Un-ITed for research

ENEA Italian National Agency for New Technologies, Energy and Sustainable Economic Development

PROGETTO AUSDA

ANTARCTICA FOR CLIMATE CHANGES

- **WHERE IS IT?**

The Italian-French station "CONCORDIA" base is located in Antarctica on a site known as Dome C at 3233 metres a.s.l.
Here scientists are carrying out studies on different fields including Atmospheric Science which also deals with measurement of solar radiation.

- **WHO IS THE SCIENTIST?**

Meganne Christian is an atmospheric physicist, born in Australia who joined the "winter over" expedition in 2019.

We wanted to study how solar radiation affects Earth's weather so we emailed Meganne in February 2019 in order to get updated information about her research procedures and data.
Meganne accurate measurements of solar radiation flux are performed through "downwelling" and "upwelling" in order to collect short-wave solar radiation and infrared radiation.

- **"DOWNWELLING"** measures the direct solar beams radiation
- **"UPWELLING"** measures the radiation that are reflected by the snow cover

RADIATION

⇓ ⇓

SHORT -WAVE

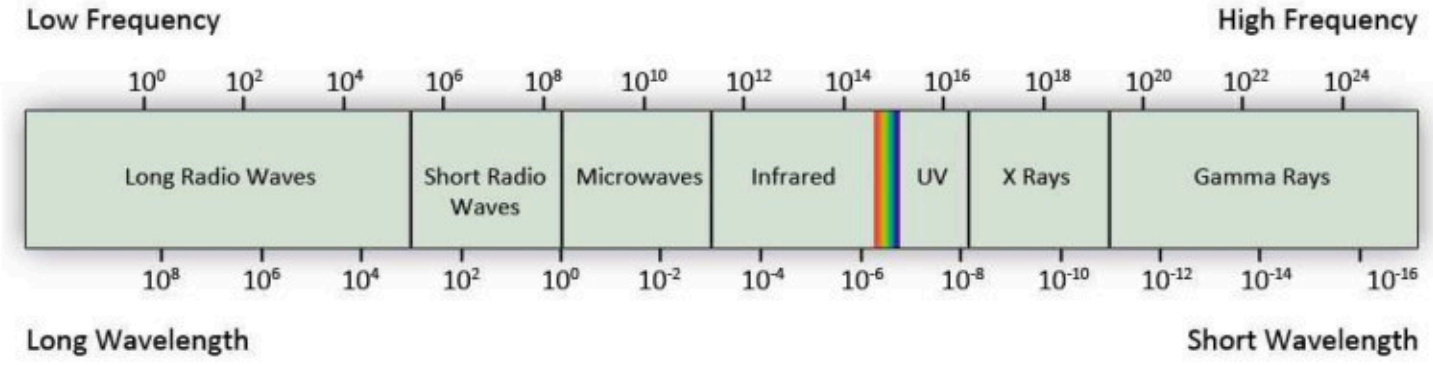
This frequency range is reflected by ionized layers of atmosphere to the earth's surface.They cover the frequency range that is from 3MHz to 30MHz

$\lambda = \frac{C}{f} = \frac{3*10^8}{3*10^6} = 10^2 m$ $\lambda = \frac{C}{f} = \frac{3*10^8}{3*10^{12}} = 10^{-4} m$

INFRARED

It's an electromagnetic radiation. The wave is longer than light which humans can see and shorter than microwaves

$\lambda = \frac{C}{f} = \frac{3*10^8}{3*10^{12}} = 10^{-4} m$ $\lambda = \frac{C}{f} = \frac{3*10^8}{3*10^{14}} = 10^{-6} m$



PROGETTO " LA FISICA DELLA VITA"
Prof. Mauro Bellei (Coordinatore),
Prof.sse Giovanna Fontana(Biologia) Donatella Barp (Inglese)
team "MECHINFO.IT" : Studenti di BIOlogia CHImica
(Alessandra Foroni – Martina Mattioli- Stella Venturi Degli Esposti-Samuele Sabadini)

RESEARCH DAY AT TIFPA

Reasearch place : TIFPA

Participants: researchers and MECHINFO team

Group Leader : Alessandra Foroni

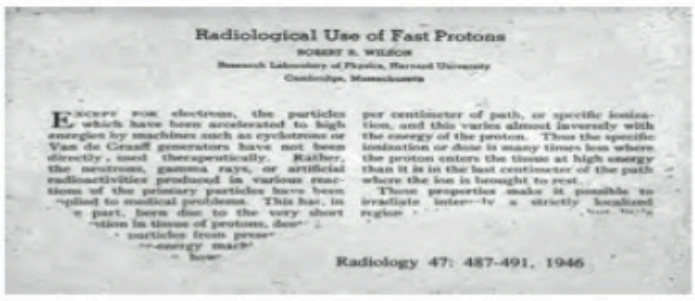
Topic of study: proton therapy

Trento Institute for Fundamental Physics and Applications

History...

