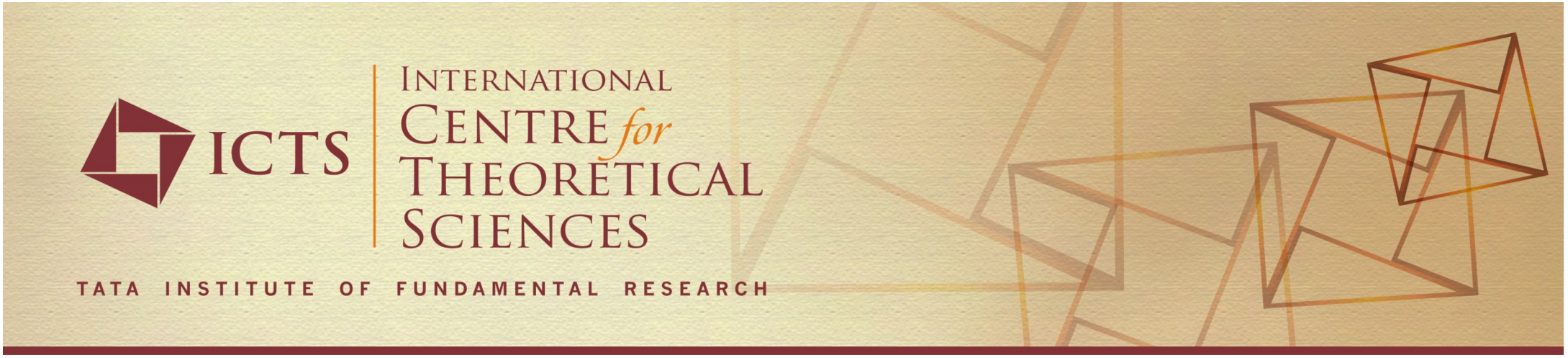


Curiosity Driven Pure and Applied Research

Spenta R. Wadia

BeST Cluster meeting for Social Impact
19 August 2021

- This session is being organized to encourage academia-industry collaboration in order to leverage science and engineering for social impact.

- It behooves one to say a few words and remind ourselves at the outset about `curiosity driven research' (both pure and applied) which forms the bedrock of a `knowledge bank' that is the basis of all technology.

Science is a curiosity driven exploration of how nature works; to find meaning and guidance in the complex world around us and then to tame it for the benefit of humankind: “Man’s power over nature is the source of history”.

Scientists ask questions whose answers need not be immediately applicable to any real-world problem.

Most scientific discoveries are owed to serendipity and curiosity driven explorations. They creates a `knowledge space’ that often translates into technologies.

Vannevar Bush in “Science the Endless Frontier (1945)”

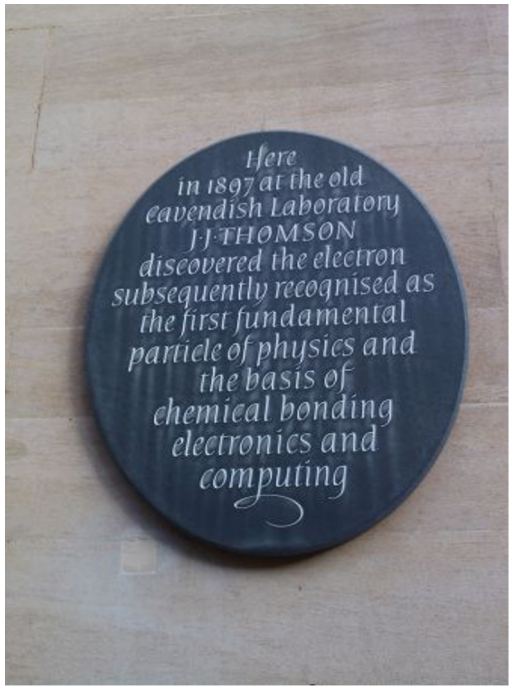
“Basic research leads to new knowledge. It provides scientific capital. It creates the fund from which the practical applications of knowledge must be drawn. One of the peculiarities of basic science is the variety of paths which lead to productive advance. Many of the most important discoveries have come as a result of experiments undertaken with very different purposes in mind.”

