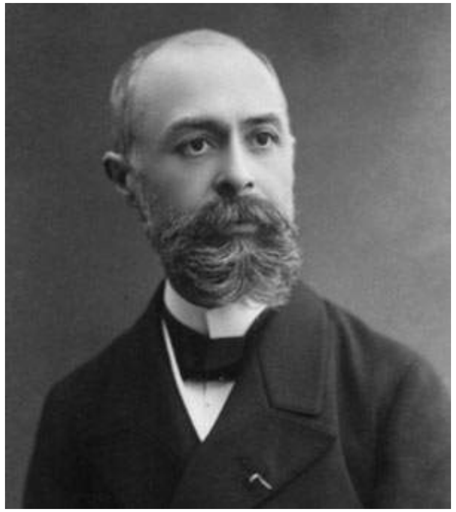
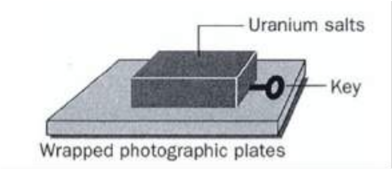
ArduSiPM (Aduino+SiPM)

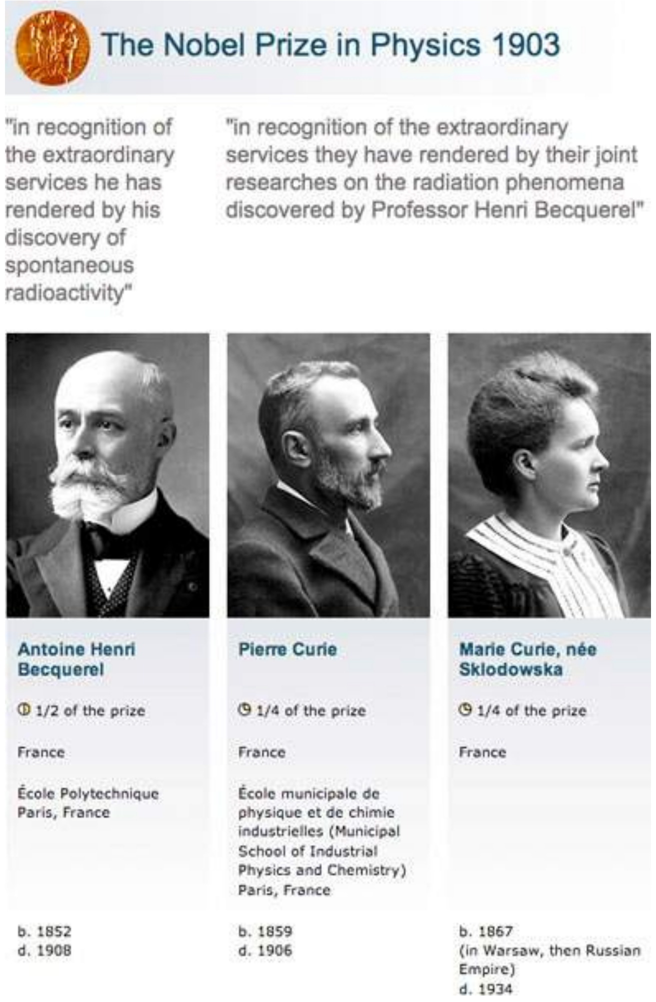
INSPYRE
INternational School on modern PhYsics and REsearch

The discovery of the natural radiation

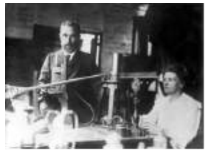
Antoine Henri Becquerel
(Parigi, 15 dicembre 1852 – Le Croisic, 25 agosto 1908)

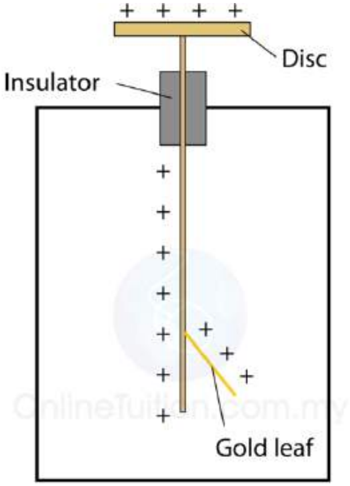




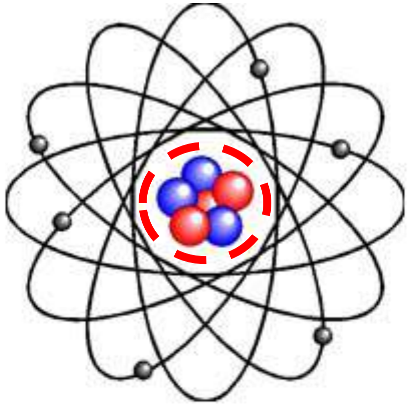


Pierre Curie
(Parigi, 15 maggio 1859 – Parigi, 19 aprile 1906)

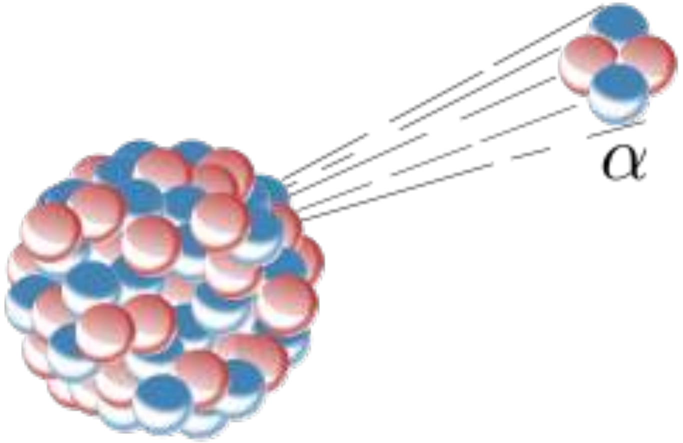




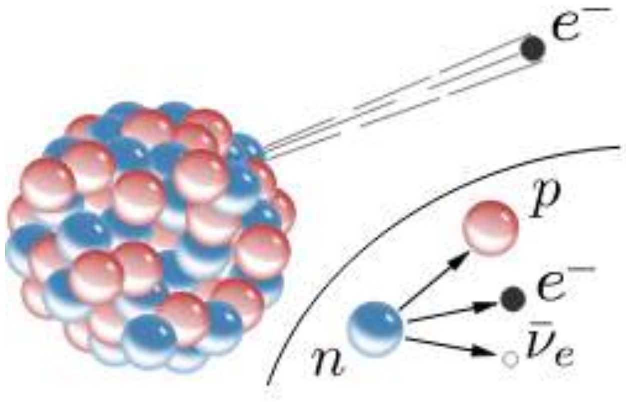
Marie Skłodowska Curie
(Varsavia, 7 novembre 1867 – Passy, 4 luglio 1934)



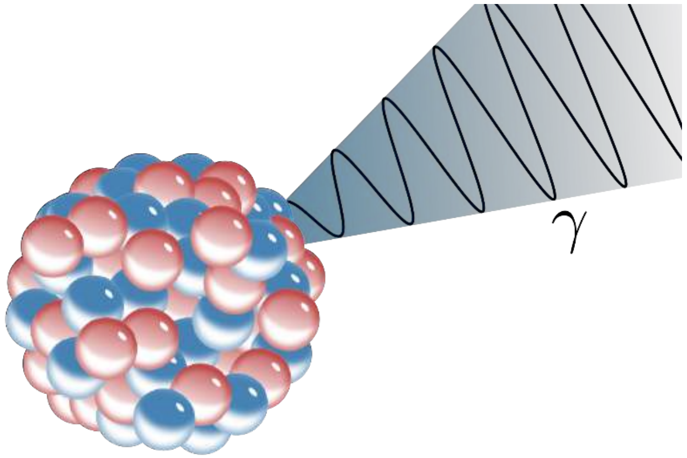
The Radioactivity



Alpha Radioactivity /
Alpha Decay



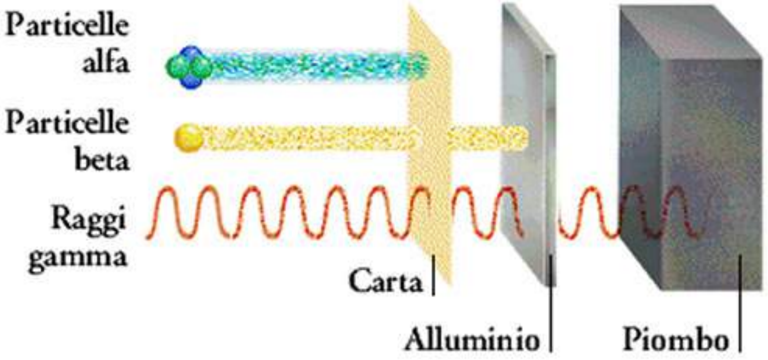
Beta Radioactivity /
Beta Decay

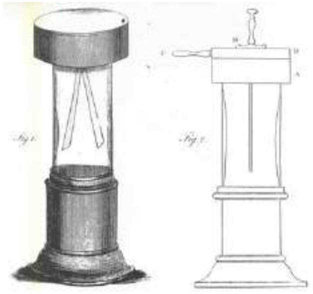


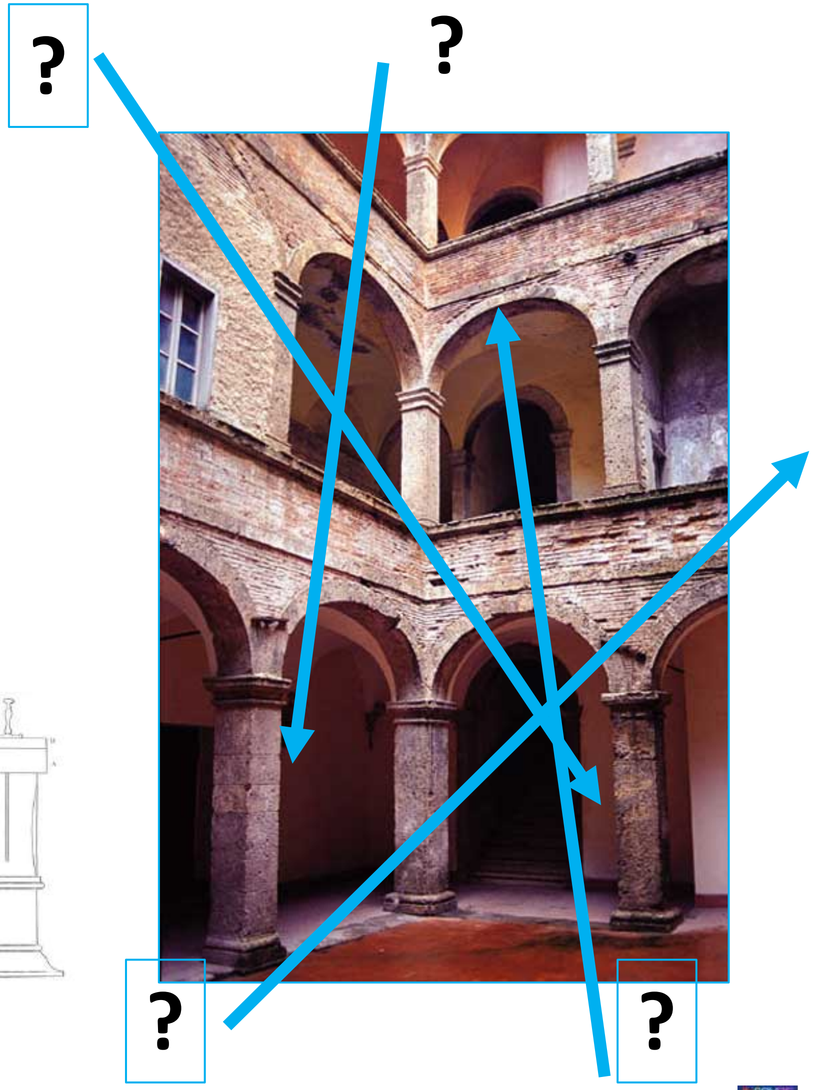
Gamma Radioactivity /
Gamma Decay

The Penetrating radiation

Radioattività naturale

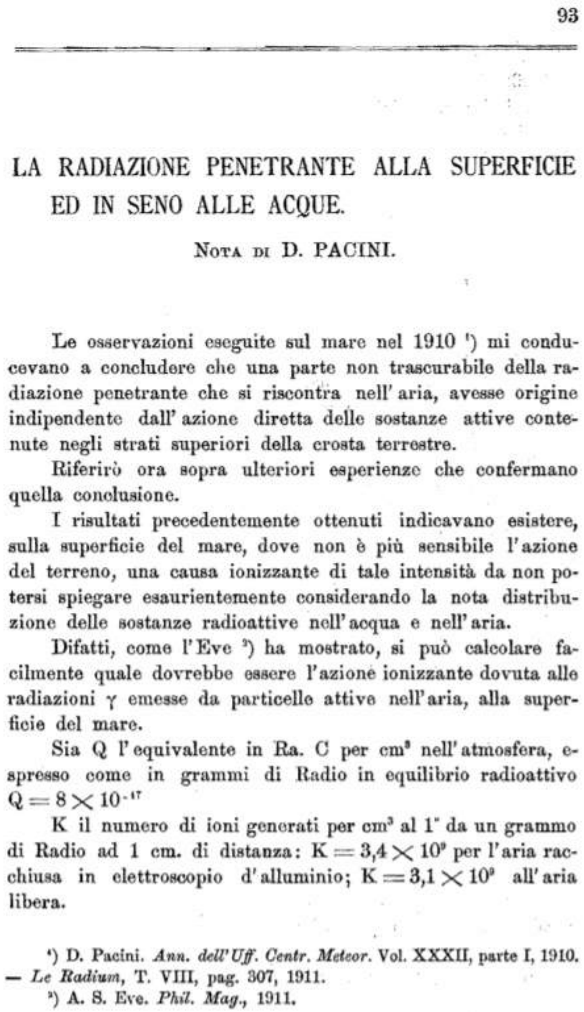






The underwater experiments of Domenico Pacini

During a series of experiments conducted between 1907 and 1911, the Italian physicist Domenico Pacini measured in the Livorno harbour and on Bracciano Lake a decrease of 20% of the penetrating radiation at a depth of 3 meters. In a 1911 article he hypothesizes the external nature of this radiation. «A small part of the penetrating radiation present in the air originates independently from the action of the active substances contained in the upper layers of the earth's crust»



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LA RADIAZIONE PENETRANTE ALLA SUPERFICIE ED IN SENO ALLE ACQUE.

