

# Optics/photonics- What's Next?

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SPIE

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# SPIE – background

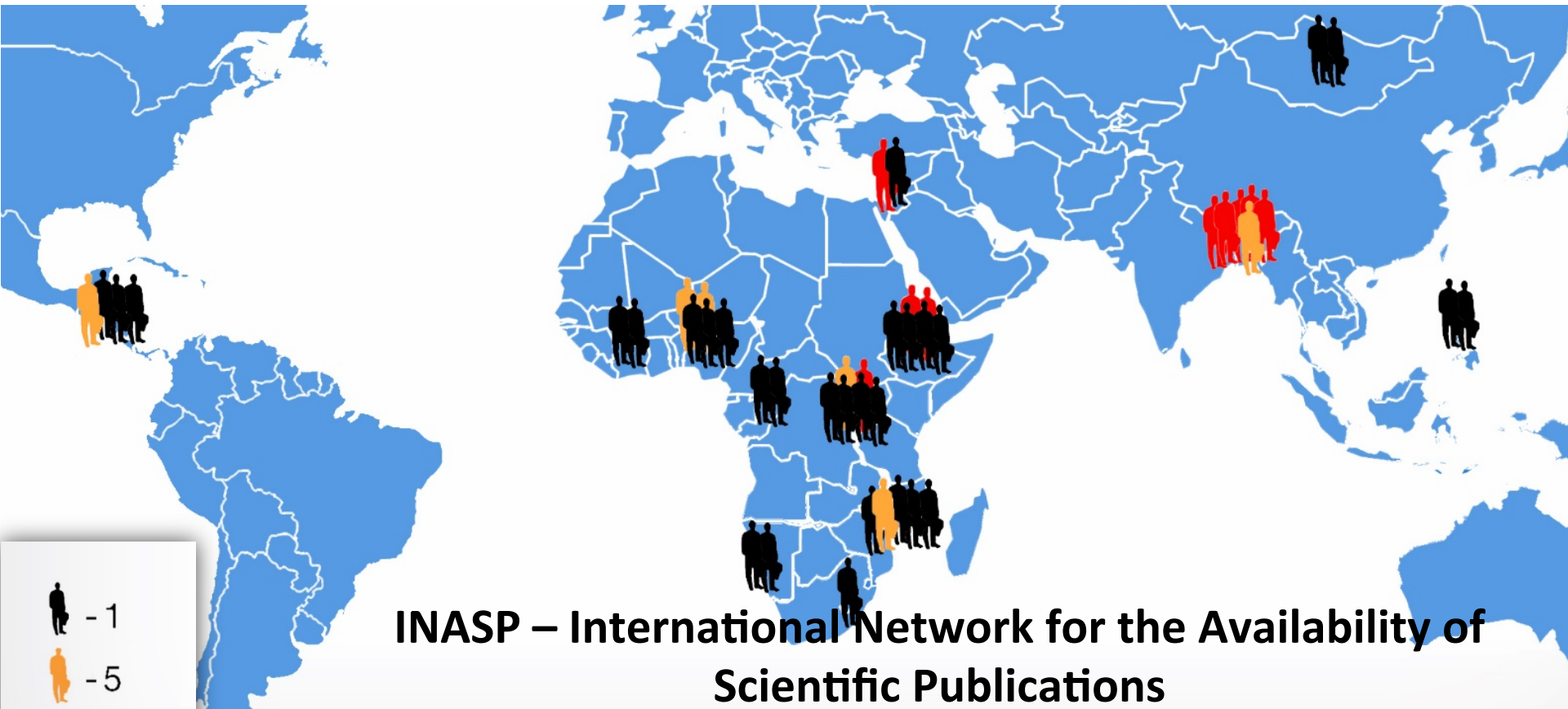
- Formed in 1955 as **Society of Photo-optical Instrumentation Engineers**
- Now the **International Society for Optics and Photonics** bridging research and applications
- Self-funded, not-for-profit, educational mission
- 175 staff and countless volunteers worldwide
- 18,000 Individual Members in 93 countries
- >250,000 individuals interacted with SPIE in last 2 years
- 650 Corporate Members
- Delivering Science & Technology Conferences, Training, Exhibitions, Publishing, Recruiting, Advocacy

