: Cost Breakdown: Leica SP5X

Year	Service Contract Cost	Expenses	Income	Income (subsidies)	Income - Expenses
FY2009	0	$6,113	$5,091	0	($1,023)
FY2010	$26,000	$2,376	$18,363	$37,500	$27,487
FY2011	$36,075	$488	$24,290	$37,500	$25,227
FY2012	$52,296	$2,056	$21,882	$37,500	$5,032
FY2013	$37,092	$1,887	$21,922	0	($17,057)
FY2014	$37,092	$360	$25,160	0	($12,290)
FY2015	$37,743	$51	$25,576	0	($12,218)
FY2016	$37,743	$609	$35,865	0	($2,487)
FY2017	$39,630	$616	$33,158	0	($7,088)
FY2018	$39,630	$96	$49,600	0	$9,873
FY2019	$36,850	$707	$39,378	0	$1282
Total	**$380,180**	**$16,015**	**$298,929**	**$112,500**	**$15,265**

Table 10: Cost Breakdown: LSM 710

Year	Service Contract Cost	Expenses	Income	Income (subsidies)	Income - Expenses
FY2009	0	0	0	0	0
FY2010	0	$1,188	$12,370	0	$11,182
FY2011	$17,730	$1,232	$33,448	0	$14,487
FY2012	$19,260	$2,951	$27,896	0	$5,685
FY2013	$19,260	$1434	$33,889	0	$13,195
FY2014	$19,260	$360	$31,471	0	$12,211
FY2015	$19,755	$51	$27,655	0	$7,848
FY2016	$19,755	$608	$32,847	0	$12,484
FY2017	$19,969	$785	$26,055	0	$5,301
FY2018	$19,969	$96	$35,400	0	$15,334
FY2019	$19,969	$707	$42,551	0	$21,874
Total	**$174,927**	**$9,410**	**$303,581**	**0**	**$119,603**

Table 11: Cost Breakdown: DeltaVision

Year	Service Contract Cost	Expenses	Income	Income (subsidies)	Income - Expenses
FY2014	$0	$739	$371	0	($422)
FY2015	$16,200	$51	$6135	0	($10,097)
FY2016	$16,200	$323	$6,824	0	($9,700)
FY2017	$17,461	$160	$8,623	0	($8,998)
FY2018	$9,180	$96	$12,674	0	$3,397
FY2019	$9,450	$707	$10,157	0	($1,546)
Total	**$68,491**	**$2,077**	**$41,847**	**0**	**($28,721)**

Projected Cost Analysis:

If rates remain unchanged and microscope use stays at FY19 levels, the IC account balance will continue to grow. This projection does not include potential large one-time expenses, such as objective lens replacements (~$2000 - $14,000 depending on the lens), and parts no longer covered under the DeltaVision's more limited service contract (light source and sCMOS camera).

Proposed Rate Schedule:

A thorough examination of confocal microscope rates at other institutions (Appendix 5) shows that the facility's confocal peak rates are priced slightly lower than the average rate of $37/hour, and the DeltaVision's rates are on par with the average. The IC continues to offer highly competitive, low-priced off-peak rates of $24/hr. The director suggests keeping these rates the same in FY19.

Table 12: Suggested Imaging Core Rates for Academic Year 2019

Instrument	UMD Users	External Users
Leica SP5X, Zeiss LSM710, PerkinElmer Spinning Disk, **Hourly Rate for Unassisted Use**	$34/hr peak $24/off-peak	$85/hr
DeltaVision **Hourly Rate for Unassisted Use**	$30/hr peak $24/hr off-peak	$85/hr
Leica SP5X, Zeiss LSM710, DeltaVision, PerkinElmer Spinning Disk **14 hour overnight flat fee, 6pm-8am, M-F**	$150	Inquire
Leica SP5X, Zeiss LSM710, DeltaVision, PerkinElmer Spinning Disk **12 hour day rate (flat fee), 8am-8pm, M-F**	$250	Inquire
Leica SP5X, Zeiss LSM710, DeltaVision, PerkinElmer Spinning Disk **24 hour rate (flat fee), M-F**	$350	Inquire
Leica SP5X, Zeiss LSM710, DeltaVision, PerkinElmer Spinning Disk **24 hour rate (flat fee), Weekend Rate**	$200	Inquire
Leica SP5X, Zeiss LSM710, DeltaVision, PerkinElmer Spinning Disk **48 hour rate (flat fee), Weekend Rate**	$400	Inquire
Leica SP5 X, Zeiss LSM 710, DeltaVision, PerkinElmer Spinning Disk **Hourly Rate for Assisted Use**	$50/hr	$180/hr
Leica SP5X, Zeiss LSM 710, DeltaVision, PE **Training Fee (per person)**	$150	$300
Zeiss AxioObserver, Axiophot and Nikon Eclipse **Hourly Rate for Unassisted Use**	$10/hr	$40/hr
Zeiss AxioObserver, Axiophot and Nikon Eclipse **Training Fee (per person)**	$25	$100