NOTA DI D. PACINI.

Le osservazioni eseguite sul mare nel 1910 [1]) mi conducevano a concludere che una parte non trascurabile della radiazione penetrante che si riscontra nell'aria, avesse origine indipendente dall'azione diretta delle sostanze attive contenute negli strati superiori della crosta terrestre.

Riferirò ora sopra ulteriori esperienze che confermano quella conclusione.

I risultati precedentemente ottenuti indicavano esistere, sulla superficie del mare, dove non è più sensibile l'azione del terreno, una causa ionizzante di tale intensità da non potersi spiegare esaurientemente considerando la nota distribuzione delle sostanze radioattive nell'acqua e nell'aria.

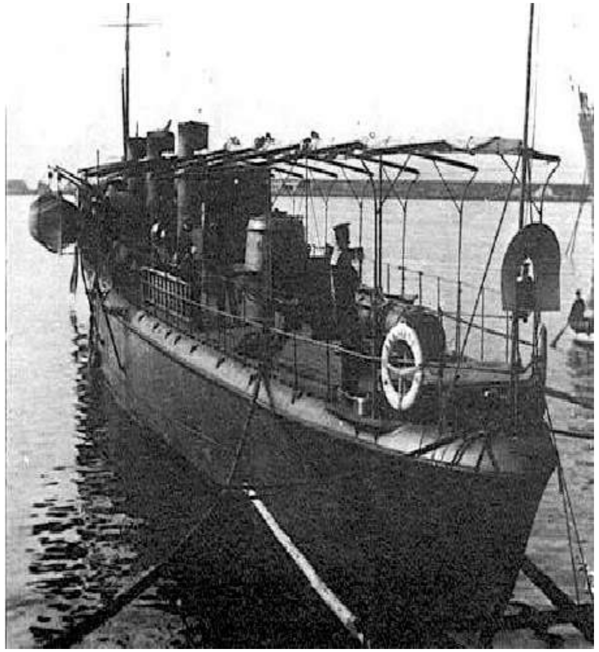
Difatti, come l'Eve [2]) ha mostrato, si può calcolare facilmente quale dovrebbe essere l'azione ionizzante dovuta alle radiazioni γ emesse da particelle attive nell'aria, alla superficie del mare.

Sia Q l'equivalente in Ra. C per cm^3 nell'atmosfera, espresso come in grammi di Radio in equilibrio radioattivo $Q = 8 \times 10^{-17}$

K il numero di ioni generati per cm^3 al 1" da un grammo di Radio ad 1 cm. di distanza: $K = 3{,}4 \times 10^9$ per l'aria racchiusa in elettroscopio d'alluminio; $K = 3{,}1 \times 10^9$ all'aria libera.

[1]) D. Pacini. *Ann. dell'Uff. Centr. Meteor.* Vol. XXXII, parte I, 1910. — *Le Radium*, T. VIII, pag. 307, 1911.
[2]) A. S. Eve. *Phil. Mag.*, 1911.

https://arxiv.org/pdf/1101.3015.pdf

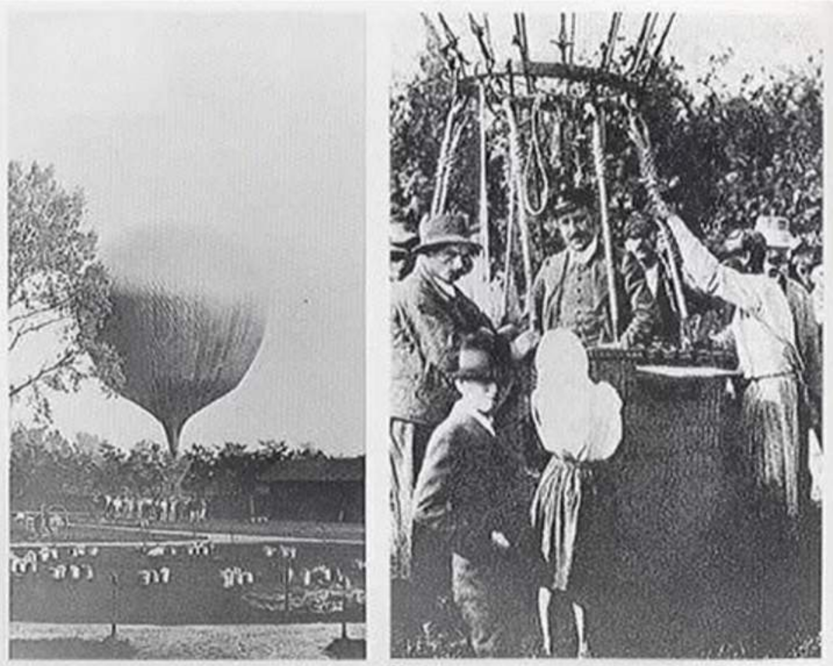


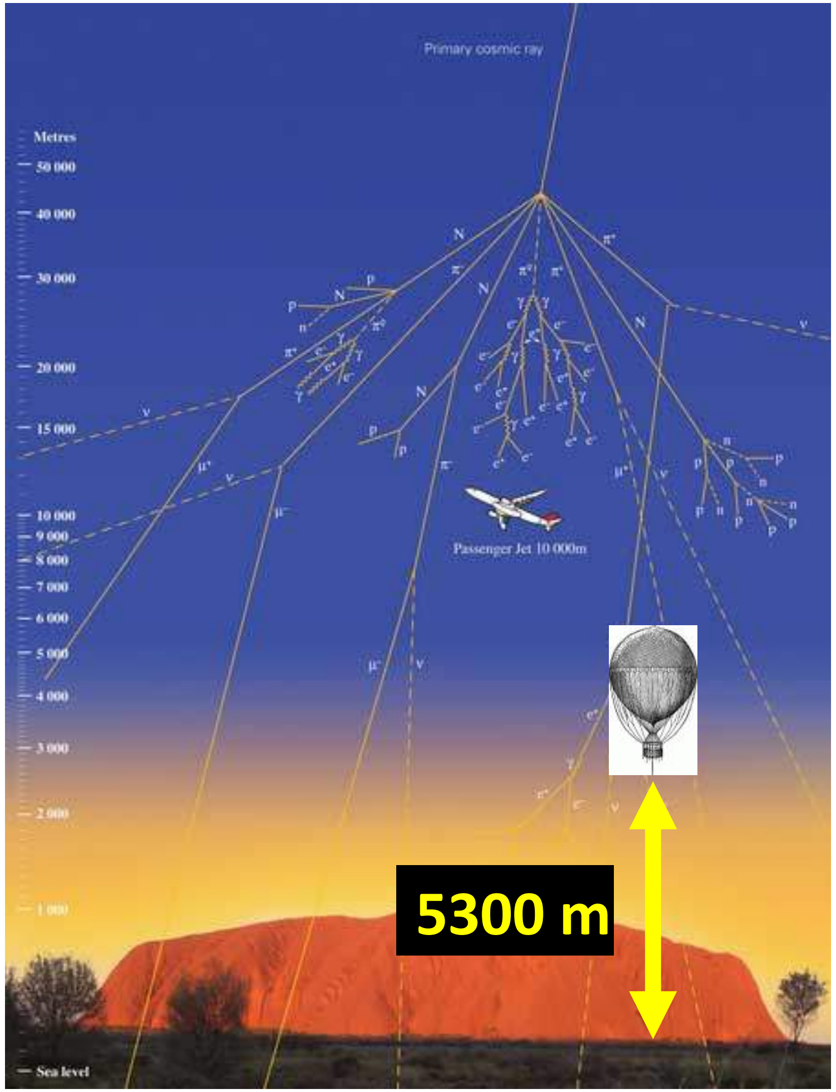
Cacciatorpediniere Fulmine

(Marino, February 20, 1878 – Rome, May 23, 1934)

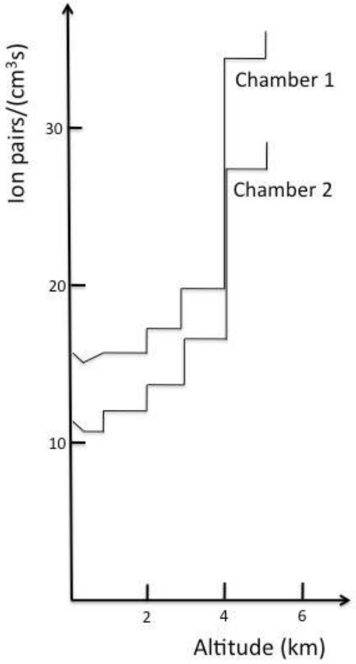
The experiments at high altitude by Victor Hesse

Between 1911 and 1912 using balloons the Austrian physicist Victor Hesse measured the penetrating radiation at high altitude.