# SPIE – purpose



- Shape our future: \$3.4 mil altruistic spending(2013),
- 270+ student chapters, building new talent pipeline
- Stimulate technology development, innovation, and commercial application: productive research
- Publish relevant technical and business information
- Create and sustain professional connections
- Support life-long learning and advancement

# Number of free SPIE Digital Library subscriptions through INASP



**INASP – International Network for the Availability of  
Scientific Publications**

- 1
- 5
- 10



# Advocacy

- Active in EU Platform, now Public Private Partnership, Photonics21 since it started to ensure recognition and funding for photonics in FPs & Horizon 2020
- Founder, joint with OSA, of US National Photonics Initiative which sprang from the 2012 US National Academies' report; "Optics and Photonics: Essential Technologies for our Nation"
- Participate and support other national bodies in the UK, Canada, Ireland

# WW Sales of Core Optics/ Photonics Components

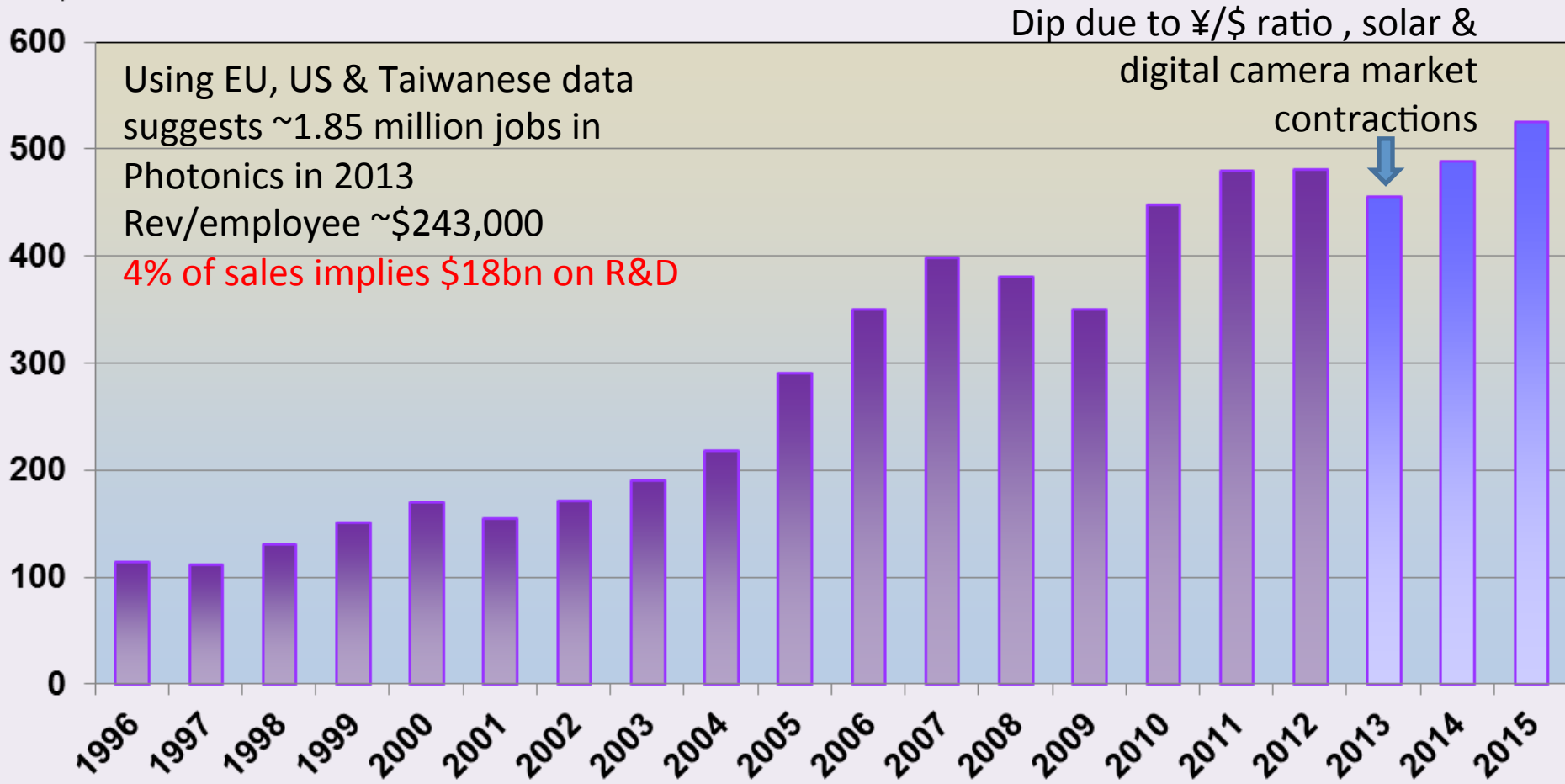
Global Photonics Sales of Core Optics & Photonics Suppliers in 2012	
Photonics firms WW	2748 <sup>1</sup>
Annual photonics sales	\$156 B <sup>2</sup>
Photonics employees (jobs)	698,266 <sup>2</sup>
Global average sales/employee	\$223,414

