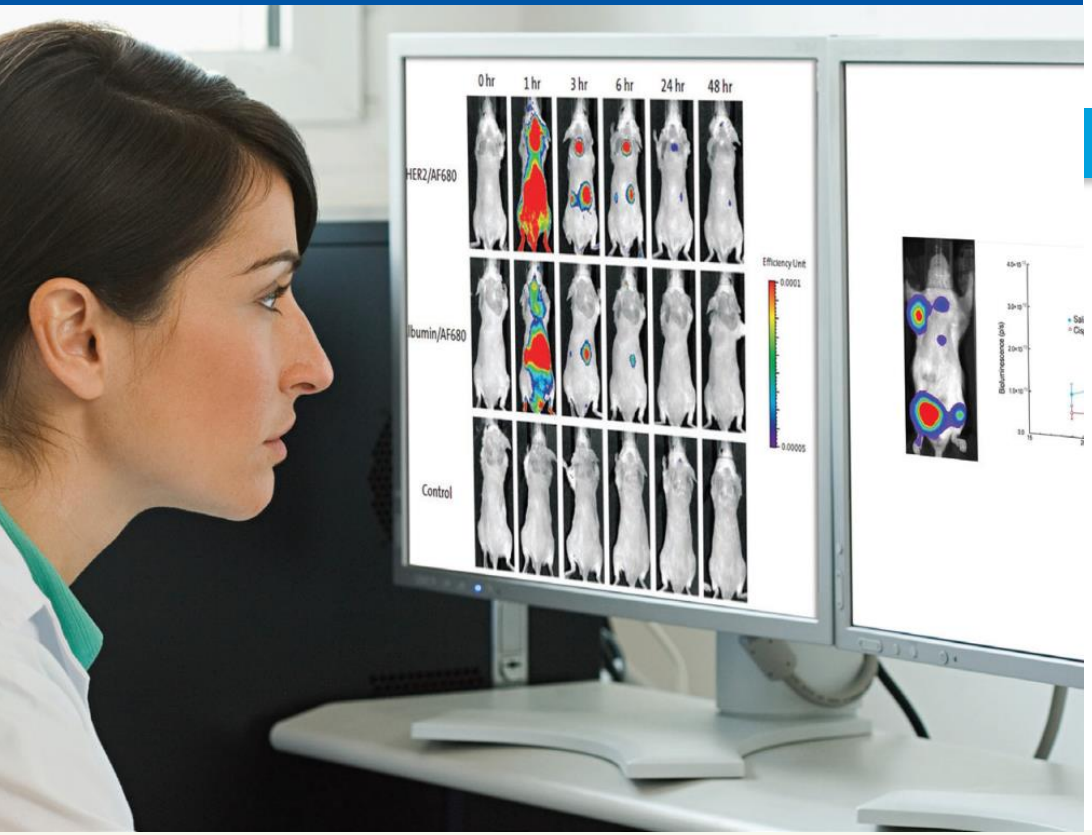


PerkinElmer
For the Better

HUMAN HEALTH | ENVIRONMENTAL HEALTH

In Vivo Imaging IVIS Lumina XRMS

J & H 博克科技有限公司

產品應用專員 葉恭誌

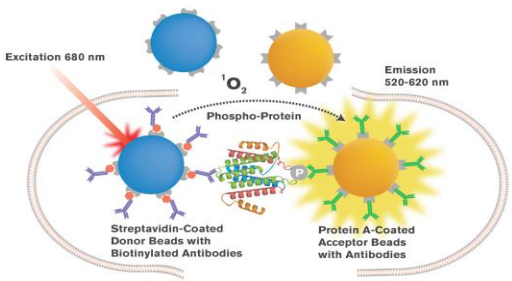
0800-898-178
http://www.jnhtech.com.tw

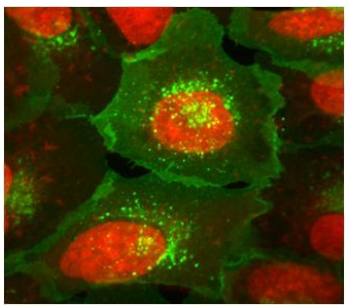
What Will Be Covered?

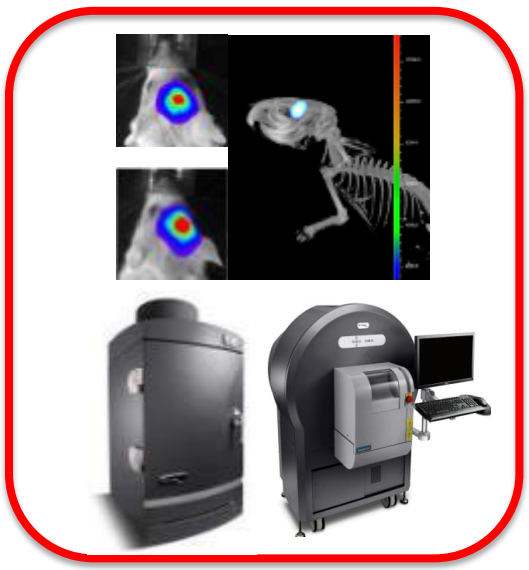
- Why *in vivo* imaging
- Principles of optical *in vivo* imaging
- IVIS® Lumina XRMS Introduction
- Pre-clinical *in vivo* Imaging Agents
- Application

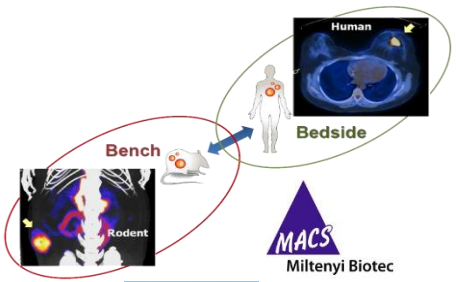
Portfolio Overview

WELL → CELL → ANIMAL → HUMAN







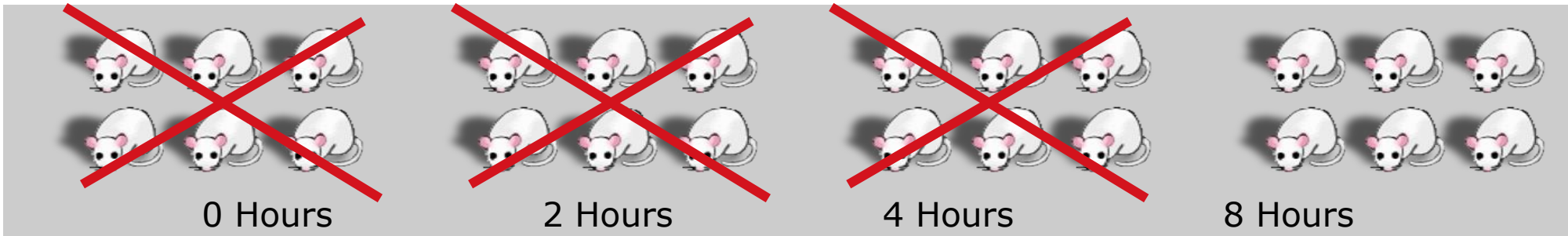


Together, Bio-discovery and IVIS platforms provide the world leading portfolio for translational disease research, drug discovery and clinical development

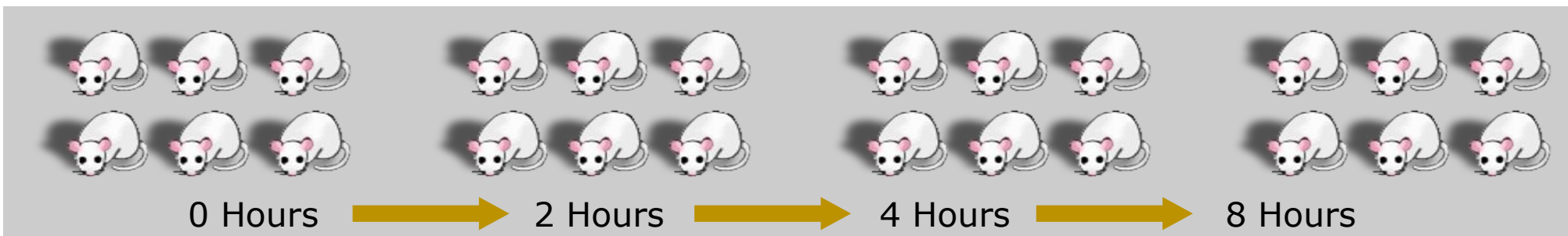
.. .integrating all stages of research workflow

Current vs. BPI methodology

Current Methodology = 24 animals over four treatment points



Biophotonic imaging (BPI) Methodology = the same 6 animals over four treatment points



- **Continued monitor**
- **Low variation**
- **3R (Replacement, Reduction, Refinement)**

In Vivo Imaging Landscape

PerkinElmer
For the Better

Type of model

Clinical

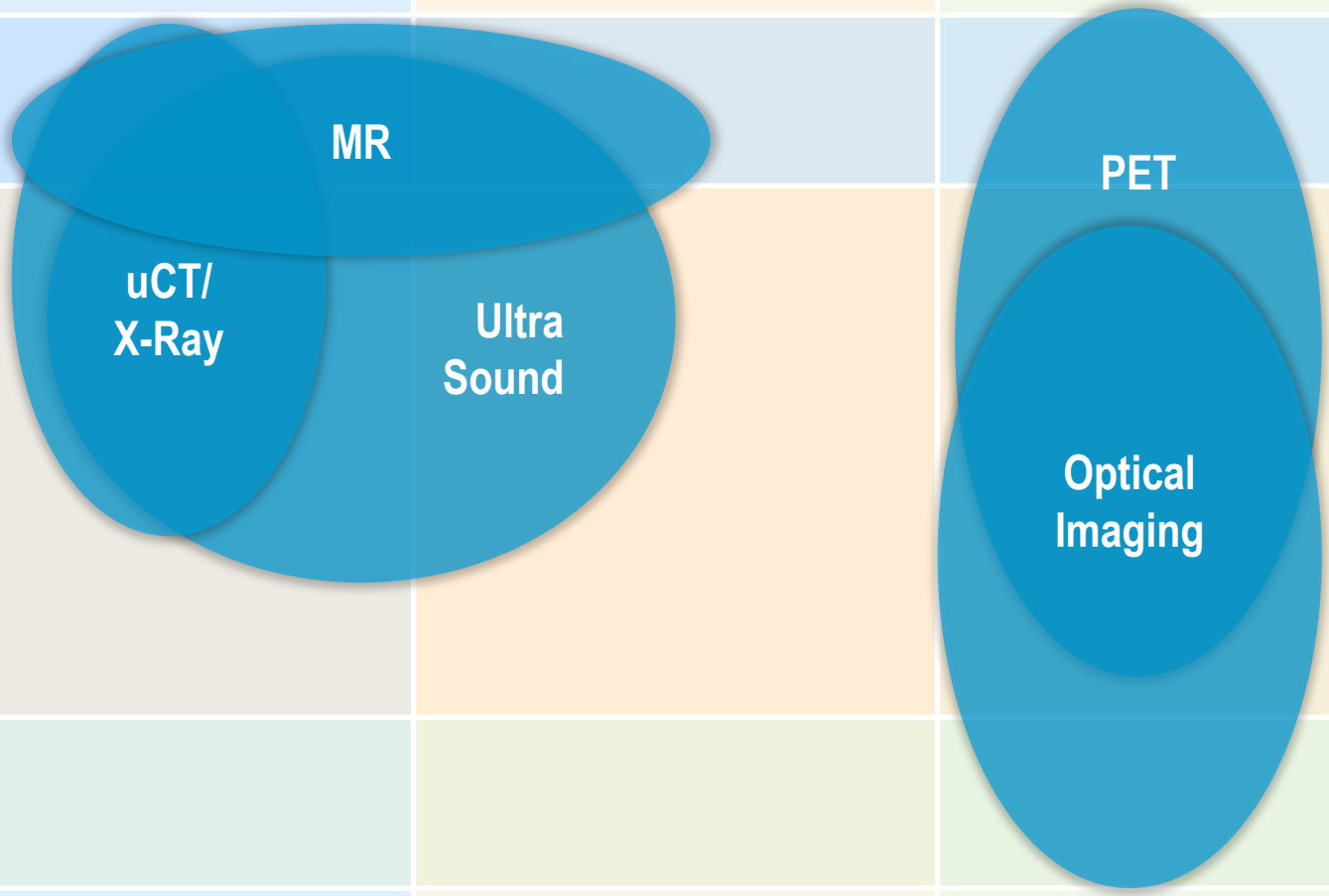
Marker location

Deep

Subcutaneous

Dermal

Transgenic



Anatomical

Fine structure

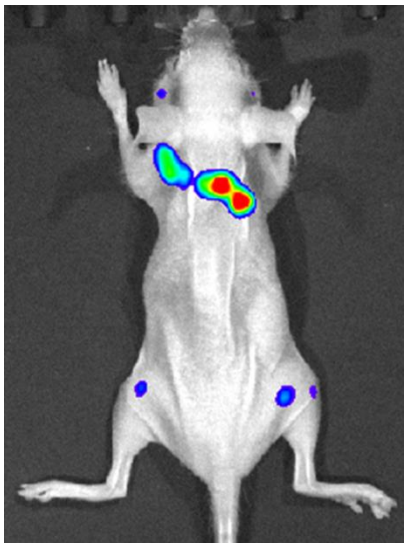
Molecular

Type of detection

in vivo Imaging Platform from PerkinElmer (2000+ Installations worldwide)

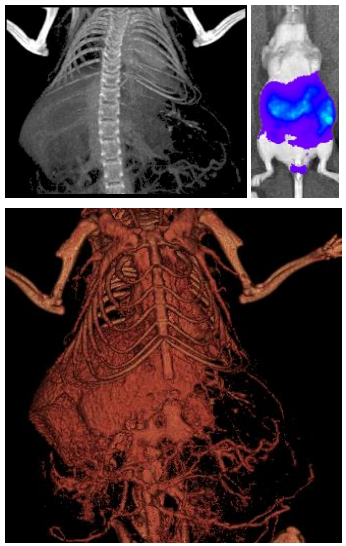
Lumina XRMS

Quantitative 2D bioluminescence, fluorescence and X-ray imaging



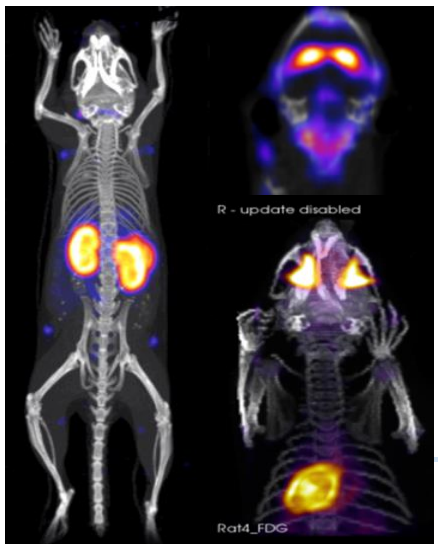
Quantum GX

High Speed (8s), low X-ray dose and High Resolution micro-CT



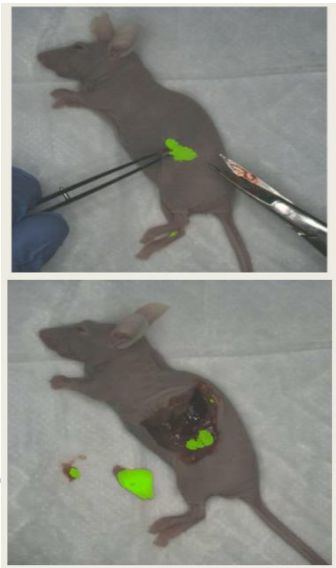
G8 PET-CT

Benchtop type High sensitivity 3D imaging Low cost of ownership

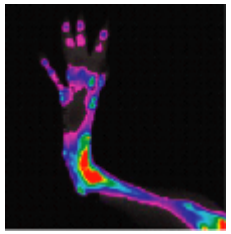


SOLARIS

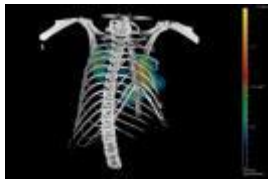
Open air fluorescence imaging for Preclinical research in large animal models



Tailored To Therapeutic Applications

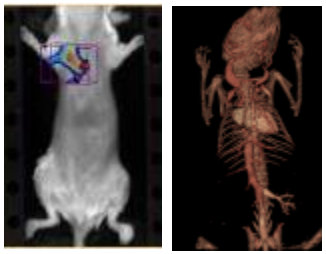


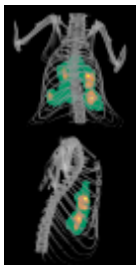
Inflammation



Oncology

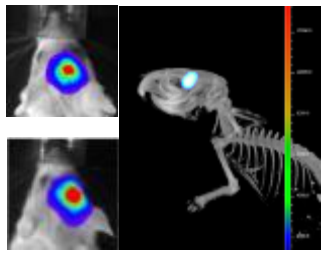
Cardiovascular Disease



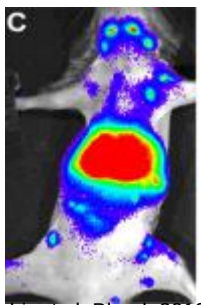


Infectious Diseases

Neuroscience

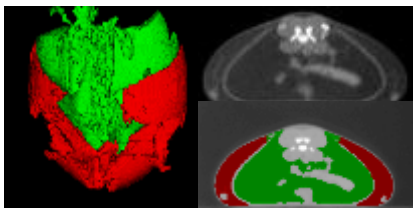


Immunology

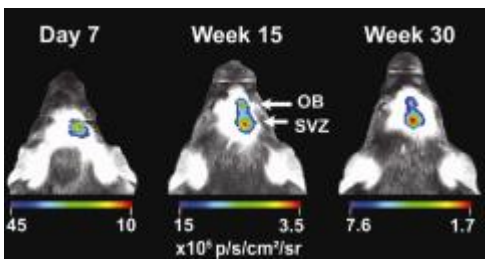


Ophir et al, Blood, 2010

Metabolic Diseases



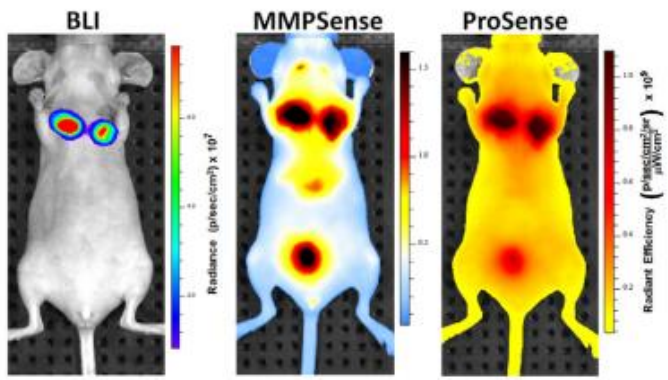
Stem Cells



Reumers et al, Stem Cells, 2008

Why Optical *In Vivo* Imaging?

- Non-invasive
  - Does not require subject to be euthanized
- High throughput
  - Take 3 mouse at one time
- Multi-function
  - Bioluminescence、fluorescence and X-Ray
- Easy to operation

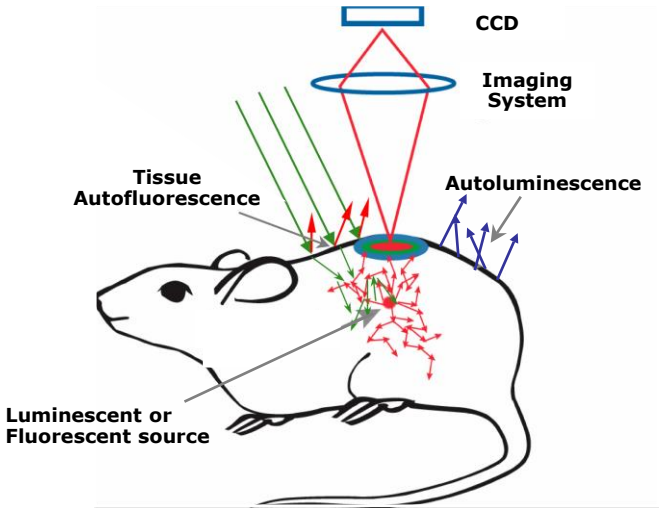


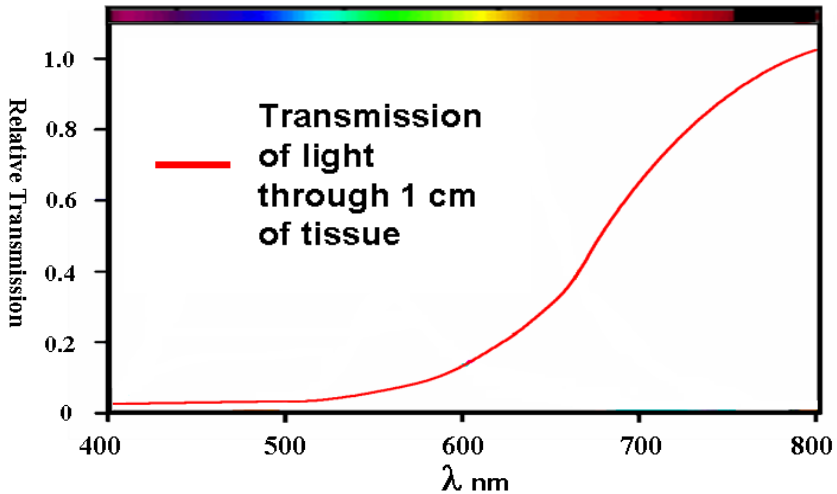
Detecting MMP and cathepsin activity with MMPSense 680 and ProSense 750EX in orthotopic 4T1-luc2 tumors.