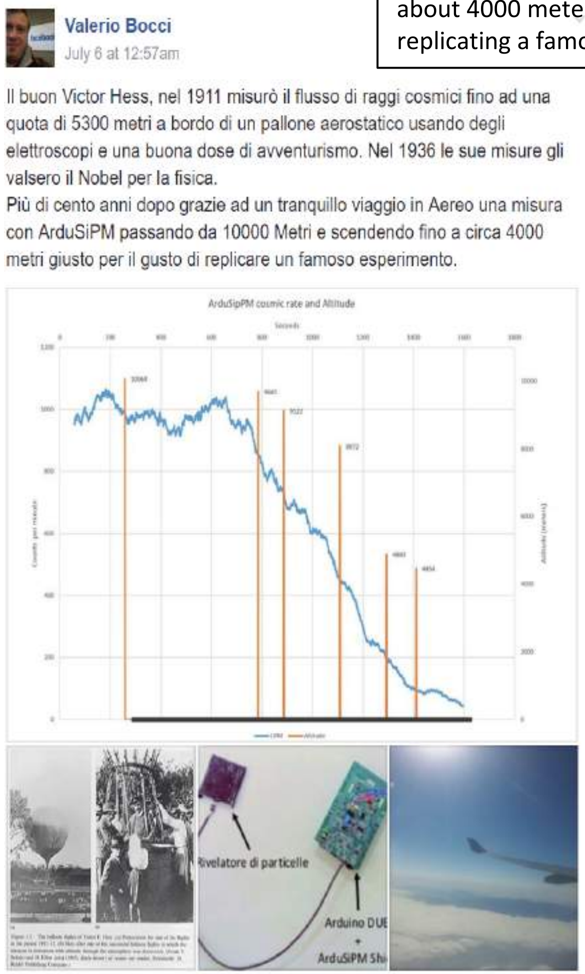


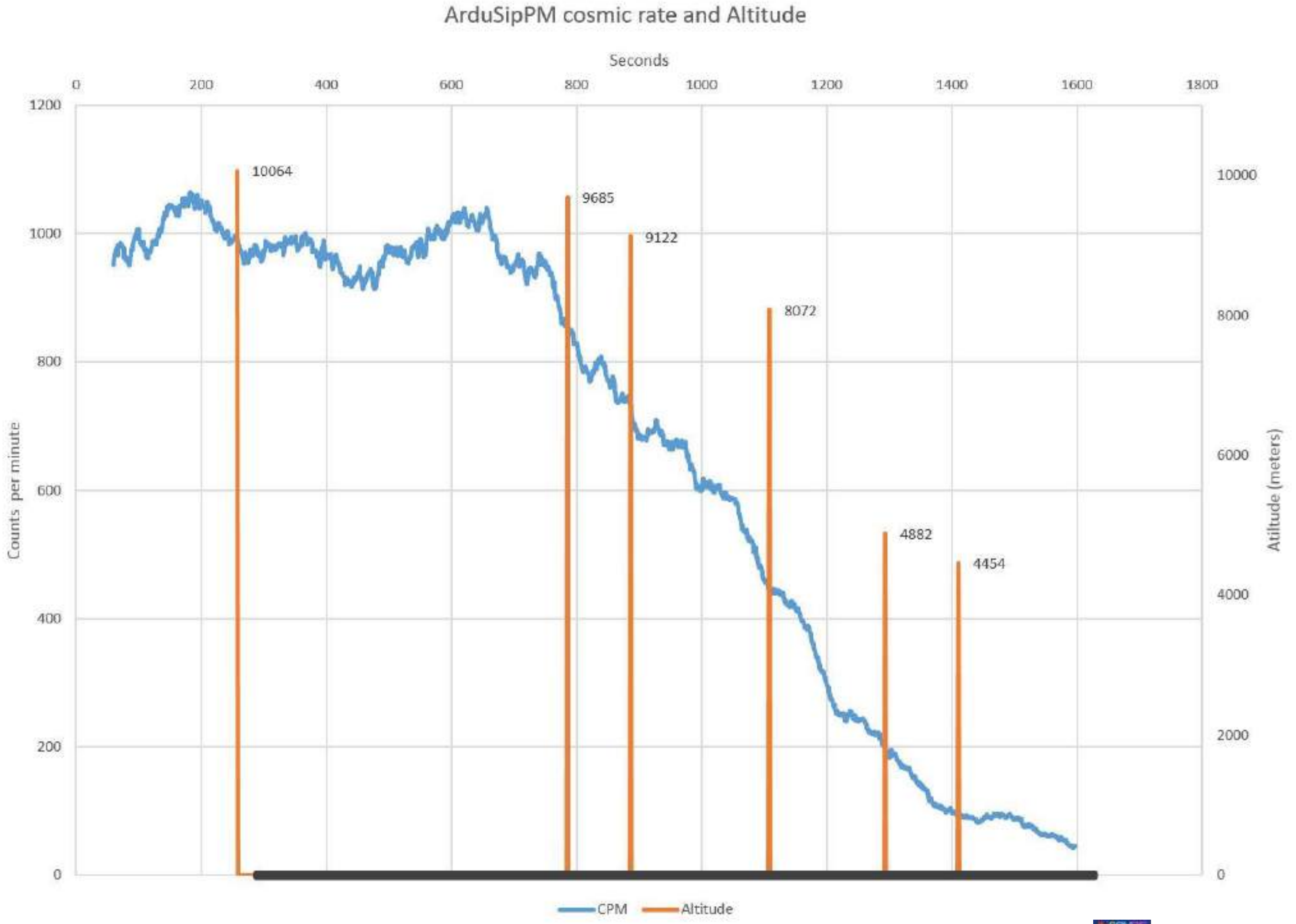
Victor Franz Hess
1883 Schloss Waldstein, Peggau
1964 Mount Vernon, New York



Cosmic ray mesasuraments during a commercial flight.

After more than a hundred years thanks to a quiet journey by plane, a measurement with ardusipm from 10000 meters altitude and descending to about 4000 meters just for the joy of replicating a famous experiment.





The Nobel Prize in Physics 1936
Victor F. Hess, Carl D. Anderson

The Nobel Prize in Physics 1936

Victor Franz Hess
Prize share: 1/2

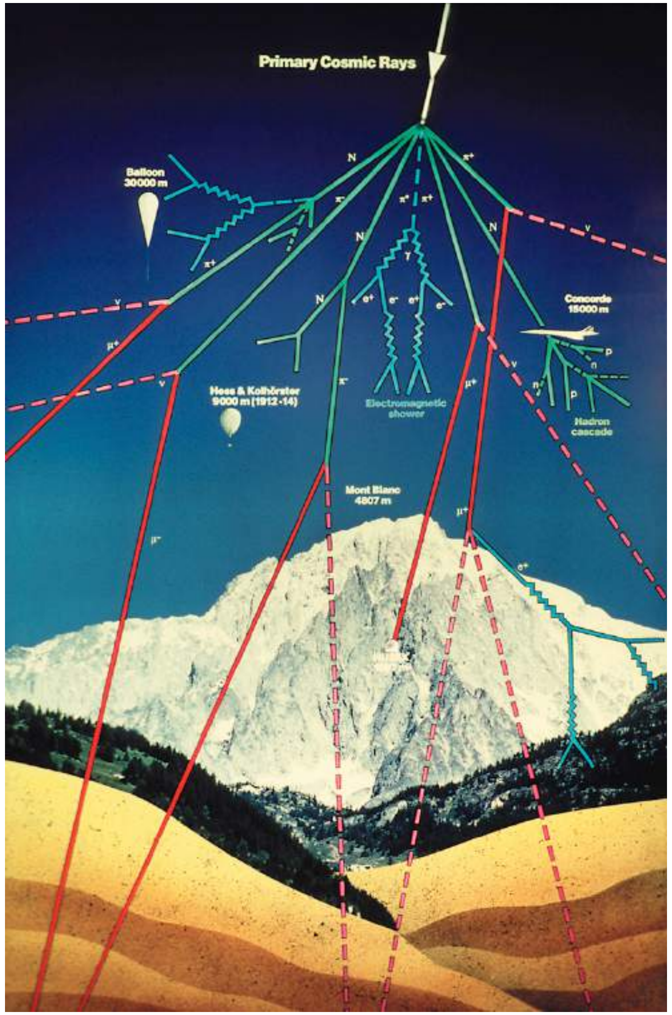
Carl David Anderson
Prize share: 1/2

The Nobel Prize in Physics 1936 was divided equally between Victor Franz Hess *"for his discovery of cosmic radiation"* and Carl David Anderson *"for his discovery of the positron"*.

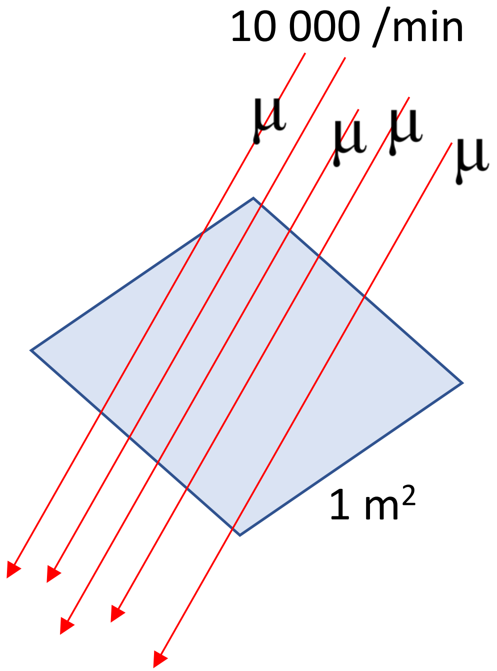
The origin of penetrating radiation…
The muon

μ

The first name was mesotron(*)
(Carl David Anderson, Seth Neddermeyer 1936)



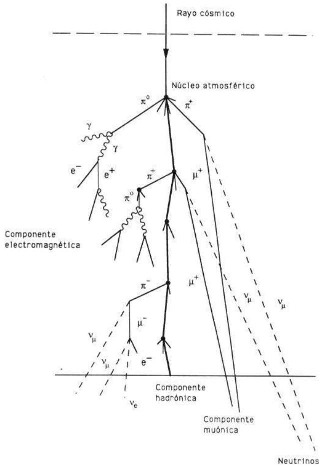
Muoni μ



The first Electronic AND Bruno Rossi coincidence circuit and the discovery of Air Shower.

1.2 Discovery of Extensive Air Showers

It was Bruno Rossi [19], who as early as 1934, had noticed coincidences between several counters placed in a horizontal plane, far in excess of chance coincidences. He had noted in one of his papers "It would seem that occasionally very extensive groups of particles arrive upon the equipment". The most systematic investigation on these showers were undertaken by Pierre Auger and his collaborators [20]. They recorded coincidences between counters separated horizontally by as far as 75 meters. While the counting rate dropped sharply in going from 10 cms to 10 meters, the rate decreased very slowly at larger distances.



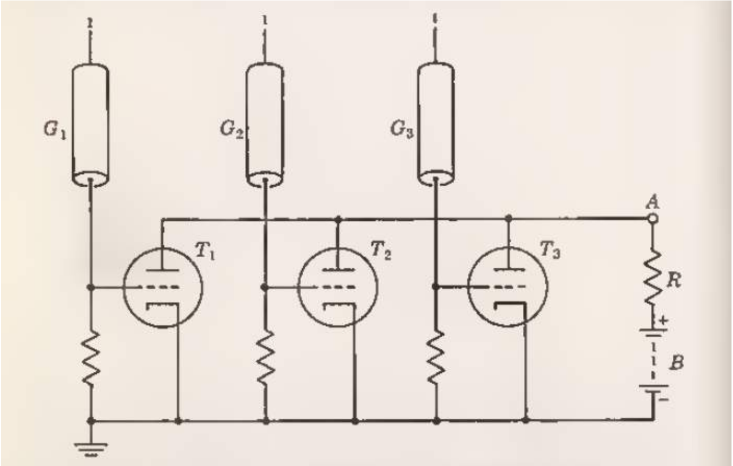


Fig. 4-1 Vacuum-tube coincidence circuit greatly reduces the number of chance coincidences recorded by G-M counters (see text). Under operating conditions, current flows from the positive terminal of the battery *B* through the resistor *R* and three tubes T_1, T_2, T_3 to a ground. This current produces a large voltage drop across the resistor, and at point *A* the potential is nearly that of the ground. When one of the G-M counters, G_1, say, is discharged, the

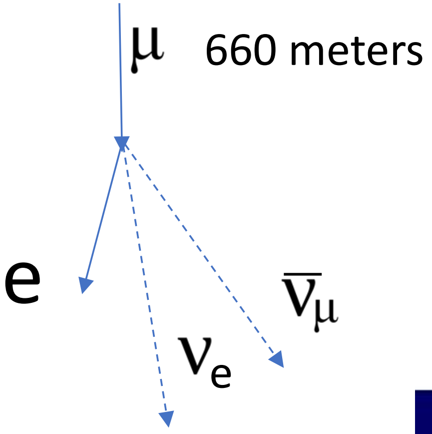
The discovery of air showers

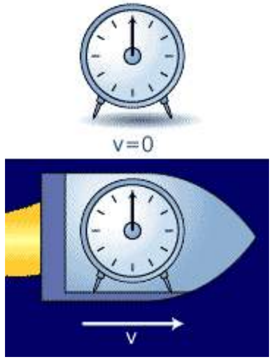
Air showers were discovered, more or less by chance, through the widespread application of coincidence-counter arrangements to the experimental study of cosmic rays. The devices used to detect coincidences will record as simultaneous the pulses of two or more counters if these pulses arrive within a certain small time interval. This interval, the *resolving time*, was of the order of 0.01 second in the early experiments of Bothe and Kohlhörster. The development of vacuum-tube circuits of increasing sophistication eventually reduced the resolving time to considerably less than 1 microsecond. But, however short the interval, there is always a possibility that unrelated particles will cross the counters in such quick succession as to produce a coincidence.

The muon’s short life.

