

**BIOGRAPHICAL SKETCH**

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NAME: Gambhir, Sanjiv Sam

eRA COMMONS USER NAME (credential, e.g., agency login): gambhir2

POSITION TITLE: Chair, Dept. of Radiology, Professor of Radiology, Bioengineering and Materials Science & Engineering

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

| INSTITUTION AND LOCATION                 | DEGREE<br>(if applicable) | Completion Date<br>MM/YYYY | FIELD OF STUDY        |
|--|---------------------------|----------------------------|-----------------------|
| Arizona State University, Tempe, Arizona | B.S.                      | 05/1983                    | Physics               |
| University of California, Los Angeles    | Ph.D.                     | 08/1990                    | Biomathematics (MSTP) |
| University of California, Los Angeles    | M.D.                      | 05/1993                    | Medicine (MSTP)       |

**A. Personal Statement**

My laboratory is focused on the molecular imaging of living subjects with a particular emphasis on cancer imaging. We have developed numerous molecular imaging assays to interrogate fundamental cell/molecular events including cell viability, cell trafficking, gene expression, protein levels, enzyme activity, and protein-protein interactions. Several of my lab's assays have been clinically translated. We continue to develop novel tracers for positron emission tomography (PET) including FHBG, FAraG, and FPPRGD2 among others. We are also developing multimodality imaging strategies that involve photoacoustics, Raman, and other related strategies and applying them to the early detection of cancer. I have significant experience as the PI in multidisciplinary grants that involve multiple investigators including P50's, U54's, U01's, and R01's. As a result of these previous experiences, I am aware of the importance of frequent communication among project members and of constructing a realistic research plan, timeline, and budget. I am also happy to train the next generation of scientists to tackle the major problems in cancer research.

**B. Positions and Honors****Positions and Employment**

1994-95 Nuclear Medicine Fellow, UCLA Center for Health Sciences.  
1994-00 Assistant Professor, Department of Molecular & Medical Pharmacology, Crump Institute for Biological Imaging & Department of Biomathematics, UCLA.  
1994-00 Director, Computational & Communication Sciences Division, Crump Institute for Biological Imaging, UCLA School of Medicine.  
1996-03 Clinical Attending, Nuclear Medicine, Center for Health Sciences, UCLA School of Medicine.  
1998-03 Principal Investigator, DOE Laboratory of Structural Biology and Molecular Medicine, UCLA.  
2000-03 Associate Professor, Department of Molecular & Medical Pharmacology, Crump Institute for Molecular Imaging & Department of Biomathematics, UCLA.  
2000-03 Chief, Division of Molecular Medicine, Laboratory of Structural Biology and Molecular Medicine (LSBMM), Department of Energy (DoE) Labs, UCLA.  
2001-03 Director, Crump Institute for Molecular Imaging, UCLA.  
2001-03 Vice Chair, Department of Molecular and Medical Pharmacology, UCLA.  
2003-11 Head, Nuclear Medicine, Stanford University School of Medicine.  
2003-present Professor, Department of Radiology and Bio-X Program, Stanford University.  
2003-present Director, Molecular Imaging Program at Stanford (MIPS).  
2005-present Professor, Department of Bioengineering (Affiliated).  
2008-present Director, Canary Center at Stanford for Cancer Early Detection.

2011-present Chairman, Department of Radiology, Stanford University School of Medicine  
2016-present Director, Precision Health and Integrated Diagnostics (PHIND).

## **Honors**

2004 Distinguished Basic Scientist of the Year Award, Academy of Molecular Imaging  
2004 Doris Duke Distinguished Clinical Scientist Award  
2005 Scientific Achievement Award, Society of Molecular Imaging  
2005 Fellow of the American Institute for Medical and Biological Engineering  
2006 Hounsfield Medal, Imperial College London  
2006 Paul C. Aebersold Award, Society of Nuclear Medicine  
2007 Nobel Conference – Organized and co-chaired Nobel symposium, “Watching Life Through Molecular Imaging,” Stockholm, Sweden  
2008 Tesla Medal, United Kingdom Royal College of Radiologists  
2008 Elected to American Society of Clinical Investigation  
2008 Elected to the Institute of Medicine (IOM) of the US National Academies  
2009 Virginia and D.K. Ludwig Endowed Professorship  
2011 George Charles de Hevesy Nuclear Pioneer Award, Society of Nuclear Medicine  
2014 American Association for the Advancement of Science (AAAS), Fellow  
2015 J. Allyn Taylor International Prize in Medicine  
2016 National Academy of Inventors (NAI)

