Infrastructure: Core Facilities, Equipment, and Services

IBS Center for Cognition and Sociality

2020-08-01

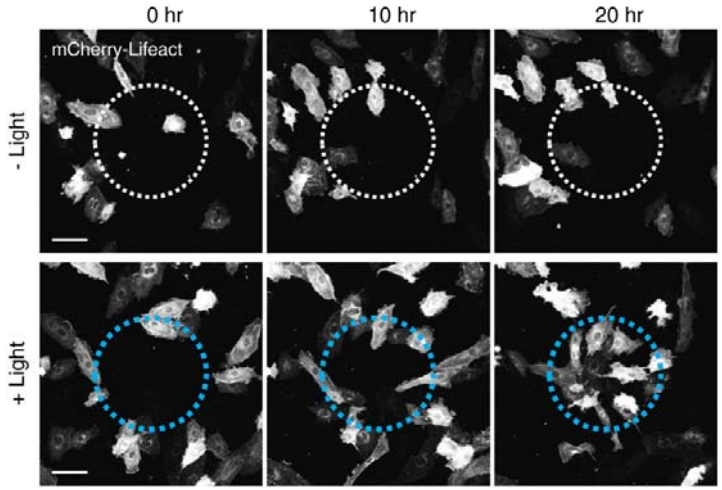
Confocal Microscopy

Available Systems

- A1R, Nikon
- A1, Nikon
- C2, Nikon
- LSM 700, Zeiss
- LSM 880 Airyscan, Zeiss
- LSM 900, Zeiss

An optical imaging instrument for enhanced optical resolution and contrast by means of using a spatial pinhole to block out-of-focus light in image formation. Broadly used to see the detailed structure of objects within specimen.

Equipped with live-cell maintenance modules and cutting-edge optogenetic applications



Light-induced cell migration (optogenetics)

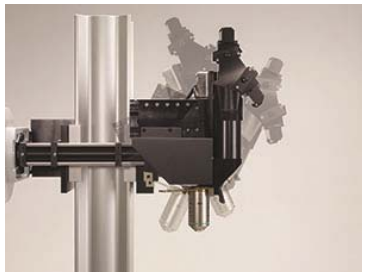
Selected Publications

Nat. Biotechnol. 2015 Oct;33(10):1092-6., *Nat. Methods.* 2014 Jun;11(6):633-6

Multi-photon Microscopy

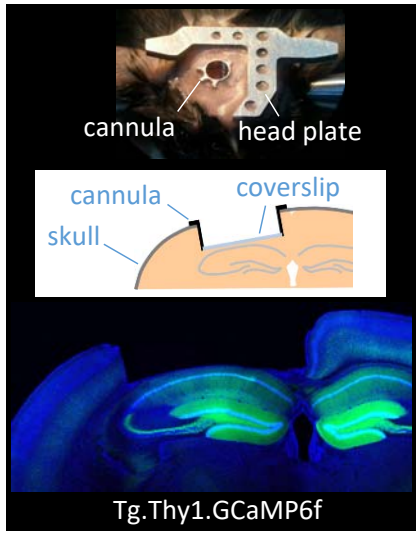
Available Systems

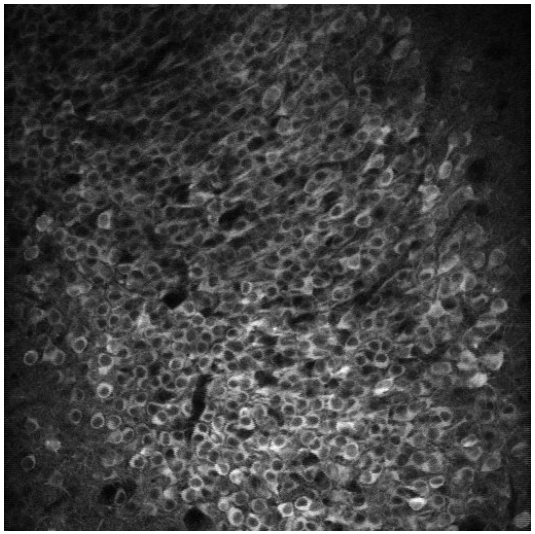
- A1R-MP, Nikon
- 2 x MOM, Sutter
- Scientifica



Enhances the ability to observe complex and dynamic biological processes from deeper within living tissue with minimal invasion and photodamage. This gives a much more effective way for imaging thick specimen.

Visualization of hippocampal neuronal activities in awake mice

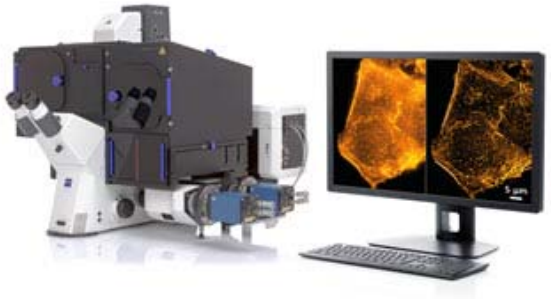




Selected Publications

Nat. Comm. 2019 Jan 14;10:211.