In 1946 Robert Wilson suggested using protons for the treatment of cancer.
He recognized the importance of the highly localized deposition of energy typical of protons as a way of increasing the tumor dose by minimizing the dose to healhty tissues.

ig. 1 La pubblicazione di R. Wilson relativa al possibile uso dei protoni come risorsa inica ed il deposito di energia nei tessuti



Radiological Use of Fast Protons

ROBERT R. WILSON

Research Laboratory of Physics, Harvard University
Cambridge, Massachusetts

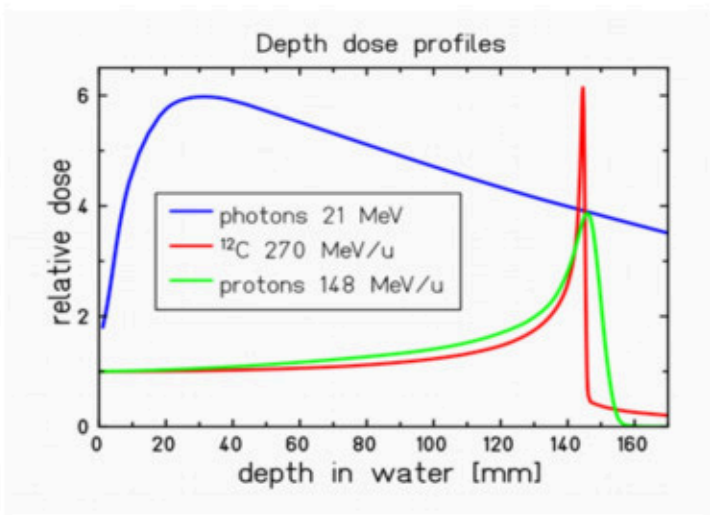
Radiology 47: 487-491, 1946

PROTON THERAPY

It is a form of radiotherapy that acts on tumors through bundles of charged particles, like protons. It is a good indication for radioresistant tumors and those found near organs considered at risk.

BRAGG PEAK

It is the curve obtained by drawing the energy lost by a particle that penetrates into matter as a function of depth.



The energetic release of protons is more localized than that of photons.

IMPACT OF NANOTECHNOLOGIES

The application of nanotechnologies is useful for diagnostic and therapeutic purposes to identify cancer cells and to target them efficiently and selectively. An example of nanotechnology is drug paclitaxel albumina used in the treatment of advanced breast cancer.
Albumin is a human protein of nanometric size; the active ingredient is linked to the albumin jets that carry it directly to the tumor site.

Albumina.

Un-IT-ed for research

Progetto Scuola - CNR per la Divulgazione Scientifica

Il linguaggio della ricerca

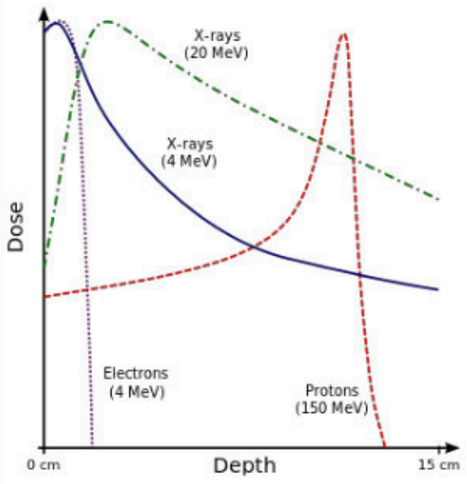
Experimental Analysis of the Bragg Peak With Simulated Model

Leonardo da Vinci istituto tecnico industriale

Theoretical Outline

The Hadrontherapy and the origin of the study:

Hadronic therapy or hadrontherapy is a form of external beam radiotherapy that uses particle beams for the treatment of tumors. In 2012 the most common therapy is that which uses energy protons: proton therapy. The only three centers in Italy that make this technology available are the CNAO of Pavia, the Proton Therapy Center of Trento (protons) and the CATANA center in Catania. Adronic therapy works by targeting the tumor with ionizing particles. These particles damage the DNA of tissue cells, causing them to die. human in a different way. For protons and heavier ions, however, the dose increases with increasing thickness up to the Bragg peak, which occurs just before the end of the journey. In our simulated model we want to verify the relationship between nano particles and the dose absorbed by human and carcinogenic cells.



- Example of graph produced from the various particles used.

Results and Conclusions

Analysis of the results:

Following various reflections, after observations within the simulated environment, we concluded that the proposed observed causes remain to be explored, but are confirmed by experimental tests produced in previous years. Moreover the equations used agree with the results obtained in previous experiments and conclusions, allowing us to attribute our results as realistic but affected by inevitable experimental errors.

Simulated Environment

Theoretical fundamentals of the simulated environment:

Without changes to the types of interactions between particles and cells, our experimental model generally produces a straight line, due to the direct relationship between the number of protons active in the system and the energy released. Later we tried to hypothesize what could change the energy release of the charged protons and we indicated three possible causes: the Lambba, the momentum and the gold nanoparticles.

LAMDBA (λ)

It was thought that introducing variations in size proportional to the energy of the proton could be a cause in the absorption of the dose by the cells. Specifically, the lambda represents the wavelength of the proton, which therefore increases allowing the particle to interact in a greater area. The increase is parabolic, thus creating a peak where the Bragg peak was considered..

QUANTITY OF MOTION

Momentum affects the energy lost by each proton after each collision, and is influenced by the energy remaining inside the particle. We hypothesize that the maximum initial energy corresponded to the maximum momentum, but also the least energy lost. It is due to the inclination of the proton to stop, higher at lower speeds, after contact with a cell and then releasing all its energy. Furthermore, energy is also directly proportional to the points of the proton incident with the cells.

NANO PARTICLES

Nano particles are used during treatments because they increase the dose absorbed by the observed area. We hypothesized that the cause is a Coulomb attraction between the positive proton and the negatively charged particles. As a result, attracting the protons to themselves, they caused them to be more effective against the cancer cells of treated patients.