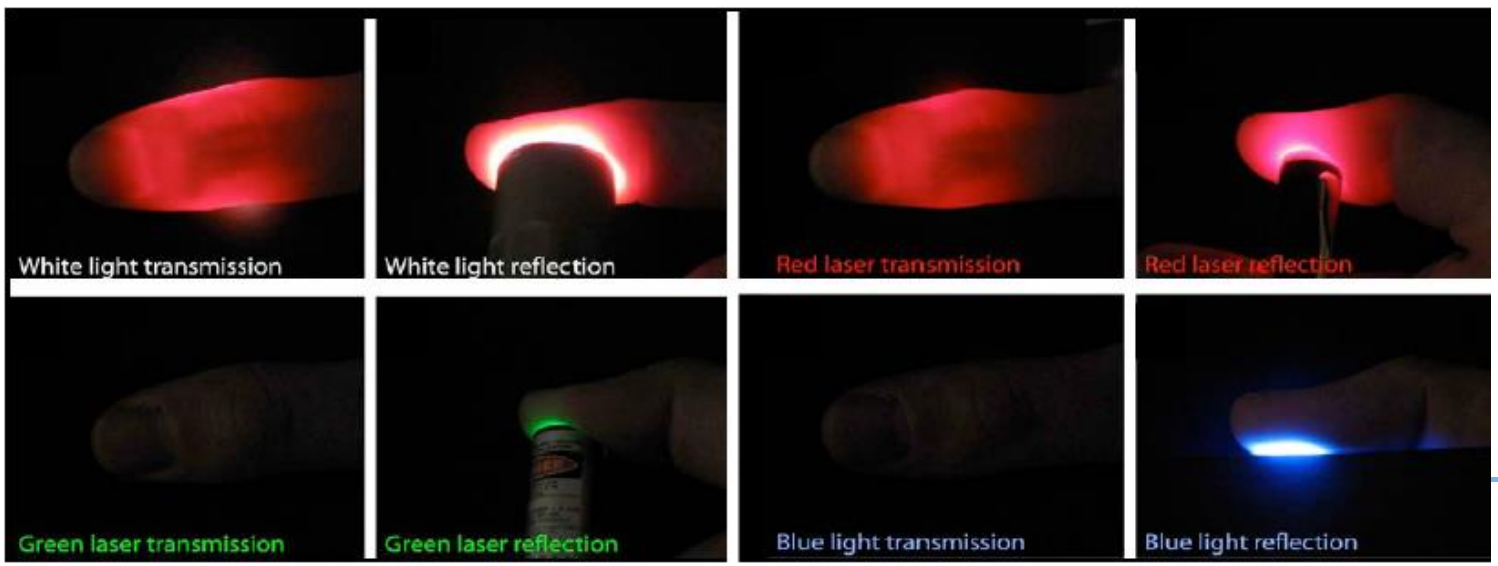
Principles of optical *in vivo* imaging

Tissue Absorption

Tissue Is Not Transparent – Light Absorbance Depends on Wavelength

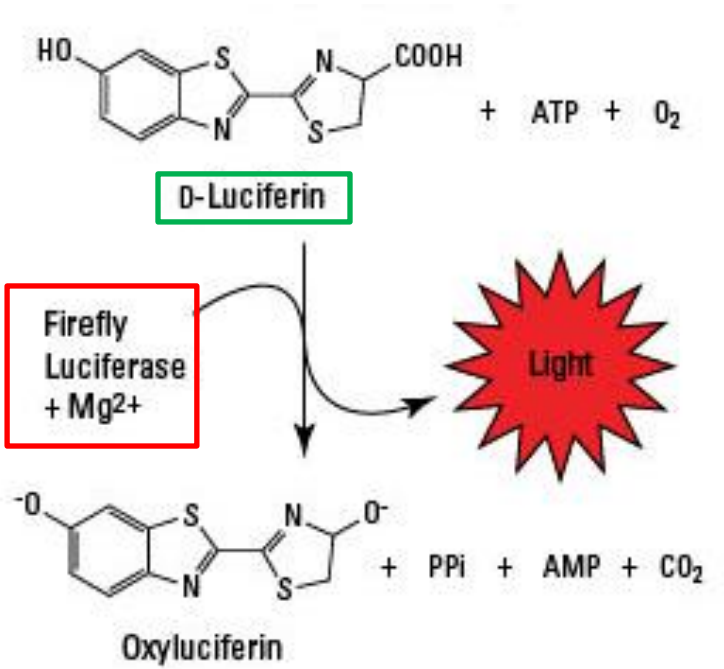




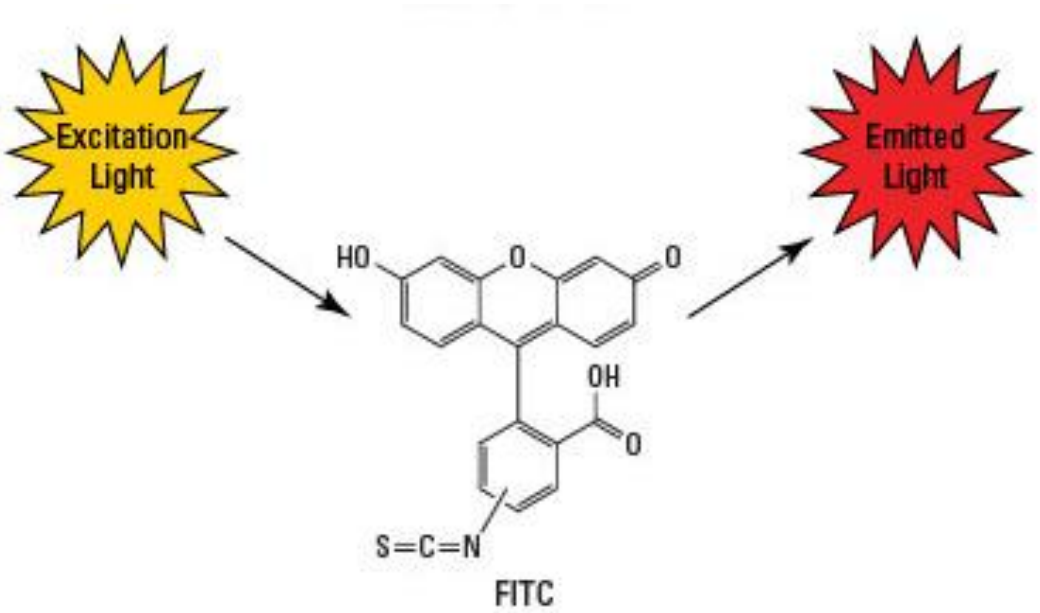


Two Image System

Bioluminescence



Fluorescence

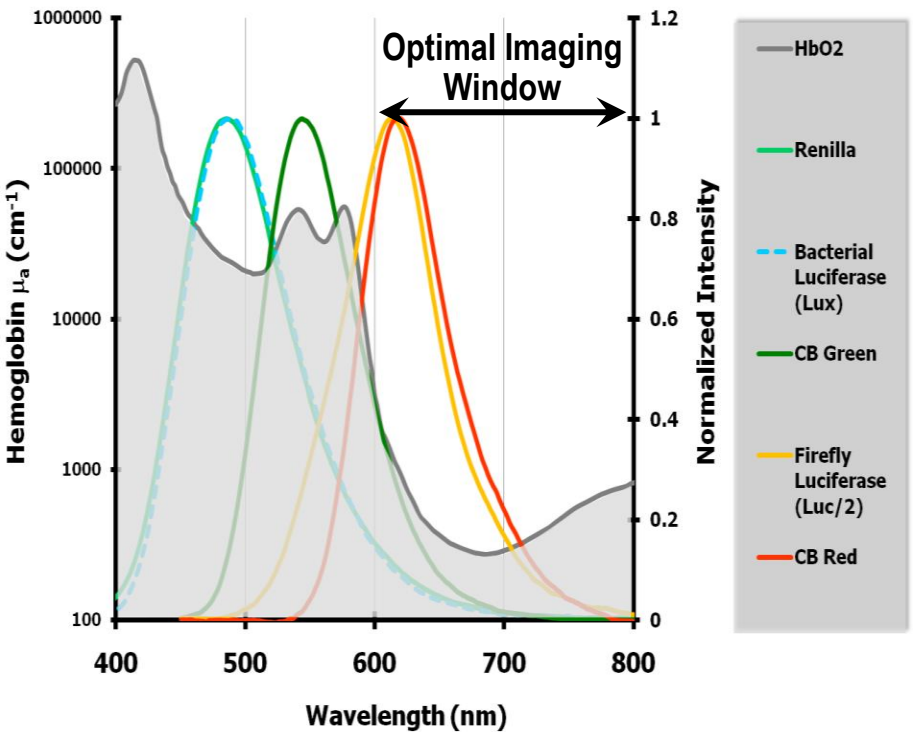


11

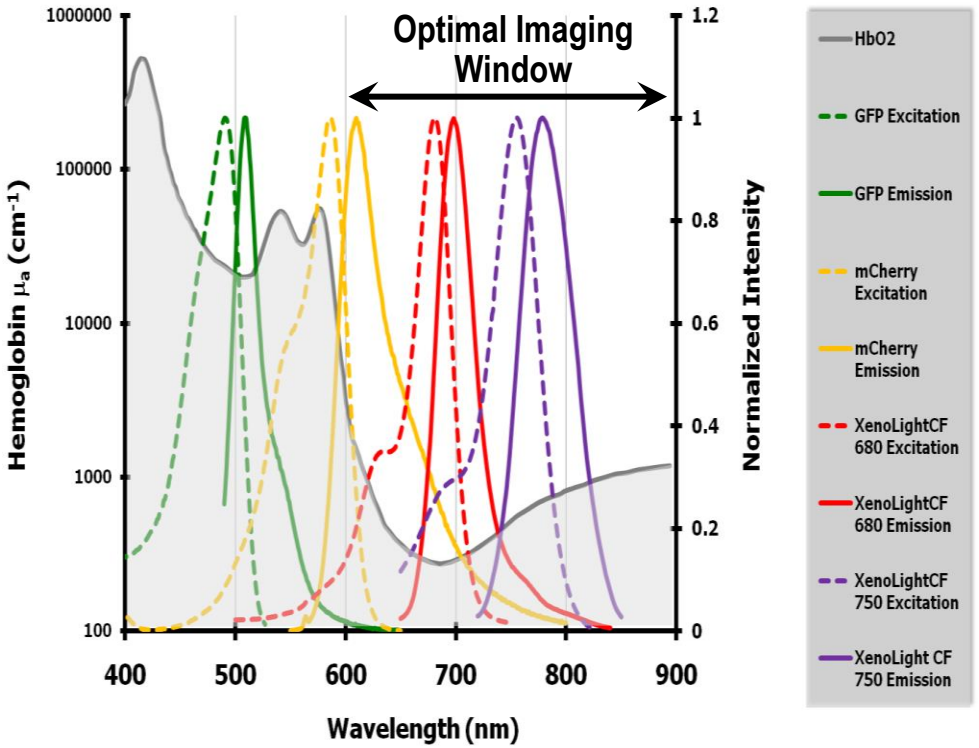
Tissue Absorption

Tissue Is Not Transparent – Light Absorbance Depends on Wavelength

Luciferase Spectrum

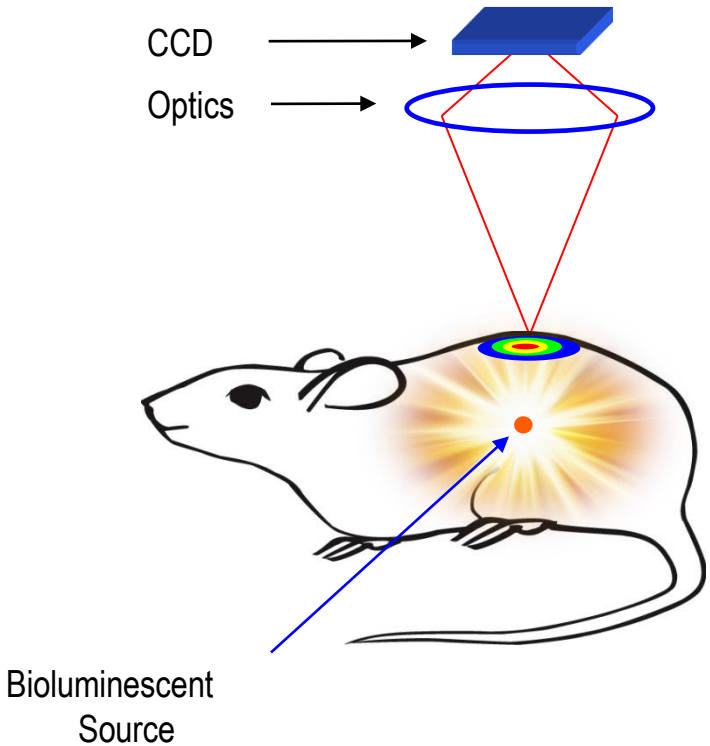


Florescence Spectrum



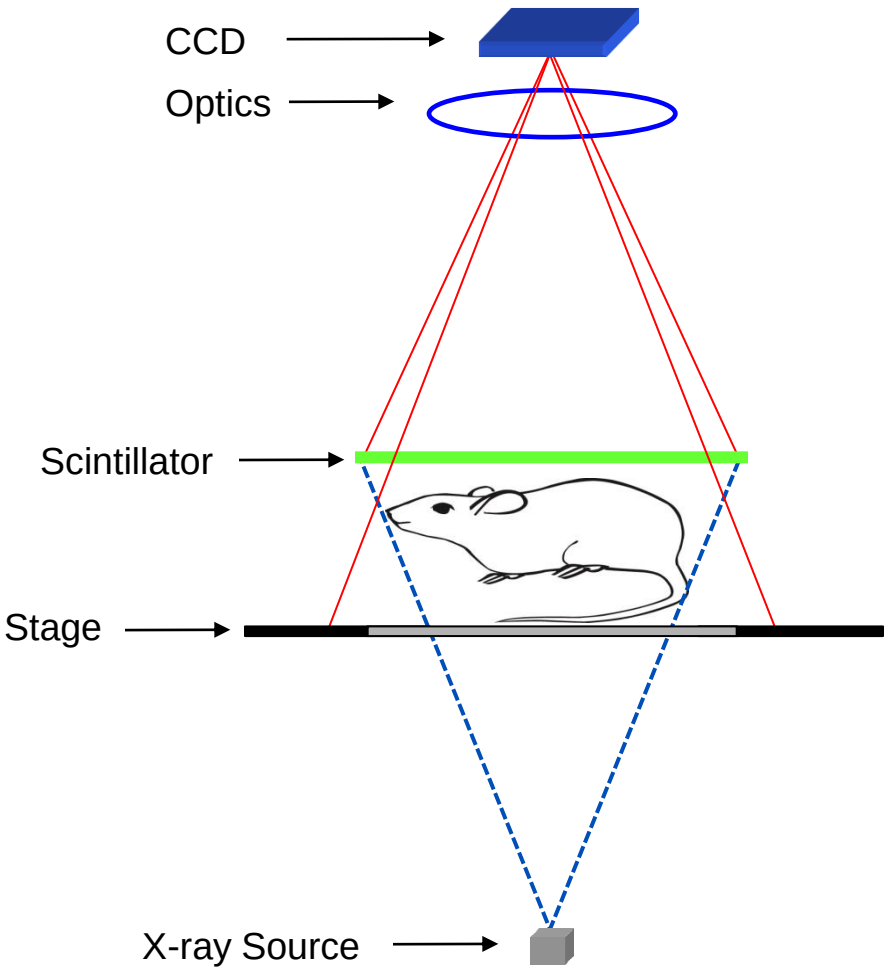
Photons Diffuse Through Tissue

The IVIS® views the diffuse image on the surface of the subject

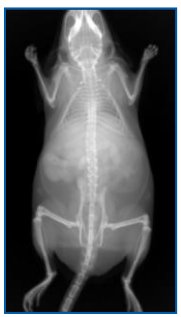


- Light traveling through tissue scatters many times creating a "fuzzy" image at the surface of the animal.
- The IVIS® views the diffuse image on the surface of the subject.

How an X-Ray Image is Acquired



- X-rays will be attenuated in tissue differently resulting in an image on the scintillator
- The CCD views the scintillator resulting in a planar X-ray image
- X-ray and Optical images have different path lengths. To correct this geometrical difference, the X-ray image is registered to the optical image



Close Up of Scintillator in Position

IVIS® Lumina XRMS Introduction

IVIS® Lumina XRMS – Hardware

CCD camera

Image chamber

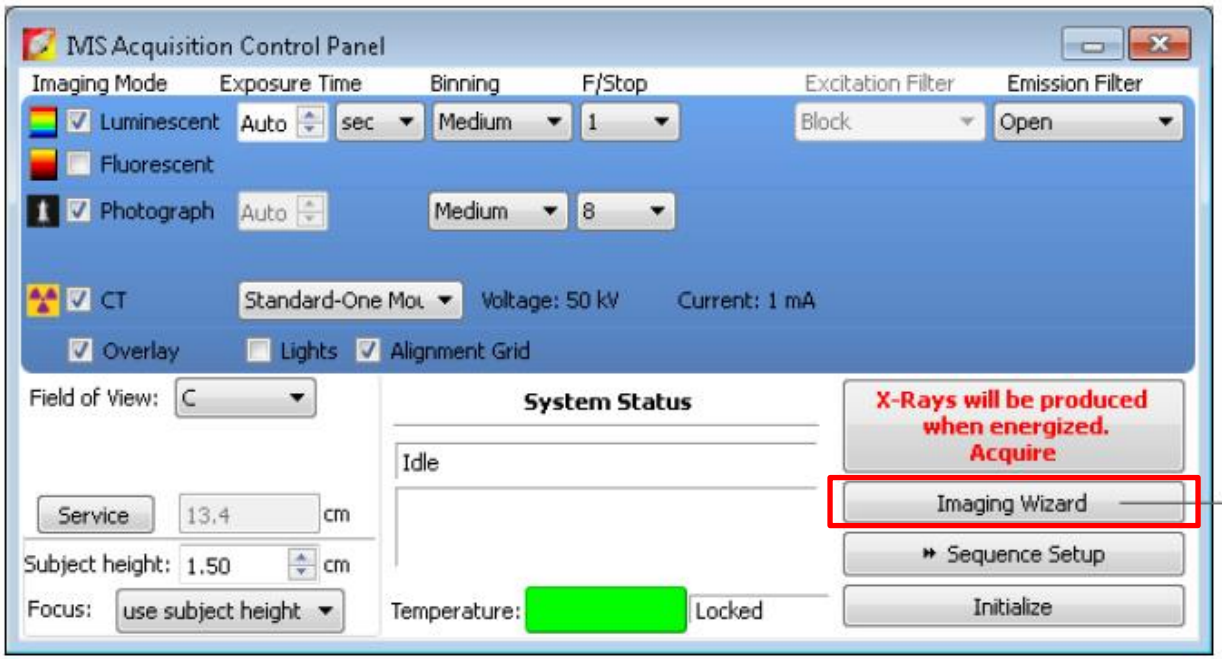
anesthesia system

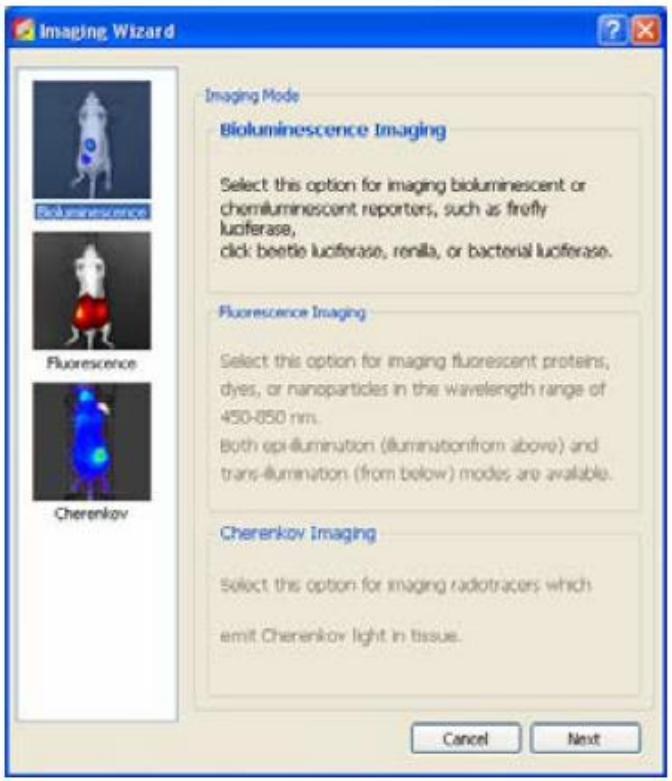
Acquisition computer & monitor

IVIS® Lumina XRMS

- High sensitivity CCD for bioluminescence or fluorescence imaging
- High throughput with 12.5 cm field of view
- 26 filters, wavelength ranges from 500 – 865 nm
- Spectral unmixing using discrete bandpass filters
- Ideal for imaging multiple probes/reporters
- Software controlled settings and analysis tools

Image Wizard: step by step for imaging setup

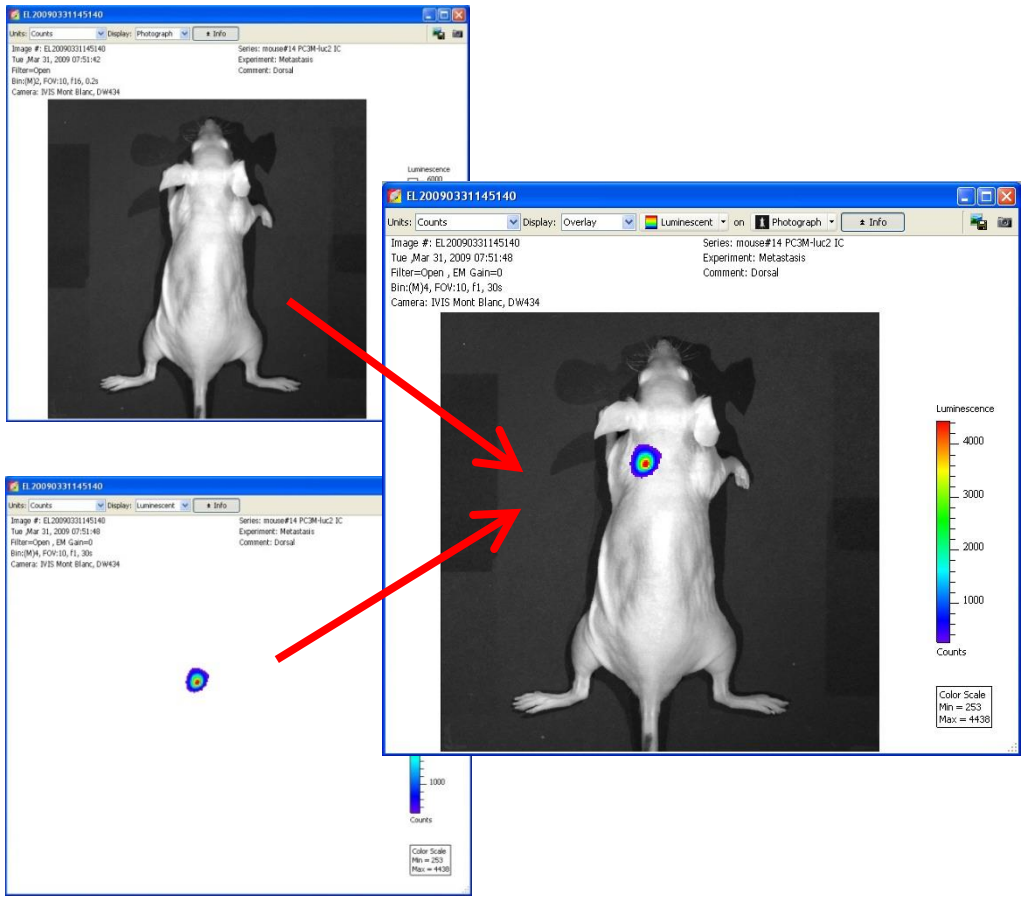


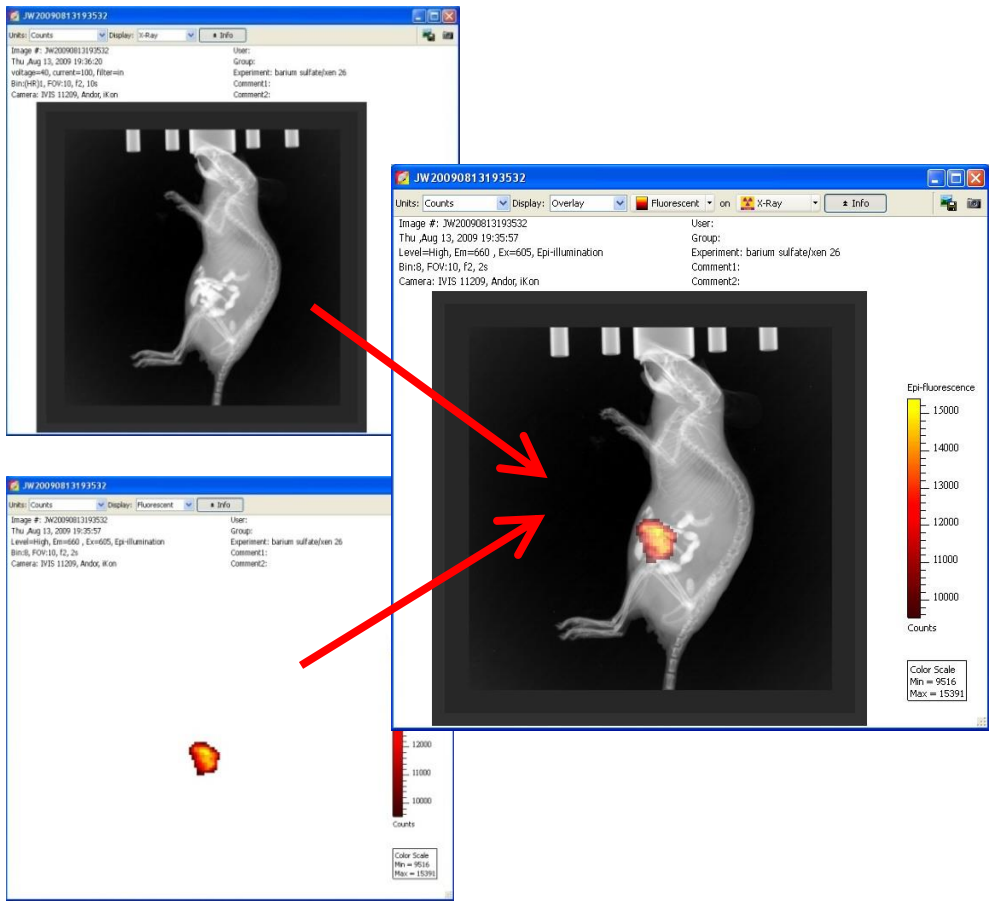


Living Image 4.5.2 download:
http://www.perkinelmer.com/lab-products-and-services/resources/software-downloads.html

Standard Acquisition – Composed of two images

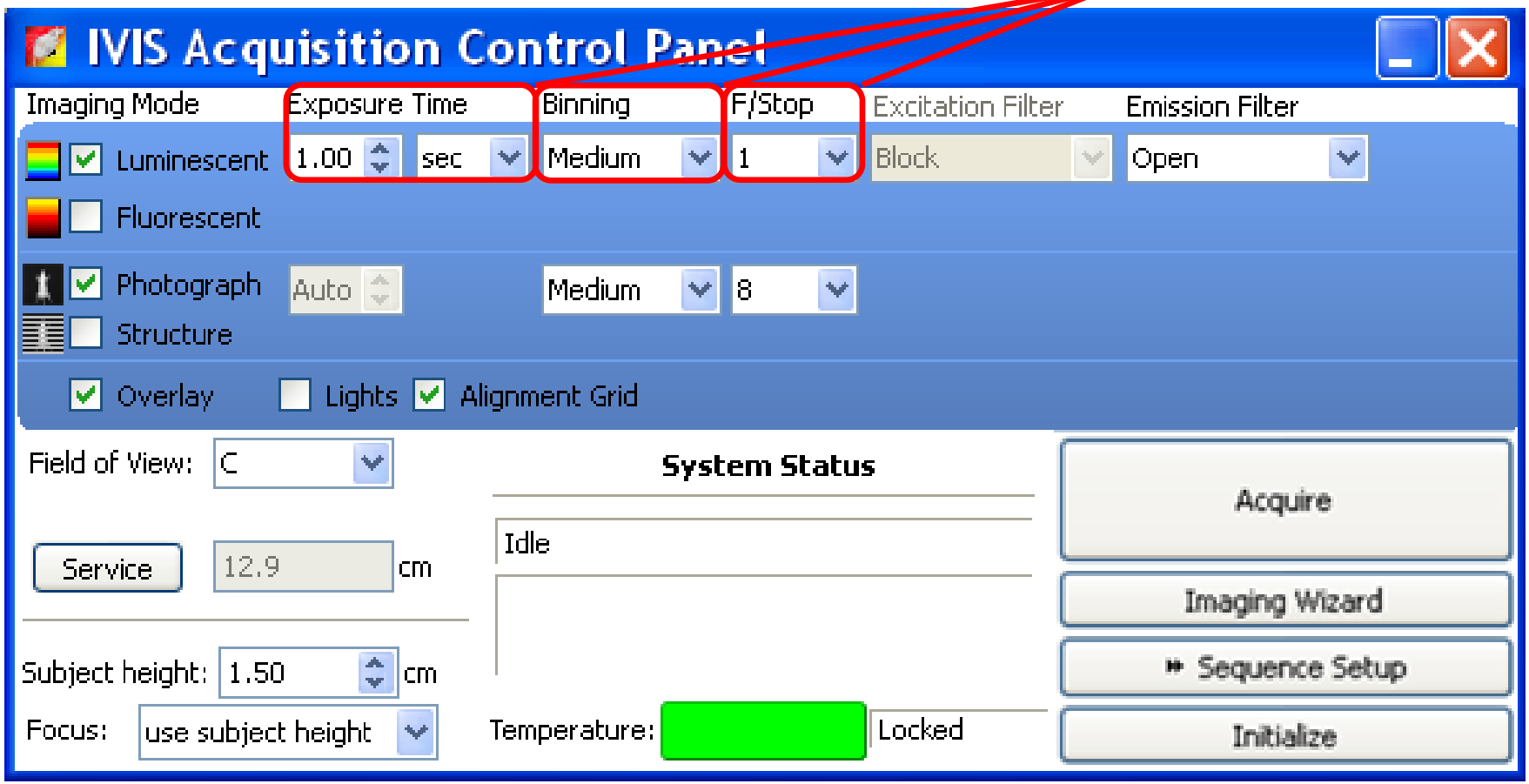
Photographic /X-Ray + Optical Image = Overlay





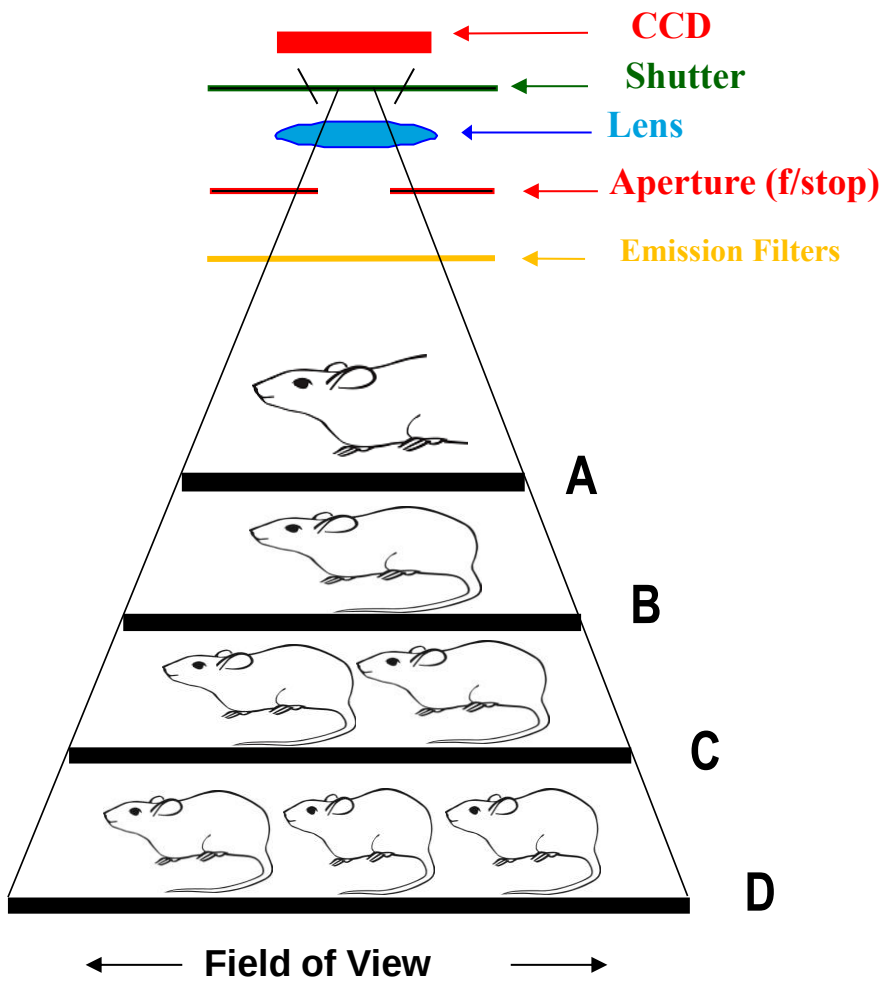
Living Image® Control Panel

Controls Sensitivity



Camera and Lens Settings are Analogous to Those Used in Standard Photography

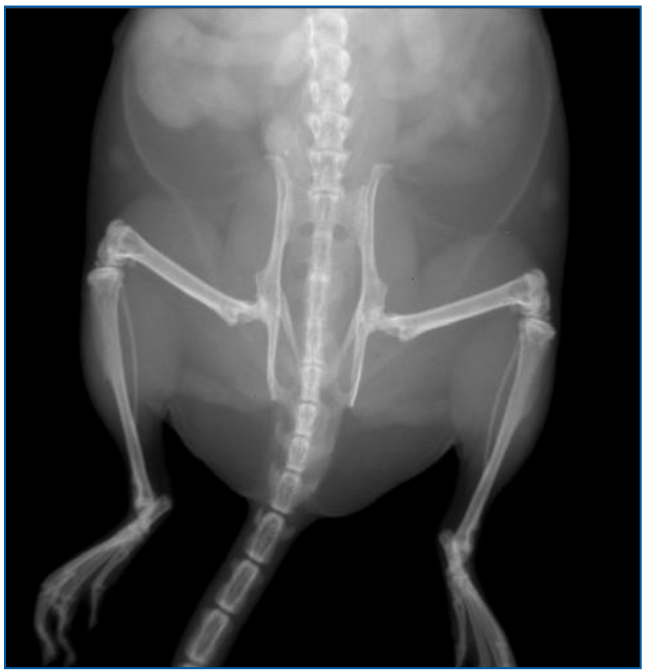
- Field of View (FOV) is dependent on the distance from the lens to the sample
- Light collected is proportional to how long the shutter is open (exposure time)
- Aperture (*f*/stop) controls the amount of light collected
- Digital pixel binning is possible on the CCD – alters sensitivity/resolution