Superresolution Microscopy

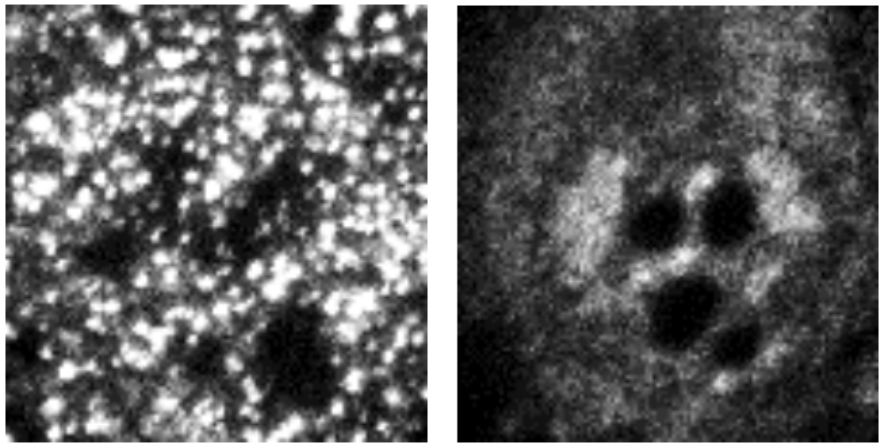


Available Systems

- Lattice SIM, Zeiss
- N-SIM, Nikon
- N-STORM, Nikon

Structured Illumination Microscopy (SIM) is a super-resolution fluorescence optical microscope imaging technique that increases resolution by patterned light. Stochastic optical reconstruction microscopy (STORM) relies on the sequential activation and time-resolved localization of fluorophores to generate high-resolution images

Observe detailed structures: structures within a structure



Visualization of protein clusters within nucleus

Selected Publications

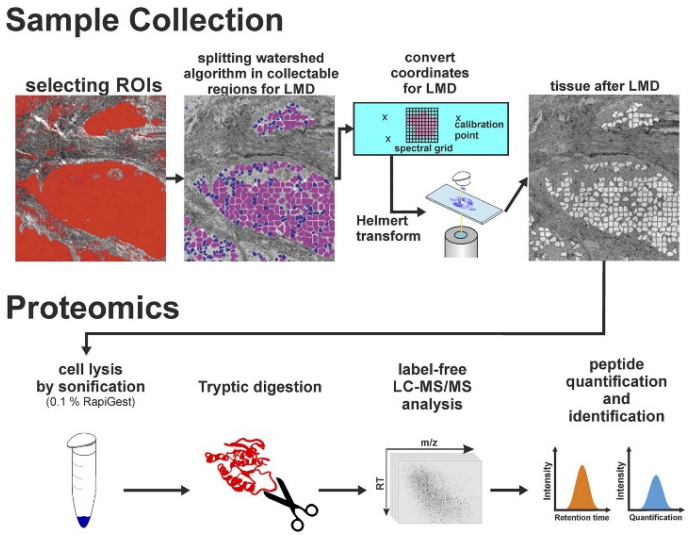
Nat. Commun. 2017 Jun 23;8(1):30, *Front. Cell. Neurosci*. 2018 Sep 27;12:319

Laser Capture Microdissection System

Available Systems

- PALM Microbeam, Zeiss

Procure subpopulations of tissue cells under direct microscopic visualization. Cells of interest or histologically pure enriched cells are directly harvested, and then the specimen is LIFTed through IR laser: separated and transferred to the adhesive cap (non-contact).

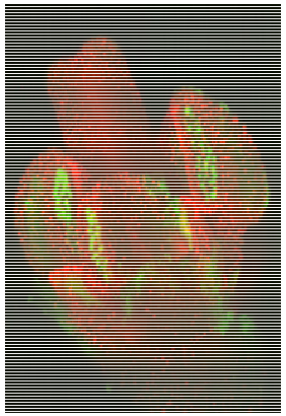


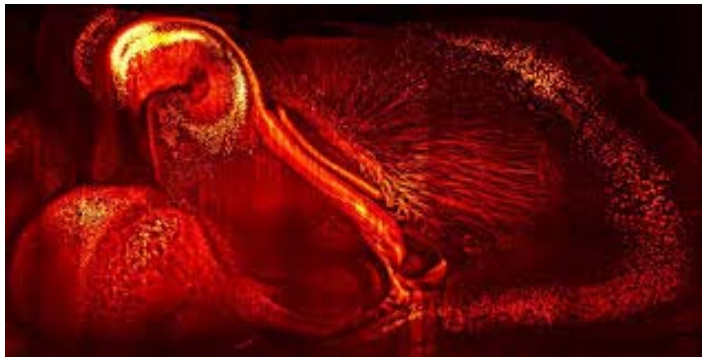
Lightsheet Microscope (LSFM or SPIM)

Available Systems

- Lightsheet 7, Zeiss

Fluorescence microscopy technique with an intermediate-to-high optical resolution, but good optical sectioning capabilities and high speed. In contrast to epifluorescence microscopy only a thin slice (usually a few hundred nanometers to a few micrometers) of the sample is illuminated perpendicularly to the direction of observation. For illumination, a laser light-sheet is used, i.e. a laser beam which is focused only in one direction (e.g. using a cylindrical lens). As only the actually observed section is illuminated, this method reduces the photodamage and stress, also the background signal. Because LSFM scans samples by using a plane of light instead of a point (as in confocal microscopy), it can acquire images at speeds 100 to 1000 times faster than those offered by point-scanning methods.