Un-IT-ed for research

Progetto Scuola - CNR per la Divulgazione Scientifica

Il linguaggio della ricerca

Leonardo da Vinci istituto tecnico industriale

Experimental Analysis of the Bragg Peak With Simulated Model

Theoretical Outline

Equations used:

To control our reflections on the possible causes that create the Bragg peak, two main formulas were used: for the line that describes the energy loss at each crash and for the calculation of the momentum.

Energy loss line:

$$-0.14 * (p - 15) + 100$$

Momentum calculation *(p)*:

$$\gamma = \frac{KineticK\ (eV)}{m_p c^2\ (eV)} + 1 = \frac{KineticK\ (eV)}{938{,}3 * 10^6} + 1$$

$$\beta = \sqrt{1 - \left(\frac{1}{\gamma}\right)^2}$$

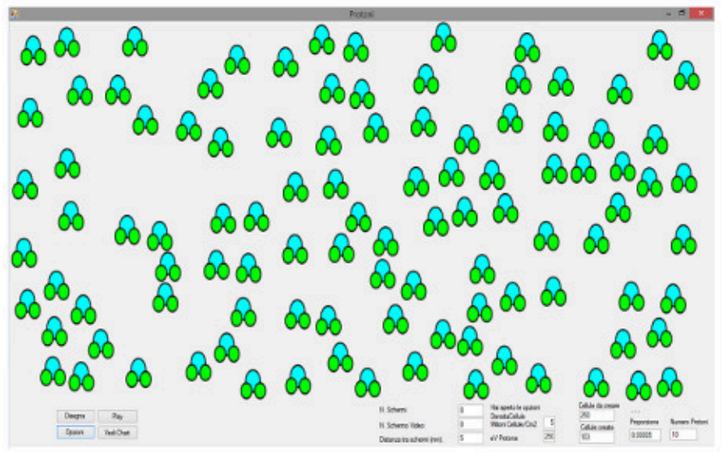
$$v_p = \beta * c\ (light\ speed)$$

$$p = \gamma * m_p * v_p$$

Simulated Environment

Origin of the simulated enviroment:

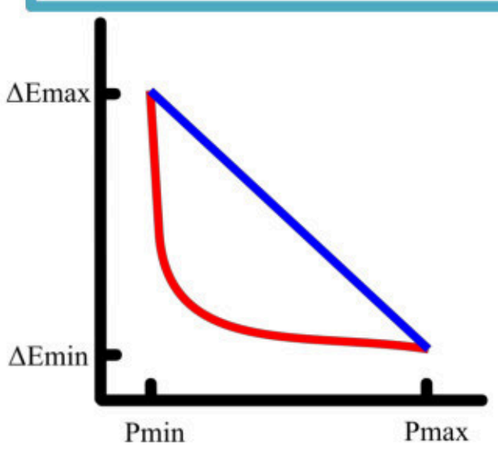
The simulated environment was created through the VisualStudio IDE in Visual C #. The program must create the cell screens, launch the proton beam and then simulate each individual collision using the formulas for calculating energy and momentum.



- Visual screen of the simulated enviroment

Each proton is cycled until it has energy, saving the number of affected screens. At each cycle the energy lost is saved, which is used for the product graph.

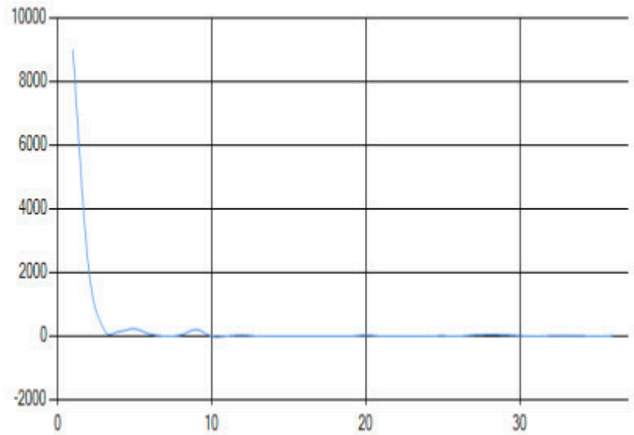
Results and Conclusions



- The two types of curve assumed: the initial line and the new curve.

Graphs and Simulated Results:

From the graph we can see the energy release curve, but it does not represent the hypothesized Bragg peak. Seeing the results it was concluded that the energy loss depending on the momentum cannot be a straight line, but a curve of different origin. The release of variable energy must balance the greater number of protons originally present, which therefore increases the probability of interaction. The general graph obtained has a much steeper curve than the test curve, without changes. In general we can affirm that more accurate results can be found through deeper analyzes and with more powerful instruments, which allow an analytical study on a greater amount of data.



- Graphic produced by protons, in abscissawe have the distance between the screens and in ordinate the total energy lost.

Un-IT-ed for research

KINEMATICS SPREADING OF A SOLUTE (NANOPARTICLES) IN A SOLVENT (JELLY)

Experiment carried out in the Biology Lab at ITIS "Leonardo da Vinci"- Carpi (MO).