Field of View (X-Ray)

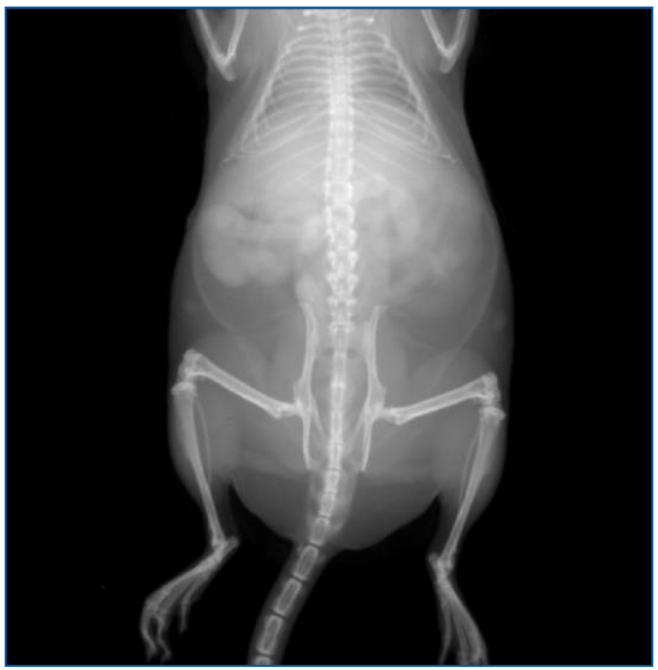
FOV A

5 x 5 cm



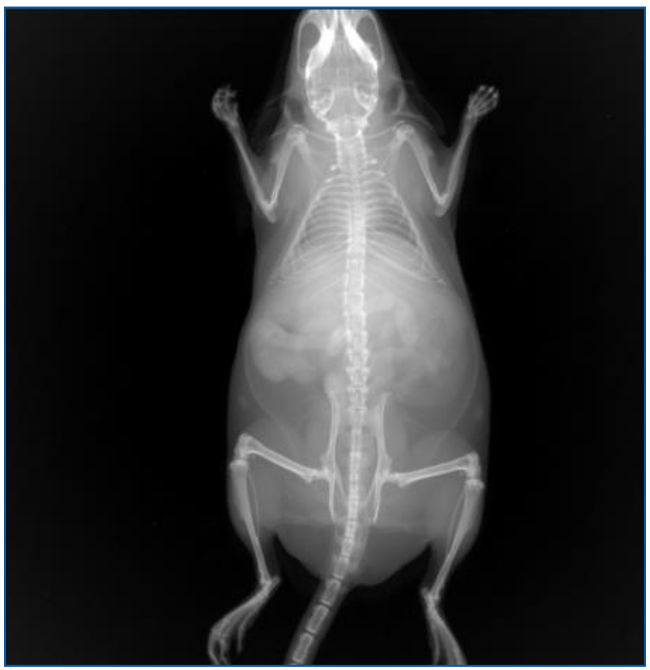
FOV B

7.5 x 7.5 cm



FOV C

10 x 10 cm

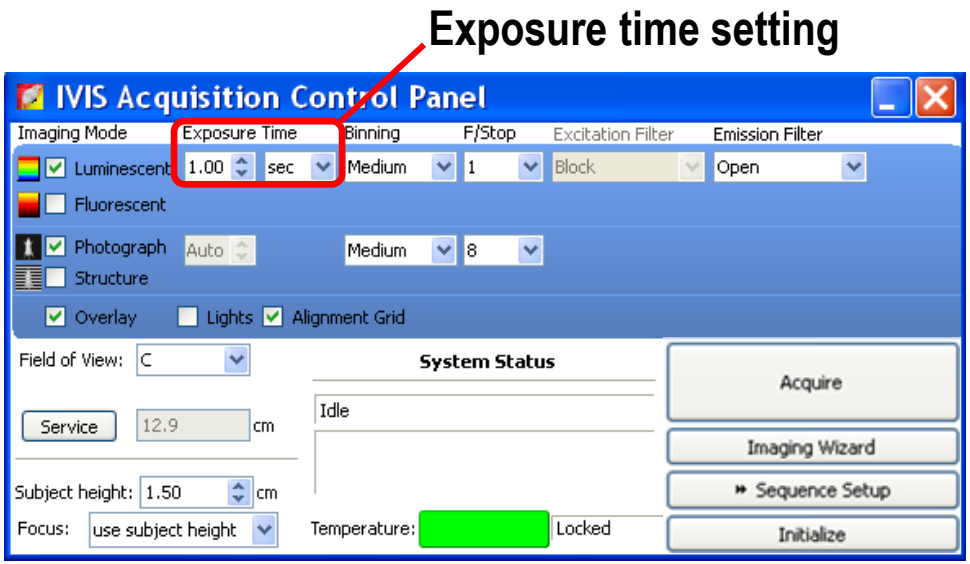


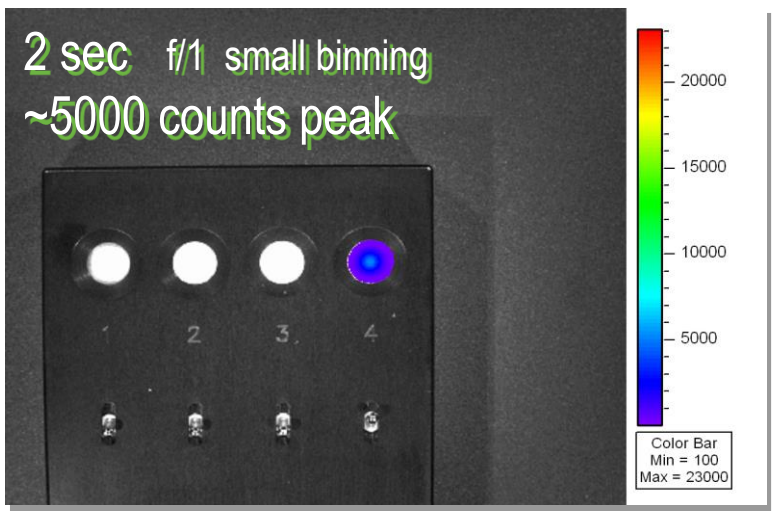
Setting Sensitivity – Signal Level

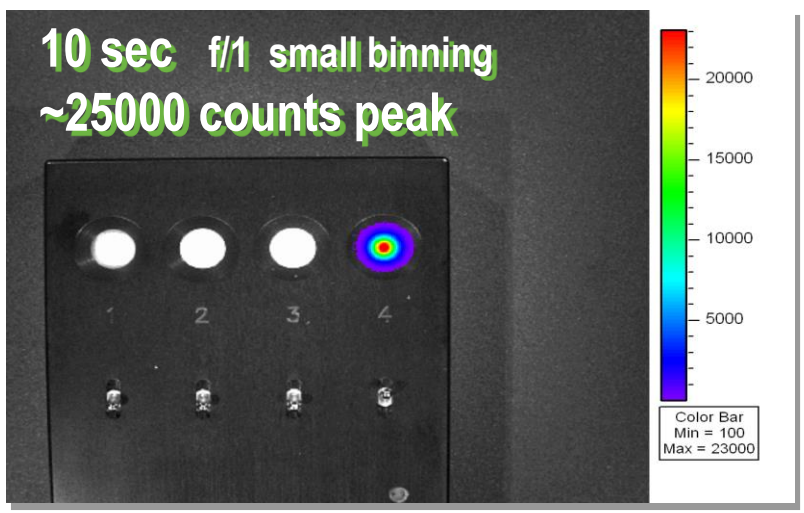
- The IVIS® CCD camera has a raw signal range of 0 to 65,535 Analog to Digital counts (2^{16})
- Adjust camera settings to obtain a signal level of **600 to 60,000 counts** to be within the linear range of the detector
- Settings that control signal level are:
  - Exposure time
  - Pixel binning (CCD resolution)
  - *f*/stop (aperture)
- Instrument is calibrated to automatically compensate for changes in sensitivity settings when count levels are within the linear range

Exposure Time

- Signal level is directly proportional to exposure time (1:1)
- Shorter exposure time improves throughput
- Recommended minimum exposure time > 0.5 seconds
- Longer exposure times increase signal intensity
- Recommended maximum exposure time < 5 minutes







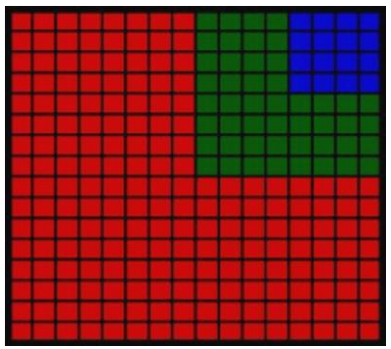
Pixel Binning (CCD Resolution)

- Binning refers to the grouping of pixels into a larger super-pixel

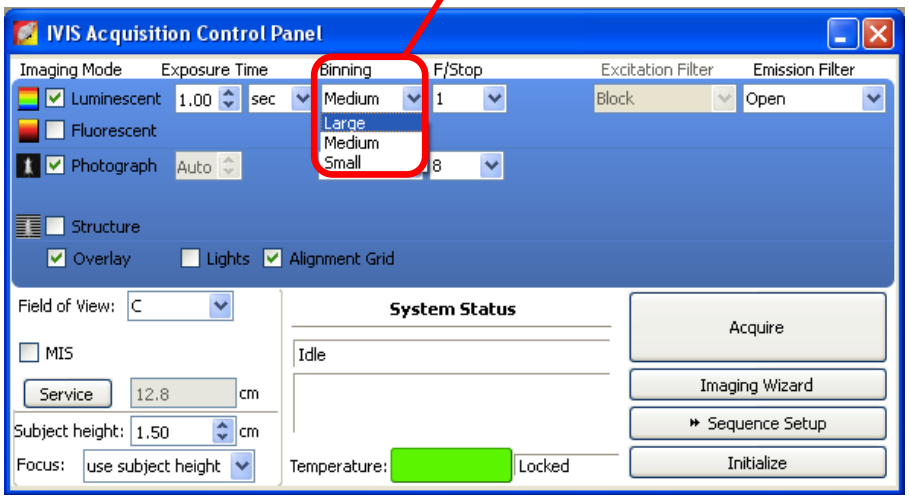
Large Binning (16)
Higher Sensitivity/Lower Resolution

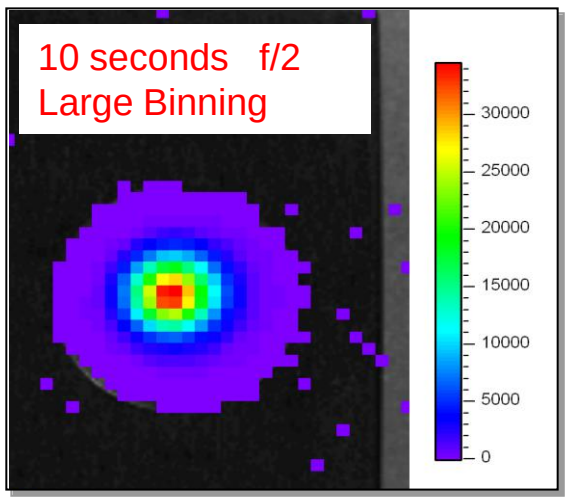
Medium Binning (8)

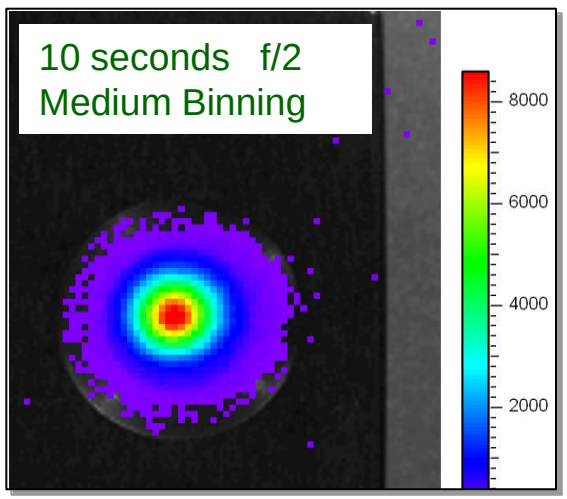
Small Binning (4)
Lower Sensitivity/Higher Resolution

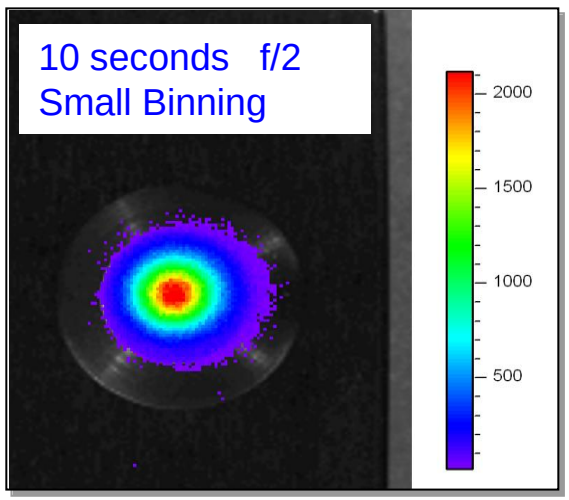


Pixel binning setting





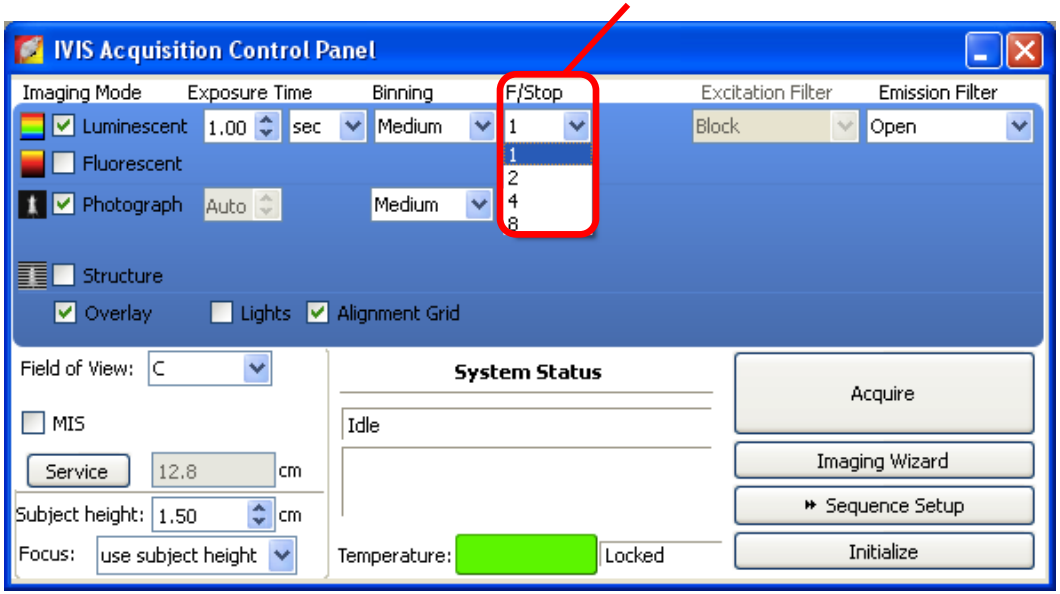




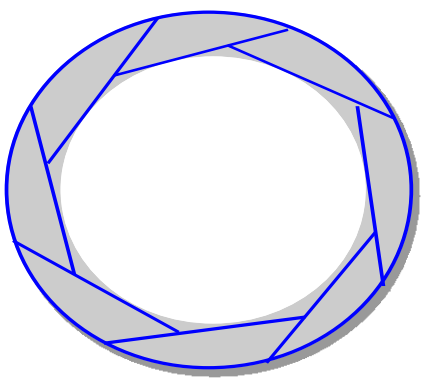
f/stop (Lens Aperture)

- *f*/stop controls the amount of light received by the CCD detector
- *f*/1 is wide open, maximum light collection – default for luminescent
- *f*/8 is smallest aperture, best resolution – default for photo

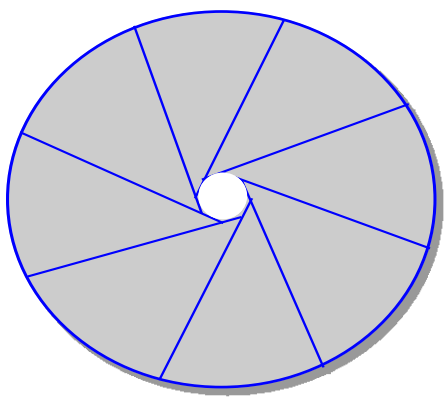
***f*/stop (aperture) setting**



***f*/1**



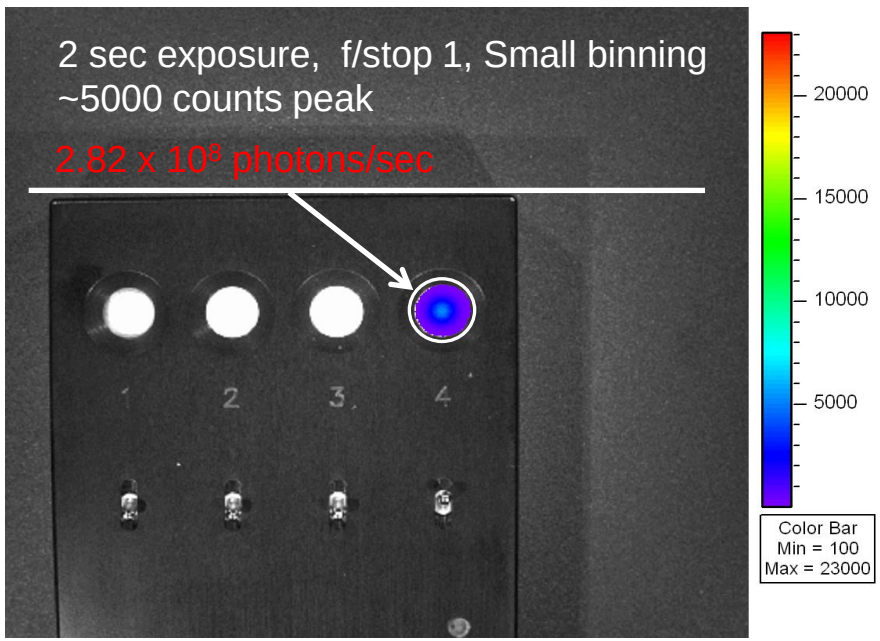
***f*/8**

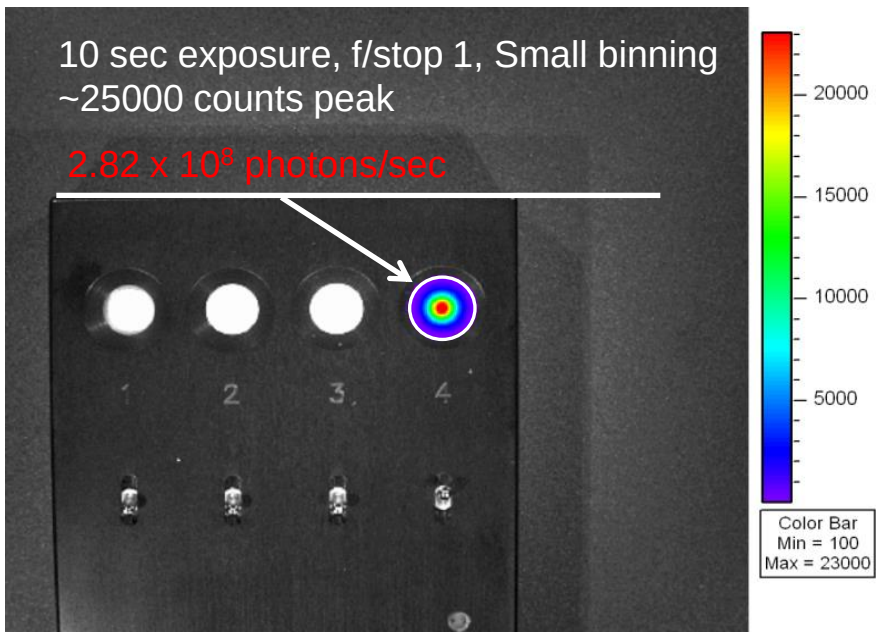


Luminescence Calibrated Physical Units - Radiance

Radiance = Emission Light (photons/sec/cm^2/str)

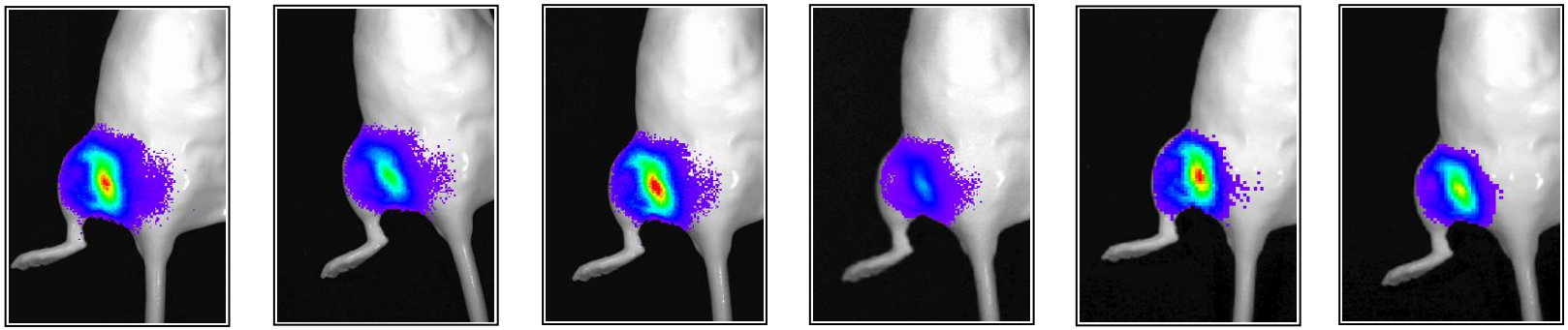
- Living Image® automatically compensates for device settings: Exposure time, *f*/stop, binning and field of View.
- Calibrated units are Photons per Second, representing the flux radiating omni-directionally from a user-defined region.
- **Absolute calibration** – calibrated to the NIST standards





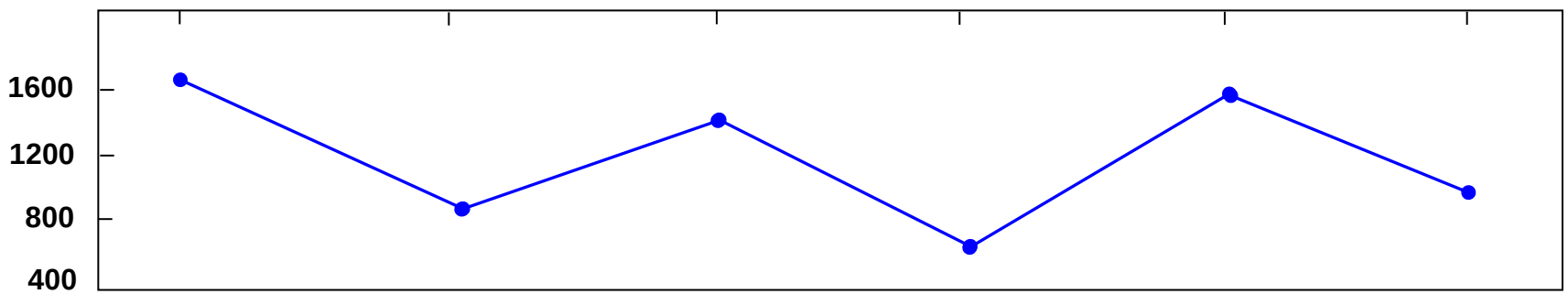
Calibrated Physical Units vs. Raw Signal

Raw Signal (*Counts*)



Exp time:	30 sec	30 sec	60 sec	60 sec	60 sec	60 sec
Binning:	small	small	small	small	medium	medium
Day:	1	2	3	4	5	6

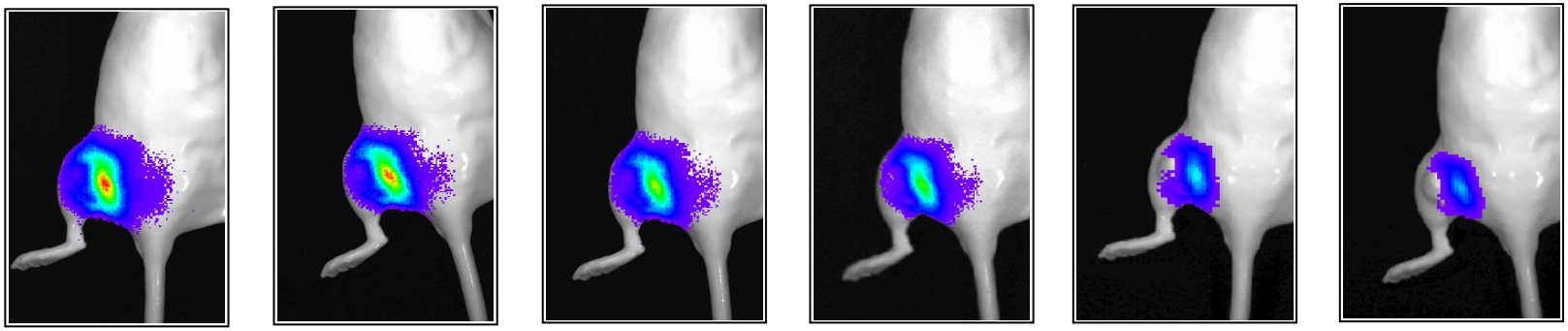
Peak Counts



Calibrated Physical Units vs. Raw Signal

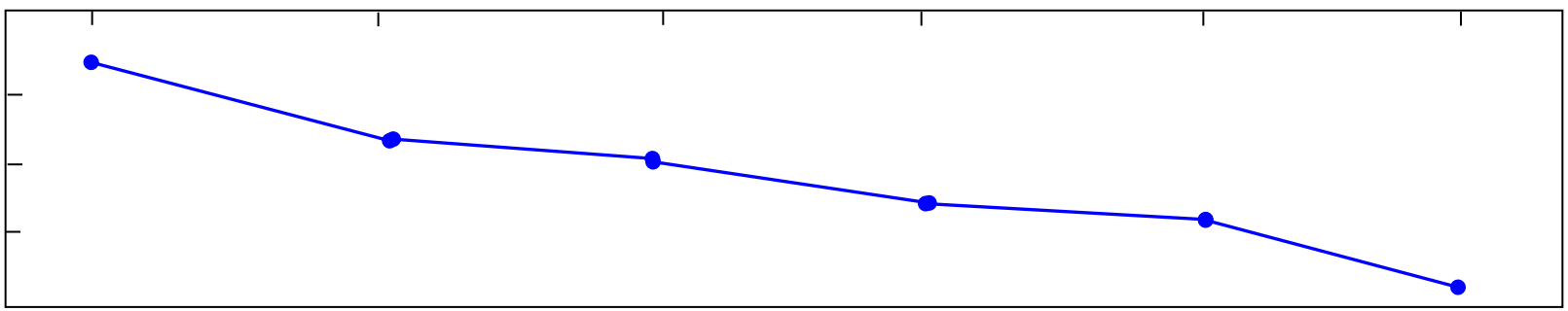
Calibrated Signal

(Photons per second)