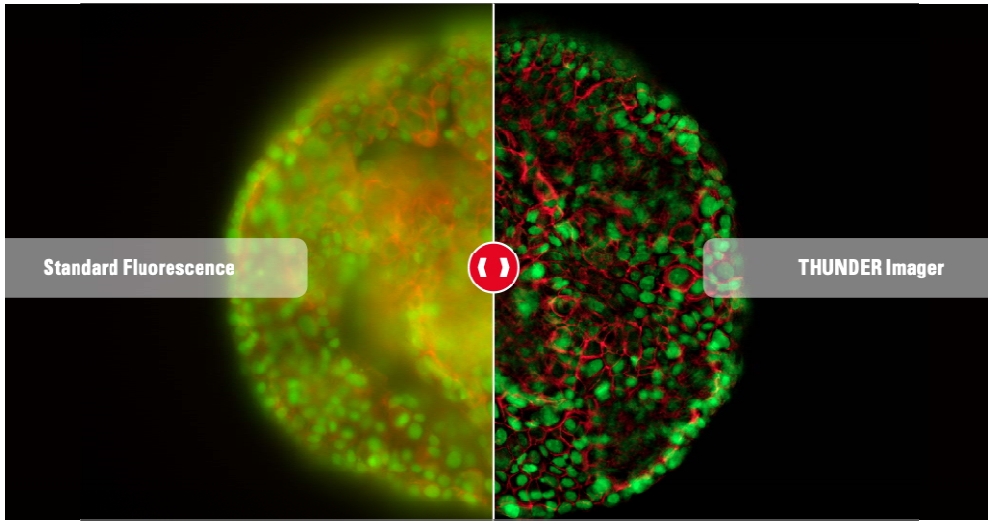
Leica Thunder

Available Systems

- Thunder Imager 3D, Leica

Thunder Imagers use an integrative holistic approach to overcome the limitations of camera-based imaging systems. Detects and removes the unwanted signals from out-of-focus regions of the specimen, distinguishes between the out-of-focus and in-focus signals via the difference in size of the features.

Comparison of images from standard fluorescence microscopy and Thunder



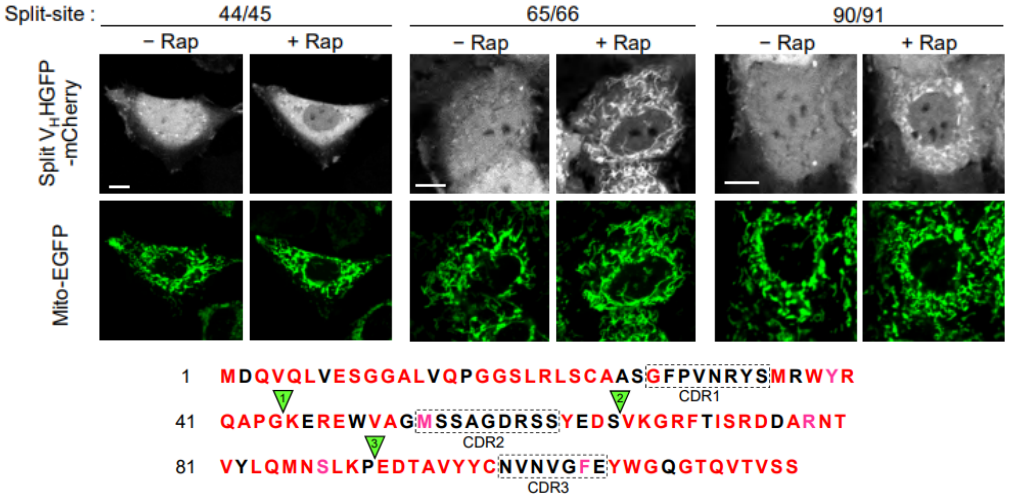
High-throughput Screening System

Available Systems

- ImageXpress XLS, Molecular Devices
- ImageXpress Pico, Molecular Devices

Using robotics, data processing/control software, liquid handling devices, and sensitive detectors, high-throughput screening allows a researcher to quickly conduct millions of chemical, genetic, or pharmacological tests. Hearted in miniaturization, automation and readouts, the HTS technology has been continuously developed for robust hit assay & validation with well-established protocols.

Protein engineering



Optimization of split-site for nanobody

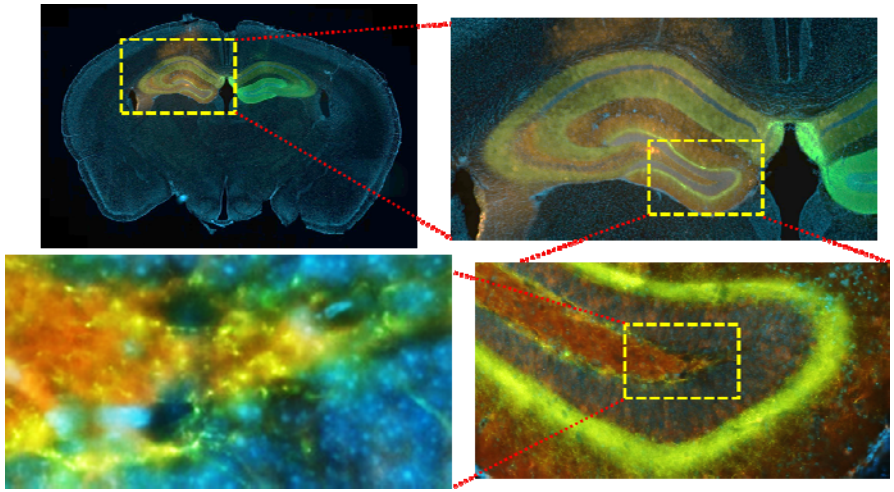
Slide Scanner

Available Systems

- Axioscan Z1., Zeiss

The tissue slide scanner automatically obtains image of multiple slides and helps analysis & management of a large amount of data. Equipped with modular tray: can digitize glass slide of any type.