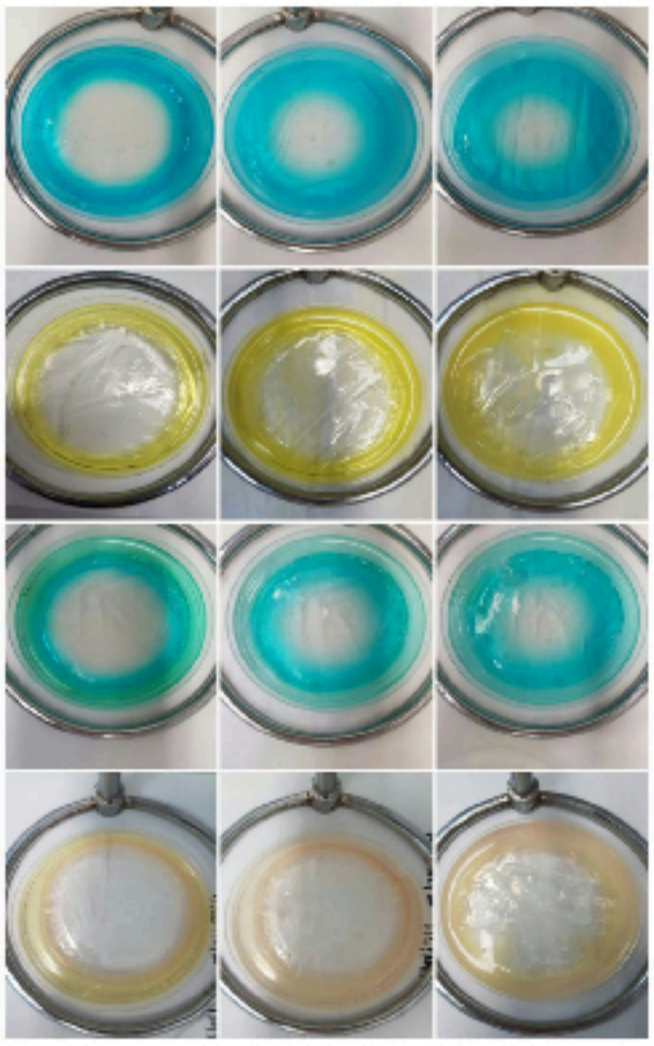
Abstract

Nowadays gold nanoparticles are emerging as promising agents for **cancer therapy** and are being investigated as **photothermal agents and drug carriers**. In this experiment we analysed the kinematics spreading of gold nanoparticles in tissues using jelly and different food colouring in order to demonstrate the mol.wt. effect during targeted drug delivery to tumor cells.

Theorethical Outline

Macroscopically our samples show a process in which the molecules of the solute change position from a region of high concentration to one of lower concentration.
Microscopically the molecules of the solute collide with the molecules of the solute or the solvent and their trajectories are similar to the zig zag of **Brownian motion**.

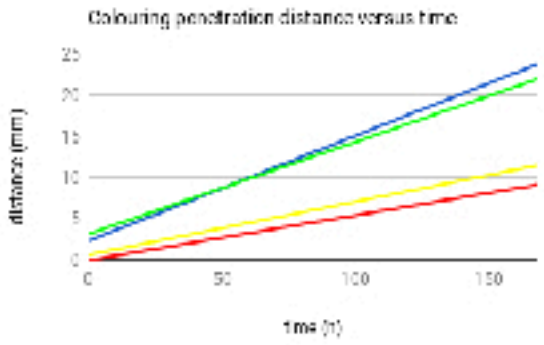
Data Obtained



Methods

Mean free path is the average distance between two successive impacts travelled by a moving particle. On the basis of this definition, on a macroscopic level we measured the mean free path of a molecule in a period of two, five and seven days. The table below shows the data collected on the different samples.

Colouring	Day 1 (the colouring was inserted 2 days before) [mm]	Day 2 (the colouring was inserted 5 days before) [mm]	Day 3(the colouring was inserted 7 days before) [mm]
Orange	3	5	10
Blue	11	19	22
Green	13	16	21
Yellow	5	7	12



LEGENDA

These four straight lines show the trend of the colouring penetration distance versus time.
blue straight line: blue colouring
green straight line: green colouring
yellow straight line: yellow colouring
red straight line: orange colouring

Results

The spreading average percentage , that depends on the room temperature, is the ratio between the average total **distance** travelled by the molecule of colouring and the **radius** of the gelatin disk:

$$\%diff = \frac{D(mm)}{R(mm)} \cdot 100$$

As you can see from the above table , the most spreading colouring in the jelly is the blue one.

$\frac{22mm}{30mm} * 100 = 73\%$ blue colouring

$\frac{21mm}{30mm} * 100 = 70\%$ green colouring

$\frac{12mm}{30mm} * 100 = 40\%$ yellow colouring

$\frac{10mm}{30mm} * 100 = 33\%$ orange colouring

Discussion

Mainly because our experiment has been carried out over a short time span , the ratio between the penetration distance and time can be considered linear. The spreading speed as well as by the nanoparticles size can be affected by the environment, the density of the gelatin disc and the concentration of the colouring. Therefore the delivery systems properties should be carefully adjusted in order to optimize the drug retention and then taking into account all the above mentioned factors. Nowadays this calibration is one of the most important goals for the nanotechnologies research mostly in the field of medical science.

