Medical Physics – Think Out of the Box to **Build the FUTURE**

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Special Thanks:



MGH, Harvard University

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Bob Austin Princeton University



Martin Ebert University of Western Australia



Research group University of Wisconsin

Beginnings of Medical Physics

Leonardo da Vinci (1452-1519)

- First "medical physicist"
- Physical description of body (physiology)

Definitely thinking WAY OUT OF THE BOX!!! So much ahead of his time!!!





Before it really started

Giovanni Borelli (1608-1679)

- iatro-physics
 (from jatros -
- (from iatros = surgeon, doctor) - Everything in the body can be
- I LOVE this one! Everything is Physics! Thinking OUT of the BOX!!!



Lots to be proud of...



Bortfeld and Jeraj 2011, Br J Radiol, 84: 485.



AAPM Articles of Incorporation





What was 60 years ago?

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How much has Medical Physics evolved?



Do we have a problem?

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- What has evolved more?
 - 1. Country
 - 2. Medical Physics
 - 3. The same
- We are all still largely using the same "instruments" (e.g., dose/RT, image)
 - Should we use them differently?
 - Should we use "new instruments"?
 - Should we invent or re-invent?

Medical physics chain



Bortfeld and Jeraj 2011, Br J Radiol, 84: 485.







The Very Best AAPM Research: Young & Junior Investigators





Weakening innovation...



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Courtesy of Brendan Whelan, University of Sydney

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Courtesy of Brendan Whelan, University of Sydney









AAPM WG FUTURE

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- Charge: To initiate, coordinate and lead activities to secure sustainable growth and improvement in the long-term future environment for high quality research and academic training of physicists in medicine
- Goals:
 - To prepare a strategic plan and coordinate activities for improvement of research environment
 - To prepare a strategic plan and coordinate activities for improvement of academic training and educational environment
- Focus:
 - Medical Physics as a scholarly discipline

WG FUTURE initiatives (Junior)

- Expanding Horizons Travel Grant:
 - Students visit non-MP conference to enrich medical physics
- Science Council Associates Medical Physicists (SCAMP) program:
 - Integrates junior medical physicists into AAPM (Committee meetings, TG reports)
- Working Group on Student and Trainee Research (WGSTR):
 - "Student Day" at the annual AAPM meeting (together with ST SC)

WG FUTURE initiatives (Selected)

- Expanding Horizons meetings:
 - Bridging the scales (BPS connection)
 - The physics of cancer (PS-OC/APS connection)
- APS Topical Group on Medical Physics (GMED):
 - Reaching beyond "traditional medical physics"
 - Linking to academic medical physics programs
- Provocative Questions (PQs) for Medical Physics:
 - Modeled after "NCI's provocative questions"
 - Defining big questions to be addressed

PQ could

Courtesy of Martin Ebert, University of Western Australia

Complimentary AAPM initiative

Charge:

- To enact, express, and enhance the full value of physics towards human health into the council working space of the AAPM
 - Includes practice, administrative, scientific, and educational goals.

Focus:

- Medical physics as a professional discipline



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Are we at the point when we need to go BACK to CHANGE the FUTURE???



AAPM 1958-... (60 years and counting!) Articles of Incorporation



- The purpose or purposes for which the corporation (AAPM) is organized are:
 - To promote the application of physics to medicine and biology
 - To encourage interest and training in medical physics and related _ fields
 - To prepare and to disseminate technical information in medical physics and related fields

AAPM Articles of Incorporation

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 The purpose or purposes for which the corporation (AAPM) is organized are:

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- To prepare and to **disseminate technical information** in medical physics and related fields AAPM Articles of Incorporation



"APS Presidential Symposium"