Appendix 1: Past Imaging Core Rates

Equipment	Location	Purchase and/or Installation Date	In-College Rate History (Academic Year)
Zeiss LSM 710 Confocal Microscope	0107E MICB	October 2009 (Purchased by CBMG/CMNS)	2009/2010: $15.00/hr 2010/2011: $18.60/hr 2011/2012: $22.00/hr 2012/2013: $26.00/hr Peak; $23.00/hr Off-Peak 2013/2014: $26.00/hr Peak; $23.00/hr Off-Peak 2014/2015: $28.00/hr Peak; $24.00/hr Off-Peak 2015/2016: $32.00/hr Peak; $22.00/hr Off-Peak 2016/2017: $32.00/hr Peak; $22.00/hr Off-Peak 2/1/2018: $34.00/hr Peak; $24.00/hr Off-Peak 2018/2019: $34.00/hr Peak; $24.00/hr Off-Peak
Leica SP5X Confocal Microscope	0107H MICB	December 2008 (Purchased via NSF MRI grant)	2008/2009: $15.00/hr 2009/2010: $15.75/hr 2010/2011: $18.60/hr 2011/2012: $22.00/hr 2012/2013: $26.00/hr Peak; $23.00/hr Off-Peak 2013/2014: $26.00/hr Peak; $23.00/hr Off-Peak 2014/2015: $28.00/hr Peak; $24.00/hr Off-Peak 2015/2016: $32.00/hr Peak; $22.00/hr Off-Peak 2016/2017: $32.00/hr Peak; $22.00/hr Off-Peak 2/1/2018: $34.00/hr Peak; $24.00/hr Off-Peak 2018/2019: $34.00/hr Peak; $24.00/hr Off-Peak
Deltavision Deconvolution/ TIRF Microscope	0107F MICB	March 2014 (Purchased by CBMG)	2013/2014: $10/hr 2014/2015: $10/hr thru 3/2015 2014/2015: $28.00/hr Peak; $24.00/hr Off-Peak 2015/2016: $28.00/hr Peak; $22.00/hr Off-Peak 2016/2017: $28.00/hr Peak; $22.00/hr Off-Peak 2017/2018: $30.00/hr Peak; $24.00/hr Off-Peak 2018/2019: $34.00/hr Peak; $24.00/hr Off-Peak
Zeiss AxioObserver Fluorescence	0107K	February 2014 (Relocated from BRB; originally purchased by CBMG)	2013 to 2017: $5/hr 2/1/18: $10/hr 2018/2019: $10/hr
Axiophot Fluorescence Microscope	Main lab	CoolSnap, Elements: July 2007 (purchased by CBMG)	$2.00/hr since installation
Nikon Eclipse	0107B	October 2017 (relocated)	2016/2017: $5/hr 2/1/18: $10/hr 2018/2019: $10/hr
PerkinElmer confocal spinning disk	B0118 PSC	December 2014 (purchased by Physics for PSC)	2014/2015: $28.00/hr Peak; $24.00/hr Off-Peak 2015/2016: $32.00/hr Peak; $22.00/hr Off-Peak 2016/2017: $32.00/hr Peak; $22.00/hr Off-Peak 2/1/18: $34.00/hr Peak; $24.00/hr Off-Peak 2018/2019: $34.00/hr Peak; $24.00/hr Off-Peak