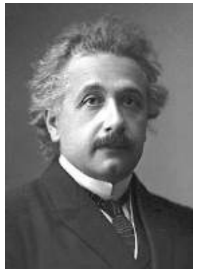
2.2 millionth of a seconds

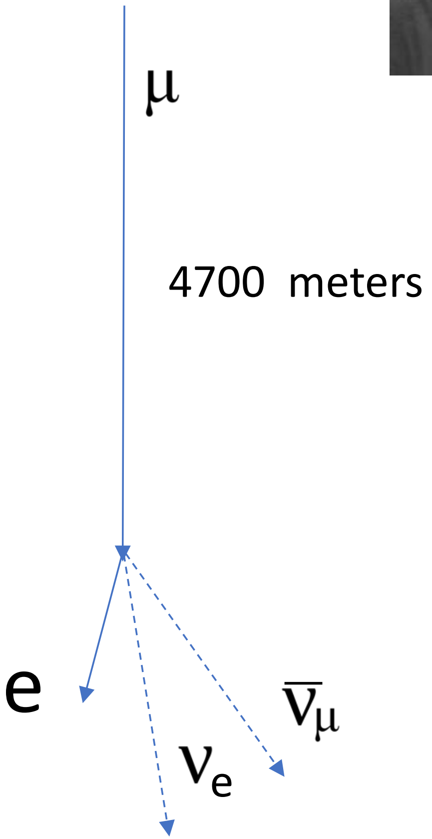
Newtonian mechanics

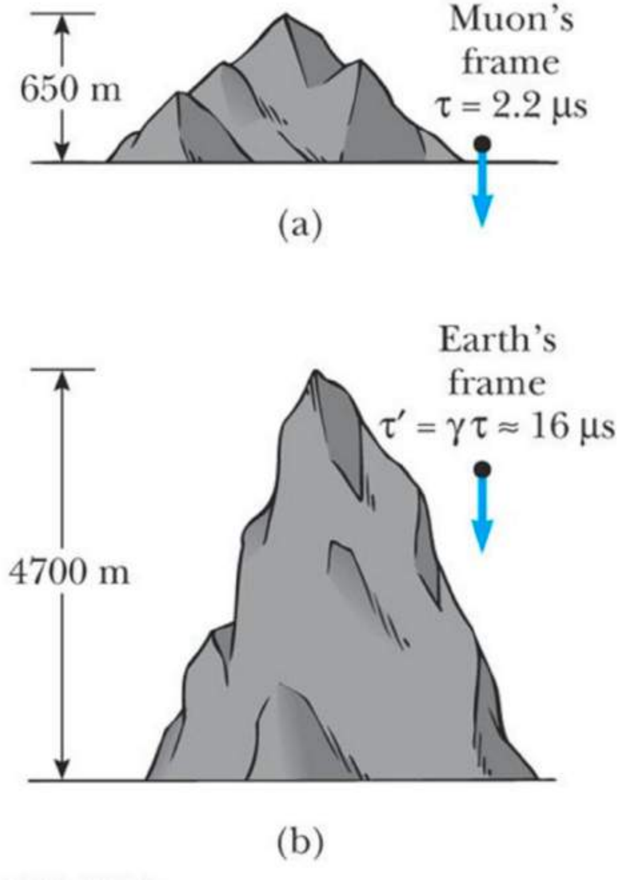


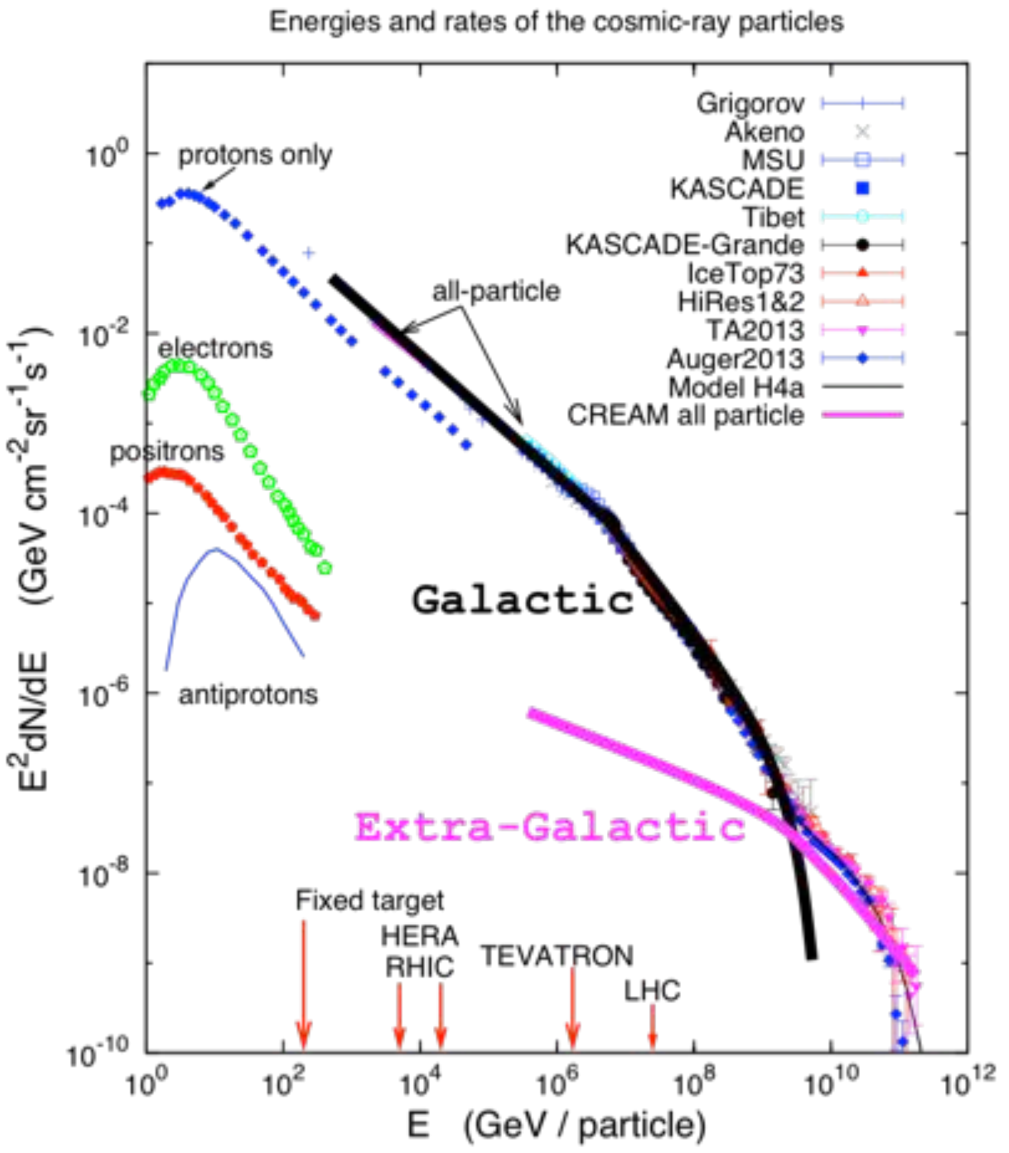


Relativistic mechanics



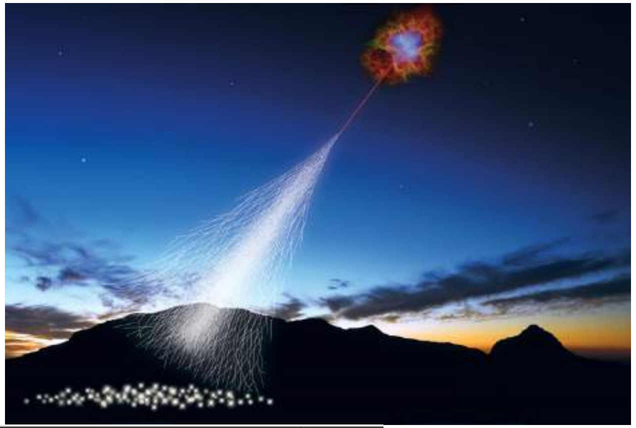


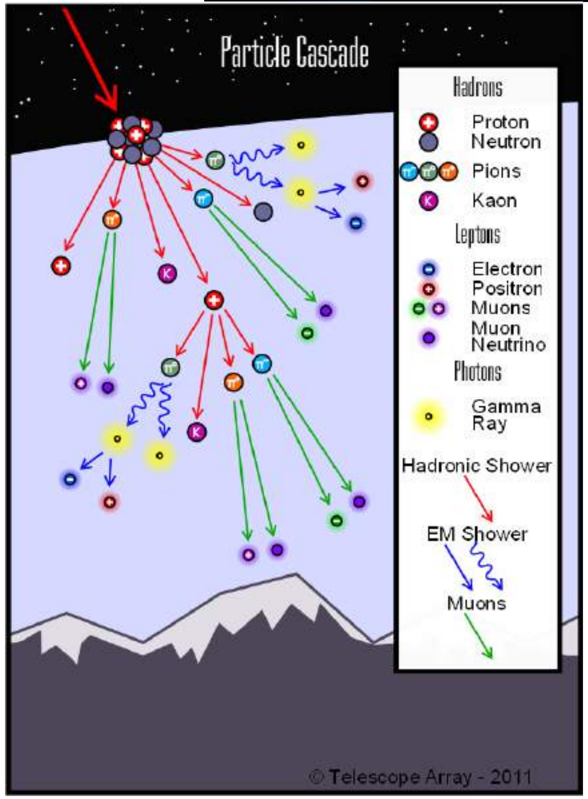



Energies and rates of the cosmic-ray particles
Grigorov
Akeno
MSU
KASCADE
Tibet
KASCADE-Grande
IceTop73
HiRes1&2
TA2013
Auger2013
Model H4a
CREAM all particle
protons only
all-particle
electrons
positrons
antiprotons
Galactic
Extra-Galactic
Fixed target
HERA
RHIC
TEVATRON
LHC
E^2dN/dE $(GeV\ cm^{-2}sr^{-1}s^{-1})$
E (GeV / particle)

The Cosmic Shower

When an high energy cosmic ray hit the atmosphere create a shower of particle. The shower comes larger reaching the earth surface. The dimension of the shower at ground level depends from the energy of the primary particle. In this way the atmosphere absorb the energy of the cosmic ray acting as another shield.
Thousands of particles reach the Earth tipically ar Muons !!