Session P61: Kavli Found	dation Special Symposium: Frontiers of Physics	Show Abs
Chair: Meigan Aronson, Texas Room: LACC West Hall B	s A&M University	
Wednesday, March 7, 2018 2:30PM - 3:06PM	P61.00001: Einstein, Gravitational Waves and a New Science Invited Speaker: Barry Barish	
Wednesday, March 7, 2018 3:06PM - 3:42PM	P61.00002. Discovery of the chiral Majorana fermion and its application to topological qua Invited Speaker: Shoucheng Zhang	intum computi
Wednesday, March 7, 2018 3:42PM - 4:18PM	P61.00003: Neuromorphic Computing Invited Speaker: Ivan Schuller	
Wednesday, March 7, 2018 4:18PM - 4:54PM	P61.00004. Frugal science: A physicist view on tackling global health and education chails Invited Speaker: Manu Prakash	enges
Wednesday, March 7, 2018 4:54PM - 5:30PM	P61.00005: When a Weed is a Flower: Reimagining Our Classification System Invited Speaker; Amir Abo-Shaeer	

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Einstein, Gravitational Waves and a New Science			
	Einstein,		
Event Source Locations	Gravitational Waves:		
GW170104	and a New Science		
UT151012 GW151226 GW176337	physics Kivi Foundation		
2017 NOBEL PRIZE IN PHYSICS	Special Symposium on the Frontiers of Physics		
	Barry C Barish Caltech 7-March-2018		

The story of gravitation





Neuromorphic Computing

- Using very-large-scale integration (VLSI) systems containing electronic analog circuits to mimic neurobiological architectures present in the nervous system (e.g., for multisensory integration)
- Understanding how the morphology of individual neurons and overall architecture creates desirable computations, incorporates learning and facilitates evolutionary change



 Designing artificial neural systems, such as vision systems, whose physical architecture and design principles are based on those of biological nervous systems Ivan Schuller

Frugal Science

- Democratizing access to scientific tools
- Design, development and deployment of ultra-affordable scientific tools for the masses
 - Origami microscope (\$1)
 - Paperfuge (20c)
- Important to:
 - Identify challenges
 - Design solutions



- to enable open ended scientific curiosity/inquiries
- Impacting human health in a resource limited world!

Manu Prakash

When a Weed is a Flower

- Many students become disconnected from science and math at an early age
- Dos Pueblos Engineering Academy (DPEA) is a four-year program with a unique entrepreneurial, interdisciplinary, project/design-based curriculum focused on STEM



- Students design, fabricate and test professional-quality installations
- Redefining what is possible in a high school setting and serving as a disruptive force for change in the world of education
- Empowered and inspired by DPEA program, 85% of graduates pursue STEM-related fields in college

Amir Abo-Shaeer

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Don't forget we are physicists!

- Are those models "useful"?
- Can we accept predictions without completely understanding how this predictions are made?
- Are there ways to make those predictions more "transparent"?
- And if they are not transparent enough, is there still a place for them in our pursuit of knowledge?

How can we expand our horizons?

- Work together on large problems (aka LIGO)
 We need to establish
 GLOBAL RESEARCH COLLABORATION TEAMS
- Reach out to innovative solutions (aka VLSI)

Do not forget WE ARE PHYSICISTS!

- We need to diversify our INTERNATIONAL HEALTH PROBLEM INVOLVEMENT
- Rethink our training strategies (aka DPEA)
 We need to reach out to
 STUDENTS MUCH EARLIER AND DIFFERENTLY

How do we move forward?

President's Workshop - Generating Visions for the Path Forward

B Thomadsen¹, (1) University of Wisconsin, Madison, WI



Presentations

(Monday, 7/30/2018) 1:45 PM - 3:45 PM Room: Davidson Ballroom C

Participants will work in groups to generate ideas about what the AAPM's future should look like and what would have to happen to make that come true.

Summary

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- Medical physics has come to an inflection point

 Very limited "cutting edge/foundational" science
 - Serious danger down the road
 - No fundamentally new science fewer jobs
- We need to re-invent what medical physics is
 - Back to the future Back to physics!
 Learn from our roots, learn from our colleagues
 - Start working on big problems e.g., PQs
- We need to:
 - Establish global research collaboration teams
 - Expand our research portfolio
 - Diversify international health problem involvement
 - Reach out to students much earlier and differently

And we should never forget: E PLURIBUS UNUM