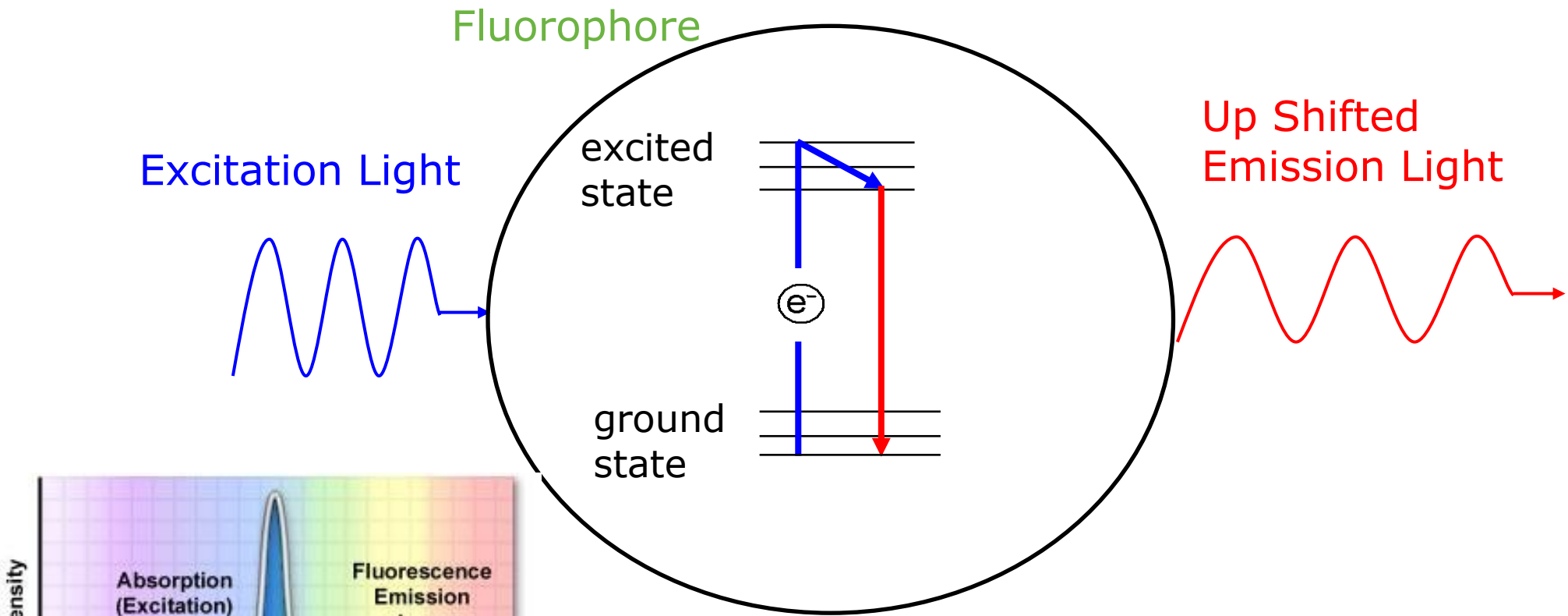


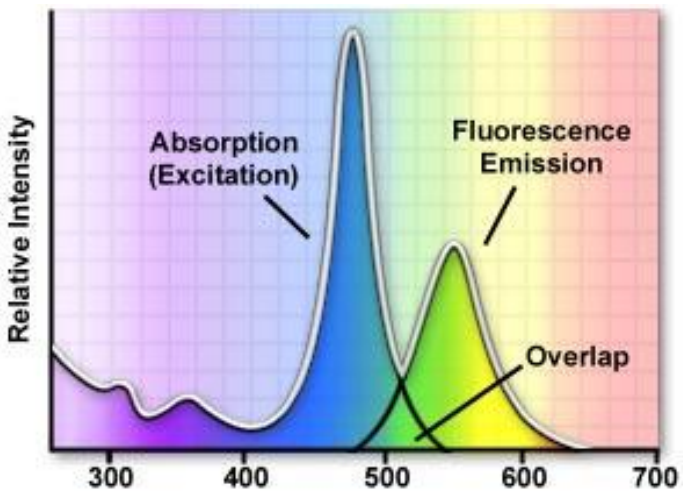
Exp time:	30 sec	30 sec	60 sec	60 sec	60 sec	60 sec
Binning:	small	small	small	small	medium	medium
Day:	1	2	3	4	5	6

Radiance:
Photons per second



Fluorescence Concept



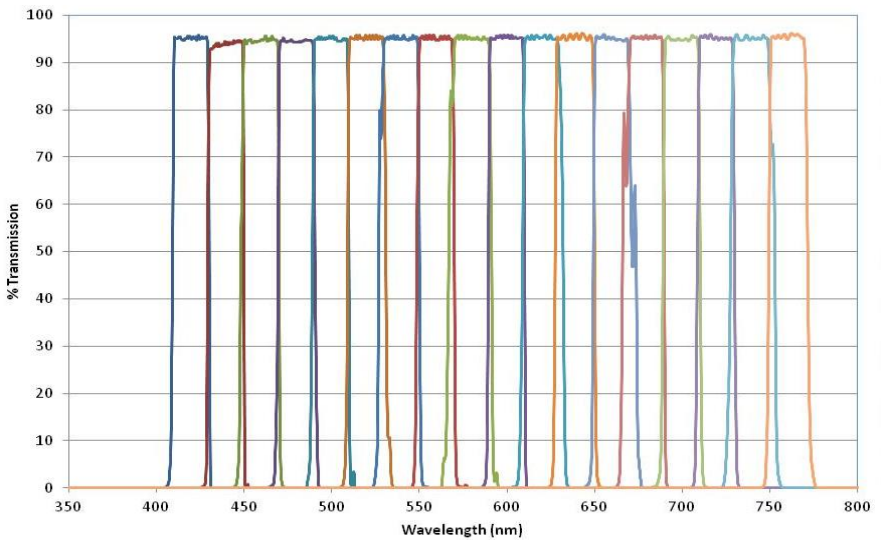


Excitation and Emission Filters

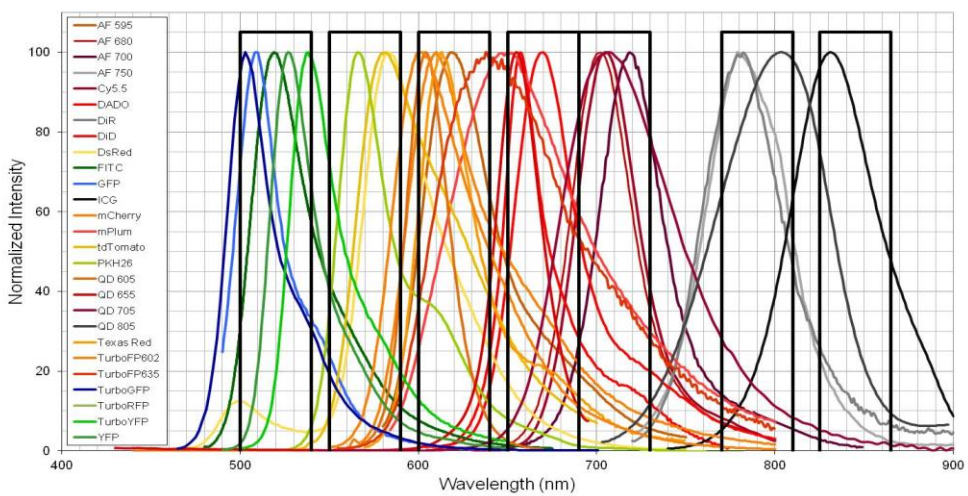
➢26 filters, wavelength ranges from 500 – 865 nm

Lumina III Instruments			
Excitation Filters		Emission Filters	
Center λ	Band pass	Center λ	Band pass
420	20	520	40
440	20	570	40
460	20	620	40
480	20	670	40
500	20	710	40
520	20	790	40
540	20	845	40
560	20		
580	20		
600	20		
620	20		
640	20		
660	20		
680	20		
700	20		
720	20		
740	20		
760	20		
780	20		

19 Excitation filters



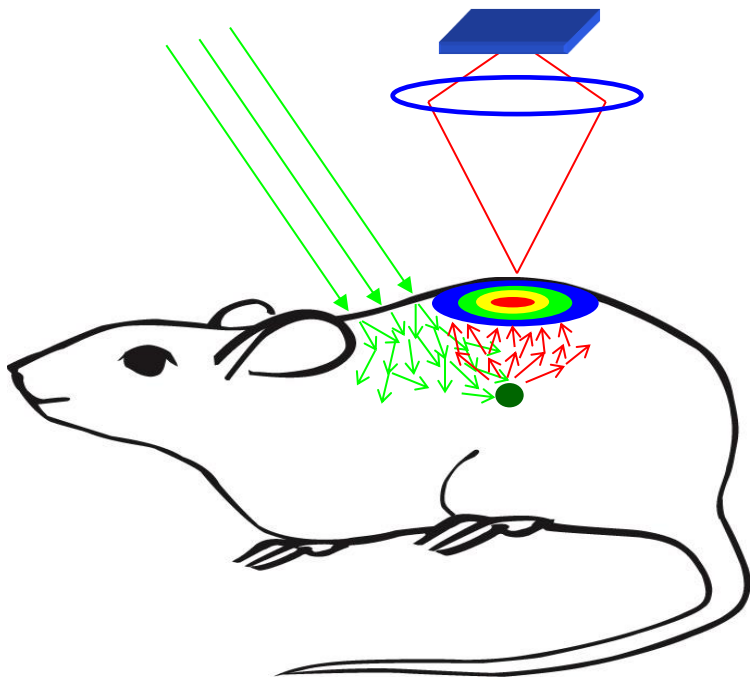
7 Emission Filters



• 27 commonly used fluorescent probes

Epi-illumination Calibration Unit: Radiant Efficiency

$$\text{Radiant Efficiency} = \frac{\text{Emission Light (photons/sec/cm}^2\text{/str)}}{\text{Excitation Light (}\mu\text{W/cm}^2\text{)}}$$

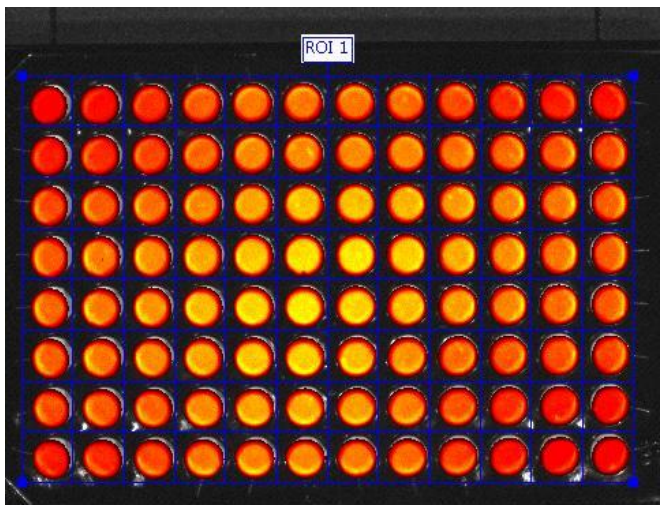


Fluorescent Calibrated Units: Radiant Efficiency

Excitation Light Pattern

Units of 'Radiant Efficiency' compensates for non-uniform excitation light pattern

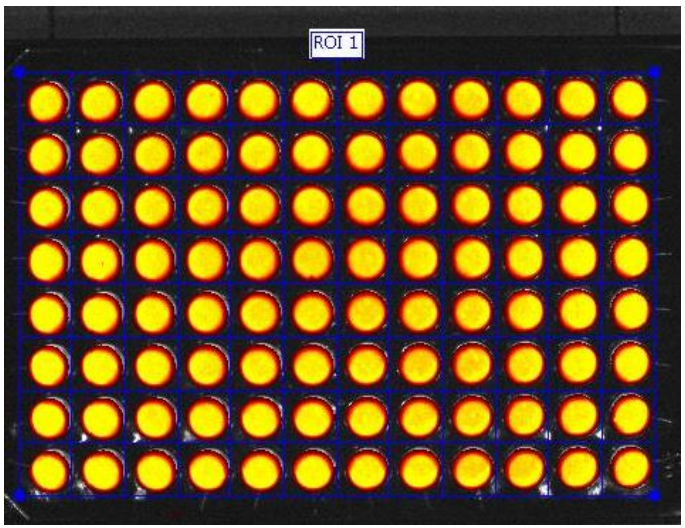
GFP Well Plate Uncorrected



Counts

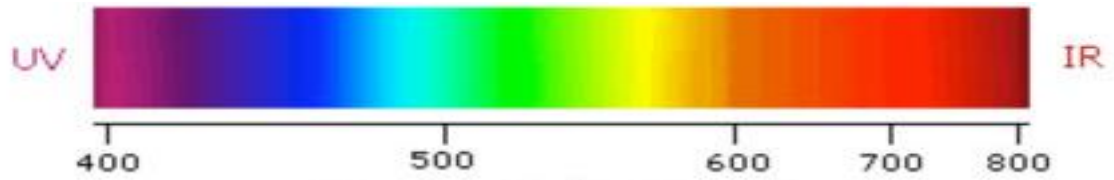
vs.

GFP Well Plate Corrected



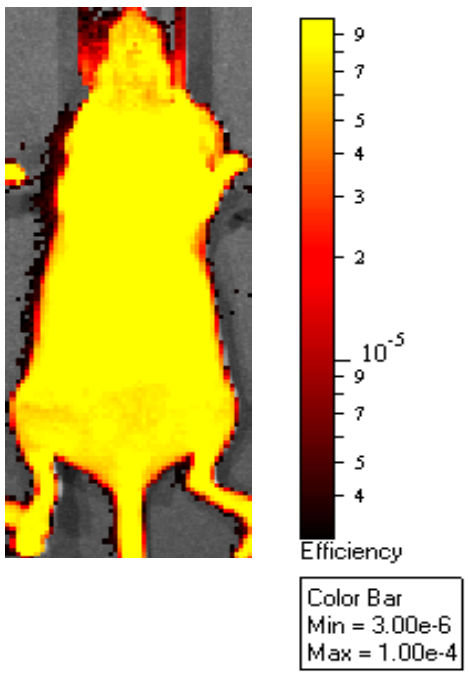
Radiant Efficiency

Autofluorescence of Control Mice



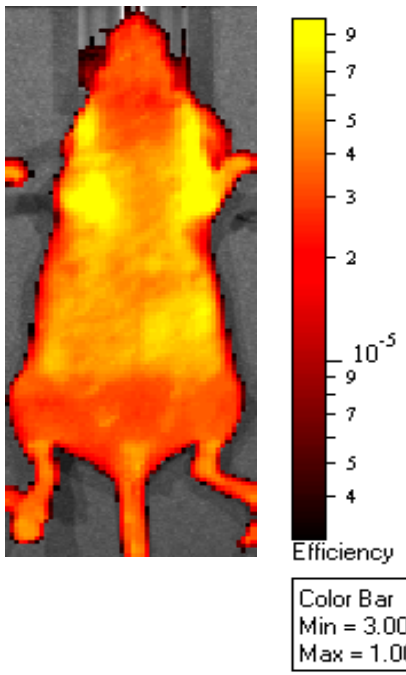
GFP

I = 550nm



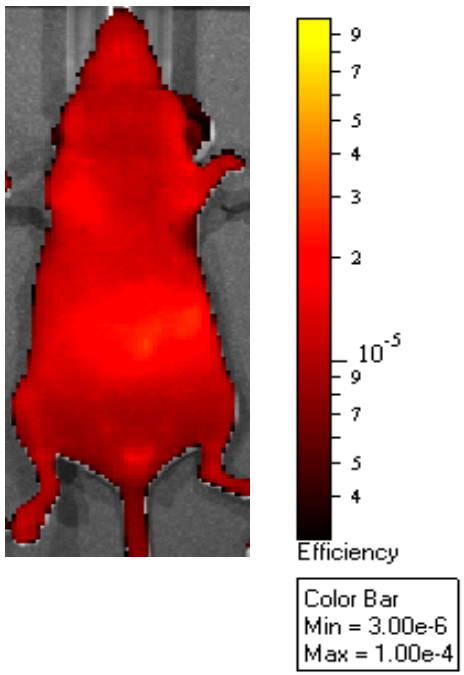
DsRed

I = 610nm



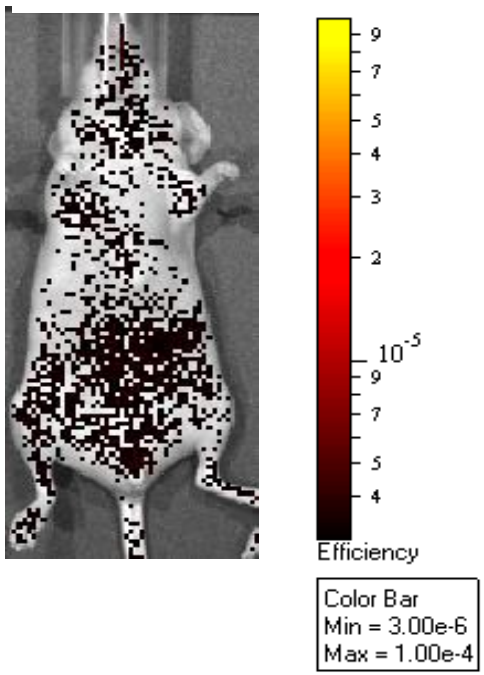
Cy5.5

I = 740nm

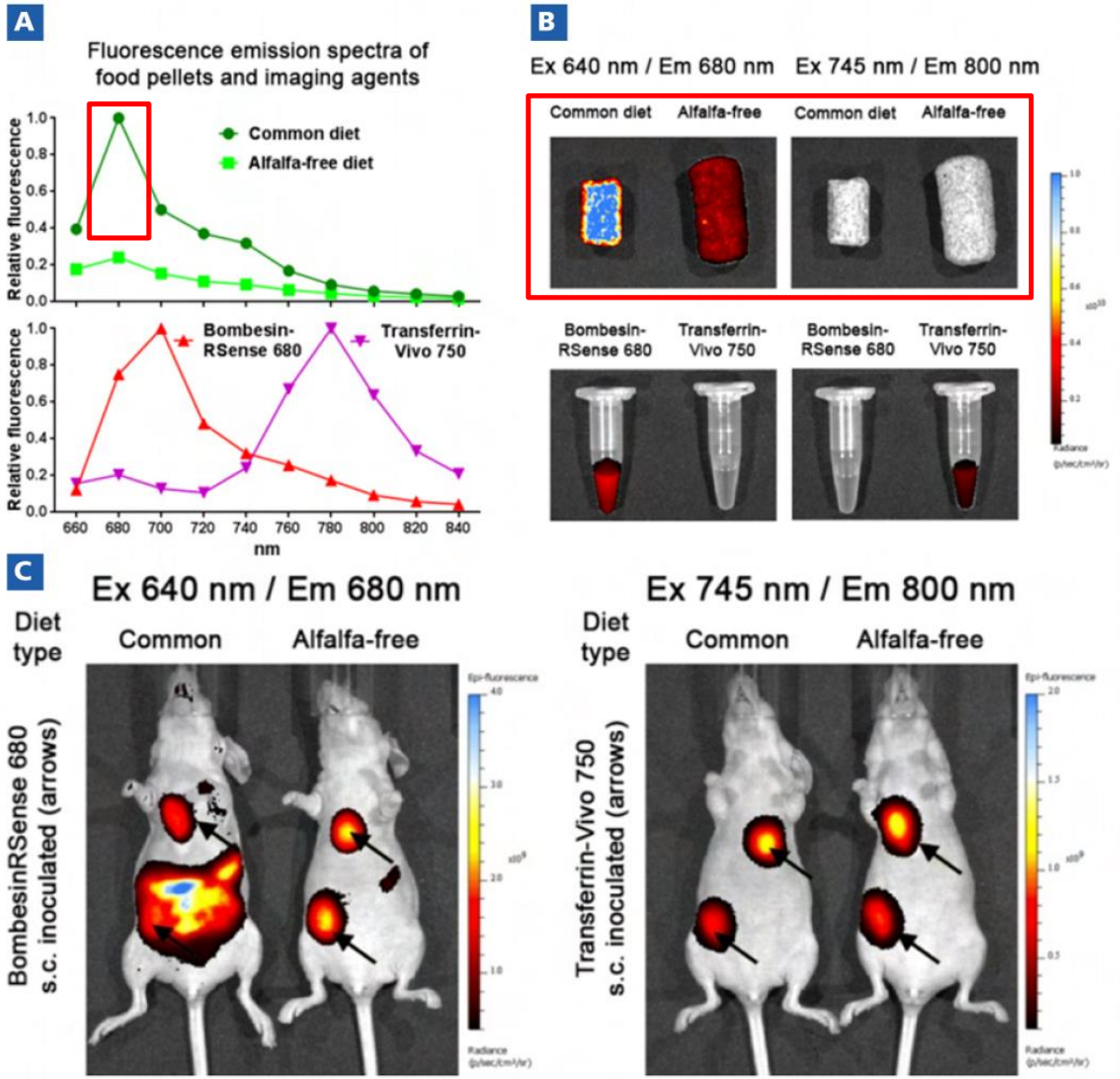


ICG

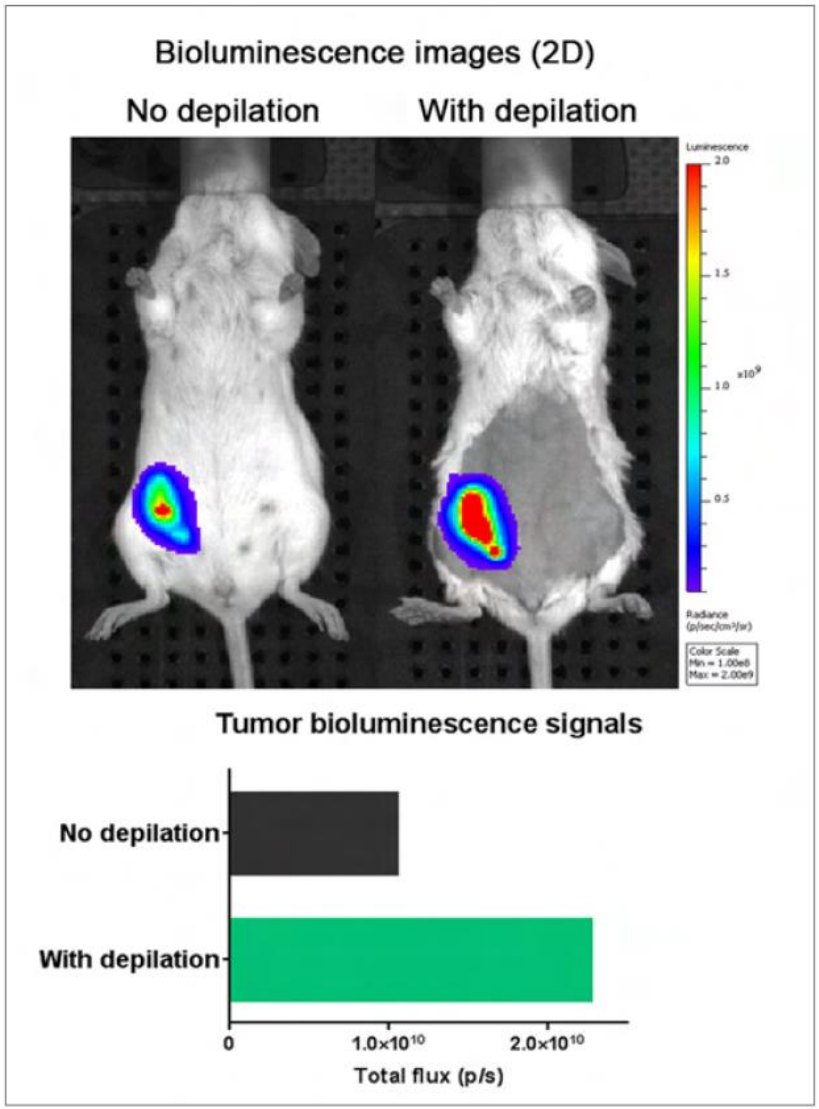
I = 840nm

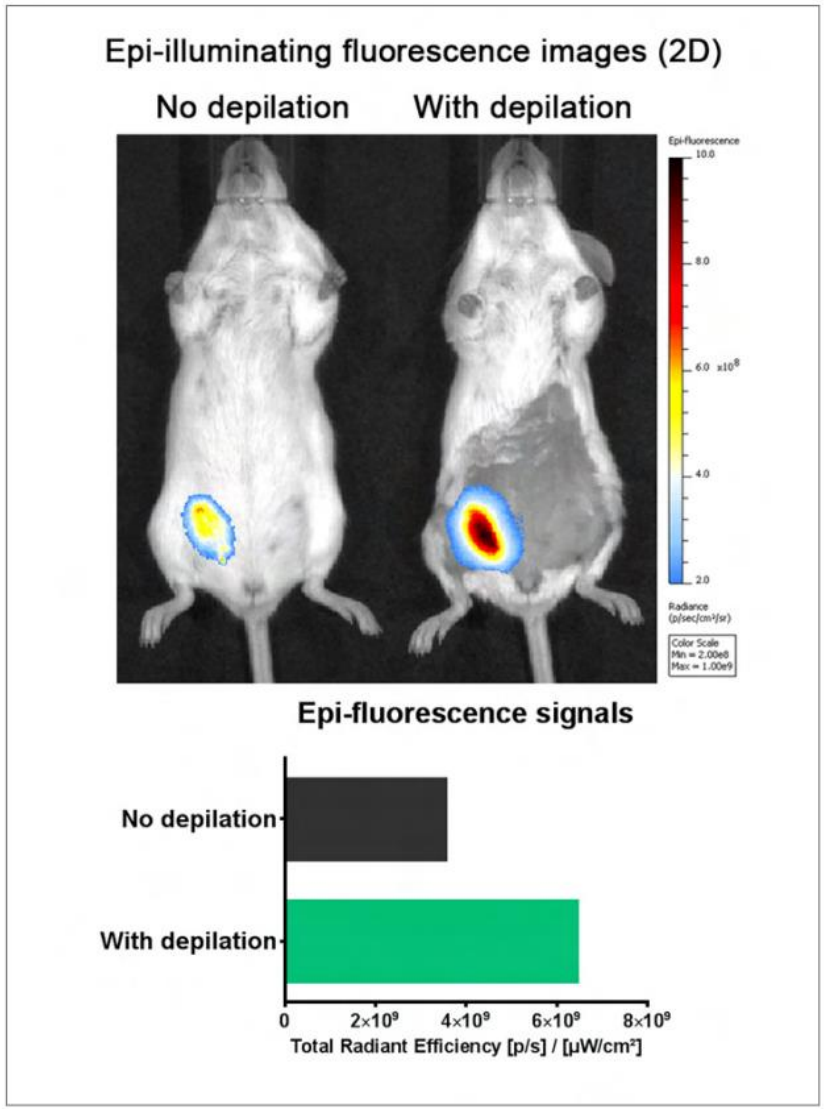


Animal Diet Autofluorescence in Control Mice



Mouse Hair Can Interfere With Both BLI and FLI

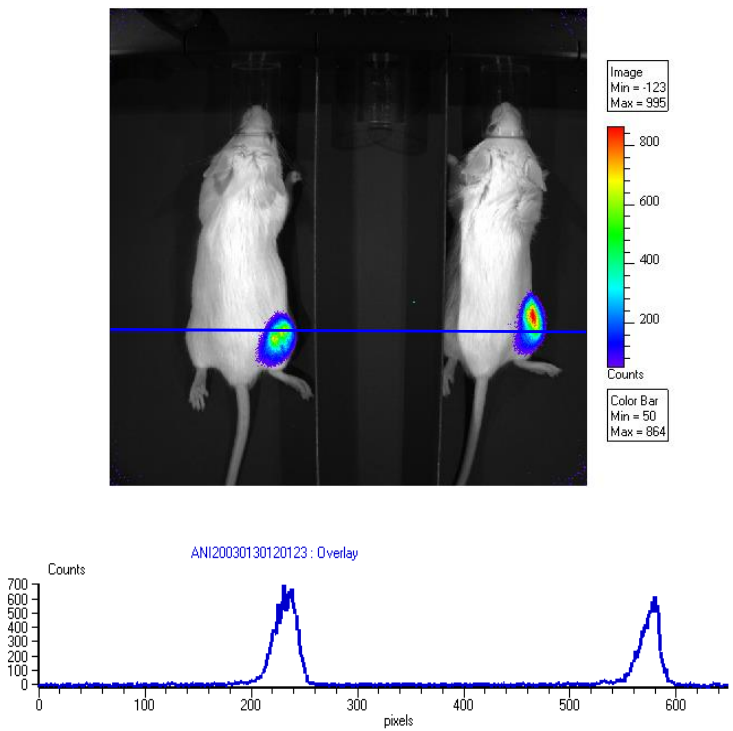




Sensitivity is a Function of a Signal to Noise

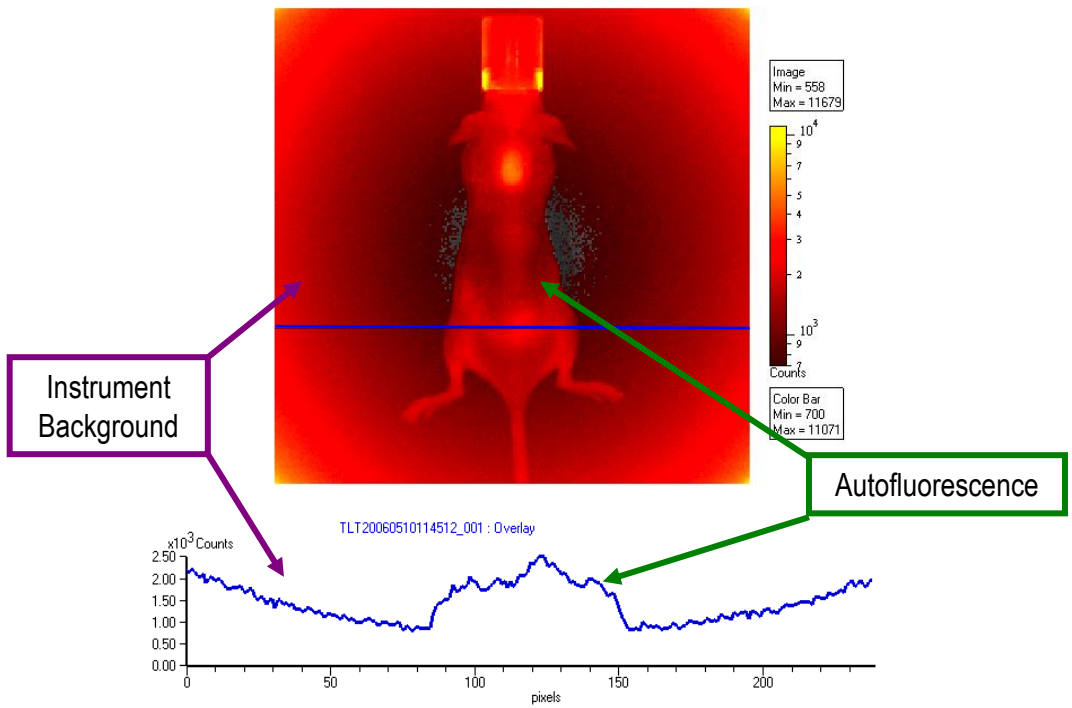
Luminescent Sources:
Signal brightness generally lower than fluorescent sources

