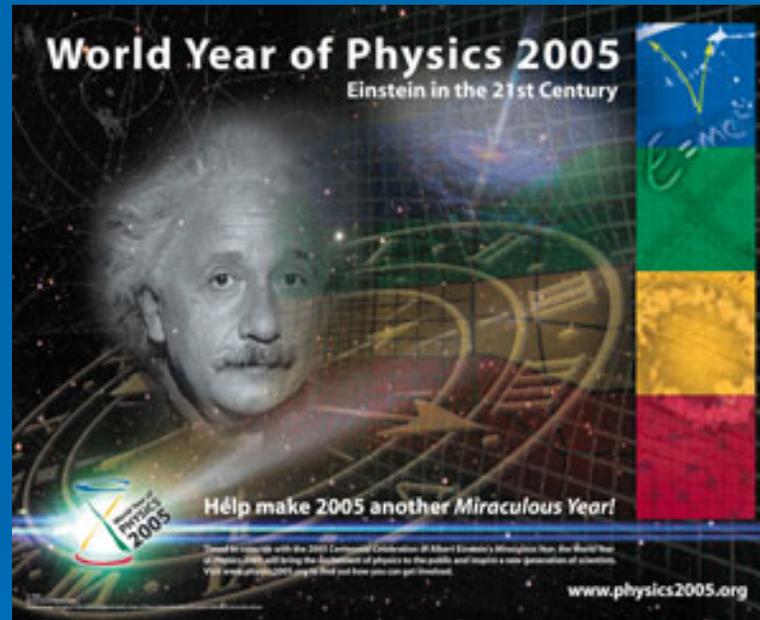


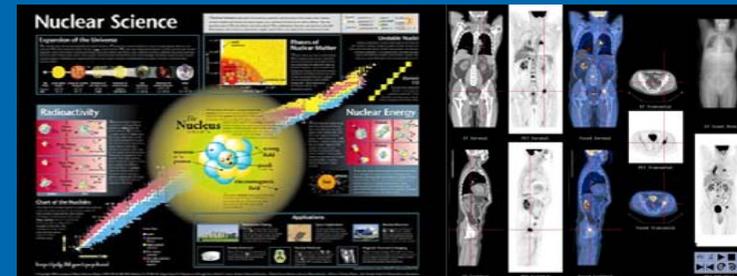
INTERFACE OF NUCLEAR AND BIOTECHNOLOGIES



By Dr. Fidel Castro Díaz-Balart

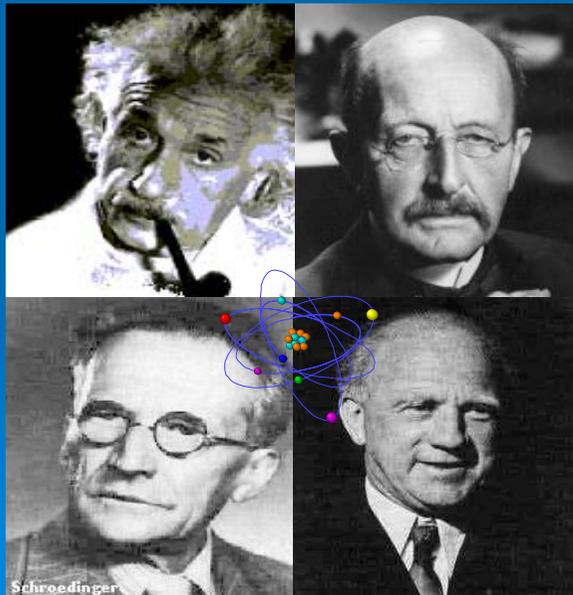
Introduction

- Ways in which nuclear technology has been used in recent biomedical applications.
- Coherent synergies between nuclear techniques and biotechnology applied to health problems: *THE CUBAN EXPERIENCE*.