## **C. Contributions to Science**

1. My labs early work developed reporter gene/reporter probe technology for positron emission tomography (PET) including translation of these approaches for gene therapy and more recently cell therapies in humans. This work allows use of different reporter genes that encode for a reporter protein that traps a PET tracer. This work has had significant impact as it has allowed many investigators to use these strategies in animal models and is being used clinically for imaging cell trafficking. This is critical as immunotherapies evolve and the need to know the numbers, locations, and viability of immune cell components.

- a. S.S. Gambhir, E. Bauer, M. Black, Q. Liang, M.S. Kokoris, J. Barrio, M. Iyer, M. Namavari, M.E. Phelps, H.R. Herschman. A Mutant Herpes Simplex Virus Type 1 Thymidine Kinase Reporter Gene Shows Improved Sensitivity for Imaging Reporter Gene Expression with Positron Emission Tomography. *Proceedings of the National Academy of Sciences (USA)*, 97(6): 2785-2790, 2000. PMID: 10932234
- b. Y. Yu, A.J. Annala, J.R. Barrio, T. Toyokuni, N. Satyamurthy, M. Namavari, S.R. Cherry, M.E. Phelps, H.R. Herschman, S.S. Gambhir. Quantification of Target Gene Expression by Imaging Reporter Gene Expression in Living Animals. *Nature Medicine*, 6(8): 933-937, 2000. PMID: 10932234
- c. M. Iyer, L. Wu, M. Carey, Y. Wang, A. Smallwood, S.S. Gambhir. Two-Step Transcriptional Amplification as a Method for Imaging Reporter Gene Expression Using Weak Promoters. *Proceedings of the National Academy of Sciences (USA)*, 98(25): 14595-14600, 2001. PMID: 11564727

2. My labs research then began to expand beyond PET reporter gene/reporter probe technology to allow for multimodality reporter gene imaging including with fluorescence and bioluminescence. I have over 15 patents in this area and our vectors are have been freely made available to over 200 laboratories all over the world. They allow for numerous applications in studying cancer biology in small animal models that were previously not possible.

- a. S. Bhaumik and S.S. Gambhir. Optical Imaging of Renilla Luciferase Reporter Gene Expression in Living Mice. *Proceedings of the National Academy of Sciences (USA)*, 99(1): 377-382, 2002. PMID: 117568
- b. P. Ray, H. Pimenta, R. Paulmurugan, F. Berger, M.E. Phelps, M. Iyer, S.S. Gambhir. Non-invasive Quantitative Imaging of Protein-Protein Interactions in Living Subject. *Proceedings of the National Academy of Sciences (USA)*, 99(5): 3105-3110, 2002. PMID: 122480
- c. P. Ray, A. De, J. Min, R. Tsien, S.S. Gambhir. Imaging Tri-Fusion Multimodality Reporter Gene Expression in Living Subjects. *Cancer Research*, 64: 1323-1330, 2004. PMID: 154814

3. Most recently over the last 10 years my lab has been developing novel nanotechnologies as well as strategies for early cancer detection that are based on numerous technologies including Raman optical and photoacoustic molecular imaging. We have also started to integrate mathematical modeling into studying cancer biology so as to inform the needed experiments, and use the experiments to improve the models.

These approaches are also being translated for clinical applications of early cancer detection and hold significant promise for future cost-effective management of cancer patients.

- a. A. de La Zerda, C. Zavaleta, S. Keren, S. Vaithilingam, S. Bodapati, Z. Liu, J. Levi, B. Smith, T. Ma, O. Oralkan, Z. Cheng, X. Chen, H. Dai, B. Khuri-Yakub, S.S. Gambhir. Carbon Nanotubes as Photoacoustic Molecular Imaging Agents in Living Mice. *Nature Nanotechnology*, 3(9): 557-562, 2008. PMID: PMC2562547
- b. M.F. Kircher, A. de la Zerda, J.V. Jokerst, C.L. Zavaleta, P.J. Kempen, E. Mittra, R. Huang, C. Campos, F. Habte, R. Sinclair, C.W. Brennan, I.K. Mellinghoff, E.C. Holland, S.S. Gambhir. A Brain Tumor Molecular Imaging Strategy Using a New Triple-Modality MRI-Photoacoustic-Raman Nanoparticle. *Nature Medicine*, 18(5): 829-34, 2012. PMID: PMC3422133
- c. S.S. Hori, S.S. Gambhir. Mathematical Model Identifies Blood Biomarker-Based Early Cancer Detection Strategies and Limitations. *Science Translational Medicine*, 3(109): 109ra116, 2011. (Cover Article) PMID: PMC3423335