Group Leader: Francesca Stella Venturi Degli Esposti , Prof: Mauro Bellei (Physics) , Giovanna Fontana (Biology) and Elisabetta Ferretti (English)

La fisica della vita

Group leader: Martina Mattioli

Un-ITed for research

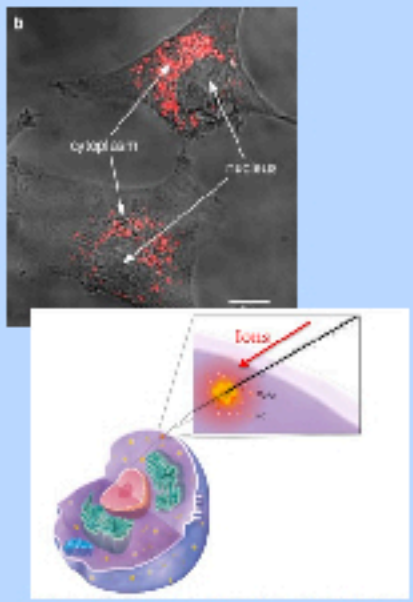
Il progetto "LA FISICA DELLA VITA" ha coinvolto i ragazzi del team MECHINFO, ovvero ragazzi del corso di chimica, informatica e meccanica. L'obbiettivo di questo progetto è stato quello di realizzare un percorso didattico con particolare attenzione alle nanotecnologie nel campo della biofisica. Un ringraziamento speciale va a i coordinatori di questo progetto: prof.ssa Giovanna Fontana e prof. Mauro Bellei.

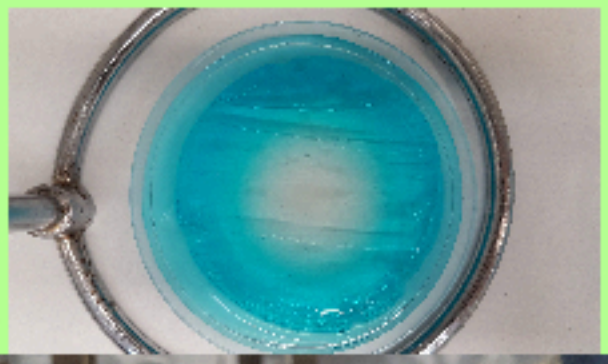
1

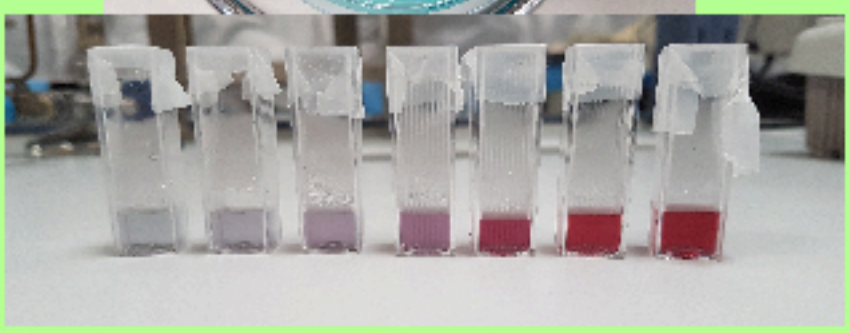
Il TIFPA di Trento

(Trento Institute for Fundamentals Physics and Applications)

Ricerca interdisciplinare con fasci di protone attraverso:
-la fisica per combattere i tumori con l'adroterapia
-la chimica con le nanostrutture e gli effetti sui tumori
-lo spazio per proteggere gli astronauti dalle radiazioni
-la biologia per studiare gli effetti delle radiazioni sugli organismi viventi e l'ibernazione







L'esperimento nel laboratorio

di biotecnologie dell'ITIS "L. da Vinci".

2

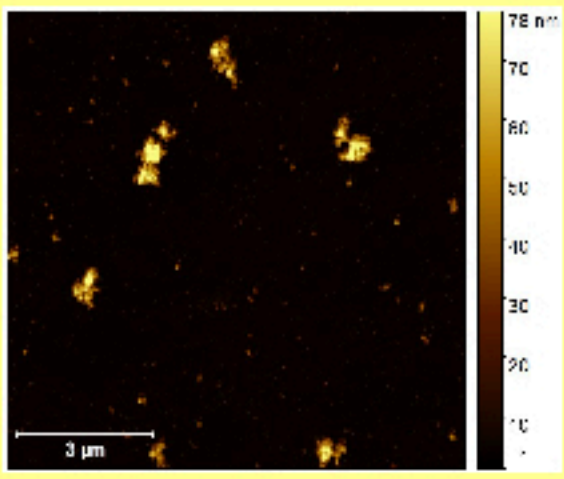
-sintesi di una soluzione colloidale di nanoparticelle d'oro
-simulazione, attraverso l'utilizzo di piastre contenenti gelatina, della diffusione delle nanoparticelle nei tessuti umani

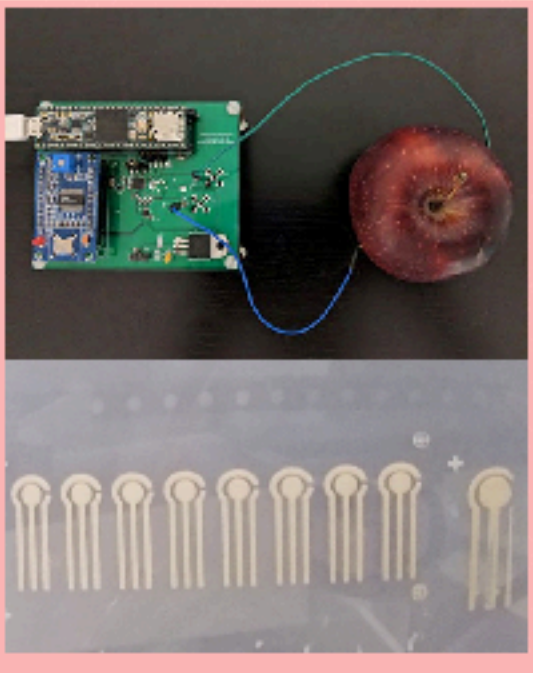
3

Il CNR di Bologna

Istituto per lo Studio dei Materiali Nanostrutturati (ISMN)