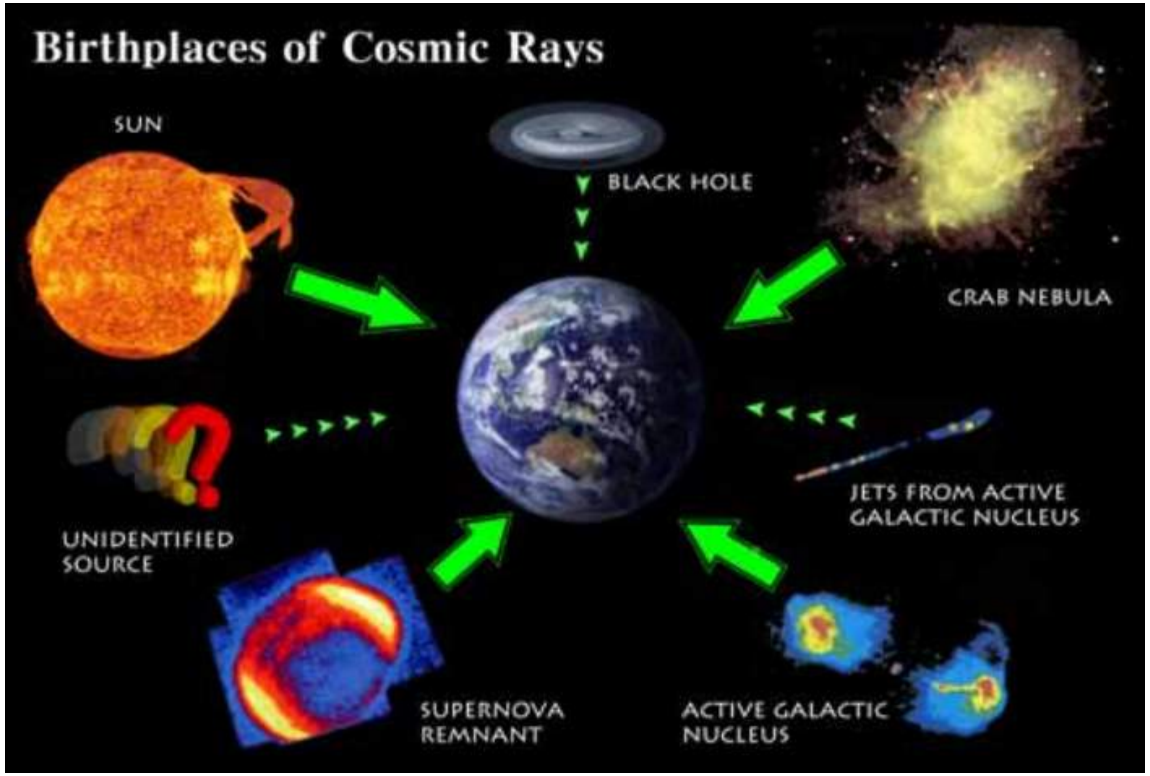




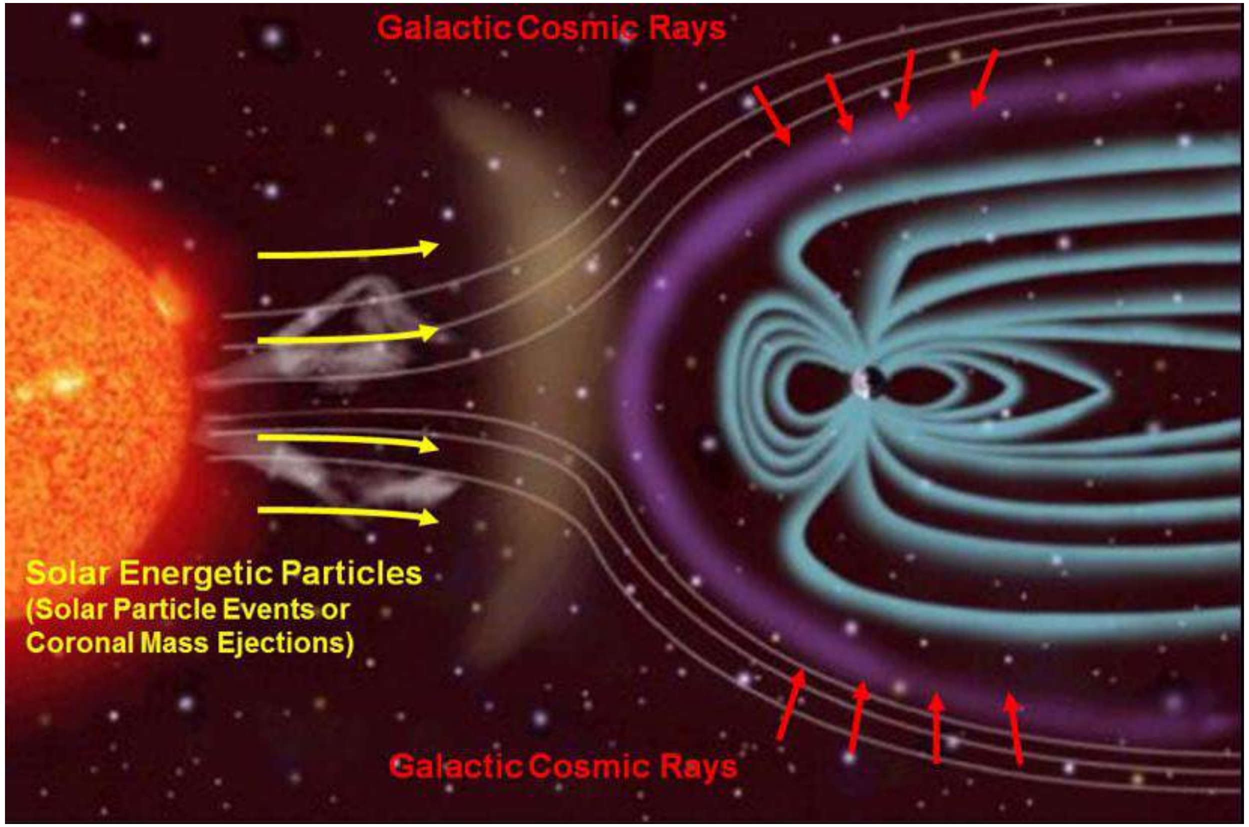
Cosmic Ray

In the universe exist Big Particle Accelerator more powerful of LHC at CERN.
These accelerator shoot cheap particle bullets (tipically protons or iron nuclei).

Some of these bullets reach our Earth



The Earth Magnetic Field Our Shield

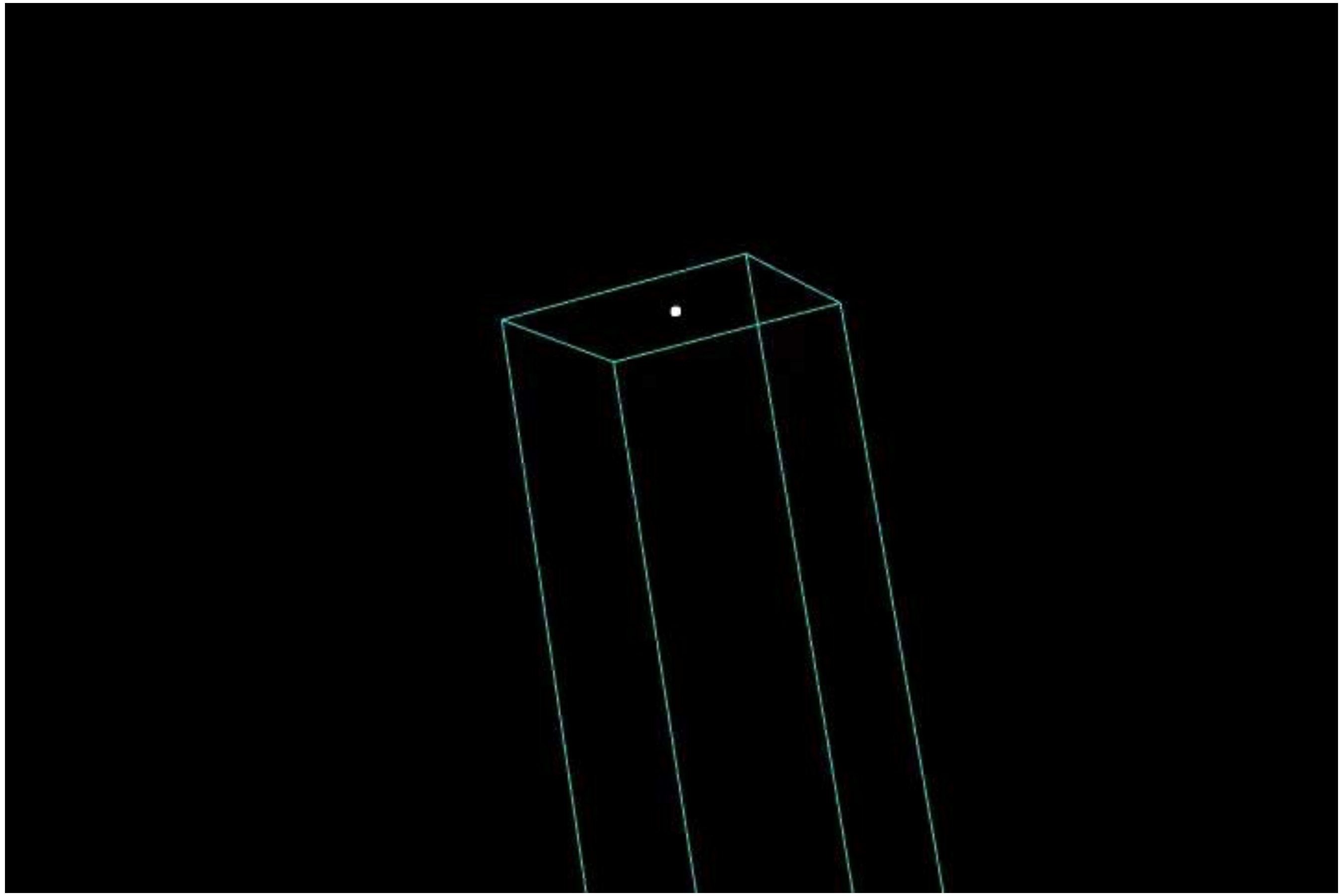


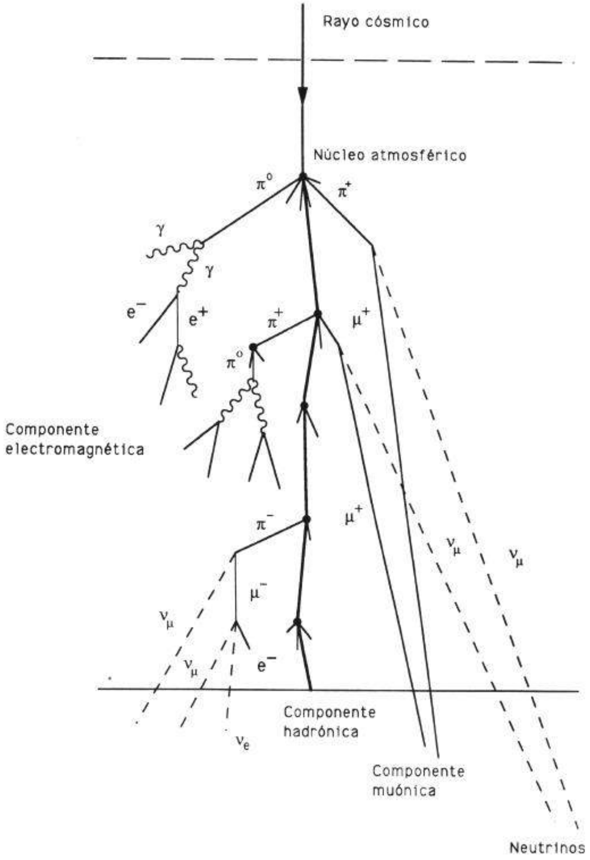
Sometimes particle coming from the Sun can traverse the Magnetic Field

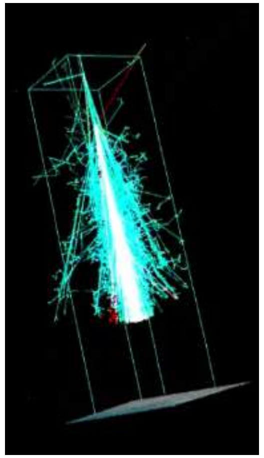
Auroras are produced when the magnetosphere is sufficiently disturbed by the solar wind that the trajectories of charged particles in both solar wind and magnetospheric plasma, mainly in the form of electrons and protons, precipitate them into the upper atmosphere. (Wikipeda)

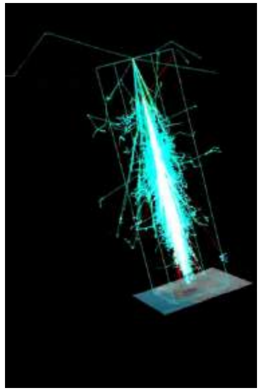
Cosmic Ray Shower animation

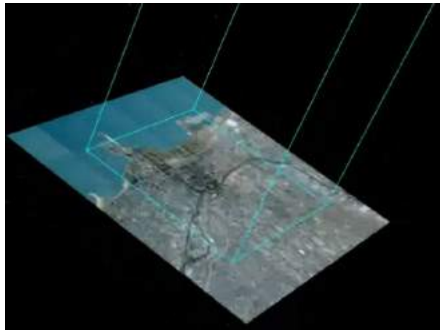
AIRES Cosmic Ray Showers
(http://astro.uchicago.edu/cosmus/projects/aires/)





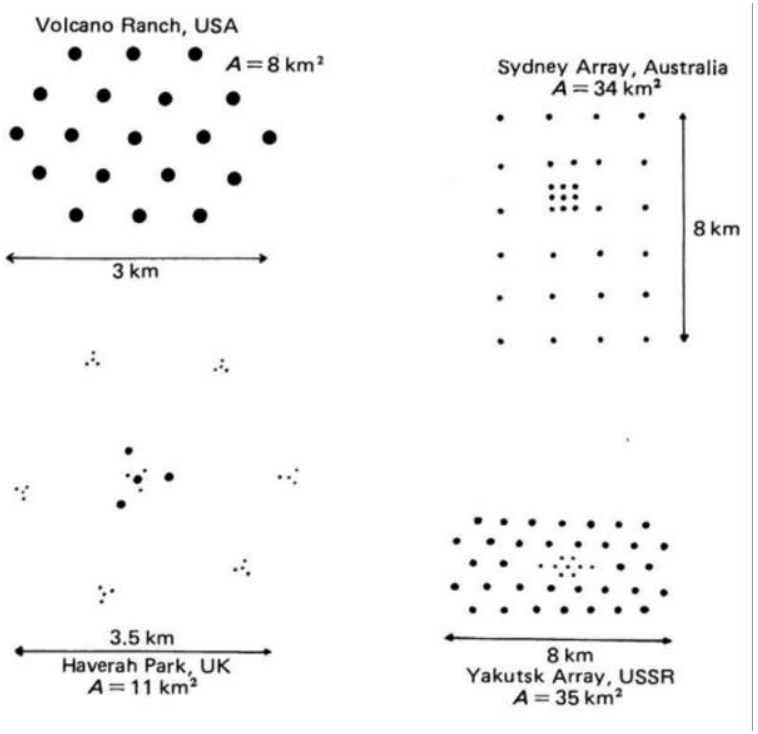




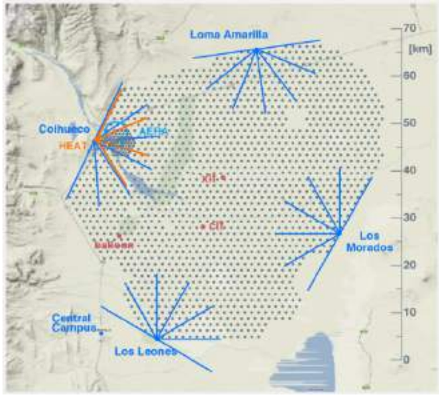


The search of Ultra Energetic Cosmic Ray E> 10^{19} eV

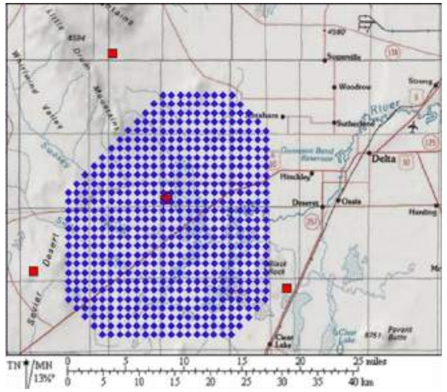
On February 22, 1962, John David Linsley observed an air shower at Volcano Ranch created by a primary particle with an energy greater than 10^{20} eV