Immunohistochemistry



Selected Publications

Nat. Methods. 2019 Nov;16(11):1095-1100, *Chem. Biol*. 2014 Jul 17;21(7):903-12

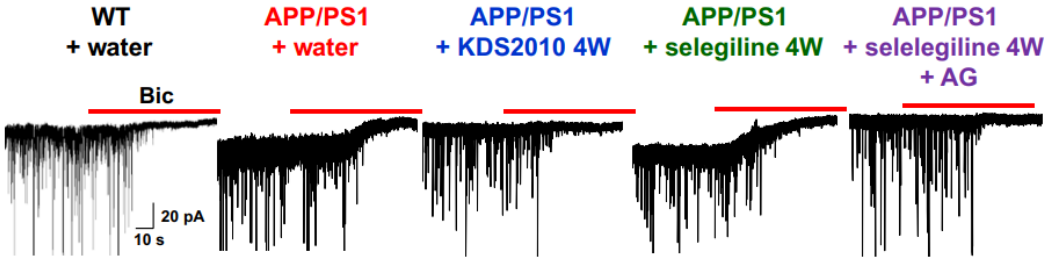
Patch-Clamp/Electrophysiology

Available Systems

- 4 cell patch rigs
- 8 acute slice patch rigs
- 8 Ch LTP rigs

A technique in electrophysiology used to study ionic currents in individual isolated living cells, tissue sections, or patches of cell membrane. It is especially useful in the study of excitable cells such as neurons, cardiomyocytes, muscle fibers, and pancreatic beta cells.

Recording trace of receptor-mediated currents



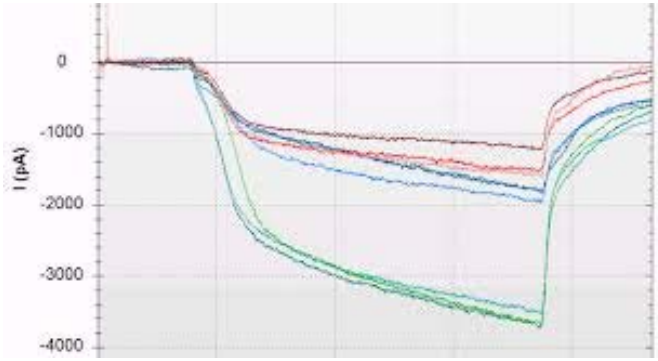
Measuring metabolic effects in long-term drug treatment

Automated Patch Clamp System

Available Systems

- IonFlux
- Orbit mini, Nanion GmbH

Integrating microfluidic perfusion with standard well plates has produced automated electrophysiology systems that look and operate much like a benchtop microplate reader. The system has a port to accept the 96-well plate, preloaded with the compounds and cells. The plate is segmented into eight separate patterns or units, each of which has 12 interconnected wells. Within each unit, two wells are interrogated with electrodes and filled with IC solution, one well contains cells suspended in EC solution, one well is a waste receptacle, and the remaining eight wells contain compound solutions. Compound release is controlled by individual valves and regulators associated with corresponding wells.



Selected Publications

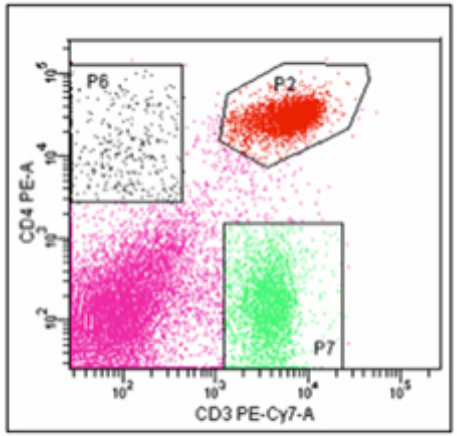
Sci. Adv. 2019 Mar 20;5(3):eaav0316, *PNAS.* 2014 Aug 12;111(32):11828-33

FACS

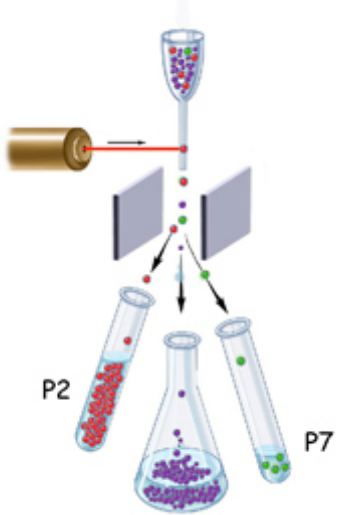
Available Systems

- Fortessa, BD
- Cantoll, BD
- Astrios, Thermo Fisher

Analyze expression of molecules in heterogeneous cell population or particles. Measures physical and chemical characteristics particles using light (laser) and used to determine cell characteristics / function, state of differentiation, and for diagnostic purpose.



Multiparamtric fluorescence analysis

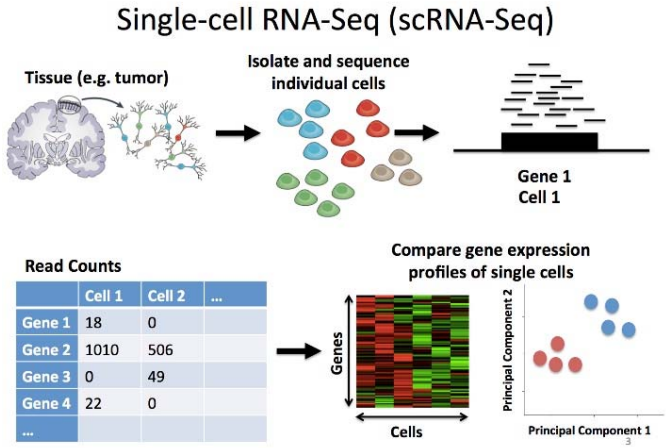


Single Cell NGS

Available Systems

- C1, Fluidigm
- BioMark HD Reader, Fluidigm
- MiSeq, Illumina

Massive sequencing tool to describe and analyze genome / transcript information. Seeks for quantified data from DNA, RNA, methylation / epigenetics. Aids research in cancer biology, neuroscience, complex (genomic) disease.