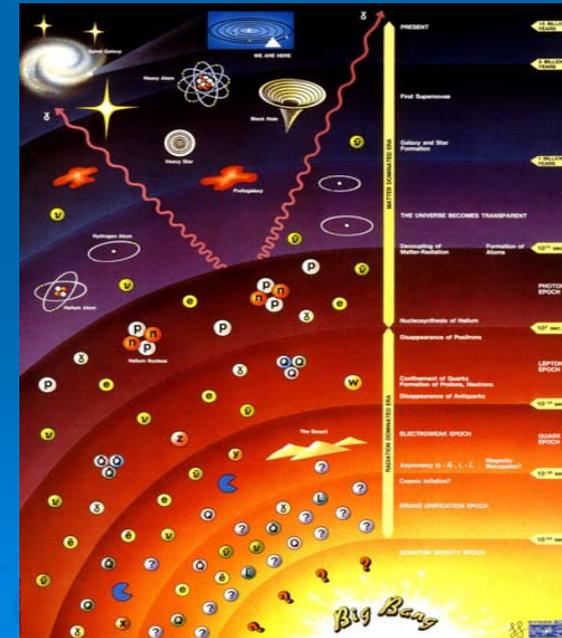
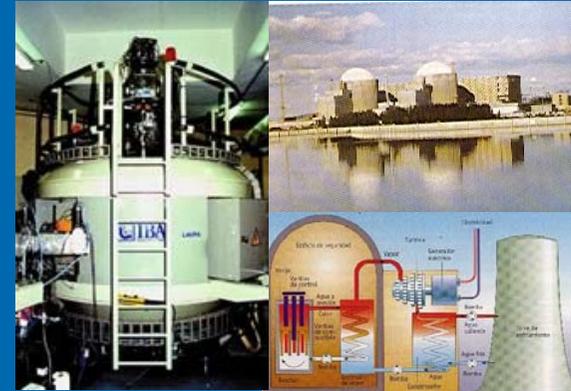


Common links between nuclear and biotech

Theory of the Relativity and Quantum Mechanics, joined together and the discovery of the DNA, revolutionized the thought, the technology and the society, with huge implications in the new milenium.



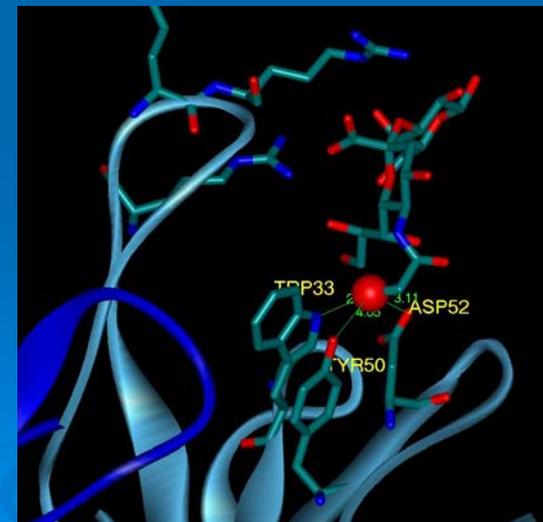
IAEA Scientific Forum



Dr. Fidel Castro Díaz-Balart

Common links between nuclear and biotech

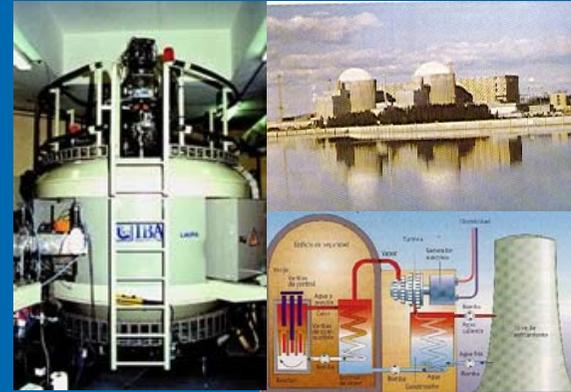
- Watson and Crick, in 1953, inspired by Schrodinger's work demonstrated the doubly helical nature of the DNA.
- At present, very advanced studies are carried out in Proteomics and Genomics, Systems Biology, Molecular and Cellular Biology.



