Lecture-10

CSO202: Atoms, Photons & Molecules

Debabrata Goswami

Module 2

Super Resolution Microscopy

2014 Chemistry Nobel Prize: Awarded jointly to Eric Betzig, Stefan W. Hell & William E. Moerner *"for the development of super-resolved fluorescence microscopy"*

Debabrata Goswami

Lecture of the Physics Society, Indian Institute of Technology Kanpur

Eric Betzig

Born: 13 January 1960, Ann Arbor, MI, USA

Affiliation at the time of the award: Janelia Research Campus, Howard Hughes Medical Institute, Ashburn, VA, USA

Prize motivation: "for the development of super-resolved fluorescence microscopy"

Field: physical chemistry

Prize share: 1/3

Kungliga
Svenska Vetenskapsakademien
har den 8 oktober 2014 beslutat
att med det
NOBELPRIS
som detta år tillerkänns den
som gjort den viktigaste kemiska
upptäckten eller förbättringen
gemensamt belöna

Eric Betzig
Stefan W. Hell och William E. Moerner
för utveckling av superupplöst
fluorescensmikroskopi

STOCKHOLM DEN 10 DECEMBER 2014

Stefan W. Hell

Born: 23 December 1962, Arad, Romania

Affiliation at the time of the award: Max Planck Institute for Biophysical Chemistry, Göttingen, Germany, German Cancer Research Center, Heidelberg, Germany

Prize motivation: "for the development of super-resolved fluorescence microscopy"

Field: physical chemistry

Prize share: 1/3

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gemensamt belöna

Stefan W Hell

Eric Betzig och William E Moerner
för utveckling av superupplöst
fluorescensmikroskopi

STOCKHOLM DEN 10 DECEMBER 2014

William E. Moerner

Born: 24 June 1953, Pleasanton, CA, USA

Affiliation at the time of the award: Stanford University, Stanford, CA, USA

Prize motivation: "for the development of super-resolved fluorescence microscopy"

Field: physical chemistry

Prize share: 1/3

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William E Moerner
Eric Betzig och Stefan W Hell
för utveckling av superupplöst
fluorescensmikroskopi
STOCKHOLM DEN 10 DECEMBER 2014

2014 Chemistry Nobel Lecture details

Single Molecules, Cells, and Super-Resolution Optics

Eric Betzig
Janelia Research Campus, Howard Hughes Medical Institute, Ashburn, VA, USA
8 December 2014 at the Aula Magna, Stockholm University

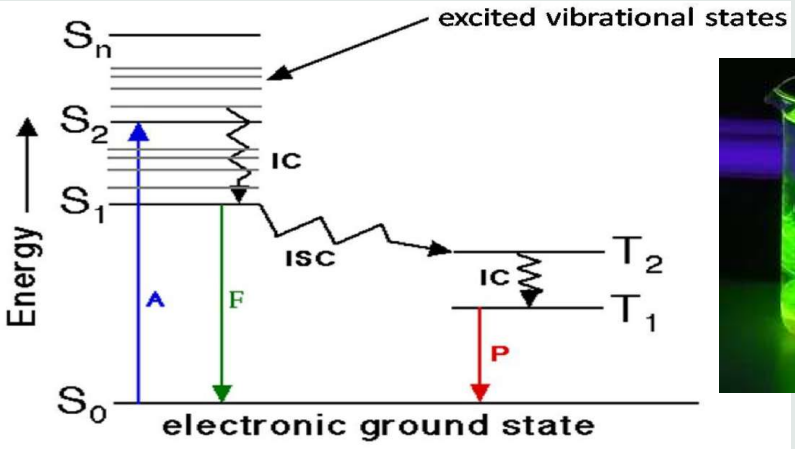
Nanoscopy with Focused Light

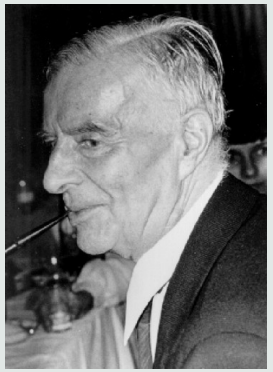
Stefan W. Hell
Max Planck Institute for Biophysical Chemistry, Göttingen, and German Cancer Research Center, Heidelberg, Germany
8 December 2014 at the Aula Magna, Stockholm University.

Single-Molecule Spectroscopy, Imaging, and Photocontrol: Foundations for Super-Resolution Microscopy

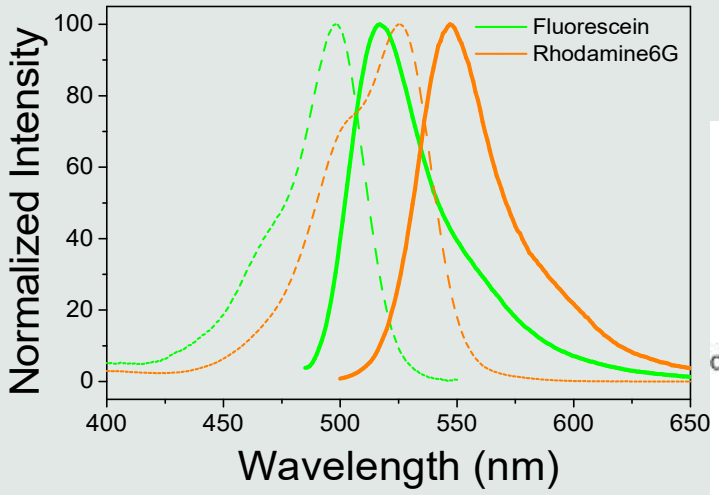
William E. Moerner
Stanford University, Stanford, CA, USA
8 December 2014 at the Aula Magna, Stockholm University

What is Fluorescence ?