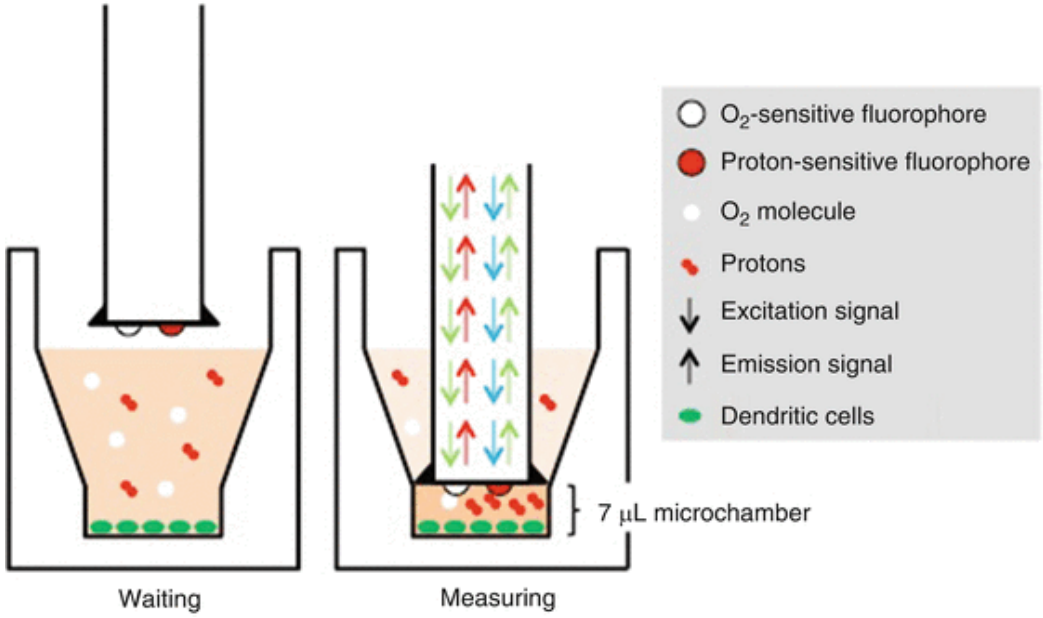


Metabolism Analyzer

Available Systems

- Seahorse, Agilent

Measures OCR (oxygen consumption rate) and ECAR (extra-cellular acidification rate) through fluorescence dyes. Uses specialized 96-well plate and fluorescent dyes for detection. Oxygen consumption indicates mitochondrial respiration, and acidification indicates glycolysis, which shows metabolic status of the cell.

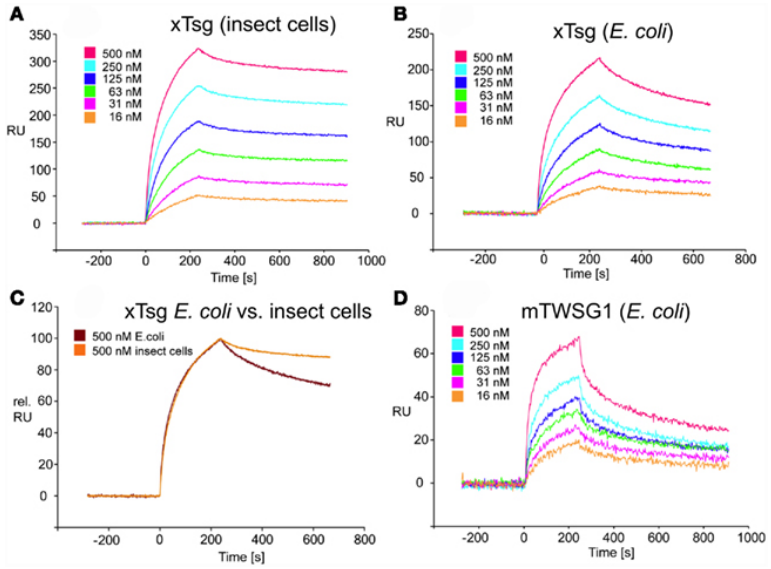


Interaction Assay

Available Systems

- T200, Biacore
- BLITZ, ForteBio

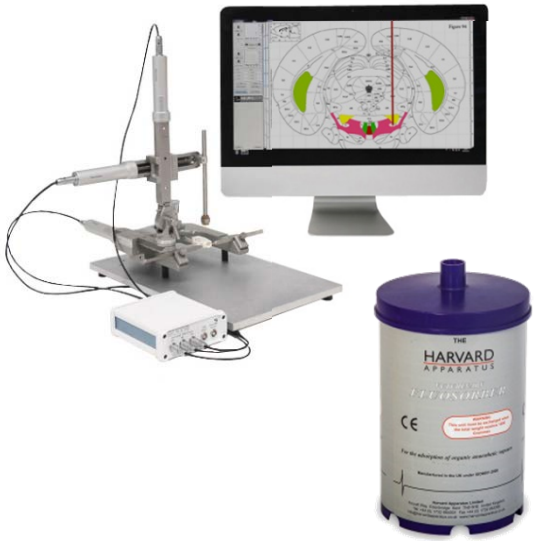
An efficient interaction assay for biomolecules like protein-protein or protein-small molecules based on interferometry or SPR. The instrument measures optical changes at the sensor, and it will give you kinetic properties of interaction like Kd.