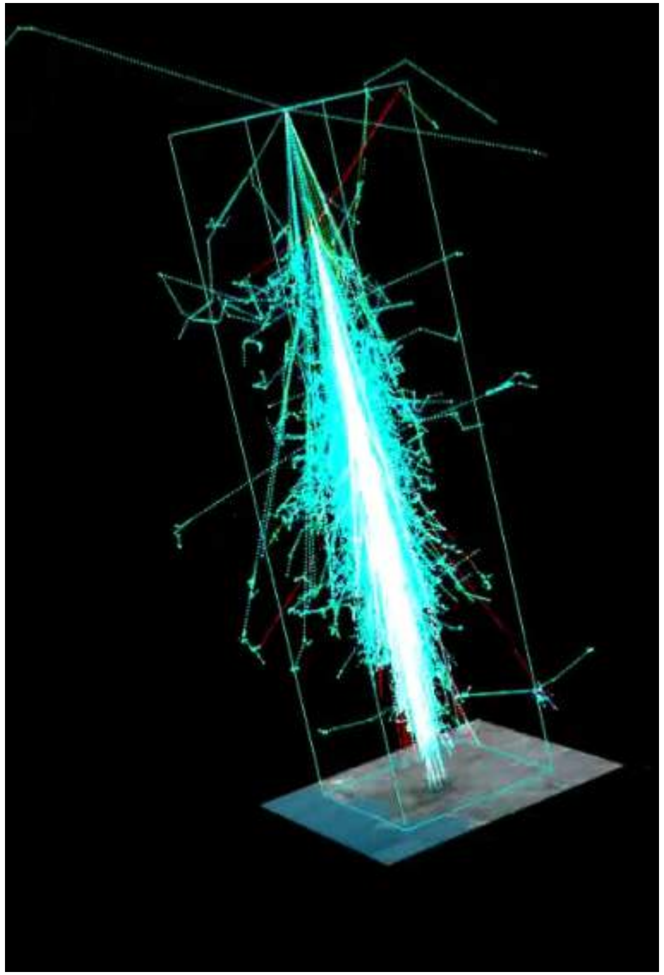


Pierre Auger Observatory (Argentina)



Telescope Array Project (Utah)





Dr. Valerio Bocci INFN Roma

2018

Breaking News from Auger Observatory

RESEARCH

COSMIC RAYS

Observation of a large-scale anisotropy in the arrival directions of cosmic rays above 8×10^{18} eV

The Pierre Auger Collaboration*†

Cosmic rays are atomic nuclei arriving from outer space that reach the highest energies observed in nature. Clues to their origin come from studying the distribution of their arrival directions. Using 3×10^4 cosmic rays with energies above 8×10^{18} electron volts, recorded with the Pierre Auger Observatory from a total exposure of 76,800 km^2 sr year, we determined the existence of anisotropy in arrival directions. The anisotropy, detected at more than a 5.2σ level of significance, can be described by a dipole with an amplitude of $6.5^{+1.3}_{-0.9}$ percent toward right ascension $\alpha_d = 100 \pm 10$ degrees and declination $\delta_d = -24^{+12}_{-13}$ degrees. That direction indicates an extragalactic origin for these ultrahigh-energy particles.

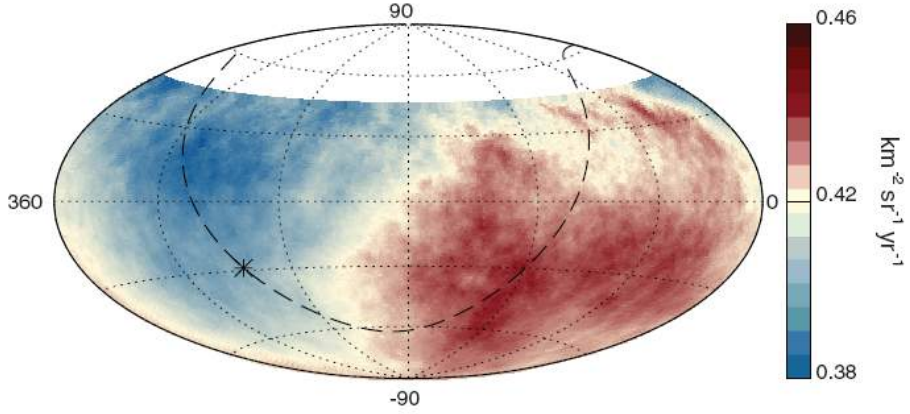
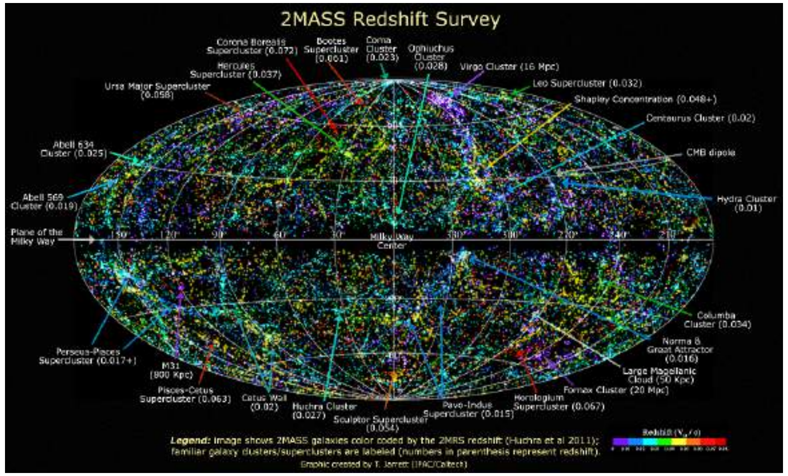


Fig. 2. Map showing the fluxes of particles in equatorial coordinates. Sky map in equatorial coordinates, using a Hammer projection, showing the cosmic-ray flux above 8 EeV smoothed with a 45° top-hat function. The galactic center is marked with an asterisk; the galactic plane is shown by a dashed line.



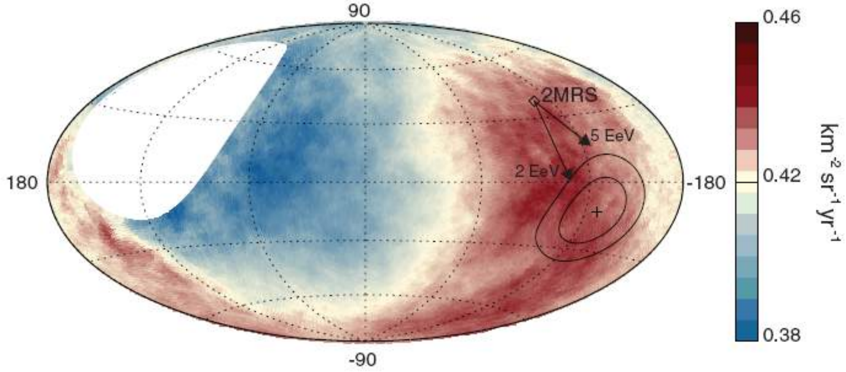
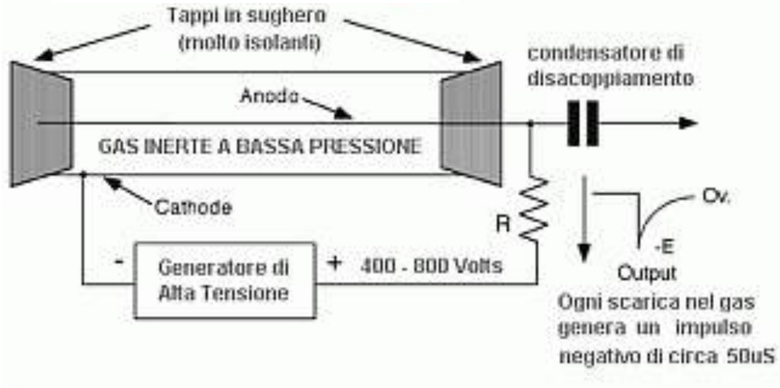


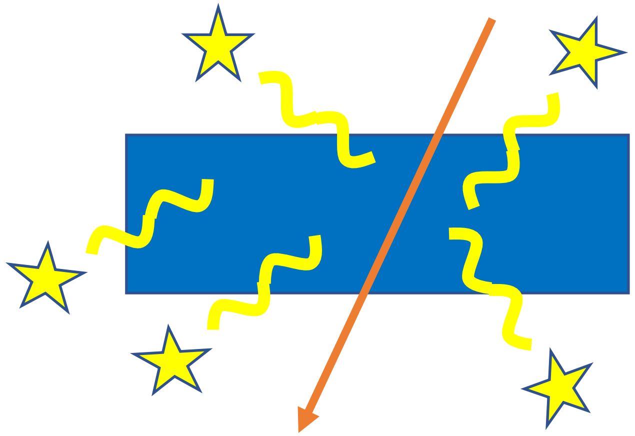
Fig. 3. Map showing the fluxes of particles in galactic coordinates. Sky map in galactic coordinates showing the cosmic-ray flux for $E \geq 8$ EeV smoothed with a 45° top-hat function. The galactic center is at the origin. The cross indicates the measured dipole direction; the contours denote the 68% and 95% confidence level regions. The dipole in the 2MRS galaxy distribution is indicated. Arrows show the deflections expected for a particular model of the galactic magnetic field (8) on particles with E/Z = 5 or 2 EeV.

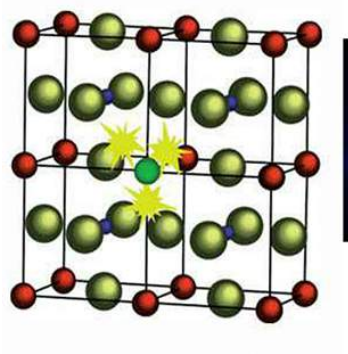
Some technics to detect ionizing particles