Higher sensitivity due to low level noise: both instrument and animal autoluminescence



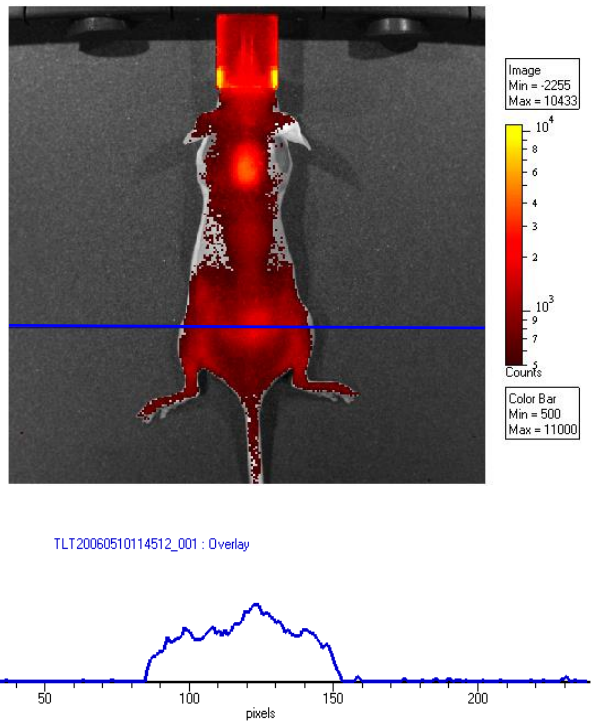
Fluorescence Sources:
Signals generally brighter than luminescent sources

Lower sensitivity due to higher noise: instrument background and autofluorescence

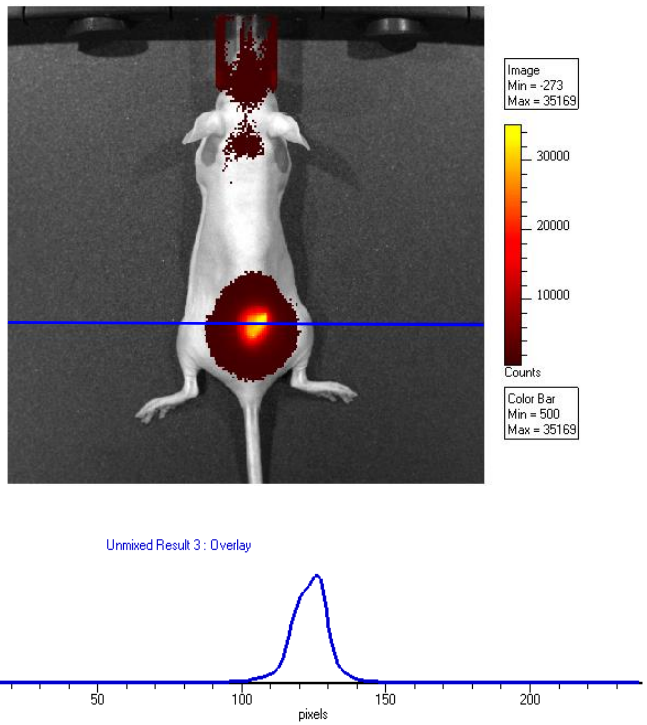


Improvements to Signal to Noise Ratio

Adaptive FL Background Subtraction:
Software tool to reduce instrument background

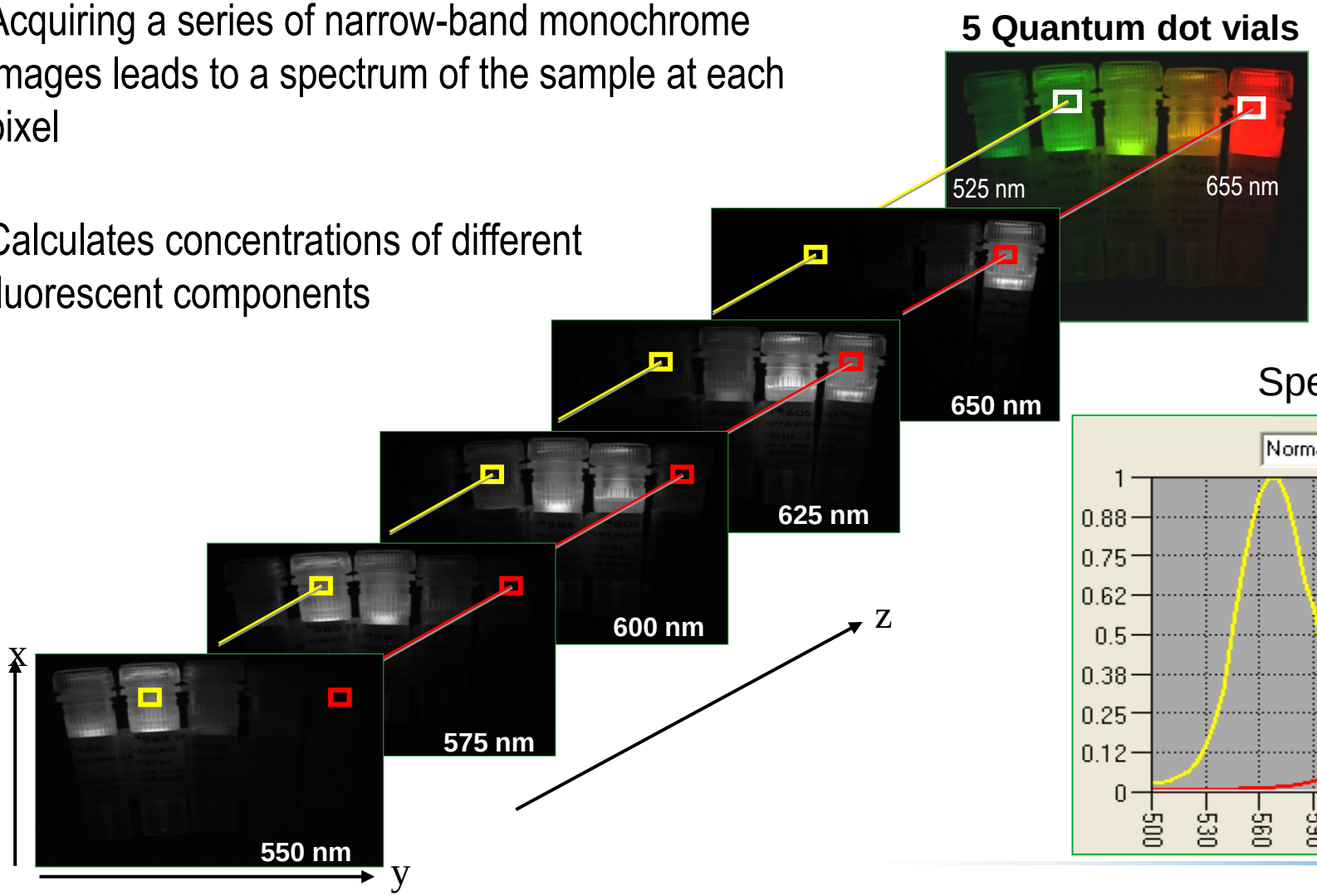


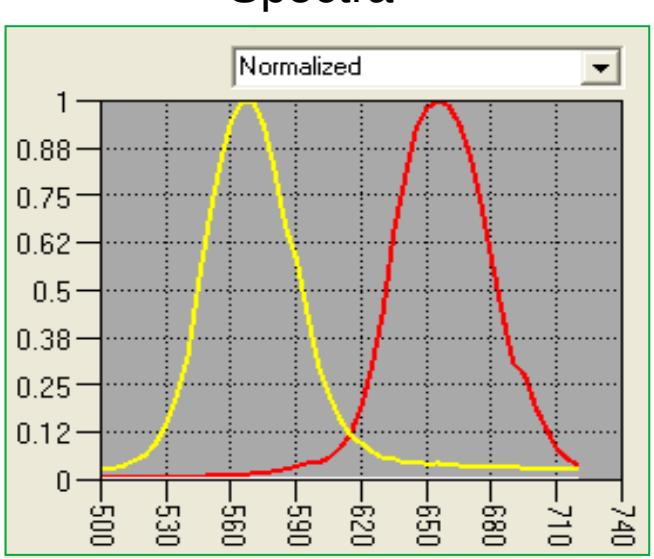
Spectral Unmixing:
Extracts fluorescent signal from autofluorescence



What is Spectral Unmixing?

- Acquiring a series of narrow-band monochrome images leads to a spectrum of the sample at each pixel
- Calculates concentrations of different fluorescent components

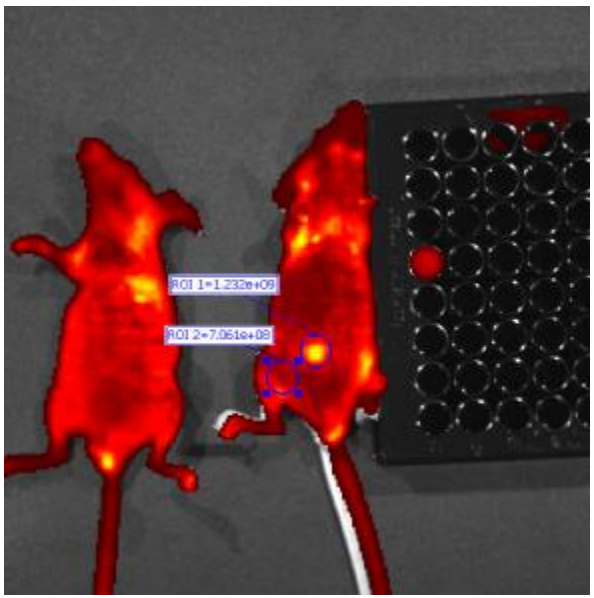




Powerful Fluorescence - Remove Autofluorescence with Spectral Unmixing

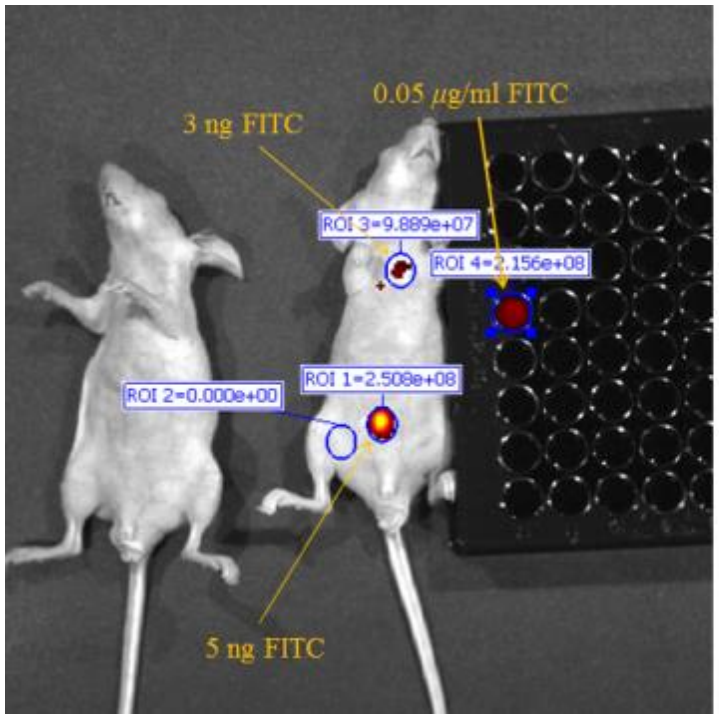
PerkinElmer
For the Better

Autofluorescence



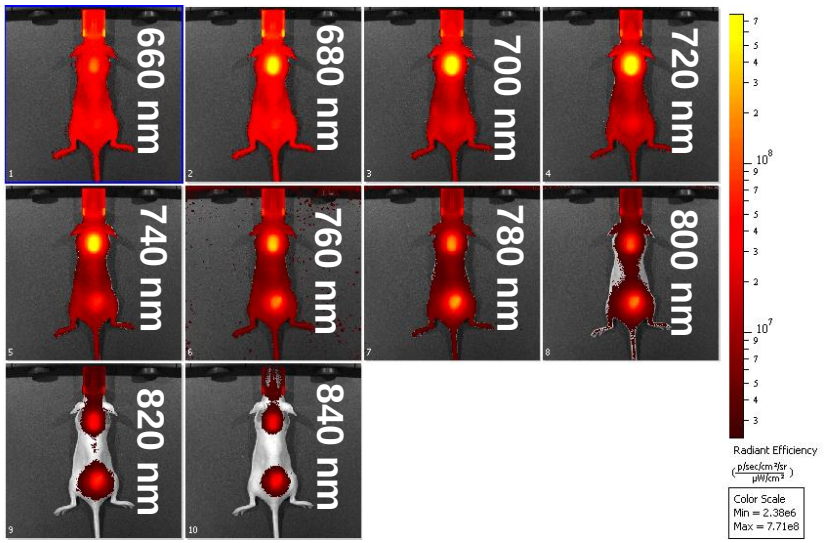
Where is the Signal?

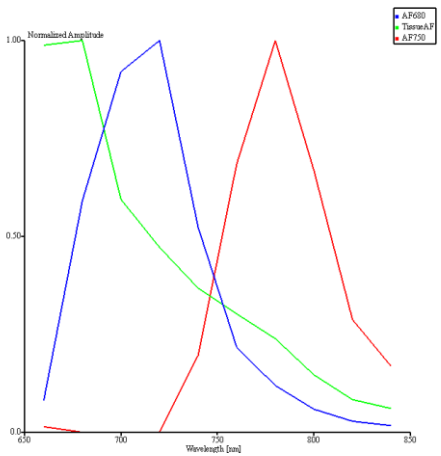
Spectral Unmixing



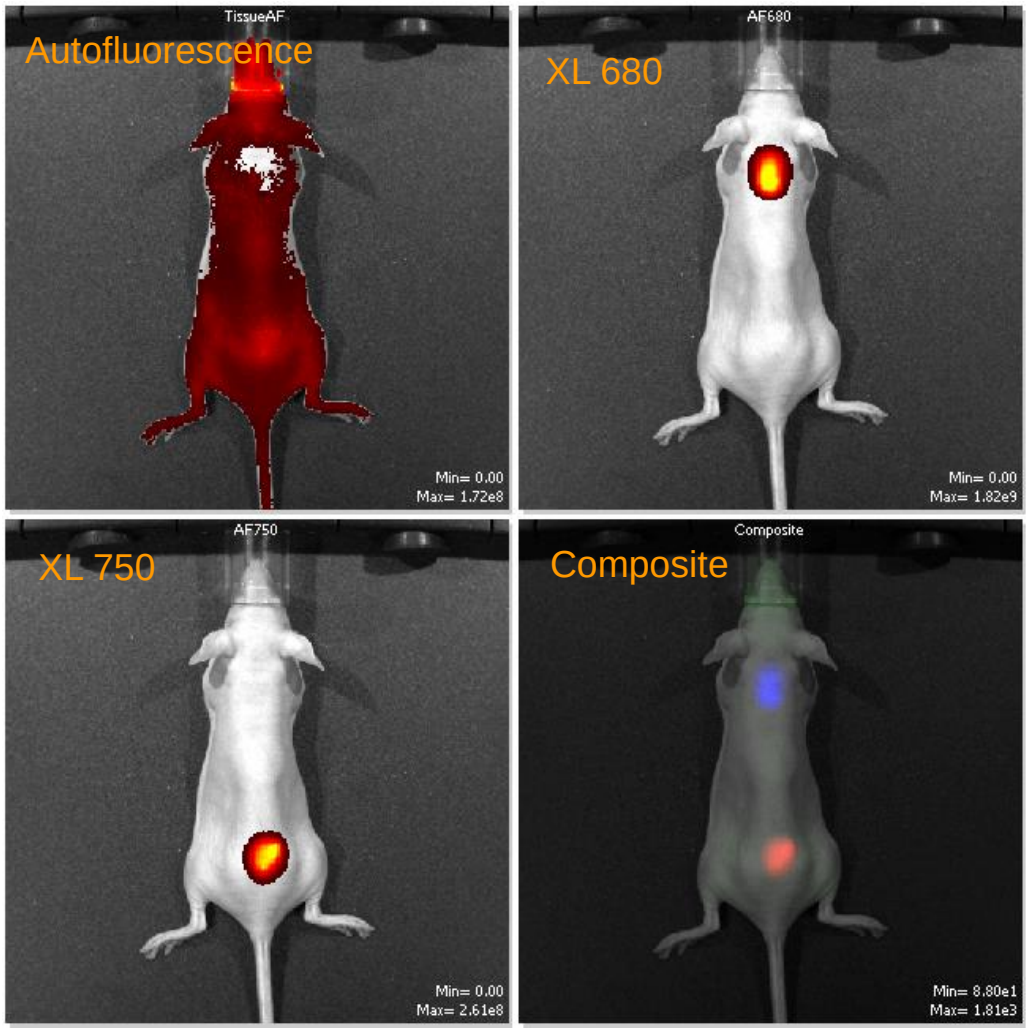
XenoLight 680/750 in a Mouse Using spectral unmixing

Raw Spectral Images



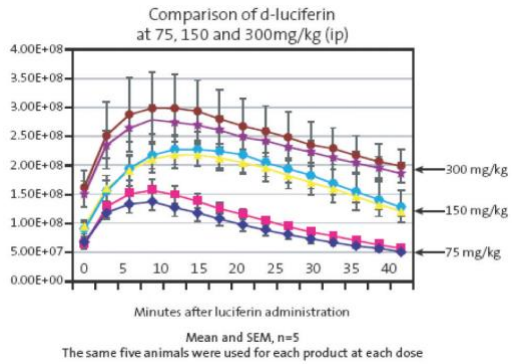


- Subcutaneous injections of 10^{14} molecules of XenoLight 680 (scruff)
- Subcutaneous injection of 10^{14} molecules of XenoLight 750 (lower dorsal region)
- 605nm excitation filter



Top Ten Tips for Optical Imaging

1. Choose reporters that maximize signal-to-noise (S:N) ratio
2. Consider the appropriate control groups and imaging time points necessary
3. Use hairless mice or white-furred animals and depilate or shave
4. Switch to autofluorescence-free mouse diet
5. Closely map the kinetics of your biological bioluminescent
6. Animal handling can significantly affect kinetics
7. Image in the animal orientation that yields the highest sign
8. Cover intense signal to allow dimmer signals to dictate auto-exposure
9. Utilize guards to prevent reflection off neighboring animals
10. Use calibration unit for quantitation (Radiance and Radiant Efficiency)



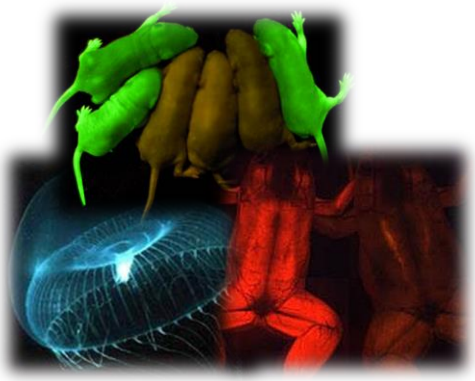
Pre-clinical in vivo Imaging Agents

Imaging Basics – Reporter Molecules

Luciferase

+ ATP and O_2 – Live cells

+ D-luciferin substrate

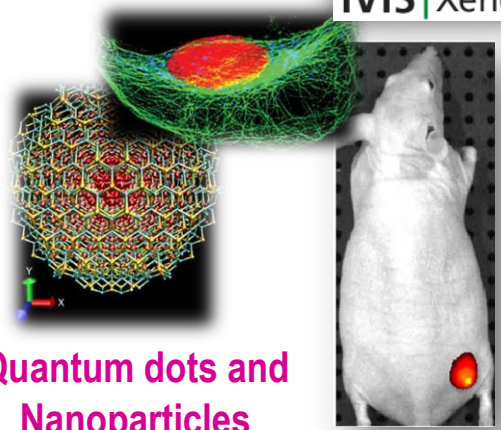


Fluorescent Proteins

Fluorescent dyes

Fluorescent Agents

IVIS | XenoLight DiR

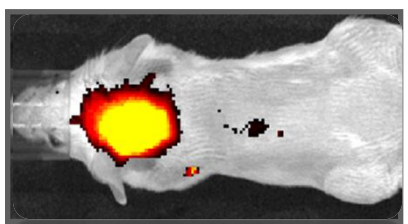


Quantum dots and Nanoparticles

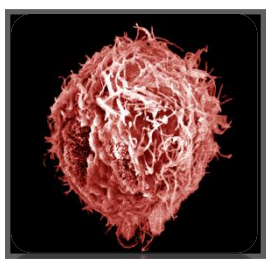
+ excitation light source

Transfection

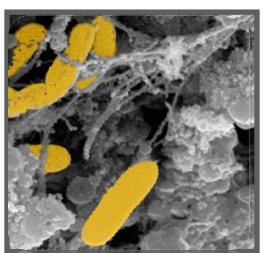
Direct cell/protein labeling



Genetic Marker



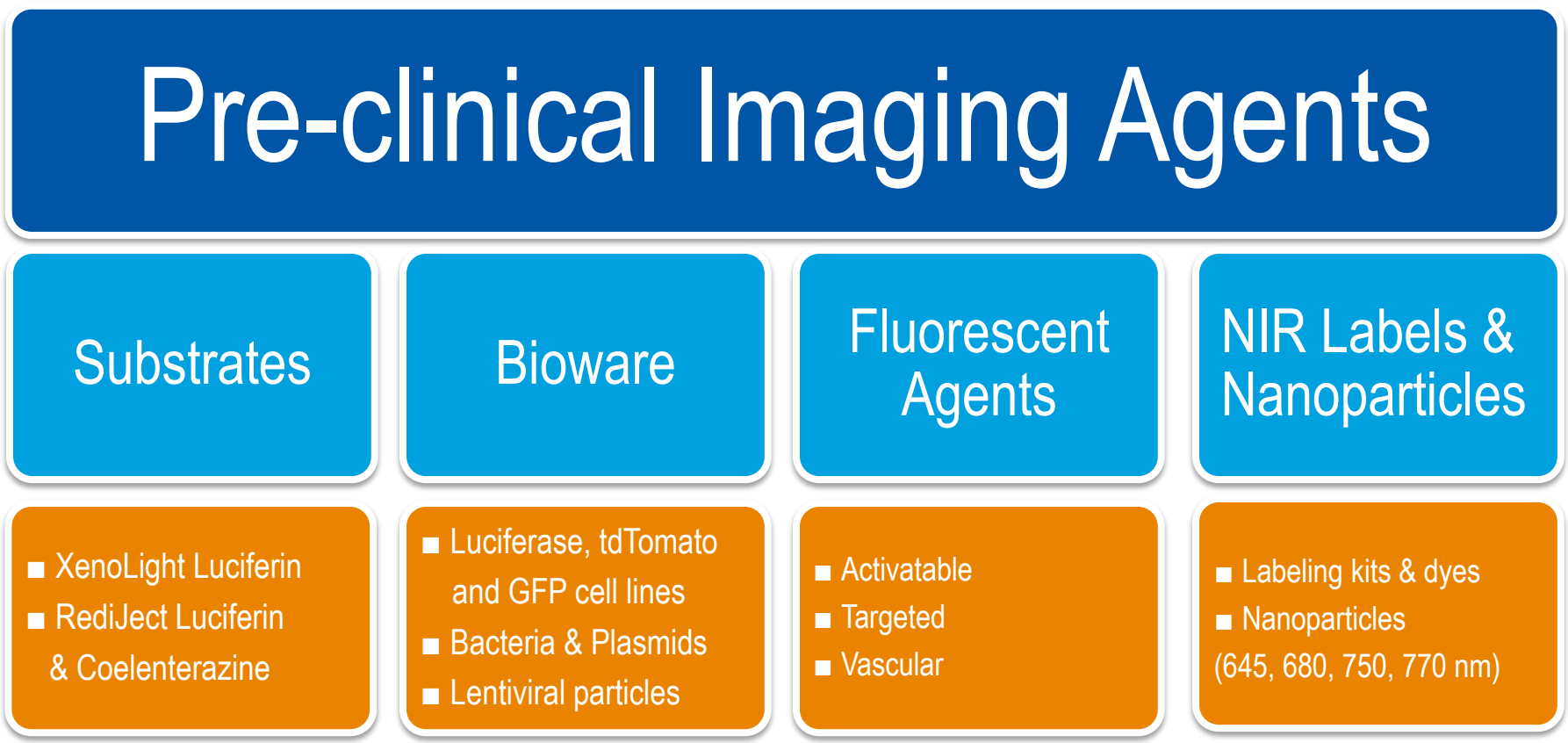
Label Cells



Label Bacteria

Label Proteins

Pre-clinical *in vivo* Imaging Agents



Luminescence Agents

XenoLight D-Luciferin (buy one get one free!)