Small Animal Surgery

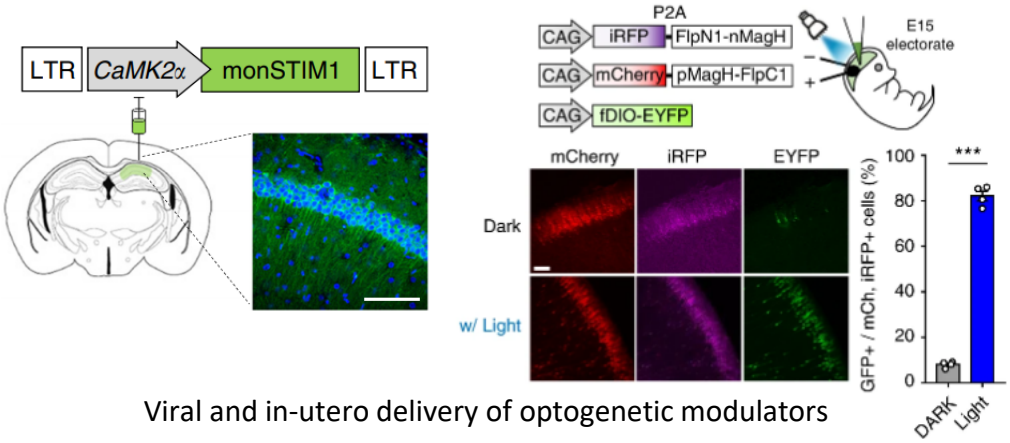
Available Systems

- 3 stereotaxics, Neurostar
- Isoflurane anesthesics, LCI
- Minivac, Harvard Apparatus



Multiple stereotaxic surgery tools with isoflurane anesthetics & temperature maintenance. Installed with isoflurane scavenger to provide safety for users. Mostly used for viral injection and imaging prep such as skull thinning or skull window.

Delivery of genes into the mouse brain



Viral and in-utero delivery of optogenetic modulators

Selected Publications

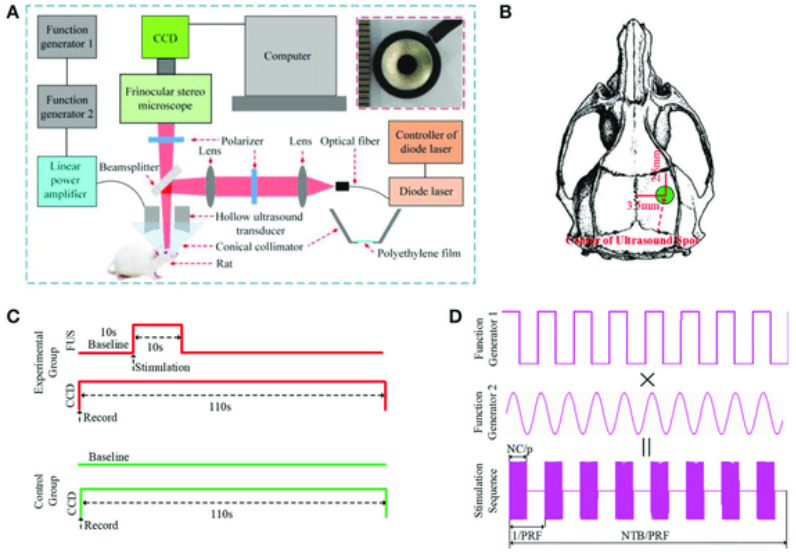
Nat. Commun. 2019 Jan 18;10(1):314, *Nat. Commun.* 2020 Jan 10;11(1):210

tFUS

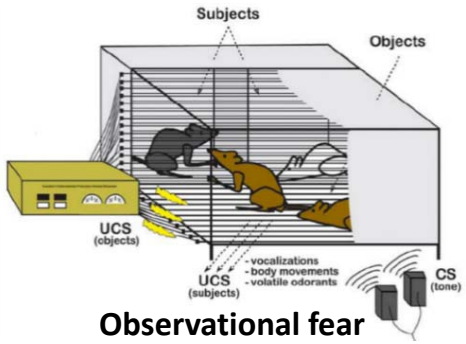
Available Systems

- tFUS

Transcranial focused ultrasound (tFUS) is an emerging technique for non-invasive neurostimulation. Compared to magnetic or electric non-invasive brain stimulation, this technique provides a higher spatial resolution and can reach deep structures