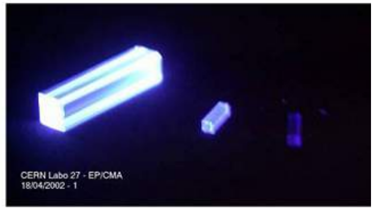
Tubo Geiger



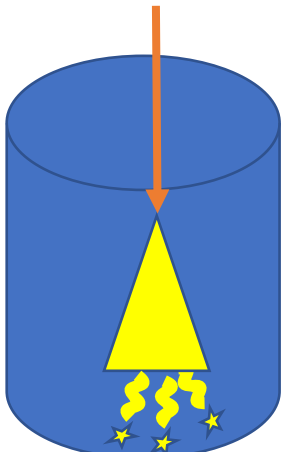
Scintillation materials

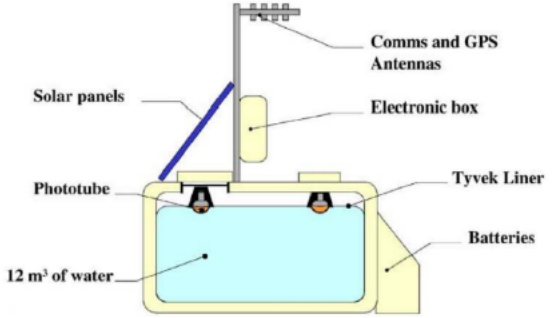






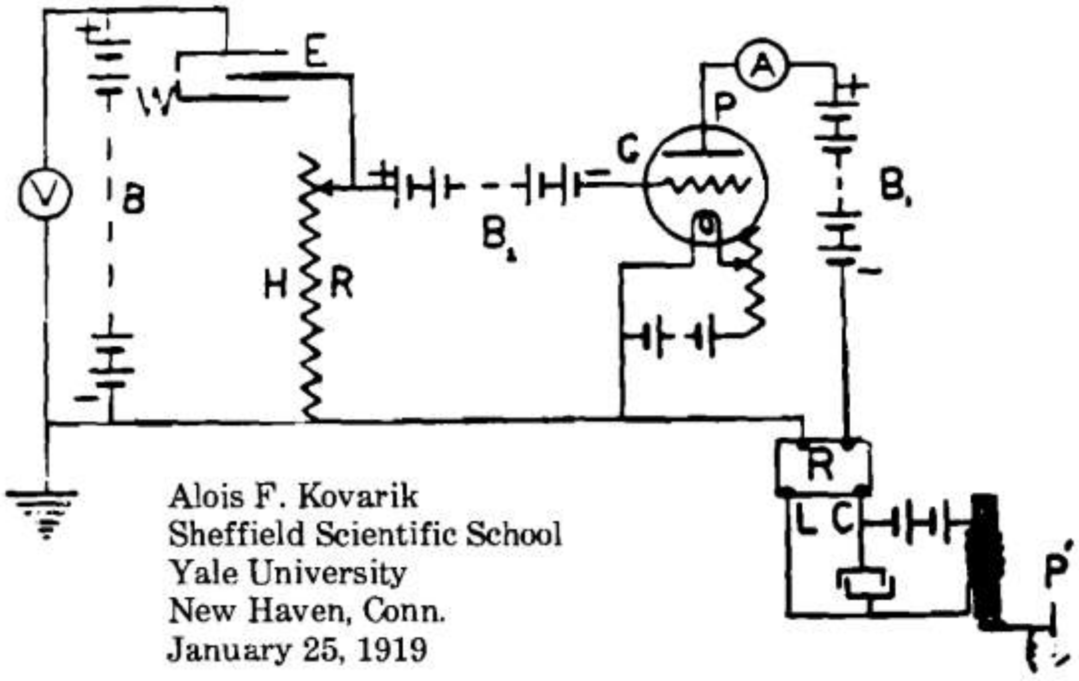
Cherenkov effects



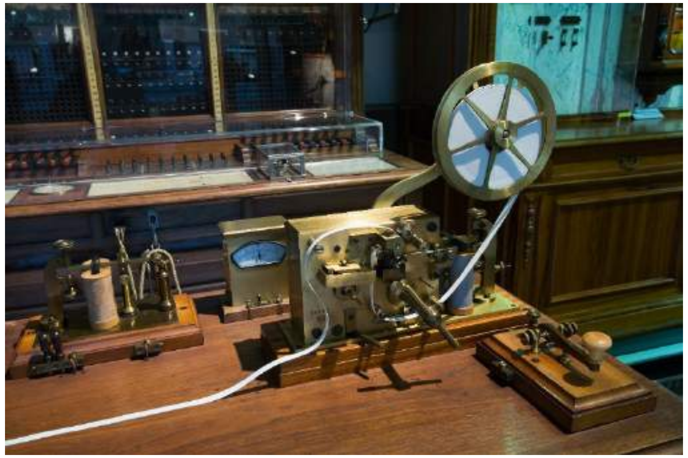


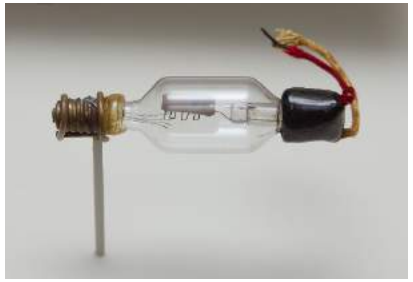
First Electronic particle detector 1919

ON THE AUTOMATIC REGISTRATION OF α-PARTICLES, β-PARTICLES AND γ-RAY AND X-RAY PULSES



Alois F. Kovarik
Sheffield Scientific School
Yale University
New Haven, Conn.
January 25, 1919

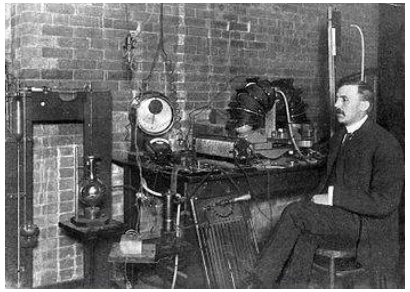




Lee De Forest Audion tube from 1908, the first triode. its ability to amplify was recognized around 1912.

The Geiger-Muller: A ‘900 detector.

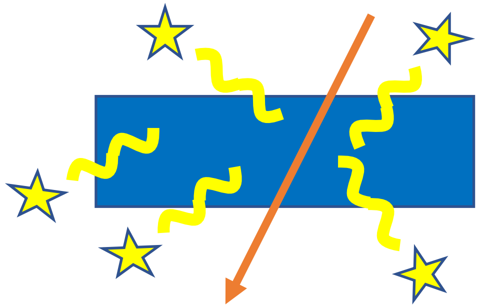
- Robust Technology 100 years old
- Economical
- Easy to find
- There are some Makers project
- The detector is preassembled from the factory



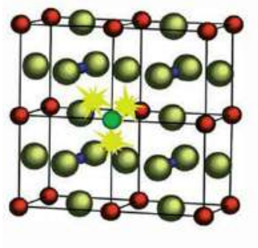
The discovery of atomic nuclei. Rutherford Hans Geiger and Ernest Marsden

- High voltage discharge (need robust electronics)
- Low efficiency.
- Yes or No detector
- Fragile.

Using Scintillation materials

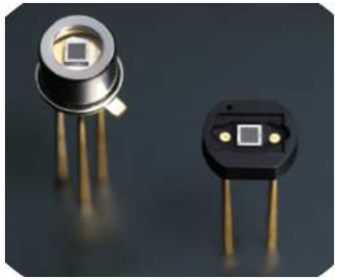


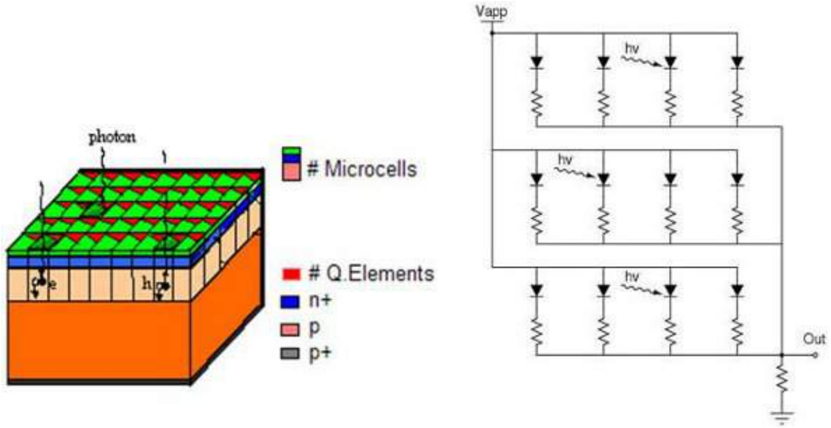
The use of scintillation materials is not for everyone in the past.
The only way was to use photomultiplier.

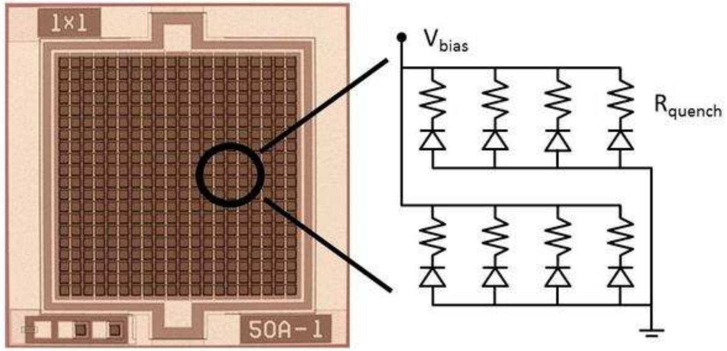


The Photomultiplier (1934).
Based on Photoelectric effect (1921 Einstein Nobel) and electron secondary emission.
The Photomultiplier are expensive and need high voltage(1000 Volt).

SiPM
(Silicon Photo Multiplier)







The idea behind this device is the detection of single photon events in sequentially connected SiAPDs.

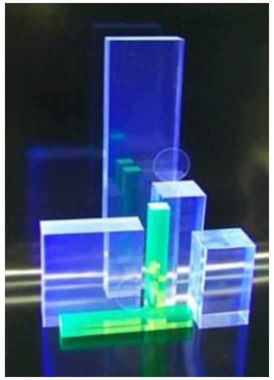
The dimension of each single APD can vary from 20 to 100 micrometres, and their density can be up to 1000 per square millimeter.

Every APD in SiPM operates in Geiger-mode and is coupled with the others by a polysilicon quenching resistor.

Although the device works in digital/switching mode, the SiPM is an analog device because all the microcells are read in parallel making it possible to generate signals within a dynamic range from a single photon to 1000 photons for just a single square millimeter area device.

The supply voltage (Vb) depends on APD technology used, and typically varies between 20 V and 100 V, thus being from 15 to 75 times lower than the voltage required for a traditional photomultiplier tubes (PMTs) operation.

Is it possible to build a complete particle detector and data acquisition system using Arduino microcontroller and Arduino Language ?



Scintillator

Photons Sensor (SiPM)

Custom Electronics (ArduSiPM Shield)