Product	Product Description	Catalog Number
XenoLight D-Luciferin (K+ Salt) (1-50 g)	Lypholized bioluminescence substrate for *in vivo* imaging with Firefly Luciferase, in bulk	122799

- The ONLY Luciferin optimized for *in vivo* image with IVIS system
- Used by PerkinElmer scientists to calibrated IVIS imaging system
- Validated on our Bioware and Bioware Ultra Cell lies
- Supplied under stringent lot control to ensure experimental reproducibility

RediFect lentiviral particles

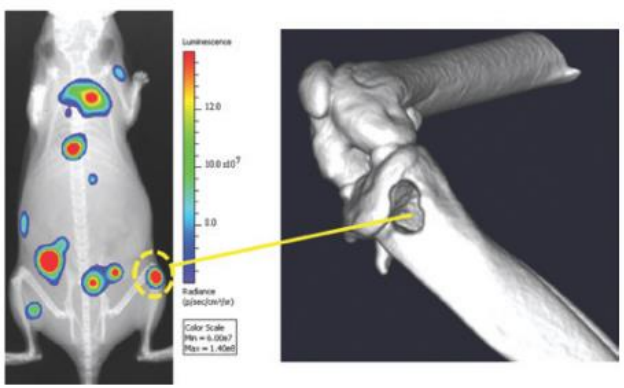
Product	Product Description	Catalog Number
RediFect Red-Fluc-Puromycin	Lentivirus particles containing red-shifted firefly luciferase with puromycin as selection marker	CLS960002
RediFect Red-Fluc-GFP	Lentivirus particles containing red-shifted firefly luciferase and Green Fluorescent Protein (GFP)	CLS960003
RediFect Green Renilla-Puromycin	Lentivirus particles containing Green Renilla luciferase with puromycin as selection marker	CLS960004

Bioware - Oncology Cell Lines

PerkinElmer
For the Better

Bioware® Brite cell lines labeled with enhanced Red-Fluc vector

Product	Product Description	Catalog Number
HT1080-Red-Fluc	Human Fibrosarcoma Cancer Cell line.	BW 128092
4T1-Red-Fluc	Murine Breast Cancer Cell line	BW 124087
GL261-Red-Fluc	Murine Glioma Cell line	BW 134246
HepG2-Red-Fluc	Human Hepatic Cancer cell line	BW 134280
PC-3-Red-Fluc	Human Prostate Cancer Cell line	BW 128444
LnCaP-Red-Fluc	Human Prostate Cancer Cell line	BW 125055
B16-F10-Red-Fluc	Murine Melanoma Cancer Cell line	BW 124734
HCT-116-Red-Fluc	Human Colorectal Cancer Cell line	BW 124318
HT-29-Red-Fluc	Human Colorectal Cancer Cell line	BW 124353
Colo205-Red-Fluc	Human Colorectal Cancer Cell line	BW 124317
U-87 MG-Red-Fluc	Human Brain Cancer Cell line, ideal for glioblastoma models	BW 124577
NCI-H460-Red-Fluc	Human Lung Cancer Cell line, ideal for orthotopic lung tumor models	BW 124316
K-562-Red-Fluc	Human Leukemia Cell line	BW 124735
BxPC3-Red-Fluc	Human Pancreatic Cancer Cell	
MCF-7-lRed-Fluc	Human Breast Cancer	
A549-Red-Fluc	Human Lung Cancer	
LL/2-Red-Fluc	Murine Lung Cancer	
SKOV3-Red-Fluc	Human Ovarian Cancer	

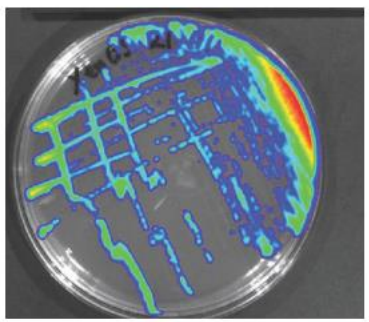


4T1-luc2 - Tumor metastasis post intracardiac injection of cells (IVIS Lumina XR). MicroCT image (Quanutm FX) confirming bone degradation in the right tibia.

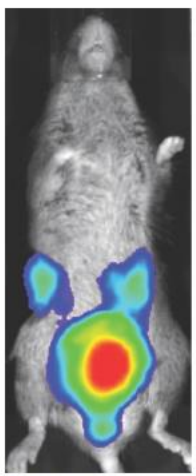
Bacteria

Bacterium	Parental strain	Catalog No.
E. coli	EPEC WS2572 (Xen14)	119223
	ETEC WS2583 (Xen16)	119225
L. monocytogenes	ATCC 23074 (Xen19)	119237
	10403S (Serotype 1/2a wild-type strain) (Xen32)	119238
P. aeruginosa	ATCC 19660 (Xen5)	119228
	PAO1 (Xen41)	119229
P. mirabilis	ATCC 51286 (Xen44)	119236
S. aureus	8325-4 (Xen8.1)	119239
	ATCC 12600 (Xen29)	119240
	ATCC 33591 (Xen31)	119242
	ATCC 49525 (Xen36)	119243
	UAMS-1 (Xen40)	119244
S. dysenteriae	88A6205. Clinical isolate (Xen27)	119231

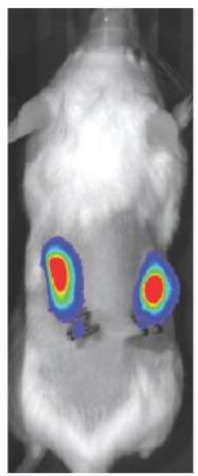
Bacterium	Parental strain	Catalog No.
S. pyogenes	Strain 591, Group A, Serotype M49 (Xen20)	119250
S. typhimurium	FDA1189 (Xen33)	119235
Y. enterocolitica	91A1854 Clinical isolate (Xen24)	119232
	WS2589 (Xen25)	119233



Xen05: *Pseudomonas aeruginosa*



Xen44: Monitoring migration of UTI infection from the bladder to the kidney non-invasively in real time



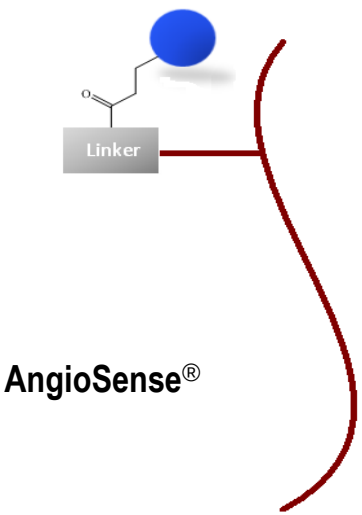
Xen5: P. aeruginosa infection on a biofilm

In Vivo Imaging Agent Platforms:

Agent Categories

	Vascular	Targeted	Activatable
Mechanism			
Detection	***Physiology***	***Biological Structure/Expression***	***Biological Function***
Value	**Increasing value of molecular information**		

Agent Platforms: Vascular Fluorescent Agents

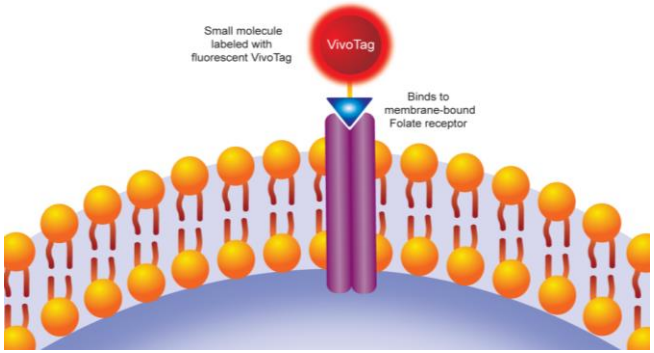


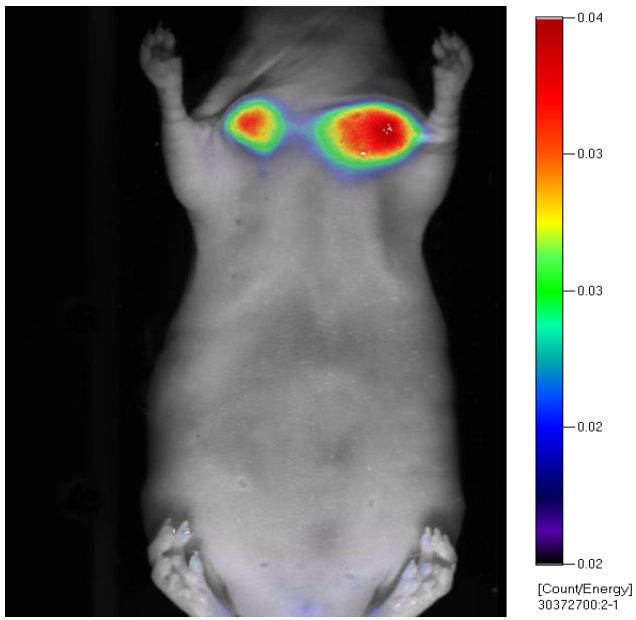
AngioSense®

Agent	Agent Description
Genhance™ 680/750	Genhance™ 680/750: Small molecule fluorescence agent. Use as a control or in vascular imaging
Superhance™ 680	Superhance™ 680: Small molecule agent. Binds to albumin in blood for extended (30m–1h) circulation
AngioSense® 680EX/750EX	AngioSense® 680/750: Agent that remains localized in vasculature for 0–4h.; 5 days in arthritic joints
AngioSPARK® 680/750	AngioSPARK® 680/750:Pegylated fluorescent nanoparticles; Remains localized in vasculature
GastroSense™ 750	Agent to monitor gastric emptying and the impact of various drugs on gastric motility

Targeted Fluorescent Agents

Agent	Binds to …
BombesinRSense 680	Bombesin receptors
HER2Sense 645	HER2/Neu receptor
FolateRSense 680	Folate Receptor Protein
TlectinSense 680	Vascular Endothelial cells (N-actelyglucosamines)
OsteoSense® 680/750/800	Hydroxyapatite
IntegriSense™ 655/680/750	Integrin αvβ3 antagonist
BacteriSense 645	Negatively charged phospholipids in Bacterial membrane
Annexin-Vivo 750	Phosphatidylserine during early apoptosis
HypoxiSense 680	Carbonic Anhydrase IX in hypoxic tissue and cells
COX-2 Probe	Cyclooxygenase-2 (COX-2)
2-DG 750	Glucose uptake Imaging
Transferrin-vivo	Transferrin receptors

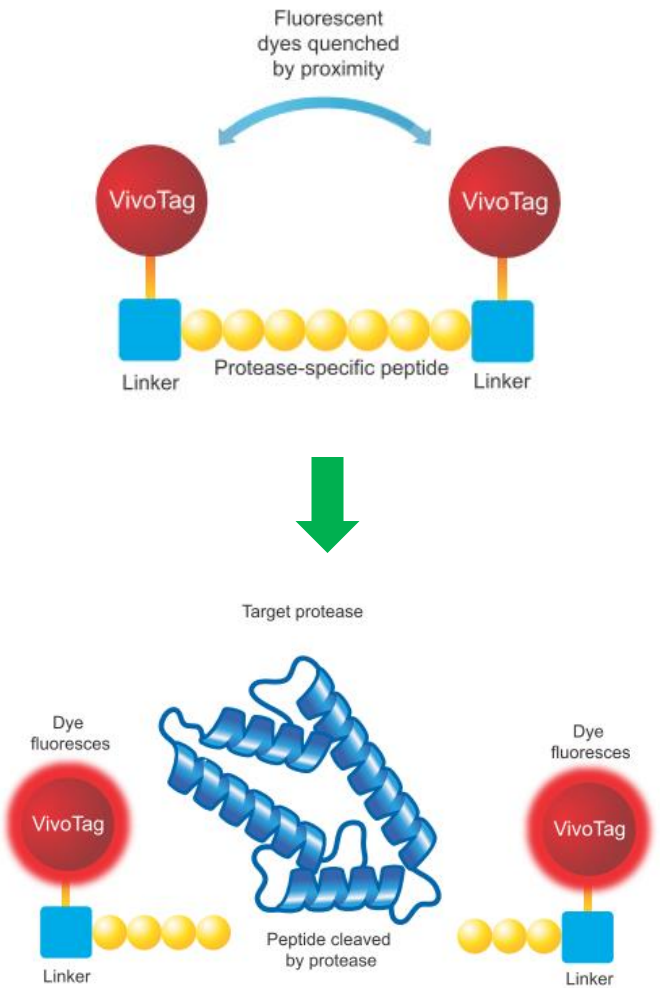




HER2/Neu+ tumor targeting by HER2Sense 645

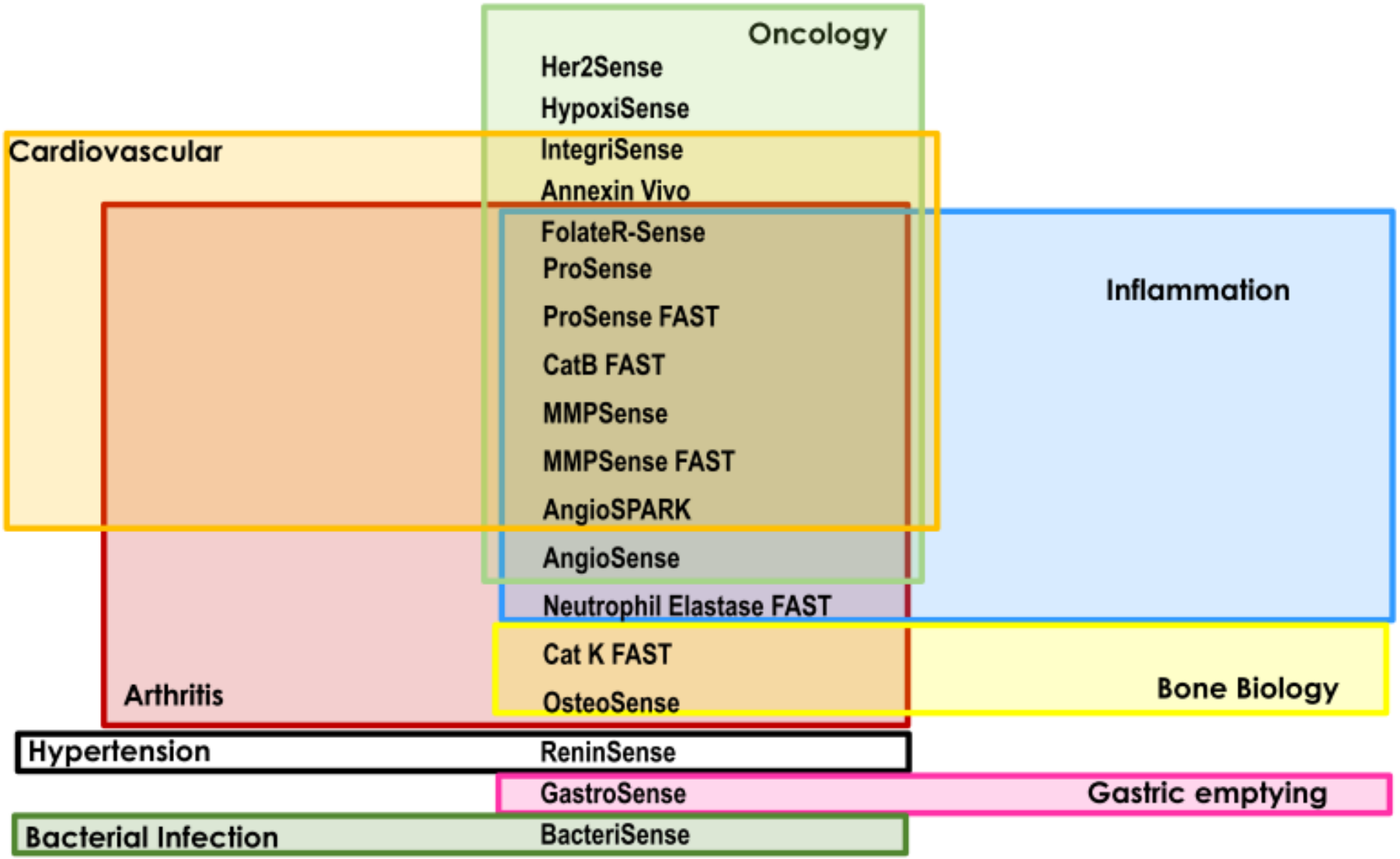
Activatable fluorescent Agents

Agent	Agent Description
MMPSense™ 680	MMPSense™ 680: Activated by matrix metalloproteinases including MMP's MMP-2, -3, -9 and -13
MMPSense™ 645, 750 FAST	MMPSense™645m 750 FAST (Fluorescent Activatable Sensor Technology) is an MMP activatable agent
ProSense® 680/750	ProSense® 680/750: Activated by proteases: cathespins B, L, S, and plasmin
Neutrophil Elastase 680 FAST™	FAST agent activated by elastase produced by neutrophil cells
Cat B 680/750 FAST™	Cathepsin B selective FAST activatable agent
Cat K 680 FAST™	Cat K 680 FAST (Fluorescent Activatable Sensor Technology) is a Cathepsin K activatable agent
ReninSense680 FAST™	ReninSense680 FAST™ (Fluorescent Activatable Sensor Technology) is a renin activatable agent
PSA 750 Fast	Activatable agent that detects active PSA in vivo



Monitor protease activity associated with disease state

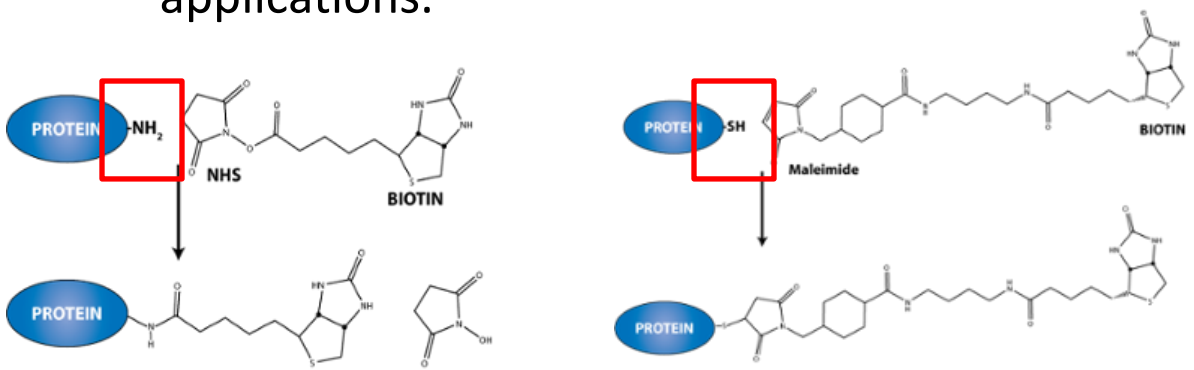
In Vivo Agent Applications



PerkinElmer offers four categories of fluorescent *in vivo* imaging agents:

LABELS and NANOPARTICLES

VivoTag™ 680XL Protein Labeling Kit : designed for preparing fluorescently labeled antibodies, proteins or peptides for small animal in vivo imaging applications.



VivoTrack 680 : cell labeling agent that intercalates into the plasma membrane of primary cells and cell lines.

iRFP plasmid for *in vivo* imaging

https://www.addgene.org/fluorescent-proteins/in-vivo/

addgene
The nonprofit plasmid repository

Login | Create Account

Search for plasmids

Find Plasmids | Deposit Plasmids | How to Order | Plasmid Reference | About Addgene

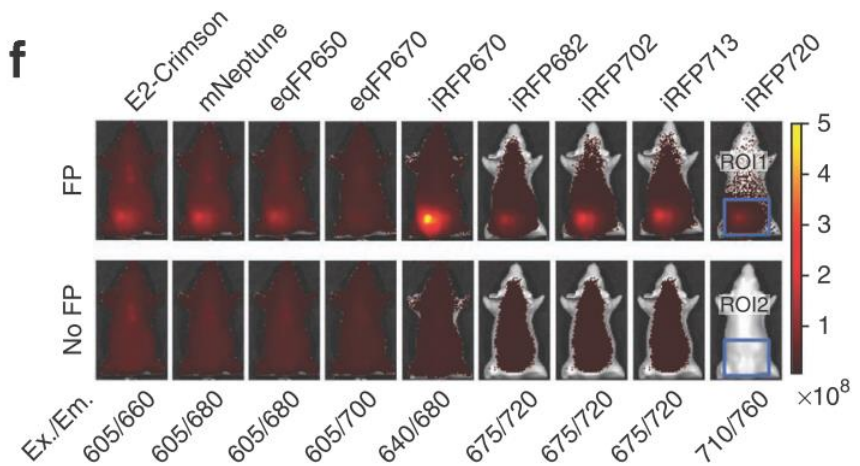
Special Collections / Fluorescent Protein Guide / *In Vivo* Imaging Guide

Reference

Fluorescent Protein Guide: *In Vivo* Imaging

Near-Infrared

Protein	Excitation/Emission	Brightness	Find Plasmids
iRFP670	643/670	12.7	piRFP670-N1
iRFP682	663/682	10.2	piRFP682-N1
iRFP702	673/702	7.6	piRFP702-N1
iRFP (aka iRFP713)	690/713	6.2	piRFP
iRFP720	702/720	5.8	piRFP720-N1
iSplit	690/713	5.3	pPAS-E and pK-GAFm



Daria M Shcherbakova et al, nature methods | VOL.10 NO.8 | AUGUST 2013

PerkinElmer
For the Better

HUMAN HEALTH | ENVIRONMENTAL HEALTH

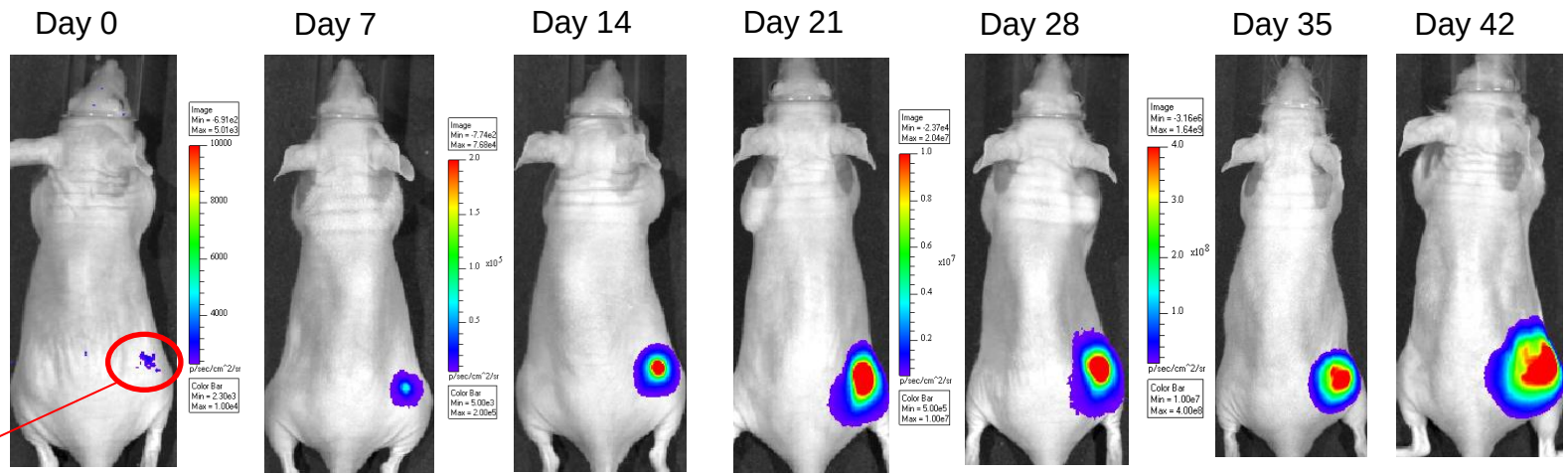
In Vivo Imaging Applications

August 2, 2017

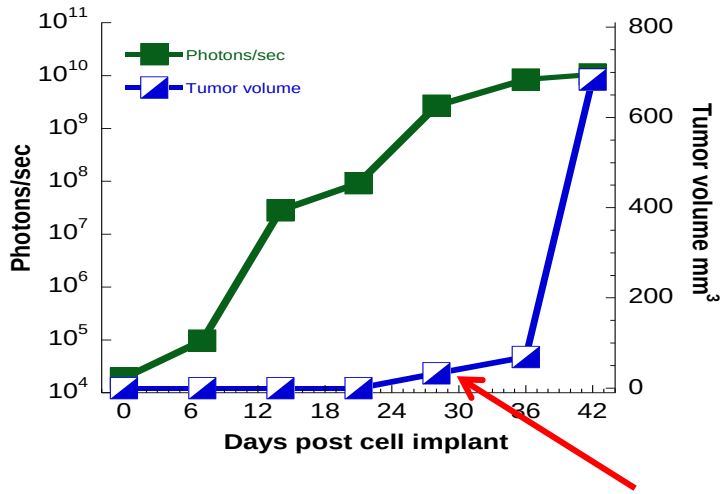
Longitudinal Monitoring of Tumor Development and Metastasis

Longitudinal monitoring of tumor development

Bioware Ultra: 4T1-luc2



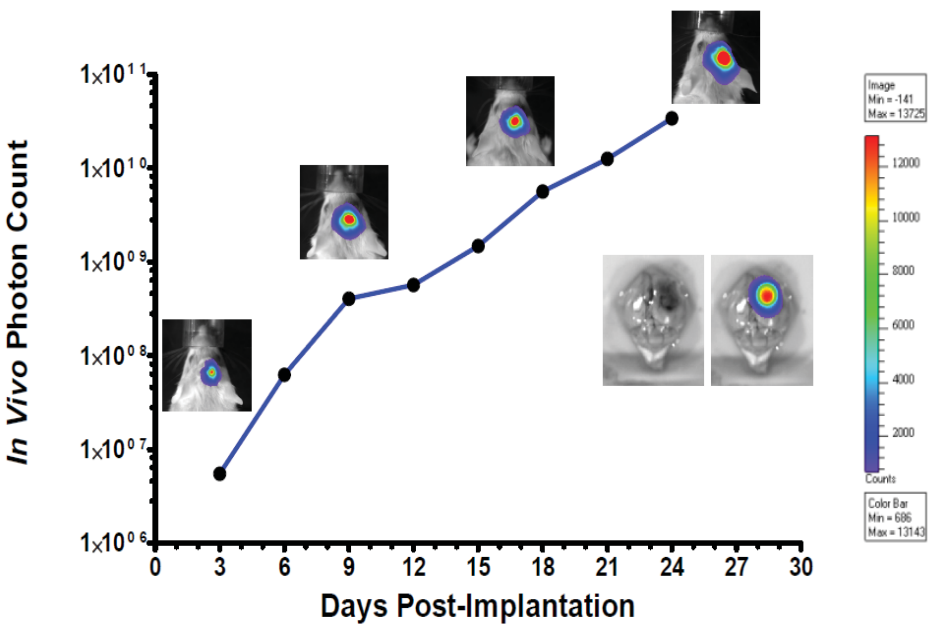
5 cells

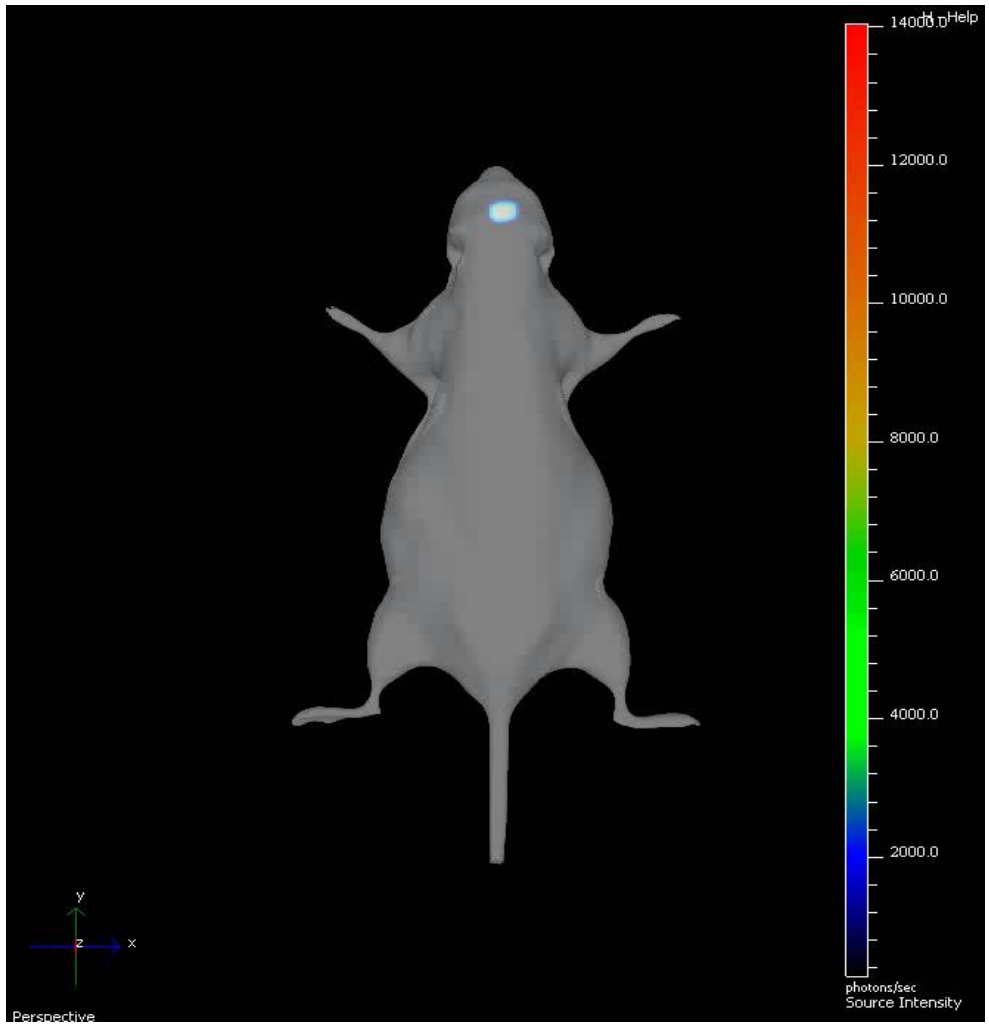


With Bioware Ultra one can start collecting data from Day 0, while with caliper measurements one has to wait at least 28 days to see any tumor growth