-osservazione allo stereoscopio della leva (cantilever) nei chip
-spiegazione del funzionamento del microscopio a scansione di sonda e tramite suddetto osservazione e misurazione delle nanoparticelle d'oro





Libera Università di Bolzano

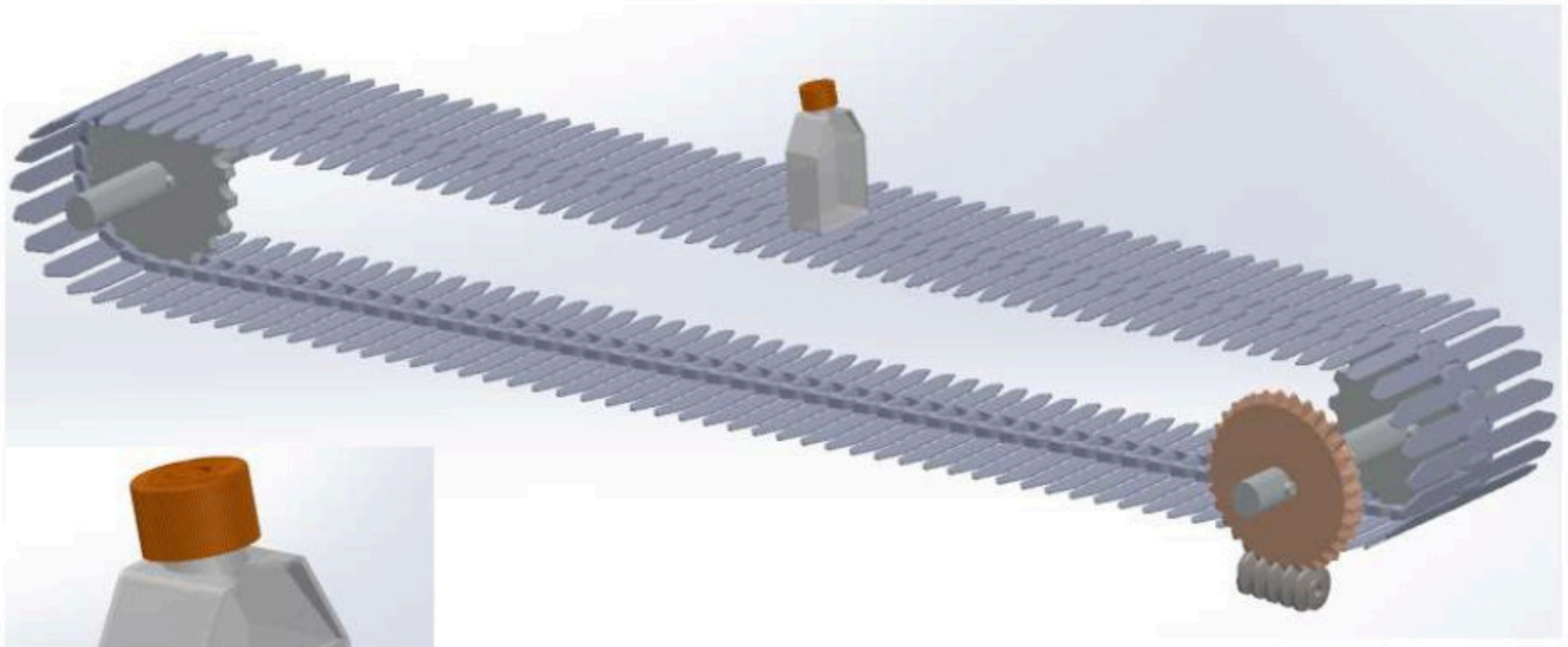
Sensing Technology Laboratory

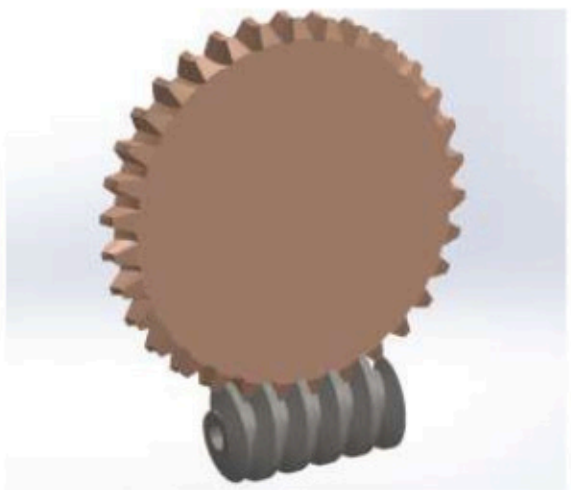
-spiegazione delle tecniche di stampa per realizzare circuiti elettrici ed elettrodi per sensori. Verifica della qualità degli elettrodi e loro caratterizzazione
-Utilizzo di elettrodi, usando tecniche di impedenza, per analizzare e conoscere il processo di maturazione della frutta