Appendix 2: Summary of changes in IC instrumentation since November 2005

- 8/2006: A Mini Med 90 Film Processor (cost: $3,588.00) replaced the old Konica processor. The department paid $2,500.00 of the total cost and each of the following PIs contributed $109: Jonathan Dinman, Jeffrey DeStefano, Kenneth Frauwirth, David Mosser, Anne Simon, Wenxia Song, Richard Stewart and Elizabeth Gantt.
- 10/2006: Dr. Steve Wolniak (Interim Chair of CBMG) procured a Zeiss Axiophot fluorescence microscope for the facility following Dr. Ron Weiner's retirement. A CoolSnap EZ monochrome camera, computer workstation and Nikon Elements software (total cost: $13,400.00) were purchased in 2007 for the microscope using CBMG funds.
- 4/2007: The 7700 Sequencer Detector was replaced with a Roche LightCycler 480 Real-Time PCR machine, which was purchased by CBMG using the Bioscience Research Building capital equipment funds (and is housed in BRB; see below).
- 8/2007: Due to a drop in usage, the 3100 North DNA sequencer was taken out of operation.
- 12/2008: The instruments in 0107H MICB (two ABI 3100 DNA sequencers, the ABI 3730xl DNA Sequencer and the Roche LightCycler 480 Real-Time PCR machines) were moved to the new Genomics Core, room 2229 Bioscience Research Building.
- 12/2008: The Leica SP5 X confocal microscope was installed in room 0107H MICB. This microscope was obtained by Drs. Ian Mather and. Steve Wolniak via an NSF MRI grant.
- 10/2009: The LSM510 confocal microscope was dismantled to make way for the new Zeiss LSM710, which was purchased using college funds, authorized by Dean Allewell.
- 1/2009: Genomics Core Equipment: Bio-Rad CFX 96 Real-time PCR machine was purchased and placed in room 2229 BRB.
- 4/2010: Genomics Core Equipment: Due to a drop in usage, the 3100 "West" DNA sequencer was taken out of operation.
- 7/2011: Genomics Core Equipment: July 2011: Both the 3100 "West" and 3100 "North" DNA sequencers were sold through Terrapin Trader.
- 11/2011: A Thermo Scientific Midi 40 CO2 incubator was purchased using IC funds ($3,194.00).
- 2/2014: a Zeiss AxioObserver widefield fluorescence microscope was relocated from room 3207 Bioscience Research Building. The microscope was installed in room 0107K and upgraded with a new computer, new software (Zen 2012) and a new power supply, using a combination of departmental and IC funds.
- 3/2014: A DeltaVision Deconvolution/TIRF microscope was installed in room 0107F MICB. The microscope was purchased with departmental and college funds.
- 4/2014: Financial responsibility for the DNA sequencer was transferred to the Biology Dept.
- 8/2014: The Leica SP5 X was upgraded with a new HyD detector and time-gating technology.
- 10/2014: The Zeiss LSM 710 computer was replaced (free upgrade due to computer issues with the old operating system) with a Windows 7 computer and the software was upgraded to the latest version of Zen.
- 12/2014: A PerkinElmer spinning disk confocal microscope was installed in the Satellite Core, room B0118 Physical Sciences Complex.
- 1/2015: As a result of increased Imaging Core responsibilities, management of the Genomics Core was transferred from Amy Beaven to Dr. Yan Wang.
- 7/24/15: The Mini Med 90 Film Processor was taken out of service. It was decontaminated by DES (Cleveland Taylor) and sent to Terrapin Trader.
- 2/2016: The IC implemented a new BSL-2 protocol to allow imaging of approved BSL-2 samples.

- 4/2016: Dr. Charles Delwiche purchased 4 new objective lenses for the DeltaVision and loaned them to the IC: 10x 0.4 NA, 20x 0.75NA, 40x 0.6NA LWD and 40x 1.3NA oil lens.
- 10/2016: A Nikon Eclipse transferred from Dr. Nicole Li's old lab on the 3rd floor of MICB to the IC, room 0107A MICB.
- 4/2017: the ASI diSPIM lighsheet microscope was installed in B0118 PSC on April 4-5 (ahead of the purchase order issued on April 27, 2017).
- 5/2017: The IC acquired room 0105 MICB. The LightCycler 480 qPCR machine was transferred from 2229 BRB to this space, and the Director of the IC now manages the instrument (again).
- 10/7/17: Old DeltaVision Nikon microscope moved to Imaging Incubator in PSC. To be incorporated in the JPK NanoWizard 4a BioAFM.
- 10/16 – 10/18/2017: JPK NanoWizard 4a BioAFM installed (purchase order issued 8/18/17).
- 11/9/2017: Launched new website: http://biosciencecores.umd.edu/
- 11/2/2018: The Covaris Ultrasonicator installed in 0107A (transferred from Antony Jose's lab; originally from the IBBR Sequencing Core)
- 5/28/2019: A new Agilent Tapestation was installed in room 0107L MICB.