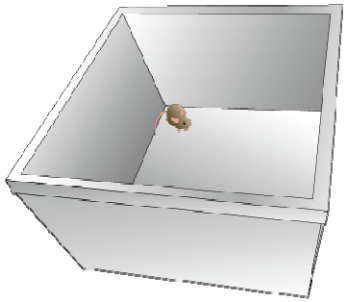
Animal Behavior



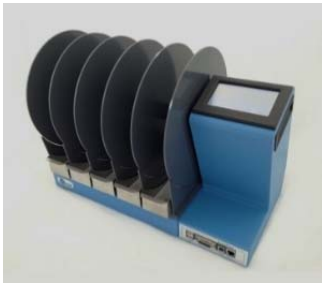
Observational fear

Vocalization

Barnes maze



Open field

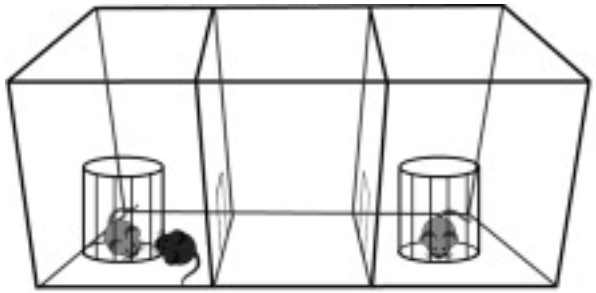


Rotarod

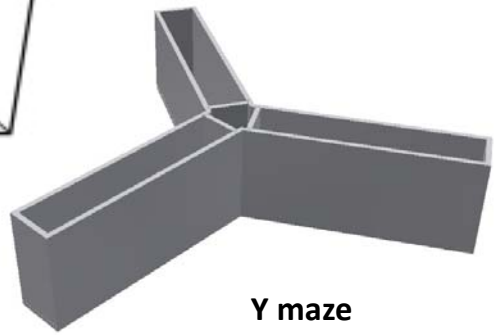
Novel object recognition

Available Systems

- Observational Fear
- Barnes maze
- Field test / object test
- Rotarod
- Ultrasound Vocalization
- Tube test
- 3 chamber
- Attention behavior
- Y maze
- Rule observance
- Sleep analysis



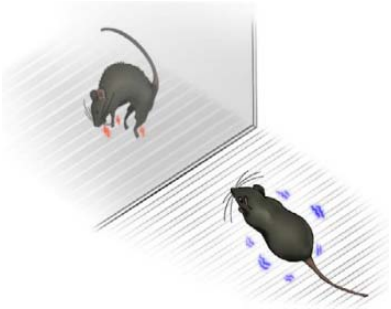
3 chamber

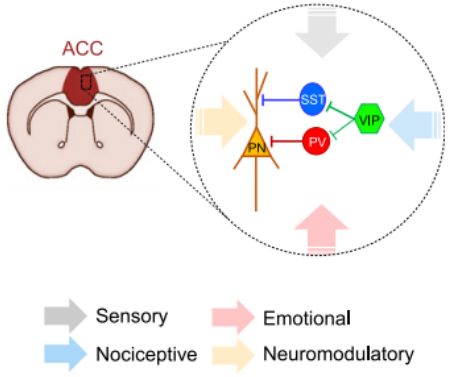


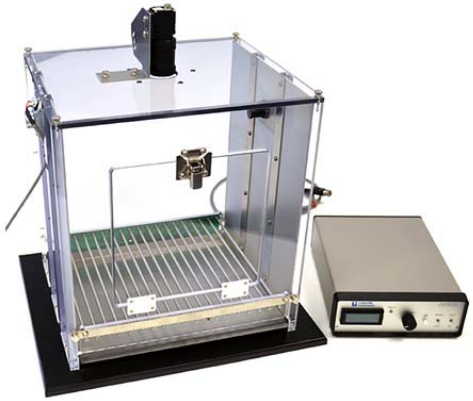
Y maze

The animal facility is heavily equipped with various animal behavior test tools, including customized instruments for testing learning & memory, cognition and sociality tasks. Can be used to address instinctive behaviors (fear) to high cognitive functions (empathy).

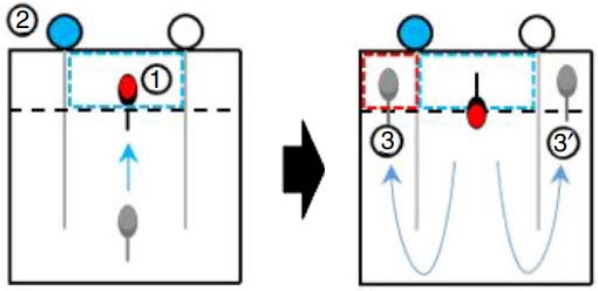
Observational fear behavior







Fear conditioning



Rule observance

Selected Publications

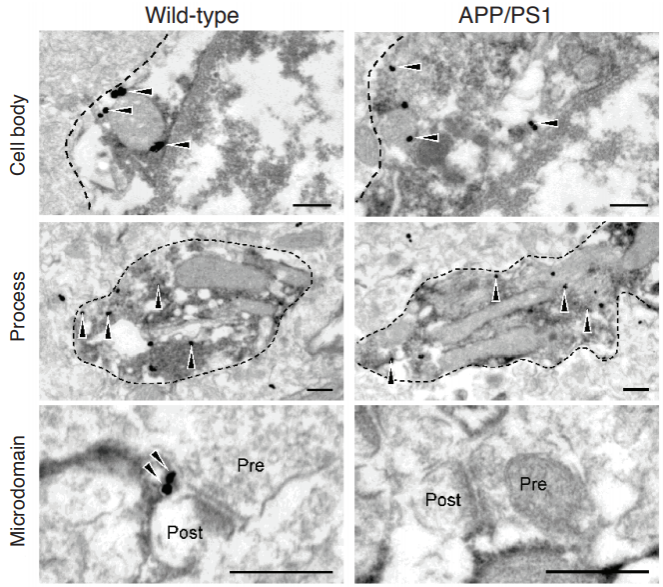
Nat. Neurosci. 2010 Apr;13(4):482-8, *Neuron.* 2019 Oct 9;104(1):78-86

Electron Microscopy Facility

Available Systems
- Glacious 200kv
- Krios 300kv

Uses a beam of electrons as a source of illumination, whose wavelength can be up to 100,000 times shorter than that of visible light photons. Has a higher resolving power, about 250 pm resolution and up to about 1,000,000× magnification.