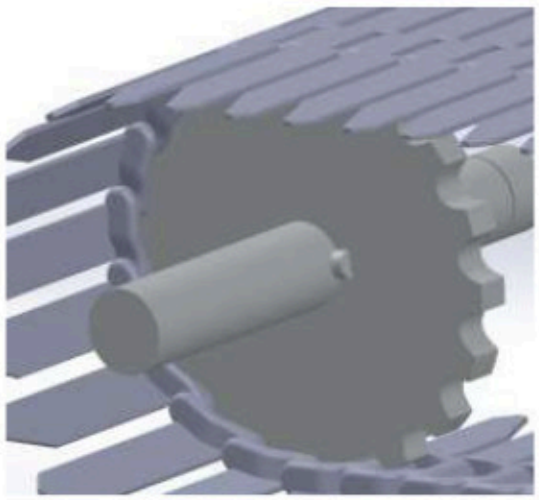
4

Alessandra Foroni, Martina Mattioli, Samuele Sabadini, Stella Venturi Degli Esposti

Costruzione al CAD e analisi dei Materiali di un Nastro Trasportatore







Il nostro principale compito è stato quello di progettare e realizzare al Cad un nastro trasportatore idoneo all'utilizzo in una sala sperimentale dove dei campioni cellulari venivano irraggiati da protoni, avvente energia intorno ai 100 Mev con dosi che oscilano dai 1 ai 10 Gy, per verificare la resistenza delle cellule stesse.

Come prima cosa siamo partiti con la progettazione degli organi in muovimento come il Motoridutore e una ruota dentata a contatto con I rulli poi siamo pasati alla realizasione degli organi a contatto con gli ingranaggi come alberi e rispettivi organi di bloccaggio. Succesivamente ci saimo posti questa domanda, di che materiale andrà realizzato il nastro trasportatore? Da un punto di vista meccanico-tecnologico è una domanda abbbastanza banale, il problema è l'interazione dei materiali con un irraggiamneto di protoni al quale il nastro trasportatore andra sottoposto. Infatti molti materiali solitamente si vanno ad attivare quando sotto posti a questi tipi di irraggiamento. Questione abbastanza complicata in quanto si andrebbe ad approfondire su campi della fisica ben più complessi di quelli da noi studiati. Percio abbiamo deciso di concentrarci sulla parte meccanico-tecnologica dei materiali. Come gia detto prima le parti principali che compongono il nostro nastro sono: ruote dentate (vite senza fine e ruote dentate per catene), I rulli a contatto con le route dentate per catene, gli alberi, gli organi di bloccaggio (linguette), struttura portante del nastro. Per la maggior parte dei componenti abbiamo potato per l'alluminio in lega con il silicio, garantendoci un materiale dalla media resistenza meccanica, leggero, resistente alla corrosione e dal peso limitato. Tale materiale abbiamo deciso di usarlo per la struttura portante, alberi, linguette e per le route dentate per catene. Poi per i rulli abbiamo optato per il Politetrafluoroetilene una plastica dalle buone prestazioni meccaniche, basso attrito e non meno importante resistenza agli agenti chimici e solventi. Infine ultimo componente la vite senza fine dove la vite è realizzata in acciaio e la ruota dentata in bronzo per garantire una buona scorrevolezza.

Un-IT-ed for research

Progetto Scuola - CNR per la Divulgazione Scientifica

STOP *TALKING*,

GET *BUSY*!

INTRODUCTION

How often have you…

1)…heard the sentence "The world is full of plastic"?

2)...heard people talking about a plastic island?

3)...heard the news about some animals that after eating plastic they thoght it was food, then died on the beach?

The answer to these questions is „SO MANY TIMES!". Aren't you tired of hearing news and statements about that topic?If your answer is yes,you have to go on reading,if your answer is no,trhow away this flyer and try to forget how many trees you are killing.

PROBLEMS

- We are used to knowing that plastic is destroying the world. But how is it doing that?
- It's in every sea of the world (creating plastic islands and damaging the environment);
- It's in our bodies, because when we eat fish, we also eat about 11millions plastic pieces every year;
- The plastic used is in home decors and in synthetic materials goes into our respiratory tracts;
- Plastic junk, which is not biodegradable, can pollute the environment if it is not recycled, and it needs from 200 to 1000 years to decompose.

SOLUTIONS

- Start using products that instead of PP,PE,PVC,PET and PS plastic, contein bioplastic.
- Differentiate and recycle your rubbish, do not only keep the several bags at home because it is obligatory .
- Stop using disposable plastic objects.
- Say **NO** to straws, to plastic bags, to plastic water bottles. Say YES to on-tap drinks, to faucet water, to washable diapers.

BENEDETTA BERBAKOV

CLASSE 1°M -LICEO L. GALVANI - BO

BASTA *PARLARE*,

DATTI DA *FARE*!

INTRODUZIONE

Quante volte...

1)...hai sentito dire(o ti sei detto) "Il mondo è pieno di plastica"?

2)...hai sentito parlare di isole di plastica?

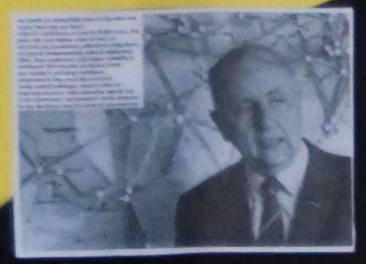
3)...hai sentito notizie su animali che, dopo aver ingerito plastica che avevano scambiato per cibo, sono stati ritrovati morti sulla costa?