<sup>1</sup> Photonics firms that make and that ship photonics core components and that exhibited at a major photonics tradeshow somewhere in the world in 2012

<sup>2</sup> Company revenues and employment are prorated based on estimates of photonics-related sales ("Photonics Factor"). Companies with sales of less than \$10 M are assumed to be 100% photonics; all data are for 2012.

# "Lower Bound" of Worldwide Photonics Market with Defense (internal SPIE estimate)

U.S. \$bn



source: SPIE

Projections use a combination of IMF global economy data, technology knowledge and market estimates. Projections are highly dependent on currency rates, and socially and politically influenced technology adoption rates in consumer markets



# 50 years from now

**“Fools rush in where angels fear to tread”**

*“Heavier-than-air flying machines are impossible.”* — Lord Kelvin, president of the British Royal Society, 1895, who also said *“X-rays will prove to be a hoax”*

*“The energy produced by the breaking down of the atom is a very poor kind of thing. Anyone who expects a source of power from the transformation of these atoms is talking moonshine.”* — Ernest Rutherford





# The 65<sup>th</sup> year of the Century of the Photon

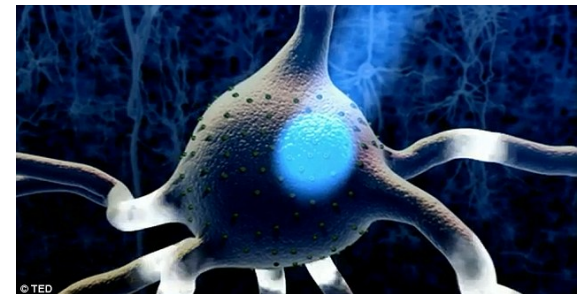
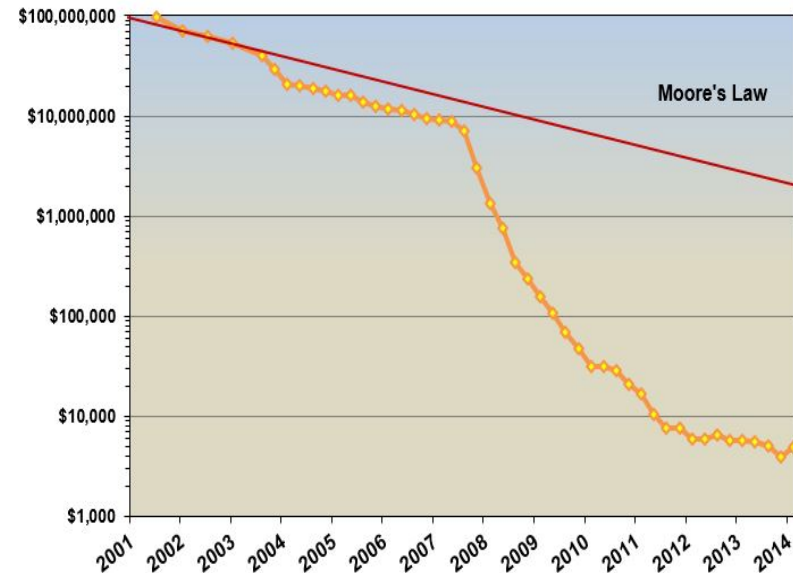
- Solar energy provides 50% of the world's still increasing energy demand
- 2<sup>nd</sup> Laser fusion power station completed
- More than 90 of humanity has Tb/s photonic connections
- Room size 3D holographic displays strain the photonic net
- Lighting has become smart and personalized after we came to understand the interaction with human biology



## Year 65

- Genomics, proteomics or metabolomics, all affordably optically determined, define therapy on an individual basis
- New generation laser-generated beam therapy
- Completed superresolution brain map, quantum computing, early detection with eye exams, and photonics neuro-therapy promise end to dementia