Longitudinal Monitoring of Brain Tumors

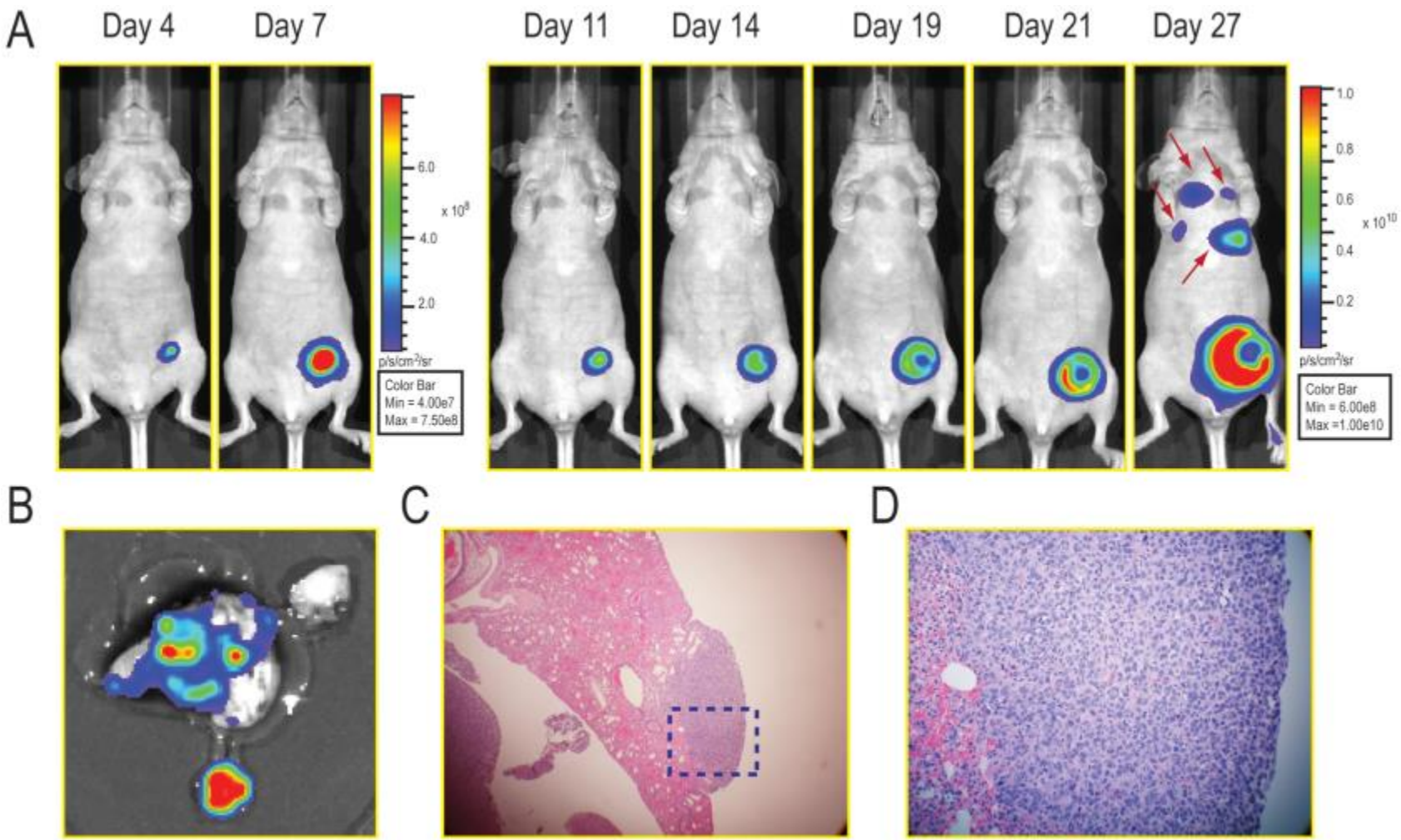
MicroCT co-registration of BLI orthotopic Brain tumor signal by U87-MG-luc2 cells





- Monitor early tumor behavior non-invasively
- Brain tumor growth and therapeutic effect *in vivo*
- 3D quantitative tomography for accurate tumor size and location

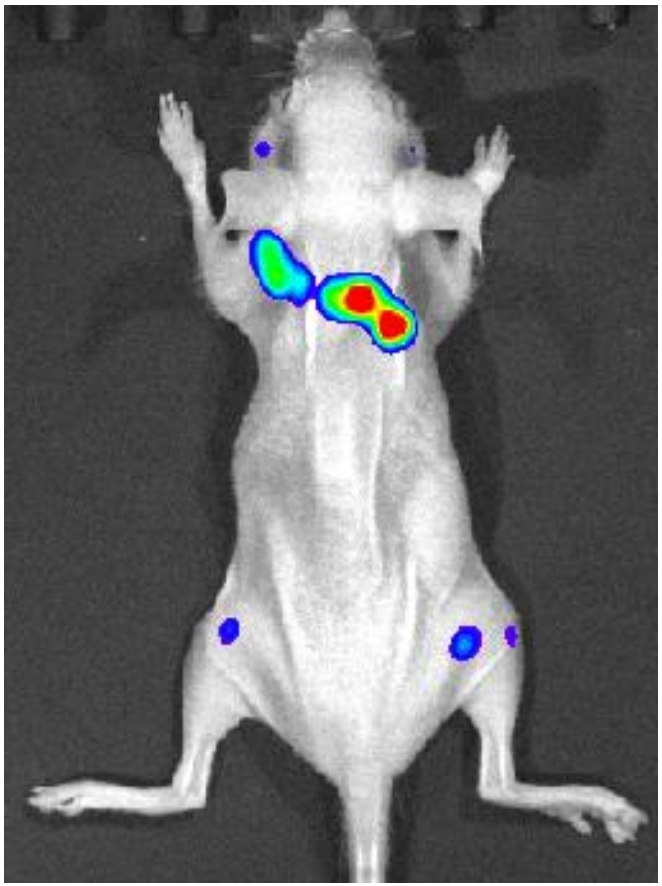
Non-Invasive Detection of Micrometastasis

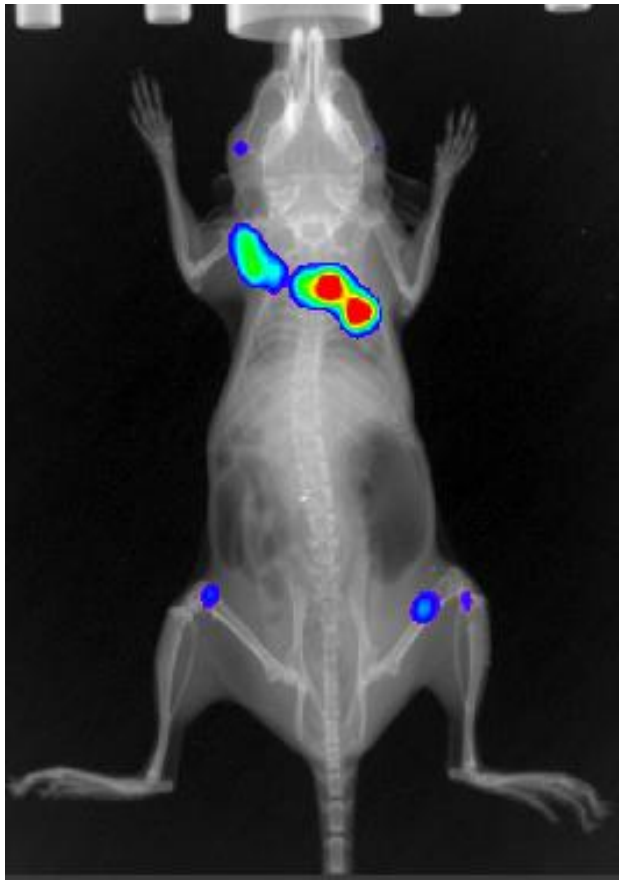


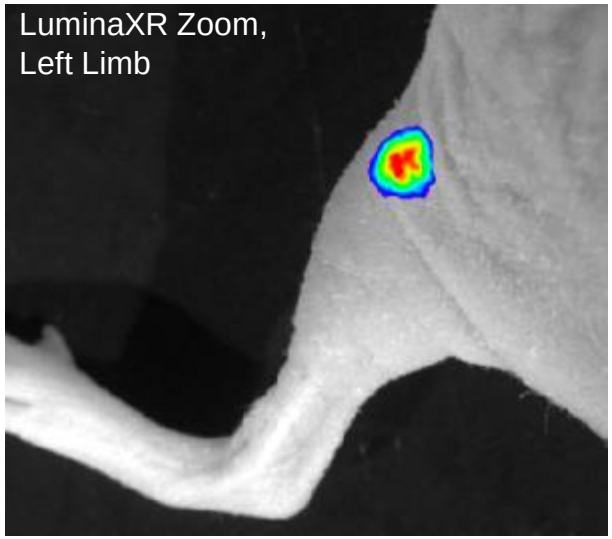
5×10^5 4T1-luc2-1A4 cells orthotopically into the abdominal mammary fat pads

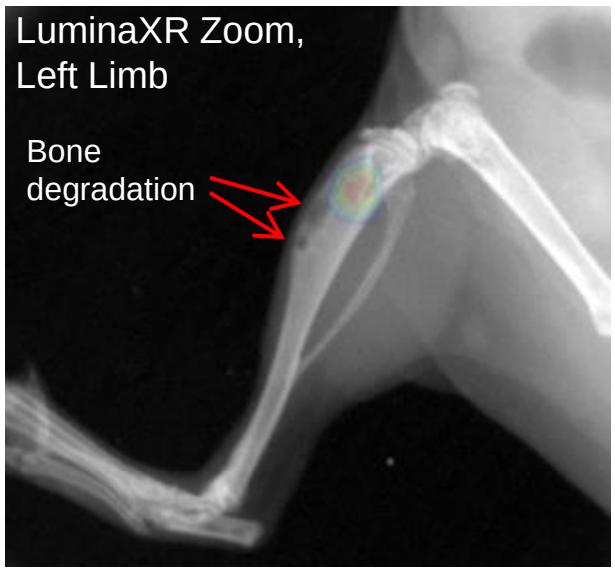
Kim et al, PLoS ONE (2010)

Imaging Breast Cancer Metastases







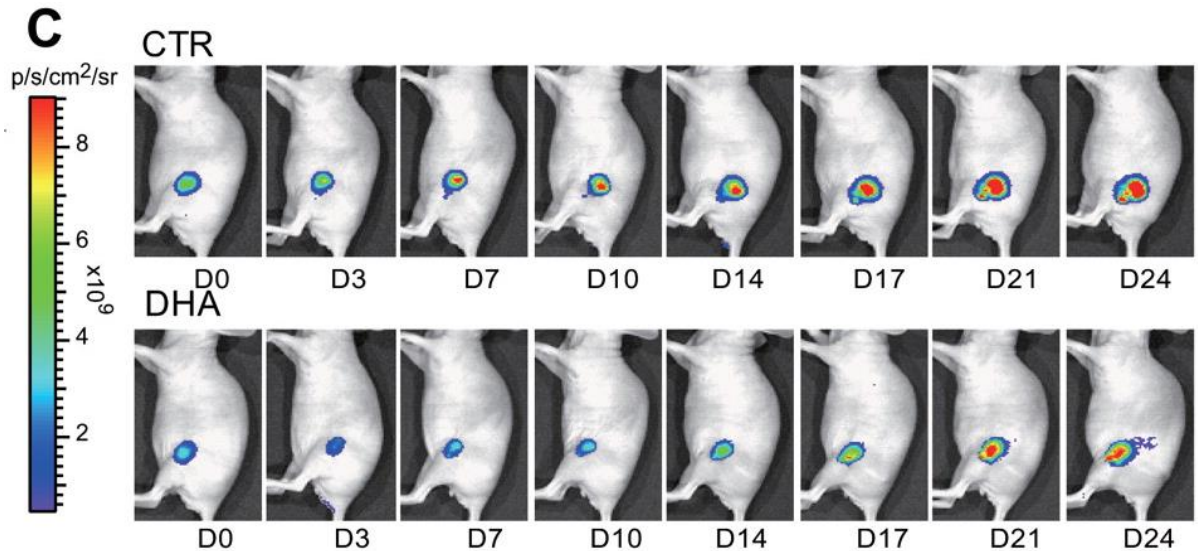


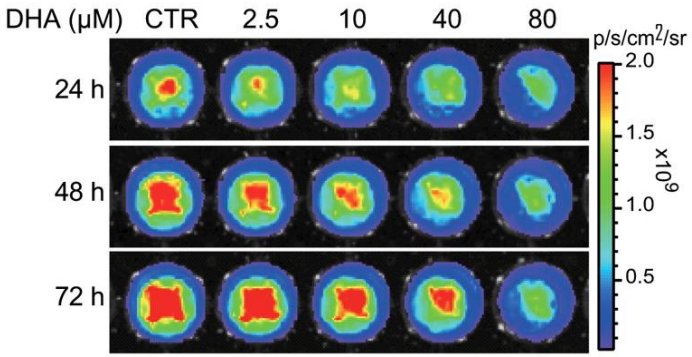
45 days following IC delivery of MDA-MB-231 cells into immune-deficient mice

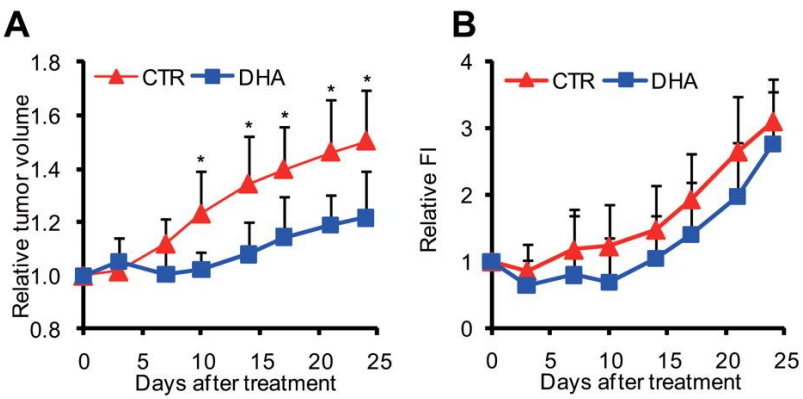
Minn et al., JCI 2005

Fluorescence Imaging of Drug Efficacy in a Pancreatic Tumor Model

Therapeutic effect of DHA (Dihydroartemisinin), a semi-synthetic derivative and active metabolite of artemisinin (a naturally occurring compound) on **RFP-labeled** pancreatic tumor cells (BxPc3-RFP) studies *in vitro* and *in vivo*







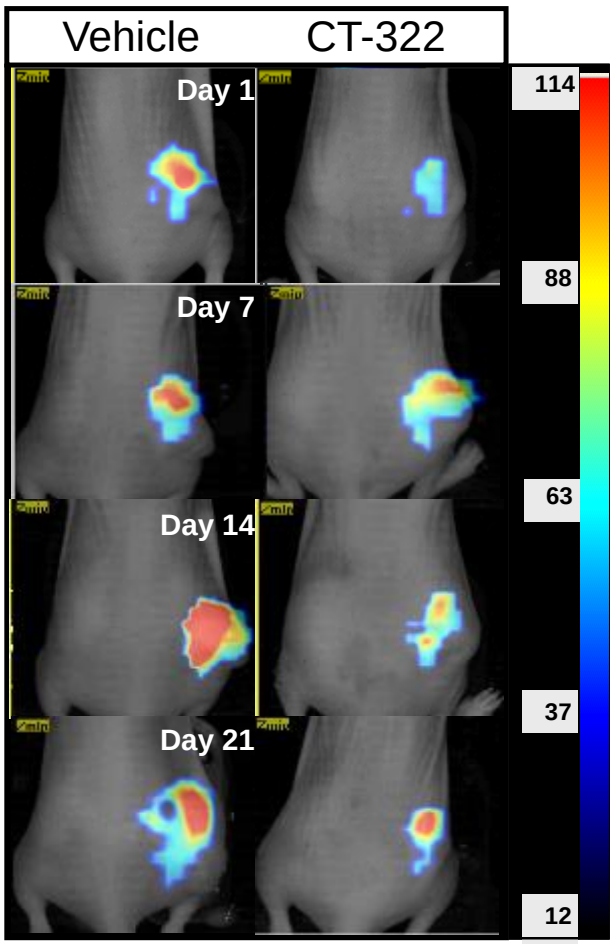
DHA treatment results in lower tumor volumes (A) and reduced fluorescence intensities compared with control CTR (B)

DHA inhibits cell and tumor growth by interfering with cell proliferation and inducing apoptosis.

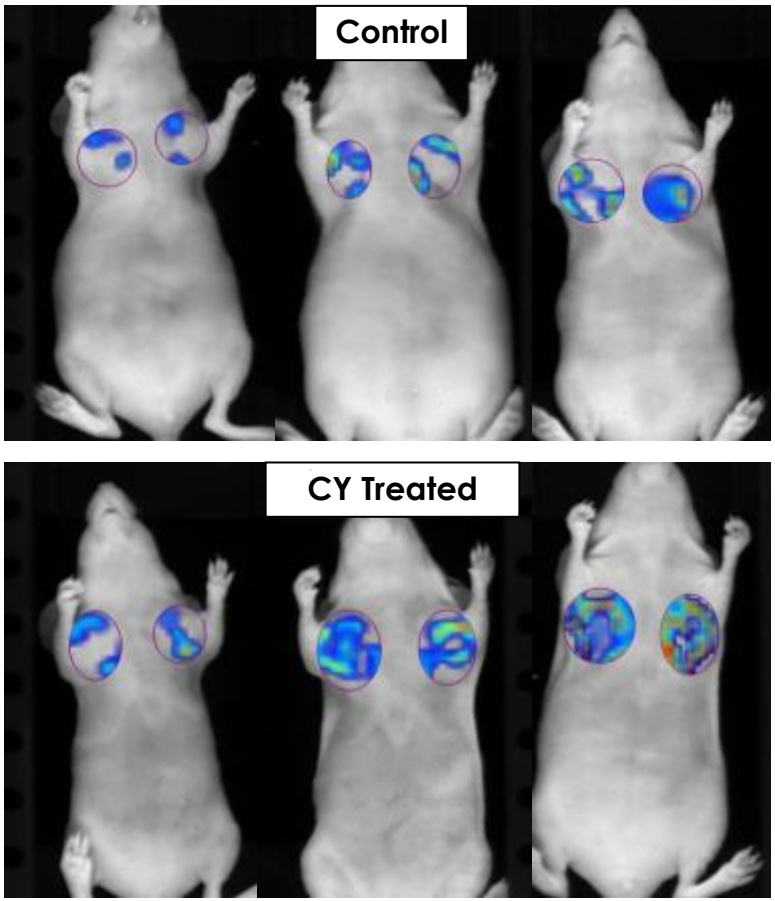
Aung et al, Anticancer Research(2011)

Treatment Effects Assessment by optical imaging

- Use Angiosense to evaluate CT-322 Treatment



- Annexin-Vivo detects Therapy-Induced Tumor Apoptosis

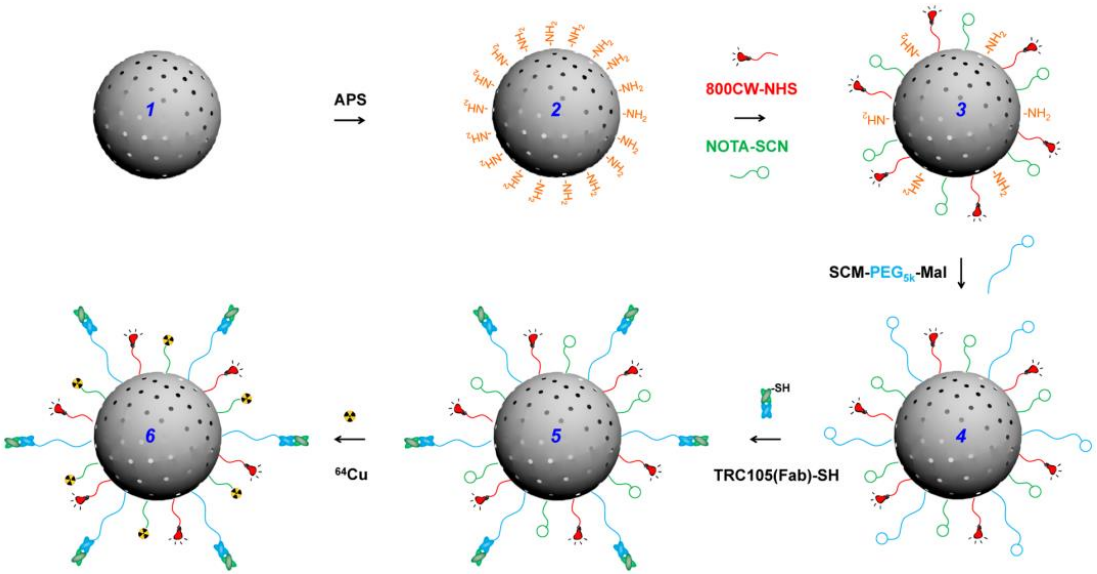


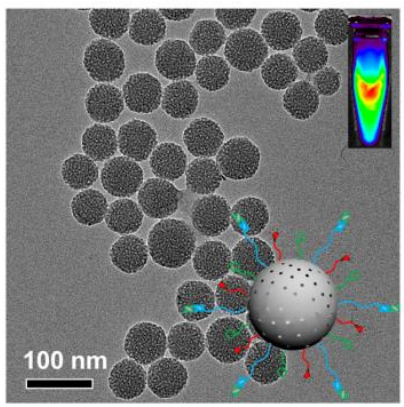
- Annexin-Vivo detects and quantifies tumor death in living mice after as little as a single dose of CY, before any tumor size changes occur

In Vivo Tumor Vasculature Targeted PET/NIRF Imaging

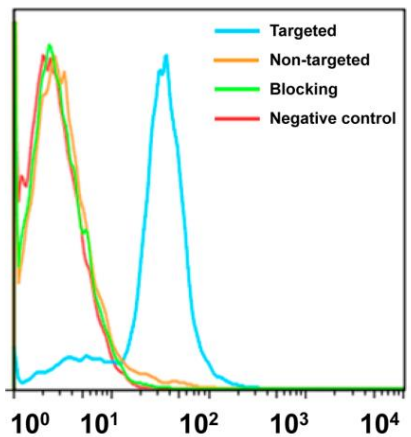
^{64}Cu-MSN-800CW-TRC105(Fab) Mesoporous silica nanoparticle

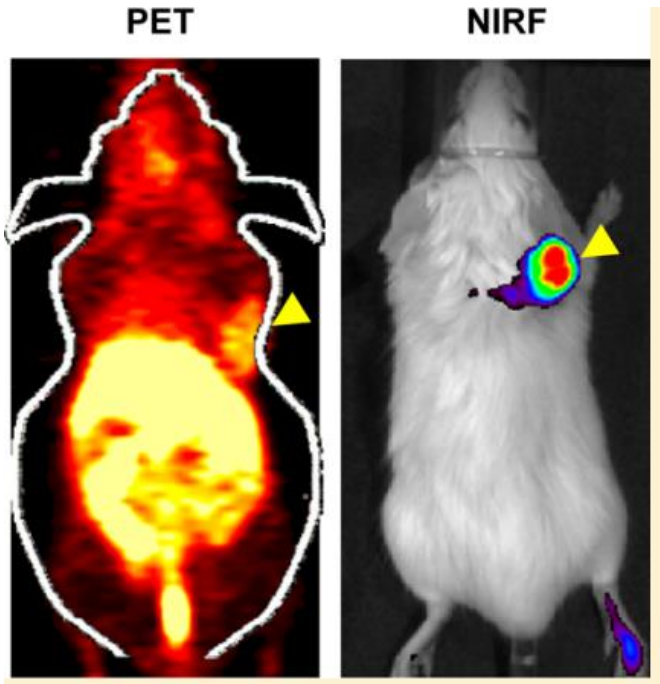
Scheme 1. Schematic Illustration of the Synthesis of ^{64}Cu-MSN-800CW-TRC105(Fab)[a]





HUVECs (CD105 positive)



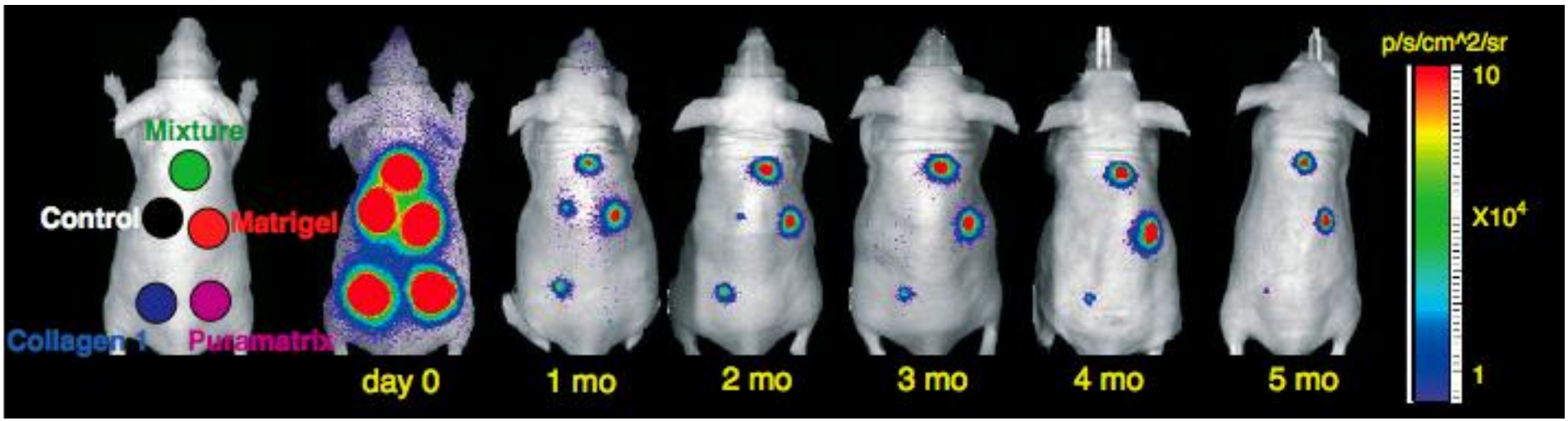


4T1 Murine Breast Cancer Model

Feng Chen et al Mol. Pharmaceutics 2014, 11, 4007 − 4014

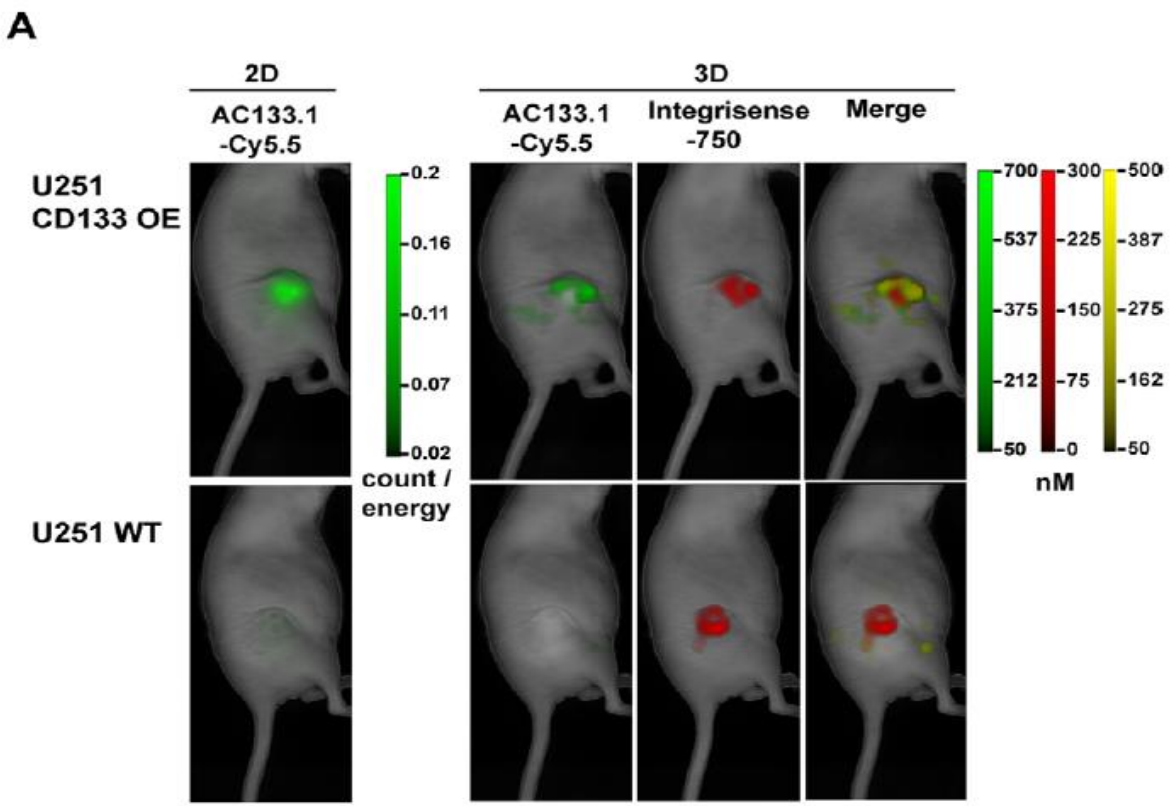
Stem cell application

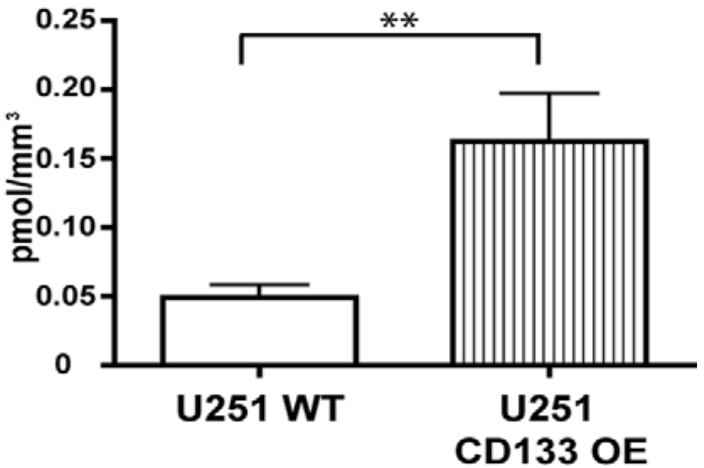
Effect of Biomatrices on Stem Cell Viability

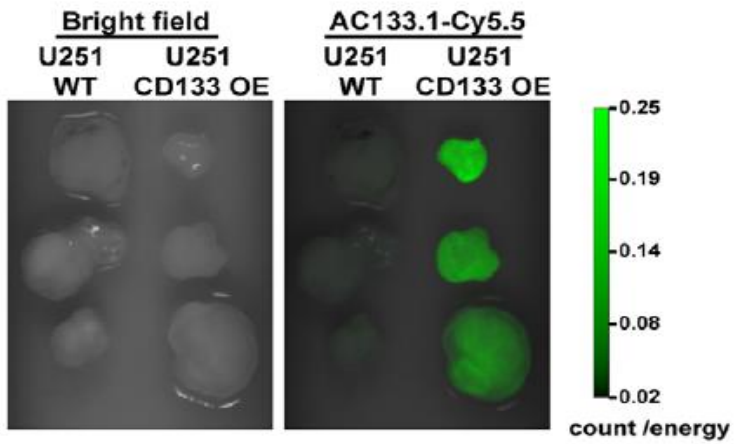


Cao *et al*, J Tissue Eng Reg Med, 2007

Non-Invasive In Vivo Imaging of Tumor-Associated CD133/Prominin







In vivo imaging of U251 xenografts in mice injected with Cy5.5-labeled AC133.1 antibody.