#### **Complete List of Published Work:**

<http://www.ncbi.nlm.nih.gov/sites/myncbi/sanjiv.gambhir.1/bibliography/44287268/public/?sort=date&direction=ascending>

#### **D. Additional Information: Research Support and/or Scholastic Performance** **On-going Research Support**

- Canary Foundation** (Gambhir) 03/06/07 – 03/31/21  
Foundation  
*Center of Excellence in Early Detection of Cancer*  
Major goal: To create a state-of-the-art facility for two areas of early cancer detection research: 1) proteomics approaches to develop blood screening tests, and 2) molecular imaging strategies to identify and localize early cancer.  
Role: PI
- R01 HD084214** (Chin) 09/22/14 – 05/31/19  
National Institute of Health  
*Cross-Species Multi-Modal Neuroimaging to Investigate GABA Physiology in Fragile X Syndrome*  
Major Goal: Determine through PET imaging the role of GABA in Fragile X-Syndrome  
Role: Investigator
- U01 CA188383** (Gambhir/Felsher) 09/16/14 – 08/31/19  
NIH  
*Modeling and Predicting Therapeutic Resistance of Cancer*  
Major Goal: Developing mathematical model strategies married to animal experimentation to understand cancer therapy resistance.  
Role: PI
- R01 EB019006** (Gambhir) 05/01/15 – 02/28/19  
National Institutes of Health  
*Optimization of An Activatable Photoacoustic Agent to Image Thyroid Cancer*  
Major Goal: To develop new smart probes that activate only at tumor site to lead to changes in photo acoustic imaging signal.  
Role: PI
- N/A** (Gambhir) 06/24/15 – 07/31/20  
Sanofi-Aventis, US, Inc.  
*Cu-DOTA-B-Fab as a PET Tracer for Evaluating CA6 Expression in Tumors: A First in Human Study*  
Major Goal: Determine utility of a new PET tracer which will serve as a companion diagnostic for a antibody-drug conjugate.  
Role: PI
- R01 CA082214** (Gambhir) 07/06/15 – 06/30/20  
National Institutes of Health  
*Reporter Gene Technologies for Integrated Cancer Diagnostics*

Major Goal: To develop novel reporter gene strategies for detection of cancer by both secretable and imageable biomarkers.

Role: PI

**U54 CA199075** (Gambhir)

09/04/15 – 07/31/20

National Institutes of Health

*Center for Cancer Nanotechnology Excellence for Translational Diagnostics (CCNE-TD)*

Major Goal: To develop in vitro diagnostics and in vivo molecular imaging using novel nanotechnology strategies. Included are cell sorting and cell analysis technologies as well as self-assembling nanoparticles and nano bubbles.

Role: PI

**R01 CA201719** (Gambhir)

12/01/15 – 11/30/20

National Institutes of Health

*A Novel PET Strategy for Early Detection and Treatment Monitoring of Graft-versus-Host Disease*

Major Goal: To determine if a new PET tracer that accumulated in activated T-cells can be useful for determining early Graft vs. Host Disease (GVHD). Optimization of several parameters to make this a useful approach for GVHD will be studied.

Role: PI

**N/A** (Gambhir)

01/01/16 – 12/31/18

The Ben & Catherine Ivy Foundation

*A New Strategy to Imaging Tumor Metabolism in GBM Patient to Help Optimize Anti-Tumor Therapy*

Major Goal: To study PKM2 levels in living subjects with Glioblastoma in order to better understand key metabolic regulatory pathways pre and post-treatment of Glioblastoma.

Role: PI

**N/A** (Gambhir)

02/28/16 - 02/27/19

*University of Texas MD Anderson Cancer Center*

Biospecimen Banking and Biomarker Validation for Lung Cancer Early Detection in Cohort Receiving Low Dose Helical Computed Tomography Screening

Major Goal: To determine if blood based testing when combined with CT can lead to effective lung cancer screening in subjects at high risk for developing lung cancer.