Appendix 3: Imaging Equipment on Campus

Equipment	Purchase/ Installation Date	Owner (purchased by…)	Location	Available to anyone in CBMG?
Zeiss LSM 710 Confocal	10/2009	CBMG/CMNS	CBMG Imaging Core: 0107E MICB	Yes
Leica SP5X Confocal	12/2008	ANSC/CBMG (Purchased via NSF MRI grant)	CBMG Imaging Core: 0107H MICB	Yes
Deltavision Deconvolution/ TIRF Microscope	3/2014	CBMG	CBMG Imaging Core: 0107F MICB	Yes
Zeiss AxioObserver Fluorescence	2/2014	CBMG (Relocated from BRB in 2014)	CBMG Imaging Core: 0107K	Yes
Axiophot Brightfield Microscope	7/2007	CBMG (Camera and software)	CBMG Imaging Core: Main lab	Yes
Nikon Eclipse w/color camera	10/2017	CBMG (relocated from Li lab)	CBMG Imaging Core: 0107B	Yes
PerkinElmer confocal spinning disk	12/2014	CMNS (purchased with PSC building funds)	CMNS Imaging Incubator: B0118 PSC	Yes
ASI diSPIM Lighsheet	4/2017	CMNS (purchased w/PSC building funds)	CMNS Imaging Incubator: B0118 PSC	Yes
JPK NanoWizard 4a BioAFM	10/2017	CMNS (purchased with PSC building funds)	CMNS Imaging Incubator: B0118 PSC	Yes
Andor Spinning Disk	August 2016	Sougata Roy (CBMG)	Roy Lab, BRB	No
Zeiss LSM700	~July 2012	IBBR/BioENGR	5131A PLS building	No
Zeiss LSM700 Confocal	Transferred in FY17 from S. Wolniak	Margaret Scull (CBMG)	Scull lab, BRB	No
Zeiss LSM 800 Airyscan Confocal	FY16	Lisa Taneyhill	Taneyhill lab, ANSC	No
Zeiss LSM710	~FY14	Murphy/Peer	Murphy/Peer lab, PLS	No
PerkinElmer Spinning Disk	FY08	Norma Andrews (CBMG)	Andrews lab, BRB	No
Olympus confocal	FY18	BioWorkshop	BioEngineering	Yes

Appendix 4: Publications

Publications that entailed the use of the Zeiss LSM 510:

1. Bish, S. E., W. Song, and D.C. Stein. 2008. Quantification of bacterial invasion into host cells using a beta-lactamase reporter strain: Neisseria gonorrhoeae invasion into cervical epithelial cells requires bacterial viability. Microbes Infect. 10:1182-1191.
2. Sikes, J. M. & Bely, A. E. Radical modification of the A-P axis and the evolution of asexual reproduction in Convolutriloba acoels. Evolution and Development 10, 619-631 (2008).
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Appendix 5: Example Rates at Other Institutions

Confocal Rates (updated July 2019)