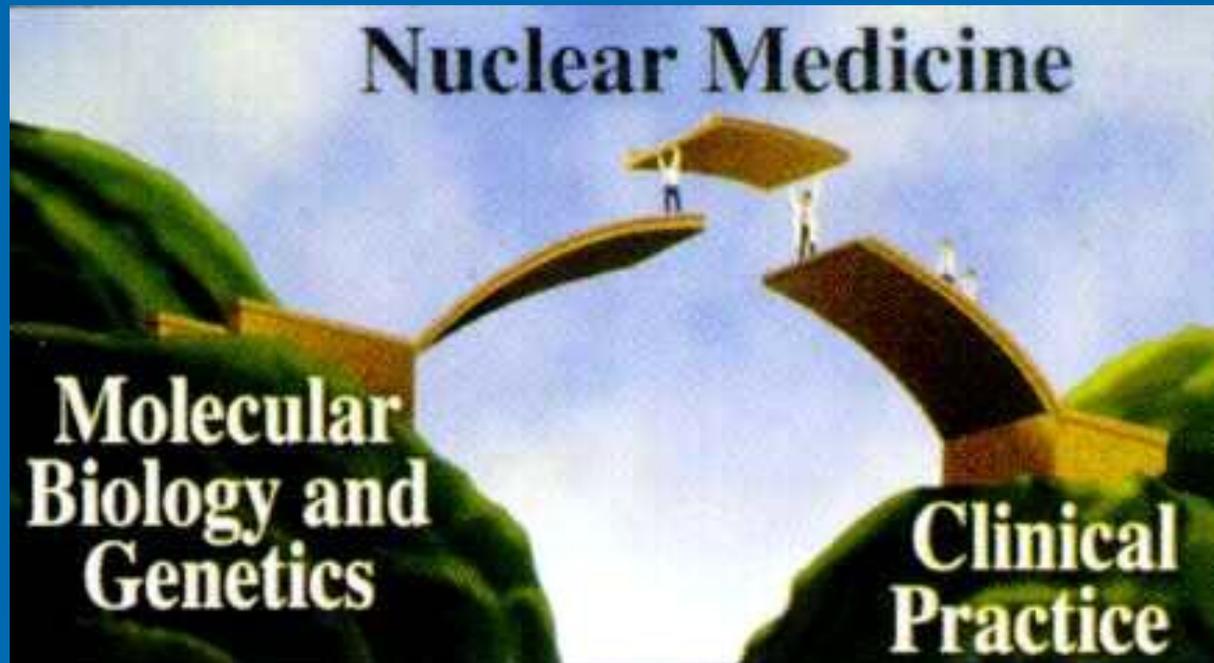
Common links between nuclear and biotech

Modern nuclear & biotechnology industries in the last 4 decades have made impressive progress.

Both have in common a complex assortment of people with the required background, expertise and skills to master it.



IMPORTANCE OF IMAGE TECHNOLOGY IN HUMAN HEALTH MOLECULAR IMAGE



ONCOLOGY

NEUROLOGY / PSIQUIATRY

CARDIOLOGY

BEHAVIOUR CHANGE

20 - 40 % Pts

Import

Local Production



Cuban Approach



^{131}I , ^{32}P ^{177}Lu

Radiopharmaceuticals

Cyclotron ?