Role: PI

**U01 CA210020** (MPI: Willmann, Park)

05/01/17 – 04/30/22

National Institutes of Health

*Molecular Imaging Methods for the Detection of Pancreatic Ductal Adenocarcinoma*

Major Goal: We aim to drive biomarker development and validation efforts by establishing standardized biorepositories of high risk individuals and evaluating two innovative molecular imaging approaches to detect pancreatic ductal adenocarcinoma (PDAC) much earlier than is currently possible.

Role: Co-Investigator

**P30 CA124435** (Mitchell)

07/01/16 – 05/31/21

National Institutes of Health

*Stanford Cancer Institute*

Major Goal: To develop novel cancer imaging applications for cancer early detection and management.

Role: Investigator

**n/a** (Gambhir)

06/01/16 – 05/31/21

Baseline Study LLC

*The Baseline Study*

Major Goal: To perform a longitudinal cohort study with detailed laboratory assessments in order to better understand the transition from health to disease

Role: PI

**R01 CA199656** (Gambhir)

09/01/16 - 08/31/21

National Institutes of Health

*Nanoparticle-based Triple Modality Imaging and Photothermal Therapy of Brain Tumors*

Major Goal: To use gold/silica nanoparticles as a way of optimizing imaging of tumor vs. normal tissues and for heating of tumor tissues as a treatment strategy.

Role: PI

**Exhibit B-26** (Demirci)

09/01/16 – 01/31/19

Philips Electronics North America Corporation

*Advancing Precision Health: Enabling Personalized Diagnostics and Treatment Delivery*

Major Goal: Imaging of the prostate with photoacoustic imaging through a novel transrectal device.

Role: Investigator

**n/a** (Gambhir)

12/01/16 – 11/30/19

The Ben & Catherine Ivy Foundation

*Glioma Imaging*

Major Goal: To develop and validate strategies for the improved detection and treatment of glioblastoma

Role: PI

**n/a** (Gambhir)

04/15/17 – 04/14/19

Pilant Therapeutics, Inc.

*Detection of Integrin  $\alpha\beta6$  in Pancreatic Cancer and Idiopathic Pulmonary Fibrosis with [ $^{18}\text{F}$ ]FP-R01MG-F2: A first in human study*

Major Goal: To study if a  $^{18}\text{F}$ -Knottin Peptide targeted to  $\alpha\beta6$  is effective in imaging interstitial pulmonary fibrosis patients. Pilot patient studies will be performed using PET-CT in order to determine if additional Phase II studies are warranted.

Role: PI

**U01 CA210020** (Willmann)

05/01/17 – 04/30/22

NIH

*Molecular Imaging Methods for the Detection of Pancreatic Ductal Adenocarcinoma*

Major Goal: We aim to drive biomarker development and validation efforts by establishing standardized biorepositories of high risk individuals and evaluating two innovative molecular imaging approaches to detect pancreatic ductal adenocarcinoma (PDAC) much earlier than is currently possible.

**n/a** (Dionne)

08/01/17 – 07/31/18

Stanford Catalyst for Collaborative Solution

*A microbial culture shift: rapid screening of bacterial blood stream infections and antibiotic susceptibility for urban and rural clinical care*

Major Goal: Develop new ways to quickly detect bacterial infections in bodily fluids using Raman Optical Strategies.

Role: Co-Principal Investigator

**n/a** (Mackall)

03/31/16 – 03/30/23

The Parker Institute for Cancer Immunotherapy

*The Parker Institute for Cancer Immunotherapy at Stanford School of Medicine*

Major Goal: To study T-cell imaging in Graft vs. Host disease in patients.

Role: Co-Principal Investigator

### **Completed Research Support**

**U01 CA152737** (Gambhir)

09/21/10 – 06/30/16

NIH/NCI

*New Tools for Prostate Cancer Detection and Prognostication*

Major goal: Development of new tools for diagnosis and prognostication of prostate cancer.

Role: PI

**n/a** (Gambhir)

04/18/11 – 12/31/17

The Ben & Catherine Ivy Foundation

*Next Generation Neuro-Oncological Imaging Strategies*

Major Goal: To develop a research program in multimodality neuro-oncologic clinical imaging