Facility	Instrument	Hourly Rate
Berkeley Biological Imaging Facility	Zeiss LSM 710	$ 40.00
Cornell University Life Sciences Imaging	Zeiss LSM 710	$ 35.00
University of Virginia School of Medicine	LSM880	$ 45.00
Northwestern University Biological	Leica SP5	$ 39.00
Northwestern University Biological	Zeiss LSM 510	$ 40.00
Arizona State Imaging Facility	Leica SP5	$ 25.00
Arizona State Imaging Facility	Leica SP8	$ 35.00
Duke University Light Microscopy Core	Leica SP5	$ 30.00
Duke University Light Microscopy Core	Zeiss LSM 780	$ 30.00
Michigan State U Center Advanced	Zeiss LSM 510	$ 25.00
Michigan State U Center Advanced	Olympus FV 1000	$ 25.00
University of Washington Keck Facility	Zeiss LSM 510	$ 45.00
University of Connecticut	Leica SP8	$ 15.00
UVA Keck Center	Zeiss LSM 510	$ 35.00
UVA Keck Center	Leica SP5X	$ 35.00
Oregon State University	Zeiss LSM 780	$ 30.00
Oregon State University	Zeiss LSM 780	$ 26.00
Yale School of Medicine	Leica SP5	$ 50.00
Texas A&M	Olympus FV 1000	$ 42.00
Boise State University	Zeiss LSM 510	$ 19.59
Rockefeller University	Leica SP8	$ 56.00
Notre Dame	Nikon A1	$ 31.00
Washington University in St. Louis	Nikon A1	$ 32.00
Perlman School of Medicine	Zeiss LSM 710	$ 42.00
University of California, Davis	Olympus FV 1000	$ 35.00
UC Santa Cruz	Leica SP5	$ 25.00
Indiana University	Leica SP5	$ 19.75
Indiana University	Leica SP8	$ 21.75
U of Georgia Biomedical Microscopy Core	Zeiss LSM 710	$ 50.00
University of Illinois at Chicago	Zeiss LSM 710	$ 45.00
University of Illinois at Chicago	Zeiss LSM 710 Meta	$ 41.00
University of Illinois Urbana-Champaign	Zeiss LSM 710	$ 35.00
University of Illinois Urbana-Champaign	Zeiss LSM 880	$ 44.00
UC San Diego	Olympus FV 1000	$ 36.00
Baylor College of Medicine	LSM880	$ 35.00
Baylor College of Medicine	LSM780 Fast	$ 35.00
Baylor College of Medicine	Leica SP8	$ 35.00
University of North Carolina Chapel Hill	Zeiss LSM 710	$ 35.90
University of Chicago	Leica SP8	$ 42.44
University of Chicago	Leica SP5	$ 42.44
Virgina Common Wealth University	Zeiss LSM 710	$ 20.00
Massachusetts Institute of Technology	Olympus FV 1000	$ 40.00
Georgia Tech	Zeiss LSM 710	$ 16.00
NYU Langone Health	Leica SP5	$ 55.00
NYU Langone Health	Zeiss LSM 880	$ 65.00
University of Minnesota	LeicaSP5	$ 52.50
University of Minnesota	Nikon A1	$ 52.50
U of Missouri	LeicaSP8	$ 35.00
Albert Einstein College of Medicine	LeicaSP5	$ 43.00
Albert Einstein College of Medicine	LeicaSP8	$ 43.00
Average Hourly Rate		**$ 37.00**

DeltaVision Rates (updated July 2019)

Facility	Instrument	Hourly Rate
Berkeley Biological Imaging Facility	DeltaVision	$ 37.00
Northwestern University Biological Imaging	DeltaVision	$ 25.00
Duke University Light Microscopy Core	DeltaVision Elite	$ 17.00
Rockefeller University	DeltaVision	$ 42.00
Notre Dame	DeltaVision	$ 19.00
University of California, Davis	DeltaVision	$ 35.00
Indiana University	DeltaVision	$ 16.50
U of Georgia Biomedical Microscopy Core	DeltaVision	$ 35.00
University of Arizona Microscopy Alliance	DeltaVision	$ 35.00
University of Arizona Microscopy Alliance	DeltaVision	$ 25.00
UC San Diego	DeltaVision	$ 28.00
University of Michigan Medical School	DeltaVision	$ 20.00
Massachusetts Institute of Technology	DeltaVision	$ 40.00
Koch Institute at MIT	DeltaVision	$ 40.00
Average Hourly Rate		**$ 30.00**

Widefield Fluorescence Microscope Rates (updated July 2019)

Facility	Instrument	Hourly Rate
Cornell University Life Sciences Imaging Core	Olympus Widefield	$ 15.00
University of Washington Keck Facility	Widefield	$ 22.00
UVA Keck Center	Widefield	$ 15.00
UC Santa Cruz	Zeiss Axioskop	$ 8.00
University of Illinois Urbana-Champaign	Zeiss Widefield	$ 22.00
Perlman School of Medicine	Zeiss Observer	$ 20.00
Average Hourly Rate		**$ 17.00**