^{18}F , ^{123}I



Radionuclide generators

$^{99\text{m}}\text{Mo}$ - $^{99\text{m}}\text{Tc}$

^{90}Sr - ^{90}Y

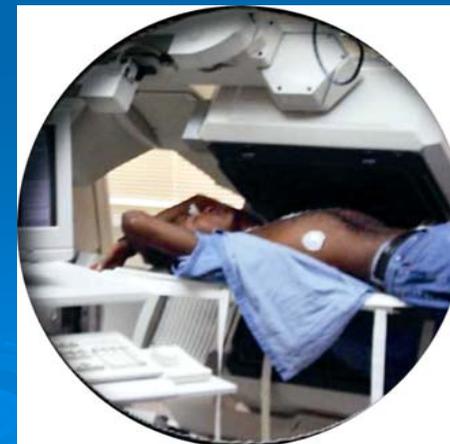


ISOTOPE CENTER, HAVANA



^{99}Mo - $^{99\text{m}}\text{Tc}$ Generators

Generators + Liofilized kits

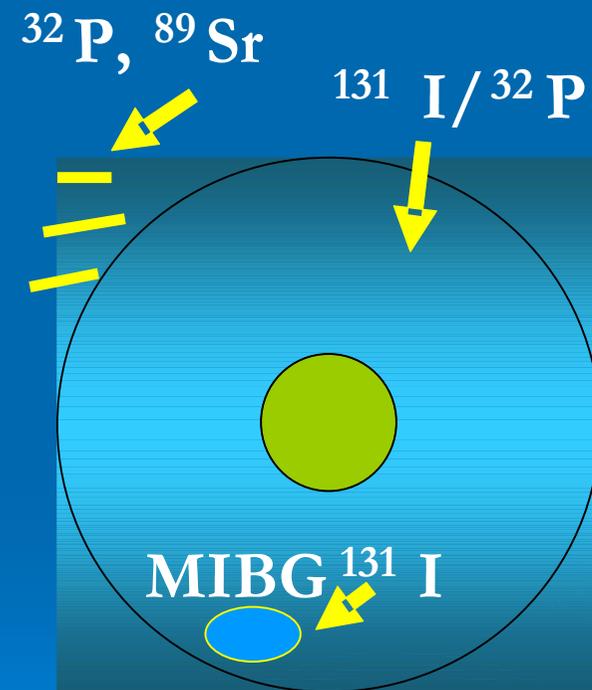


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Radiopharmaceuticals for therapy

- Thyroid cancer
- Metastatic bone pain
- Polycythaemia vera, ^{32}P
- Radiosynoviorthesis ^{90}Y , ^{32}P



Drug evaluation



- Melagenine – ^{125}I ,
- PPG - T, 14 C,
- Synthetic Peptides.
- Monoclonal,
- Antibodies,

Currently,

- genetherapy research related to VEF,
- Stem cells

West Havana Scientific Pole

CIGB



IPK



CNB



CIE



CNIC



CIM



I. FINLAY



CENSA



NEUROSCIENCES CENPALAB



The Biotechnology and Pharmaceutical Industry



Strategic concepts for building a biotechnology sector:

- Closed – loop organizations.
- Export – oriented organization
- Building of an Intellectual Property platform.
- A tight relationship between research and the industrial strategy

Examples of Cuban health biotechnology products.

Sector	Type	Application	Producer^a
Vaccines	Purified meningococci	Meningitis B and C	Vacunas Finlay (FI)
	Recombinant hepatitis B surface antigen	Hepatitis B	Heber Biotec (CIGB)
	Synthetic Hib	Pneumonia and meningitis	Heber Biotec (CIGB)
Therapeutics	Recombinant streptokinase	Cardiovascular disease	Heber Biotec (CIGB)
	Recombinant IFN - α	Viral infections and oncological diseases	Heber Biotec (CIGB)
	Recombinant epidermal growth factor	Burns, ulcer healing	Heber Biotec (CIGB)
	Recombinant granulocyte colony-stimulating factor	Leukopenia, neutropenia	Heber Biotec (CIGB) and CIMAB (CIM)
	MAb to CD3	Organ transplant rejection	CIMAB (CIM)
	Recombinant erythropoietin - α	Anemia	CIMAB (CIM)
	Humanized MAb against epidermal growth factor receptor	Head and neck tumors	CIMAB (CIM)
	Ateromixol (PPG)	Anti cholesterol	Laboratorios Dalmer (CNIC)
Diagnostics	Miniaturized enzyme-linked immunosorbent assay kits	AIDS, blood certification, prenatal diagnosis	Tecnosuma International (CIE)
	Radiolabeled mAbs targeting various cancer markers	Cancer imaging	CIMAB (CIM)
	Enzyme-linked	Syphilis, celiac disease	Heber Biotec S.A. (CIGB)

Center for Genetic Engineering and Biotechnology Havana, Cuba



Staff: 1245
Facilities: 70 000m²

Leading products:

- Hepatitis B recombinant vaccine
- Alpha IFN and Gamma recombinant IFN
- Recombinant EGF
- Recombinant Streptokinase
- Diagnostic Kits
- Tick – bovine recombinant vaccine
- Synthetic vaccine Haemophilus Influenzae Type B

Research Focus:

Vaccines, pharmaceuticals, diagnostics,
plant, and animal biotechnology, industrial
biotechnology

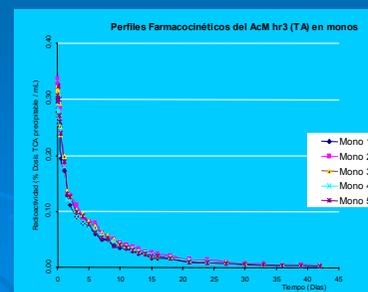


Heberbiovac HB
WHO Certified
Dec. 2001

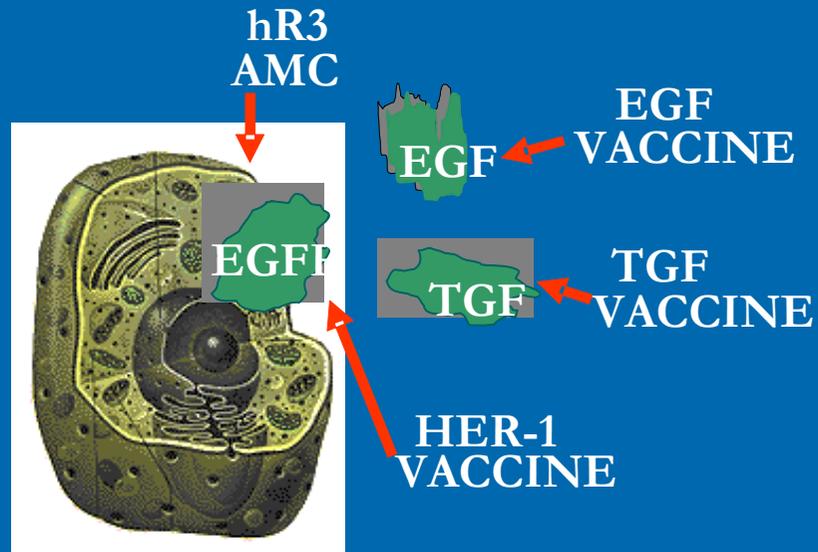
Center for Molecular Immunology Havana, Cuba



Drug evaluation



IMMUNOTHERAPY DIRECTED TO THE EGF SYSTEM



RADIOIMMUNODIAGNOSTIC:
AcM – R3 – Technetium 99



RADIOIMMUNOTHERAPY:
AcM – R3 – Rhenium 188

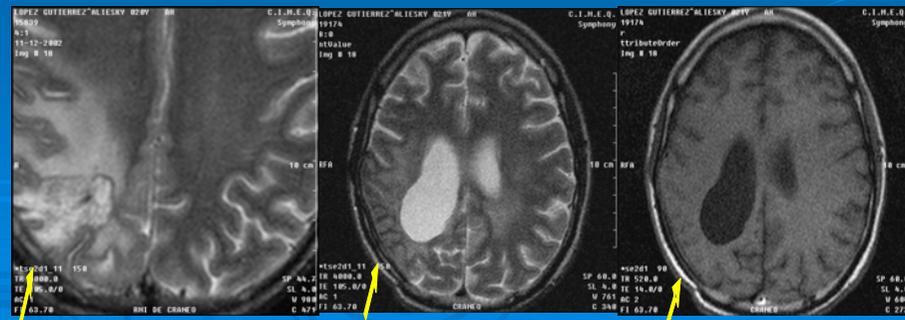
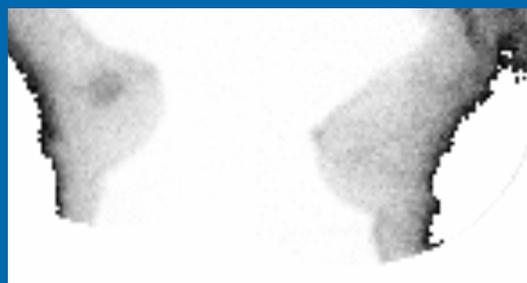