Immunogold image of Best1 in the molecular layer of DG

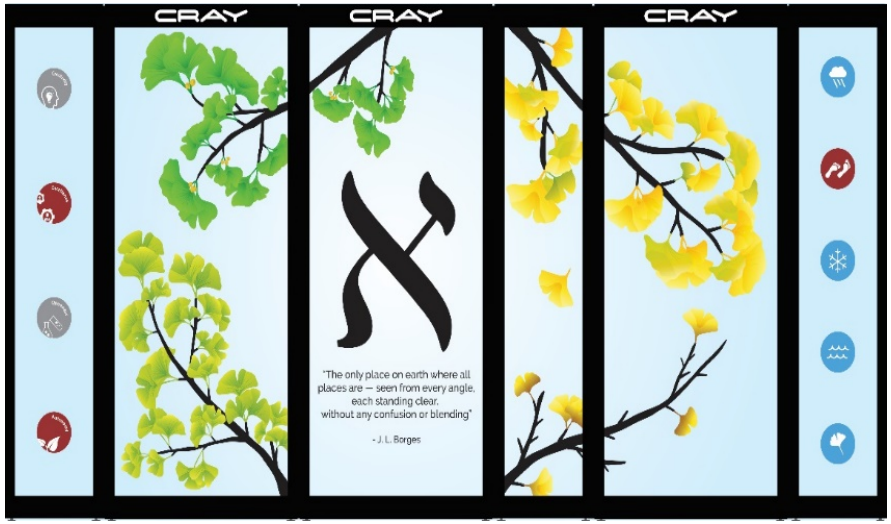


Selected Publications

Nat. Med. 2014 Aug;20(8):886-96, *Cell*. 2012 Sep 28;151(1):25-40

Data Center

Available Systems
- ALEPH



The ALEPH is a super-computer in IBS ranked in 3rd in Korea / 445th in worldwide with maximum performance of 1.43 Pflops. This will give you a great opportunity to deal with a large dataset, or train the AI you made.

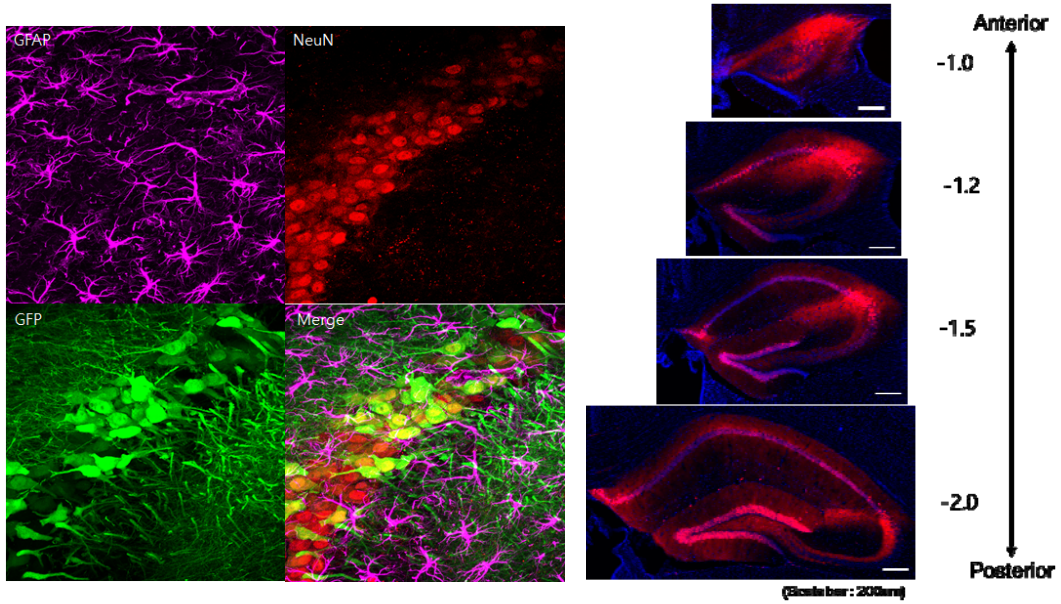
COMPUTE
- 468 Skylake compute nodes
- 192 GB RAM per node

STORE
- 8.74 PB Lurtre parallel file system
- 10 PB tape archive

ANALYZE
- 4 data analysis nodes (768 GB RAM)
- NVIDIA Tesla P100 GPU

Virus Facility

https://www.ibs.re.kr/virusfacility/



Provide services of viral vector design, cloning, and virus production for gene of interest to the worldwide basic science researchers

shRNA
- Over 50 shRNA available
- Based on pSico/pSicoR

Neuro-transmitter sensors
- 17 biosensors available
- Deposited by Prof. Y. Li

Custom services
- Optogenetic tools, expression vectors, etc
- Available on request

Animal Facility

As the core facility for life science research at IBS, the Laboratory Animal Resource Facility(LARF) ensures an optimal support for animal experiments with proper care and management of animals.

Animal Environment
- IVC system (Individually Ventilated Cage)
- Temp:20~26℃ Humidity:40~60%
  Light:~300Lux Noise:<60db

Capacity
- 1600cages for each zone
- A,C : SPF zone / B : Preservation zone / D : Conventional zone

Animal Service
- Cryopreservation
- In vitro fertilization