Tsurumi C, Esser N, Firat E, Gaedicke S, Follo M, et al. (2010) PLoS ONE

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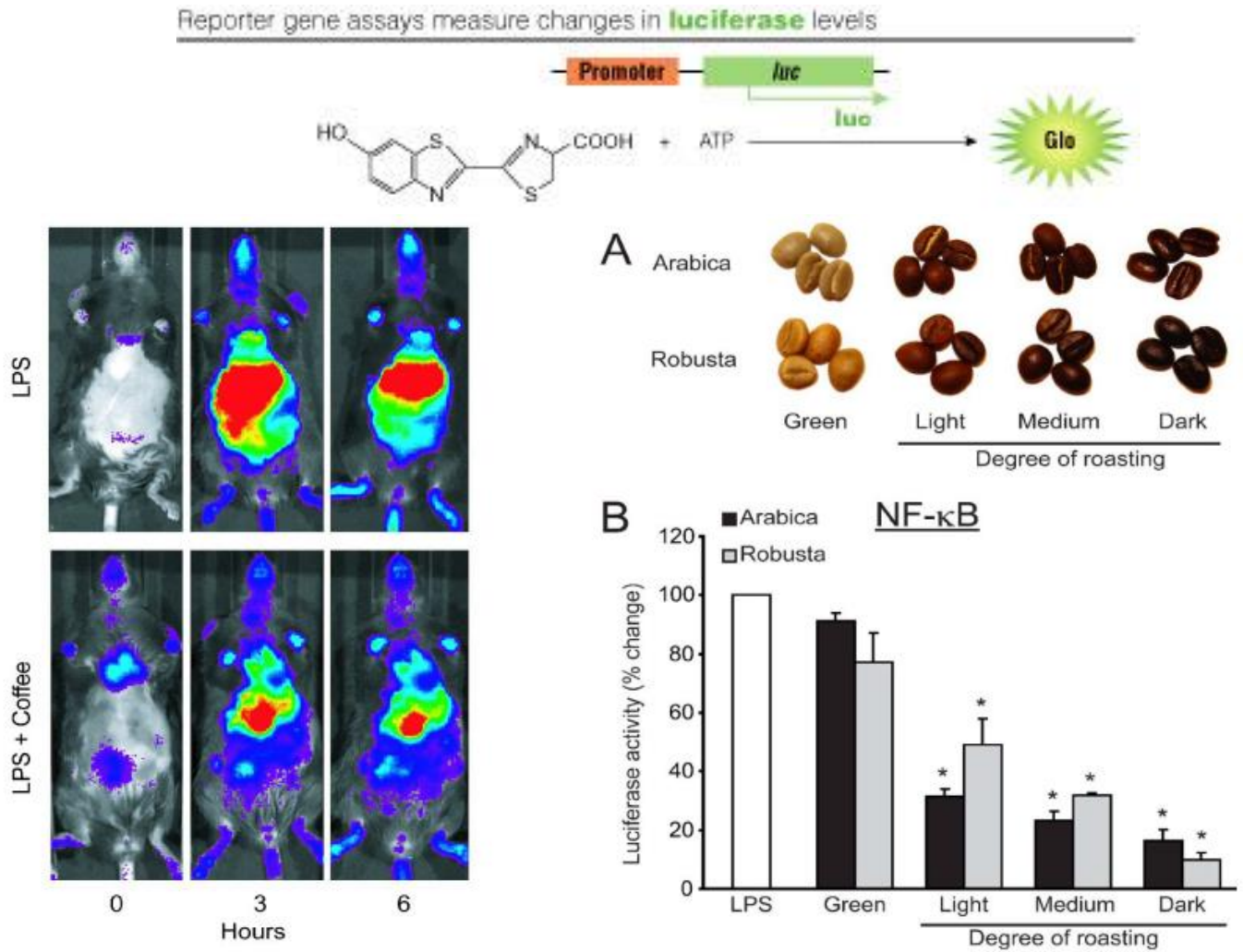
Inflammation

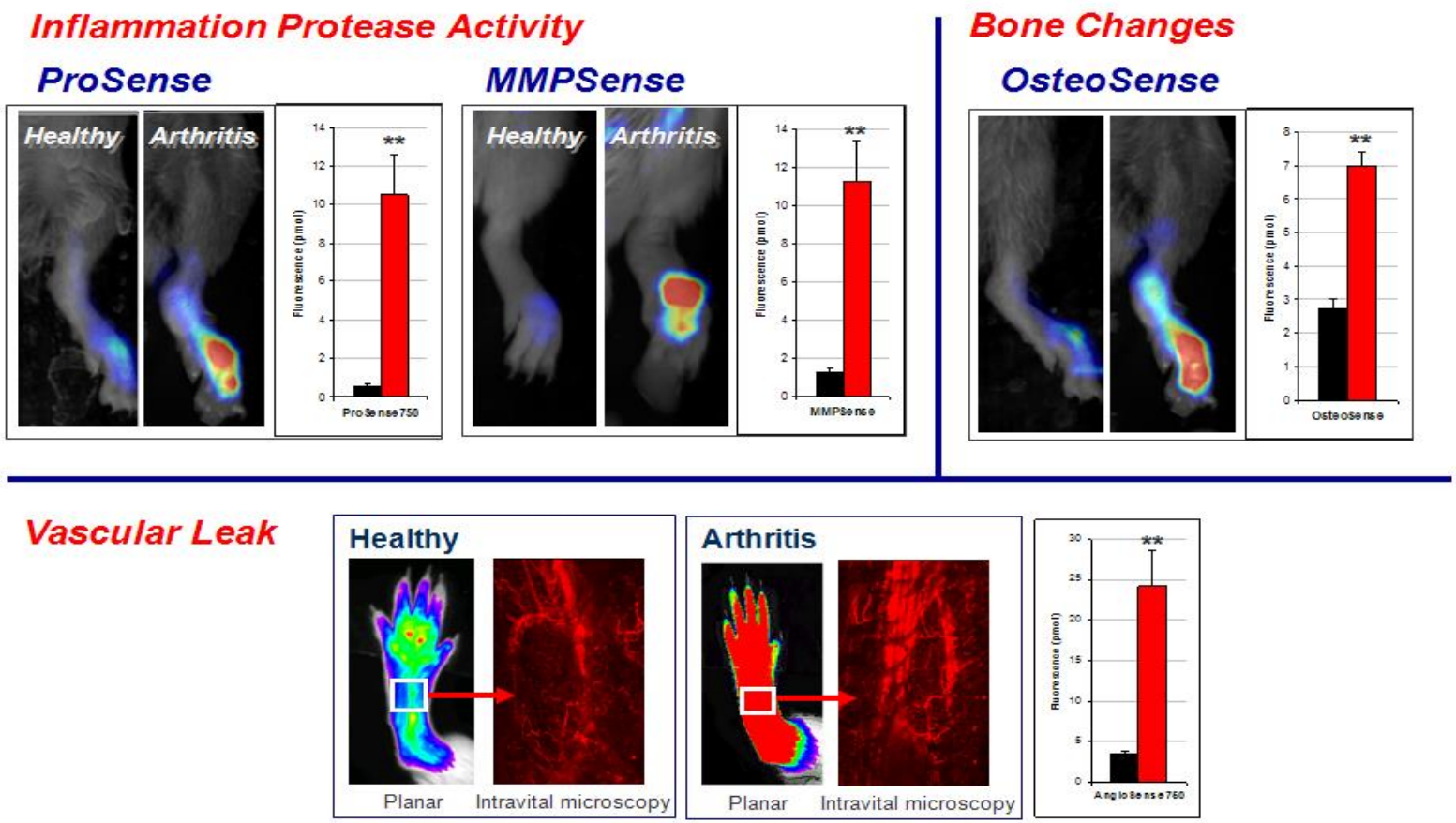
Degree of Roasting is the Main Determinant of the Effects of Coffee on NF-κB



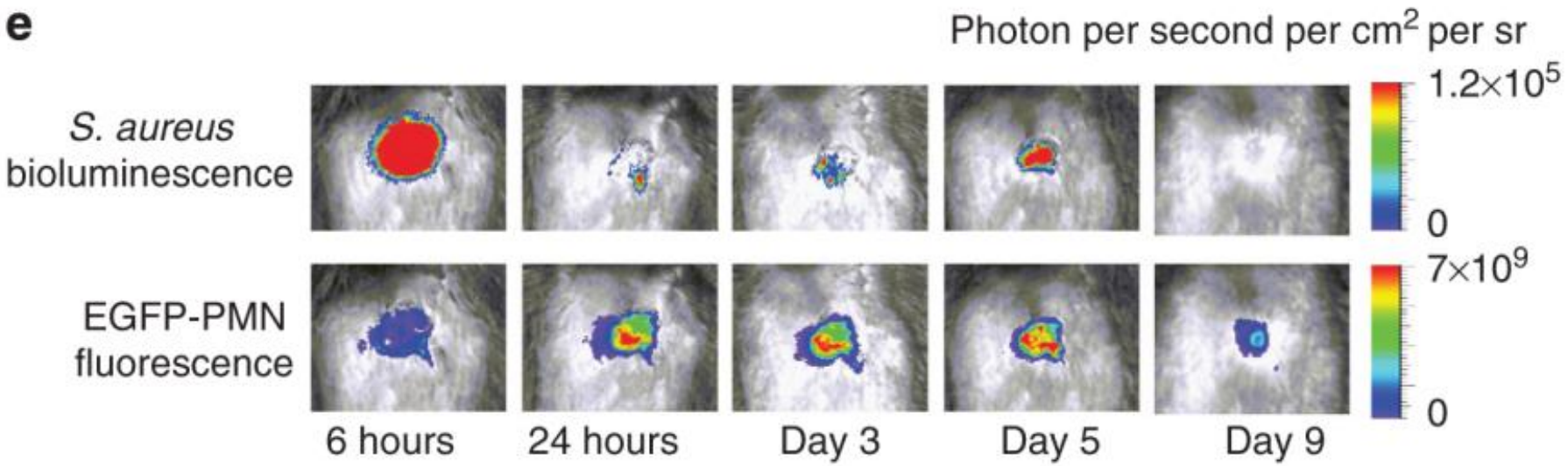
Transgenic NF-kB reporter mice were given a single dose of coffee extract by oral gavage 3h prior to s.c. LPS injection (at 0h). A) The luciferase activity was measured by in vivo imaging at 0h, 3h and 6h.

Paur *et al*, 2010

Multiplex fluorescence Imaging



Dual imaging of infection (BLI) and immune response (FLI)



Non-invasive assessment of bioluminescent *S.aureas* infection and EGFP PMN infiltration

Kim *et al*, 2007

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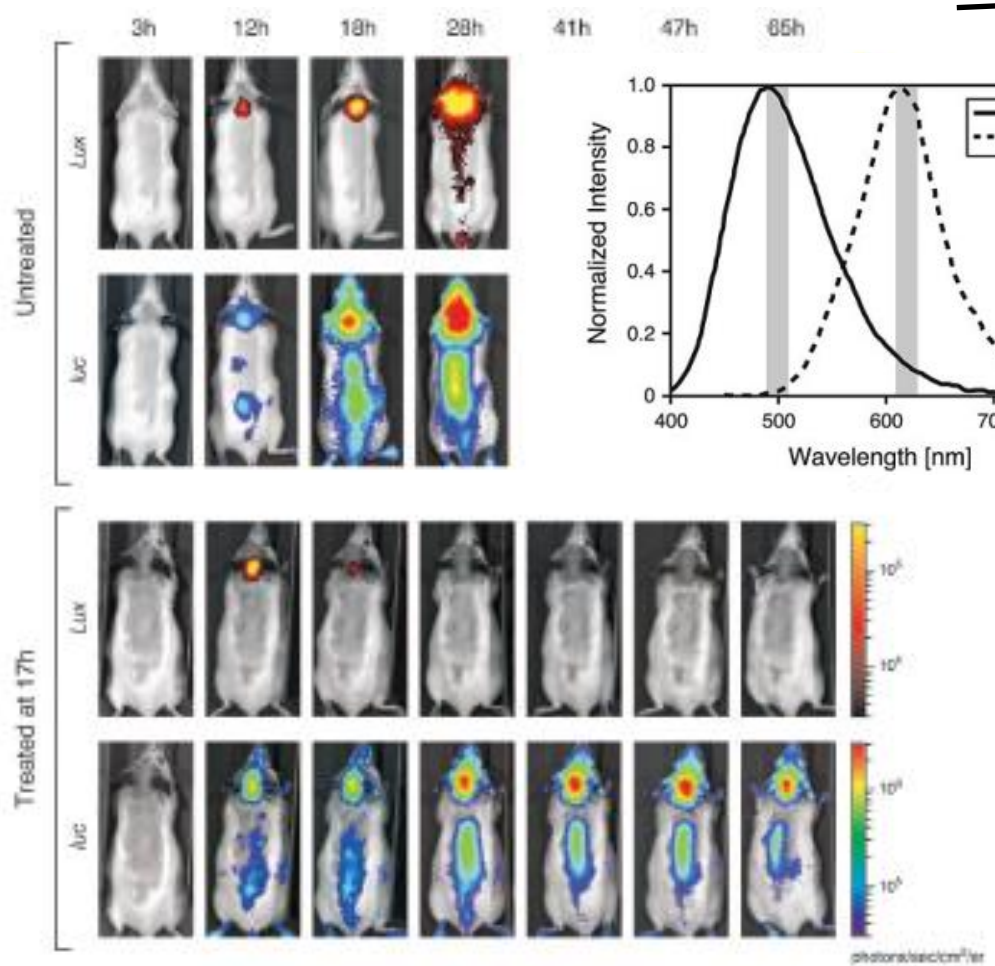
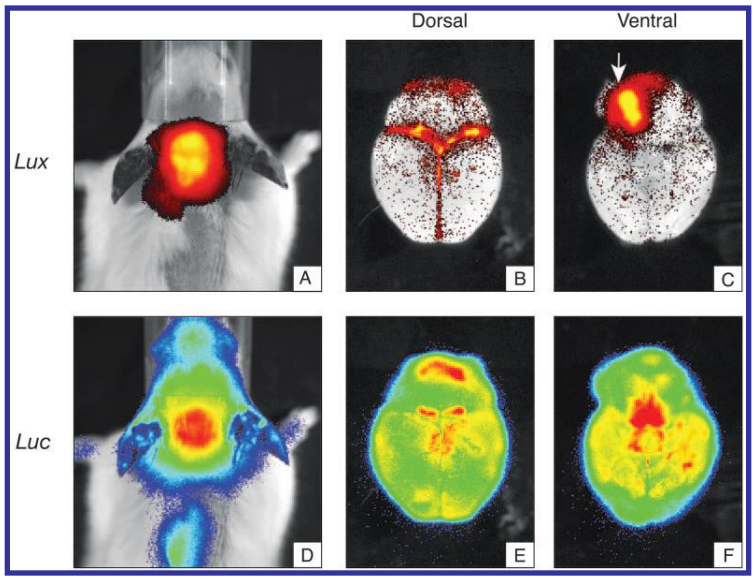
Dual Reporter: Bacterial *luc* and GFAP Brain Imaging

luc and *lux* in Pneumococcal Meningitis





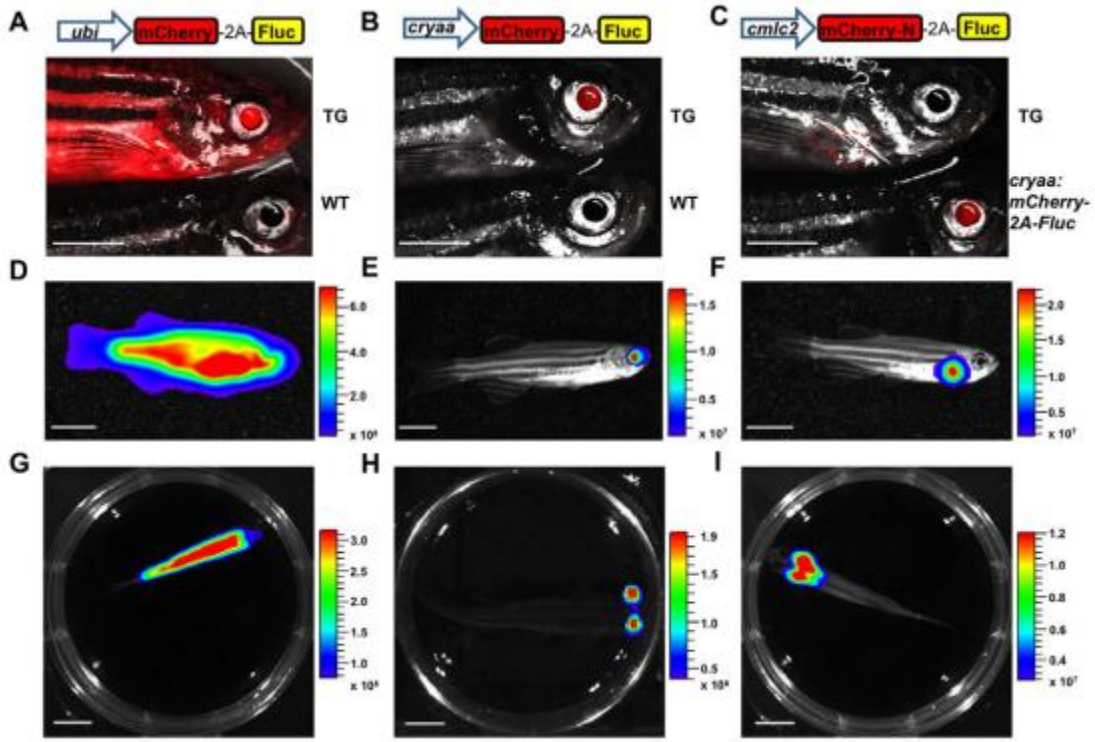
Simultaneous visualization of:

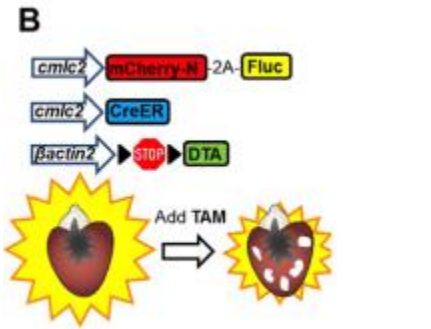
- ***Streptococcus pneumonia*** **(lux)**
- **Glial Fibrillary Acidic Protein - FAP (luc)**

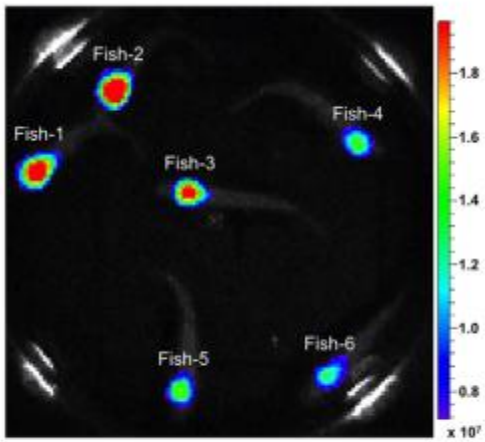
INFECTION AND IMMUNITY, Dec. 2005, p. 7836–7843

Others

Imaging of stem cells and regeneration in adult zebrafish





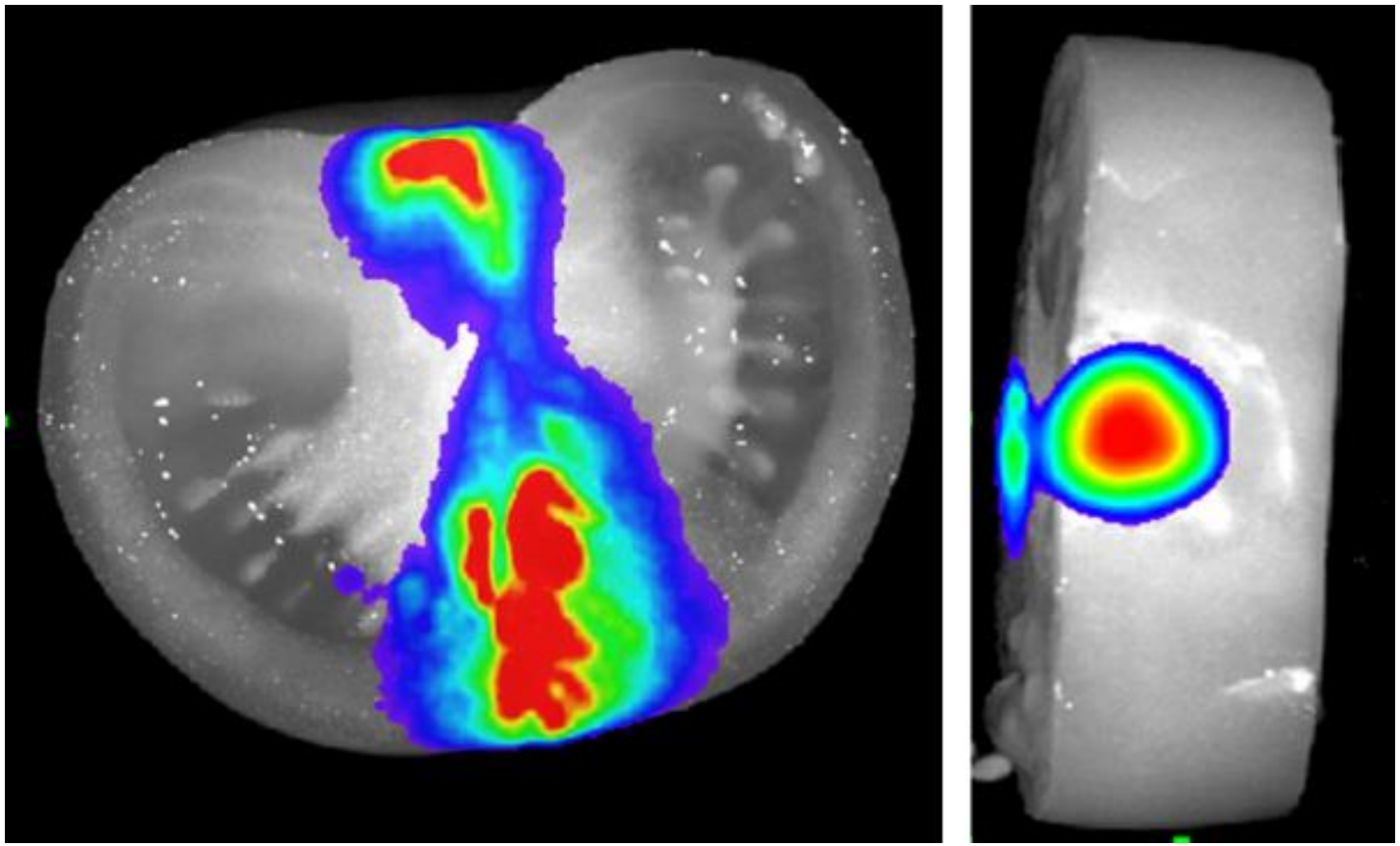


Vehicle treated animals: Fish-1, Fish-2, and Fish-3.
TAM treated animals : Fish-4, Fish-5, and Fish-6.

Chen-Hui Chen *et al*, 2013

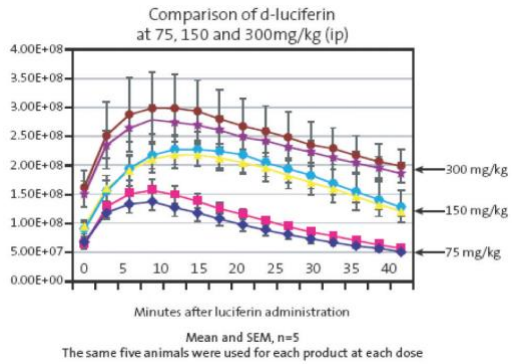
Bacterial contamination in Tomato

Enterotoxigenic *E. coli* (ETEC)



Top Ten Tips for Optical Imaging

1. Choose reporters that maximize signal-to-noise (S:N) ratio
2. Consider the appropriate control groups and imaging time points necessary
3. Use hairless mice or white-furred animals and depilate or shave
4. Switch to autofluorescence-free mouse diet
5. Closely map the kinetics of your biological bioluminescent
6. Animal handling can significantly affect kinetics
7. Image in the animal orientation that yields the highest sign
8. Cover intense signal to allow dimmer signals to dictate auto-exposure
9. Utilize guards to prevent reflection off neighboring animals
10. Use calibration unit for quantitation (Radiance and Radiant Efficiency)



Thank you for your attention!