Cost Per Genome





## Year 65

- GMT joins EELT in retirement as third generation International JWST and MoonScopes provide 10X higher resolution
- Planets with “life signatures” now at 1849. No communication as yet
- Silicon Valley Museum’s Moore’s law exhibit closed – obsolete X-ray lithography equipment sold off
- No one sickened: Networked hyperspectral home food inspectors immediately identify two local ecoli sources



# Concerns

- A worrying lack of translation of scientific advances into useful outcomes
- While basic science is a key element of the innovation infrastructure, by itself, it is not sufficient
- Science increasingly measured by criteria that are taking it away from innovation,
- e.g. Impact factor with its inverse relationship to practicality
- Growing scientific illiteracy in the public and politicians in many nations



# “Hypercompetition”

## Rescuing US biomedical research from its systemic flaws

**Bruce Alberts<sup>a</sup>, Marc W. Kirschner<sup>b</sup>, Shirley Tilghman<sup>c,1</sup>, and Harold Varmus<sup>d</sup>**

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Edited by Inder M. Verma, The Salk Institute for Biological Studies, La Jolla, CA, and approved March 18, 2014 (received for review March 7, 2014)

The long-held but erroneous assumption of never-ending rapid growth in biomedical science has created an unsustainable hypercompetitive system that is discouraging even the most outstanding prospective students from entering our profession—and making it difficult for seasoned investigators to produce their best work. This is a recipe for long-term decline, and the problems cannot be solved with simplistic approaches. Instead, it is time to confront the dangers at hand and rethink some fundamental features of the US biomedical research ecosystem.

### Supporting the Next Generation of Scientists

There is a no more worrisome consequence of the hypercompetitive culture of biomedical science than the pall it is casting on early careers of graduate students, postdoctoral fellows, and young investigators.



With the percentage of recent PhDs in academic positions falling to 20% (2), the training of graduate students needs to diversify to reflect the realities of the job market.



# Another Future View

*“I have a foreboding of an America in my children's or grandchildren's time -- when the United States is a service and information economy; when nearly all the manufacturing industries have slipped away to other countries; when awesome technological powers are in the hands of a very few, and no one representing the public interest can even grasp the issues; when the people have lost the ability to set their own agendas or knowledgeably question those in authority; when, clutching our crystals and nervously consulting our horoscopes, our critical faculties in decline, unable to distinguish between what feels good and what's true, we slide, almost without noticing, back into superstition and darkness...”*

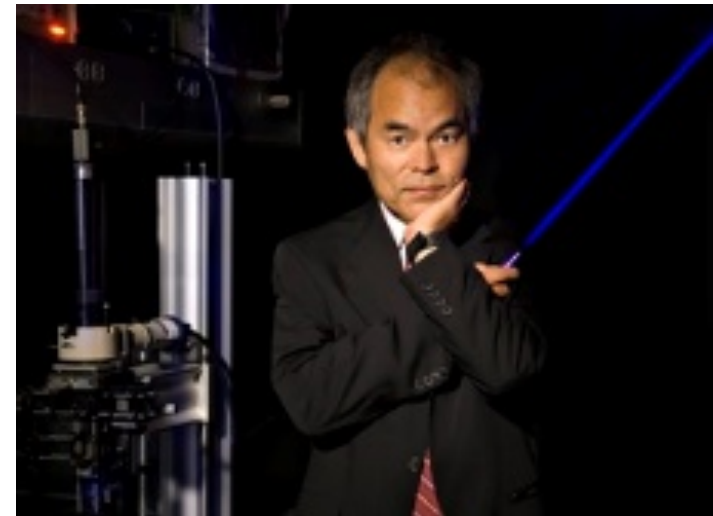
Carl Sagan. 1997

# 2014 Nobel to LED Pioneers

Isamu Akasaki, Hiroshi Amano and Shuji Nakamura win  
Nobel Prize in Physics 2014

*“11 percent of people believe the government is mandating a switch to compact florescent light bulbs because the light bulbs make people obedient and easy to control”*

Oliver & Wood, JAMA Intern Med.  
2014;174(5):817-818. doi:10.1001/  
jamainternmed.2014.190



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SPIE is proud to support optics and education programs at ICTP and looks forward to continued scientific and moral leadership from this wonderful centre