(Nannevar Bush set up the National Science Foundation of the USA)

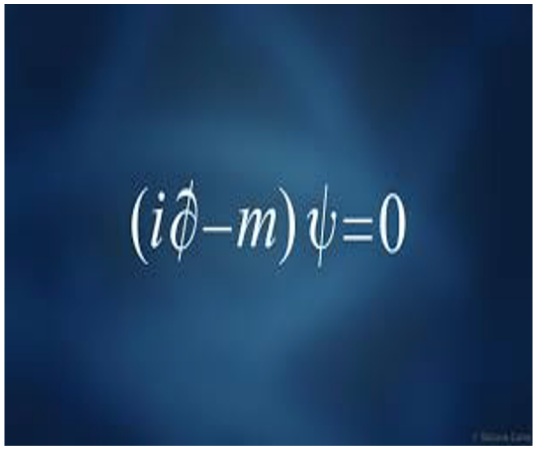
Four Examples

1-The Cell Phone

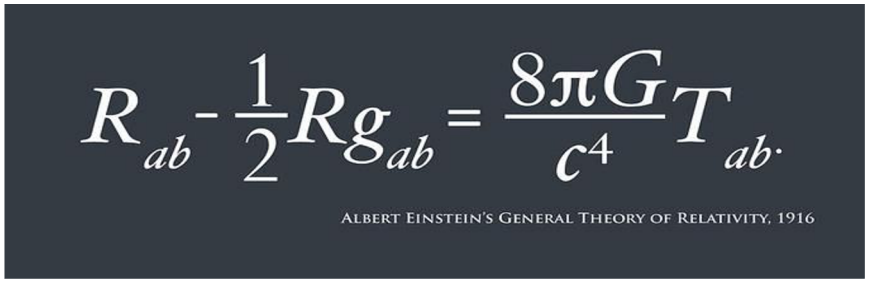
Electron (1897)



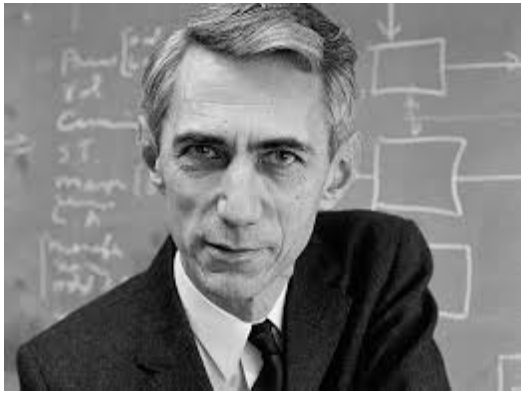
Dirac Equation (1928)



Einstein's General Relativity (1915)



Alan Turing ~ 1930s



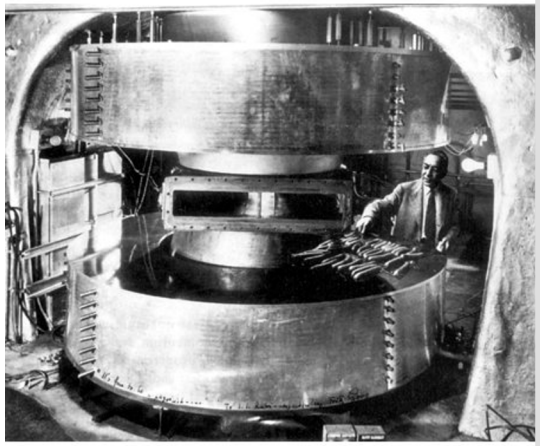
Claude Shannon ~ 1940s

2- NMR and MRI

Nuclear Magnetic Resonance or NMR is a spectroscopic technique developed by Isidor Rabi to study magnetic fields around atomic nuclei. Today it is widely used for Magnetic Resonance Imaging (MRI).

Rabi was reminded of his work when he was being examined in a MRI machine. He saw himself in the reflective inner surface of the machine and said…"I never thought my work would come to this".