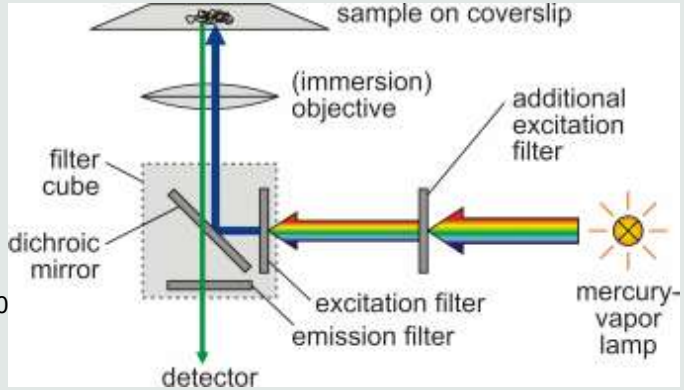




Aleksander Jabłoński
1898 – 1980



Stokes Shift of Fluorescence



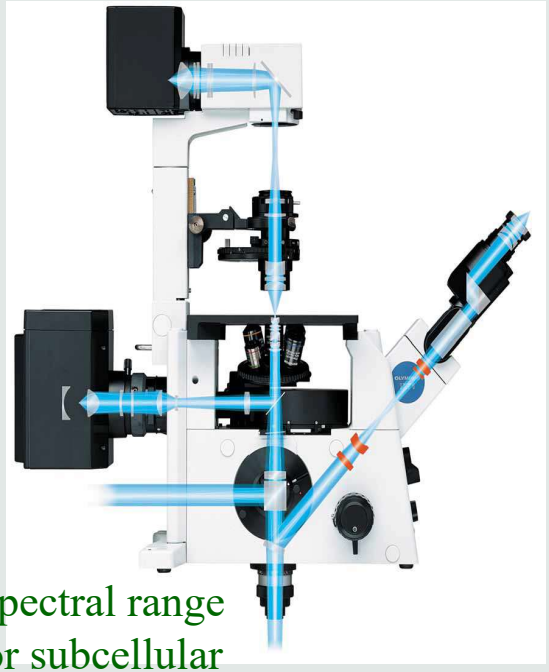
Fluorescence Microscopy

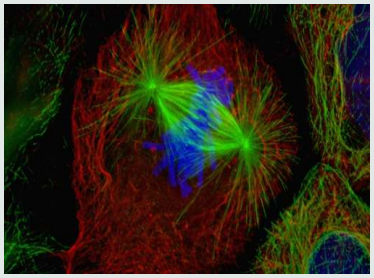
❖What is Microscope?

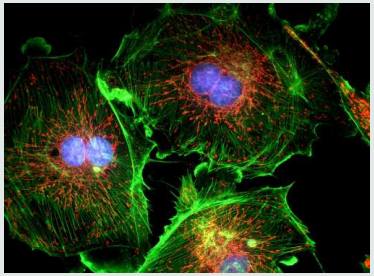
It is an instrument for magnifying things too small to see with the naked eye

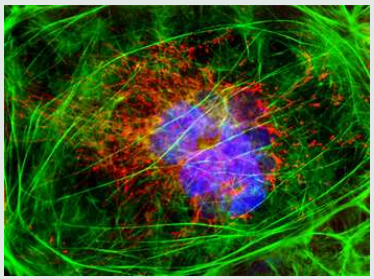
❖ Many types:

- ❑ Bright-field Microscope
- ❑ Dark-field Microscope
- ❑ Phase-contrast Microscope
- ❑ Fluorescence Microscope



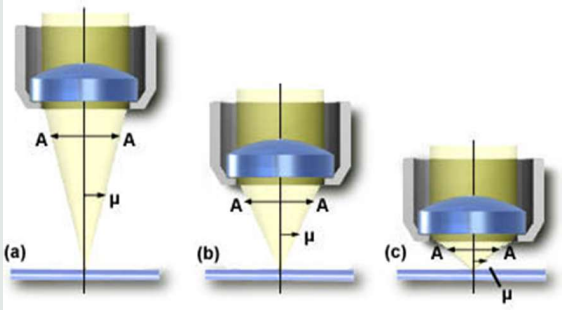


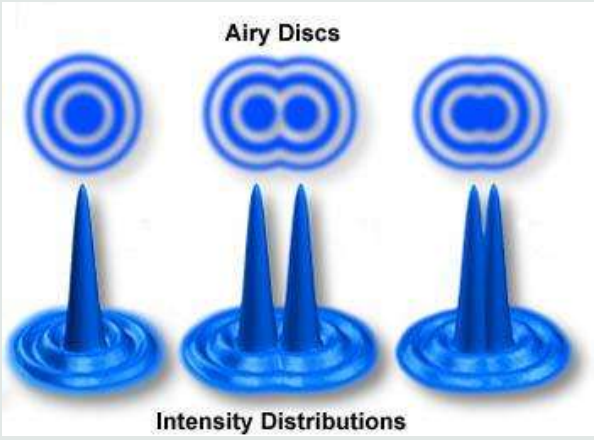




- ✓ Higher sensitivity
- ✓ Using visible or near IR spectral range
- ✓ Dyes which are specific for subcellular components, proteins or ions
- ✓ Observation of cell division
- ✓ 3D

Resolution of Microscope





According to Geometrical optics: focal spot is a Point

Reality: it has Finite dimensions

Tightly focused beams form airy disc pattern