IMAGE OF MAMMARY TUMOUR WITH ACM 14F7 MARKED WITH Tc-99

PV Dose 0.3 mg

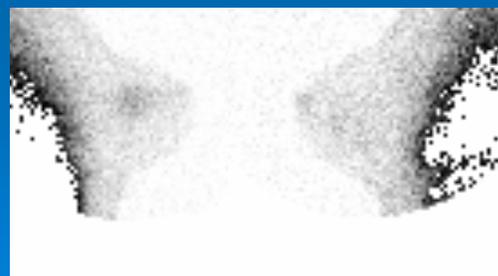
8 h



RIGHT

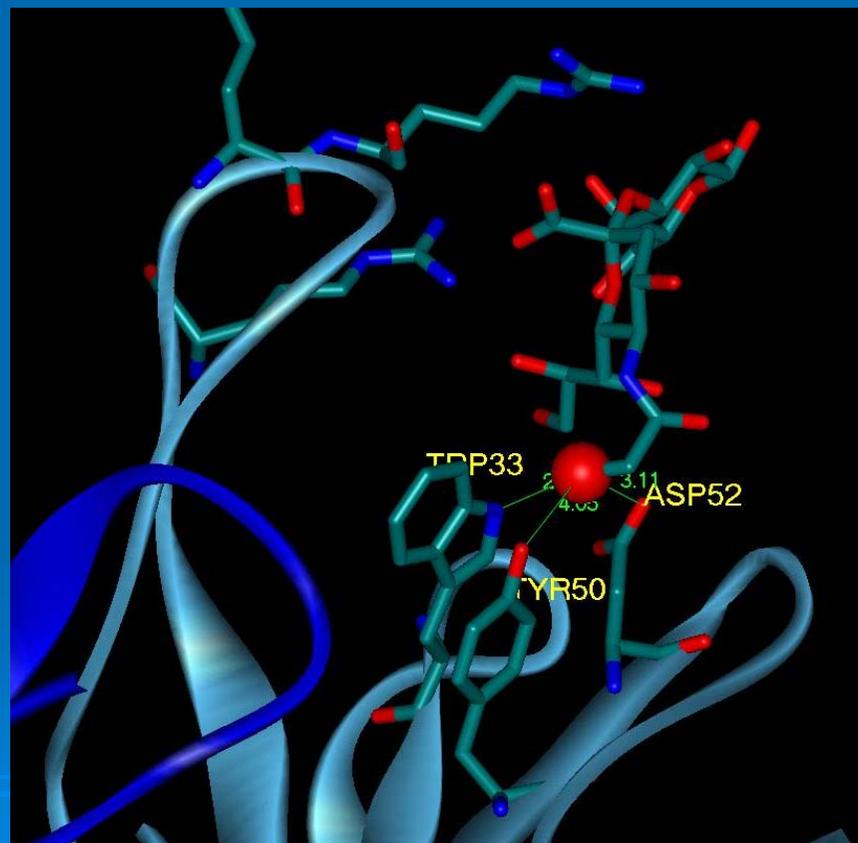
LEFT

24h



RIGHT

LEFT



CONCLUDING REMARKS



- *the ability to use knowledge is increasingly linked to the ability to generate it*
- *many new products combining radioisotopes and biopharmaceuticals*

Cuban experience:

- *large numbers of workers and specialist with basic and higher education*
- *a 'critical mass' of research and educational institutions of excellence*
- *In nuclear and molecular medicine; the development of Biotech Complex which has yield impressive results.*

To be free, first be cultured.

Jose Martí



**THANK VERY MUCH
FOR YOUR ATTENTION**

Interface of Nuclear and Biotechnologies

Fidel Castro Díaz -Balart

Scientific Advisor State Council of Cuba

E-mail: ofascience@enet.cu

Scientific Forum IAEA

Vienna, September 28, 2005