1944 Nobel Prize for discovery of NMR



3 - How the transistor came about at Bell Labs

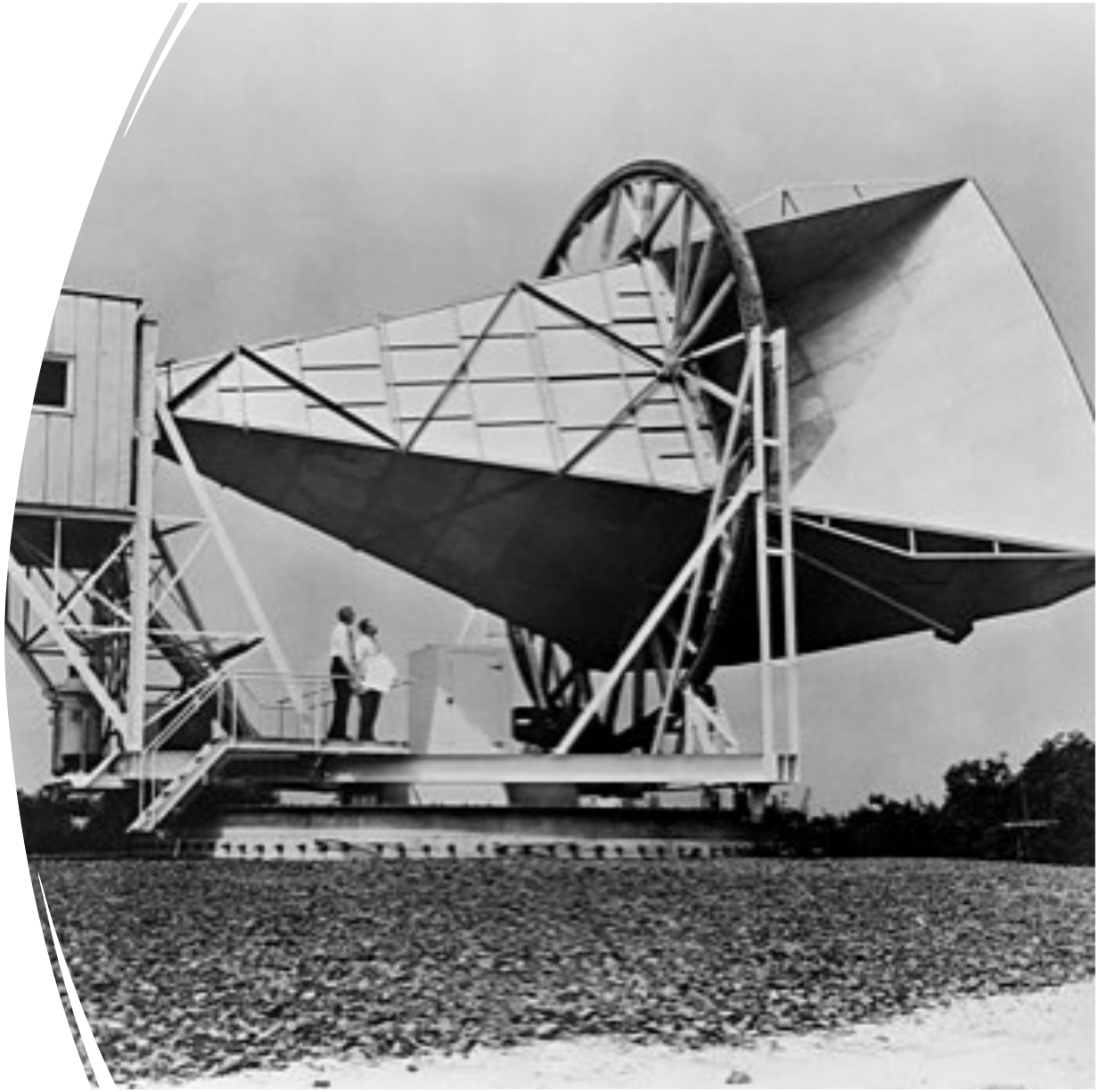
There is a deep connection between basic discoveries in physics and the invention of the transistor in 1947-48, the basic component of all modern electronic devices that ushered in the electronics age.

Excerpt From: Jon Gertner, "The Idea Factory: Bell Labs and the Great Age of American Innovation."

"One study group in particular, informally led by William Shockley at the West Street labs, and often joined by Brattain, Fisk, Townes, and Woolridge, among others, met on Thursday afternoons. The men were interested in a particular branch of physics that would later take on the name "solid-state physics." It explored the properties of solids (their magnetism and conductivity, for instance) in terms of what happens on their surfaces as well as deep in their atomic structure. And the men were especially interested in the motions of electrons as they travel through the crystalline lattice of metals"...

4-Applied Research and Fundamental Discovery

- In trying to perfect a microwave antenna at Bell Labs in 1964, Penzias, Wilson and Dicke discovered the persistent Cosmic Microwave Background that pervades our universe and contains the signatures of the very early universe and the source of what became the stars and galaxies and us!



Pure and Applied Research have no Boundaries

"The distinction between applied and pure research is not a hard and fast one, and industrial scientists may tackle specific problems from broad fundamental viewpoints. But it is important to emphasize that there is a perverse law governing research: under the pressure for immediate results, and unless deliberate policies are set up to guard against this, applied research invariably drives out pure. The moral is clear: It is pure research which deserves and requires special protection and specially assured support".

(Vannevar Bush in "Science the Endless Frontier", 1945)

Thank you

Public Lecture today at 7pm:

Technology & Cosmic Frontiers

Kip Thorne and Rana Adhikari

Youtube Live: https://youtu.be/5cc2DWnXuGI