La risposta a queste tre domande è „TANTE!". Non sei stanco di sentire continuamente notizie e affermazioni di questo genere? Se la tua risposta è sì, allora continua la lettura, se la tua risposta è no, butta questo volantino e cerca di non pensare a quanti alberi stai uccidendo.

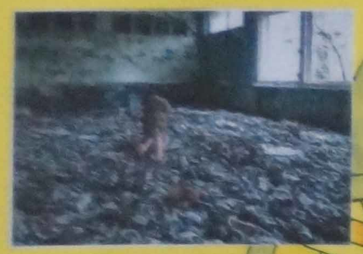
A prima vista sembra un iceberg, ma se osservate meglio è un semplicissimo e inquinantissimo sacchetto di plastica.

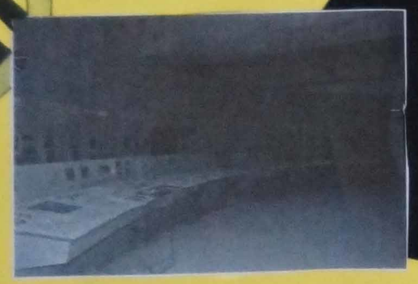
PROBLEMI

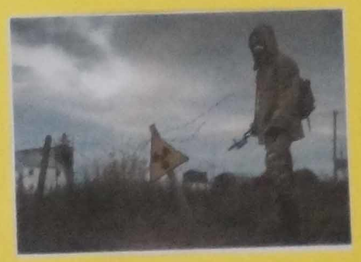
- Spesso sentiamo dire che la plastica sta rovinando il mondo.Ma come?
- Finisce nei mari di tutto il mondo (creando le isole di plastica e danneggiando la flora e la fauna marina).
- Finisce nei nostri organismi (quando mangiamo pesce o mitili ingeriamo circa 11 mila pezzi di plastica all'anno.)
- La plastica presente in arredi e tessuti sintetici finisce nella polvere che si accumula in casa e da qui nelle nostre vie respiratorie.
- I rifiuti plastici, essendo nella maggior parte non biodegradabili, quando non vengono riciclati e finiscono in natura inquinano, impiegando dai 200 a oltre 1000 anni a decomporsi.

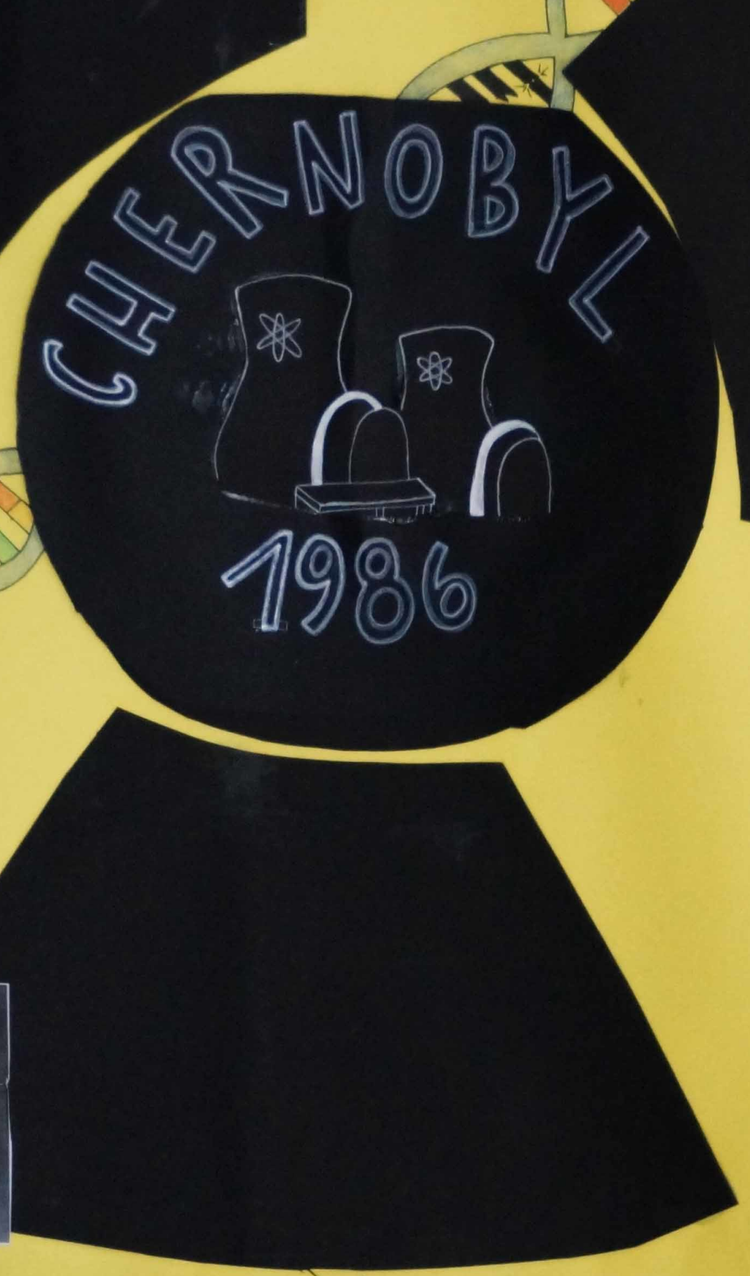



La nube radioattiva al 1° maggio del 1986








CHERNOBYL
1986