Arduino DUE

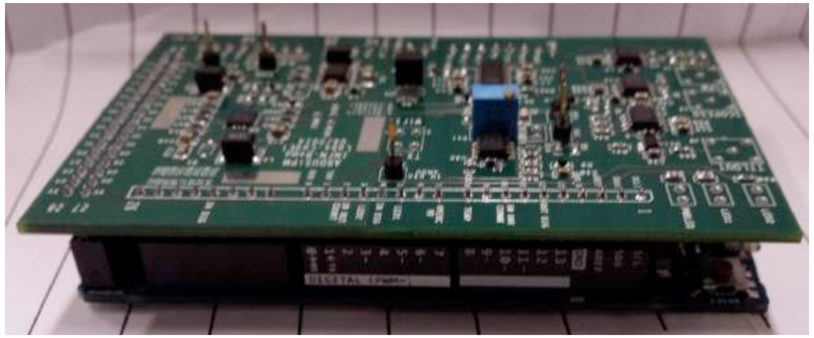
ArduSiPM Software

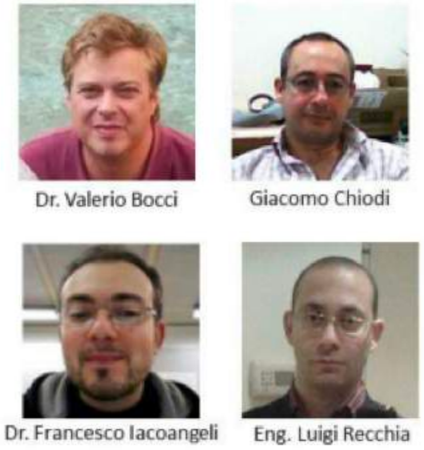
ArduSiPM

Dr. Valerio Bocci INFN Roma

2018

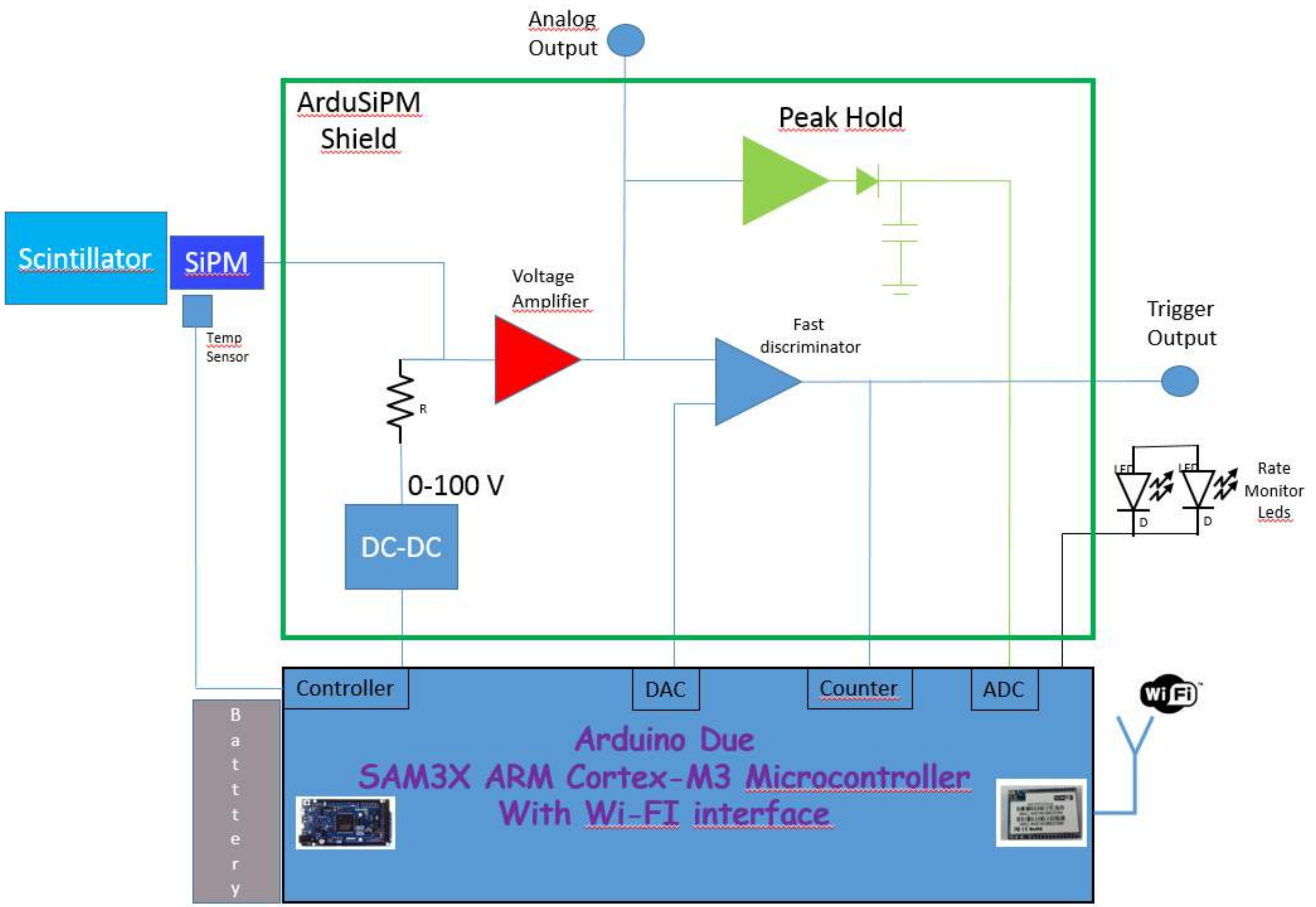
ArduSiPM Shield



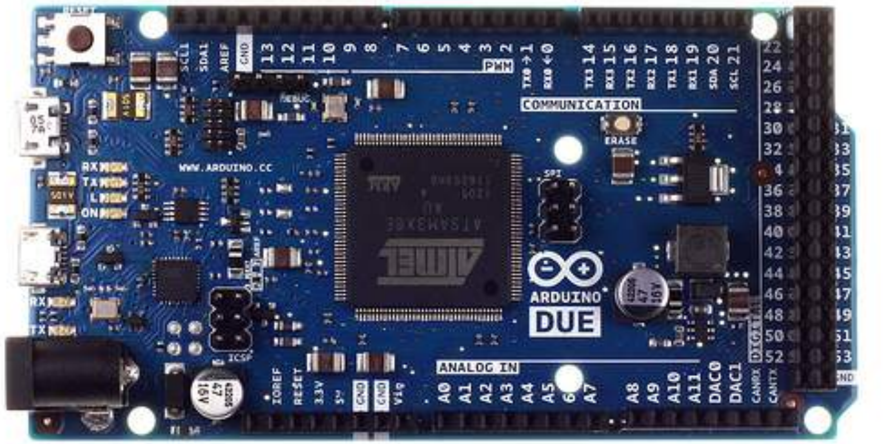


- Shield for Arduino DUE : a custom designed piggy-back board with all the analog parts
- Same form factor of Arduino DUE
- The ArduSiPM Shield contains:
  - Fast preamplifier
  - Analog Output monitor
  - Fast discriminator with threshold and pulse output width (both digitally programmable).
  - Trigger output
  - Peak hold circuit with programmable sample window.
  - Digitally controlled voltage bias up to 90 Volt (8 bits precision for temperature compensation)
  - Monitor of: temperature,threshold ,HV Bias

ArduSiPM Block Diagram

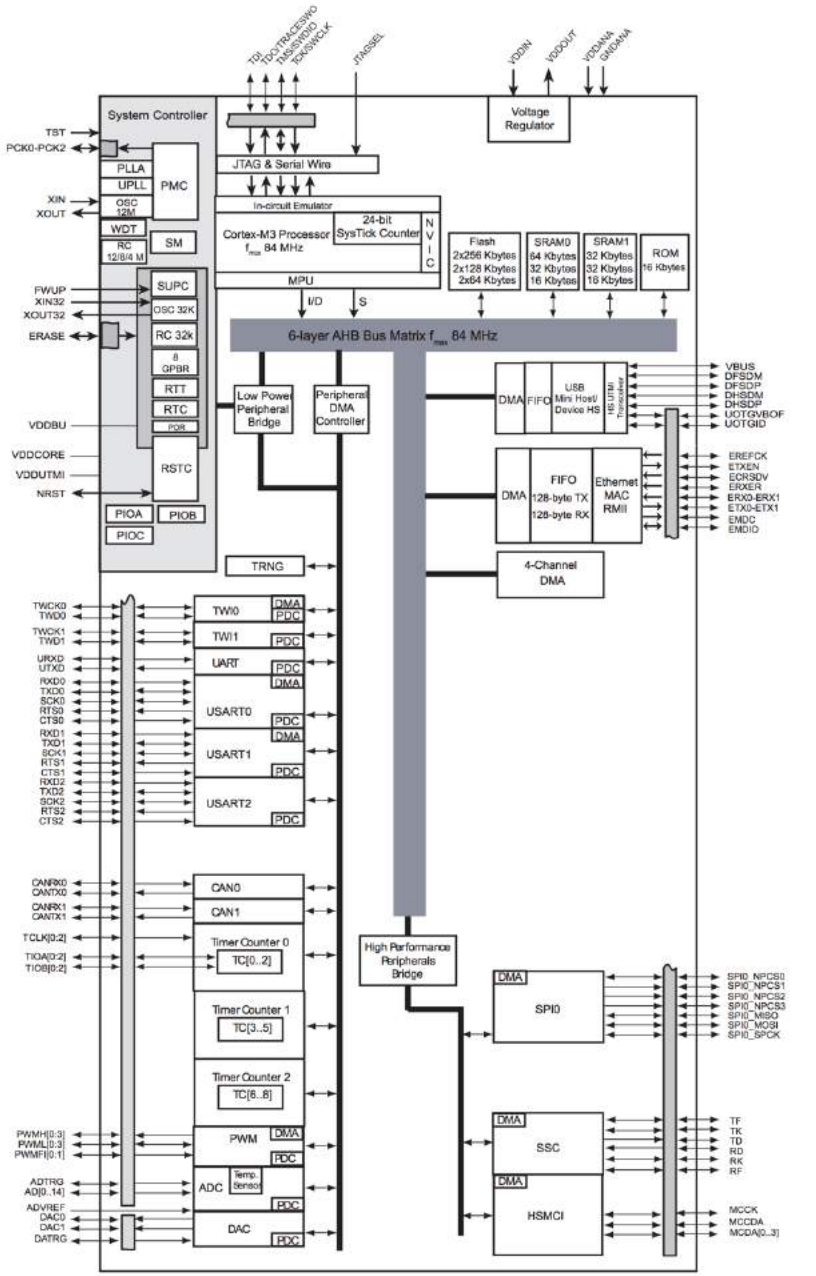


Arduino Due



- Arduino is an open-source electronics platform based on easy-to-use hardware and software.
- Arduino Due is the first Arduino board based on SoC (System on Chip) SAM 3X8E a 32-bit ARM core microcontroller.
- Main features available on Arduino Due to build up around an acquisition system are:

  - 16 Channel Multiplexed Analog to Digital converter with 12 bit and 1 MHz sample rate
  - Multiple Input output pins
  - 9 fast Counter and pulse generator
  - 2 Digital to Analog converter with 12 bit resolution
  - Different serial interface like I2C,SPI,onewire, RS232, Ethernet MAC in SAM3X8 (not routed ☹)
  - An easy to use development software, with high level instruction for main program and interrupt handling, with the possibility to use all the complex features of the SoC SAM3X8.



Application Example 1:
Intraoperative β- Detecting Probe

nature.com > scientific reports > articles > article

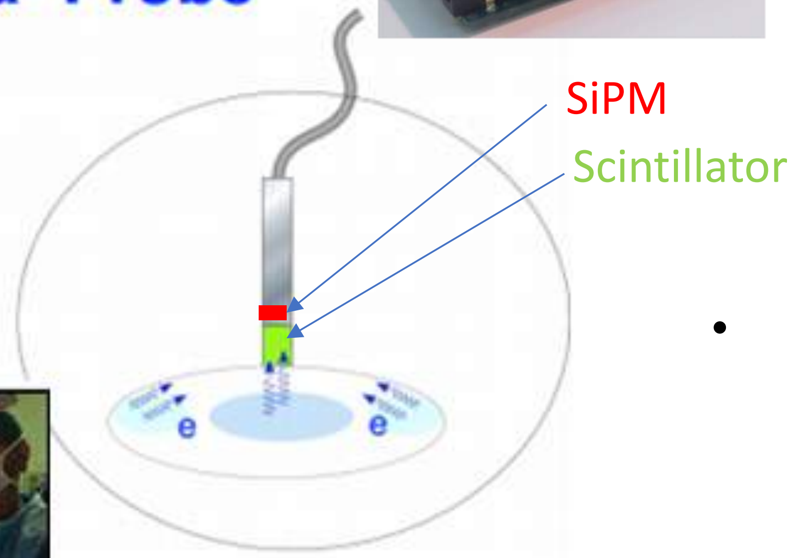
SCIENTIFIC REPORTS

A novel radioguided surgery technique exploiting β^- decays

E. Solfaroli Camillocci, G. Baroni, F. Bellini, V. Bocci, F. Collamati, M. Cremonesi, E. De Lucia, P. Ferroli, S. Fiore, C. M. Grana, M. Marafini, I. Mattei, S. Morganti, G. Paganelli, V. Patera, L. Piersanti, L. Recchia, A. Russomando, M. Schiariti, A. Sarti, A. Sciubba, C. Voena & R. Faccini

Beta- Probe

ArduSiPM

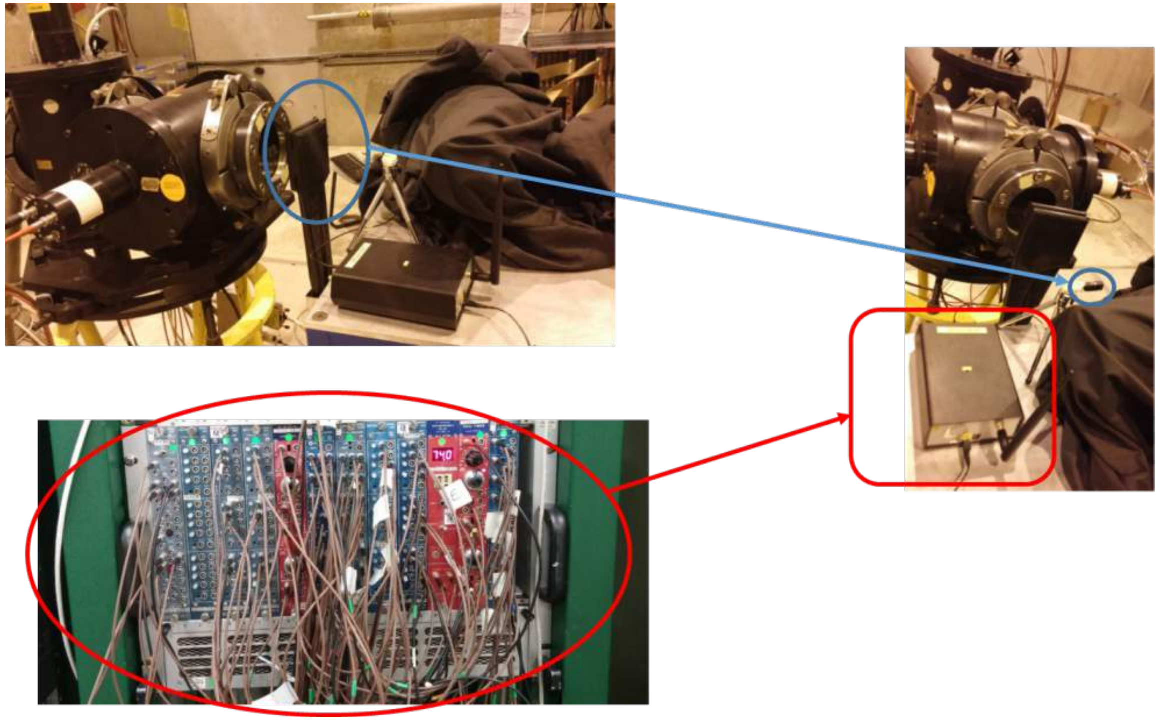


Control and readout
Android App

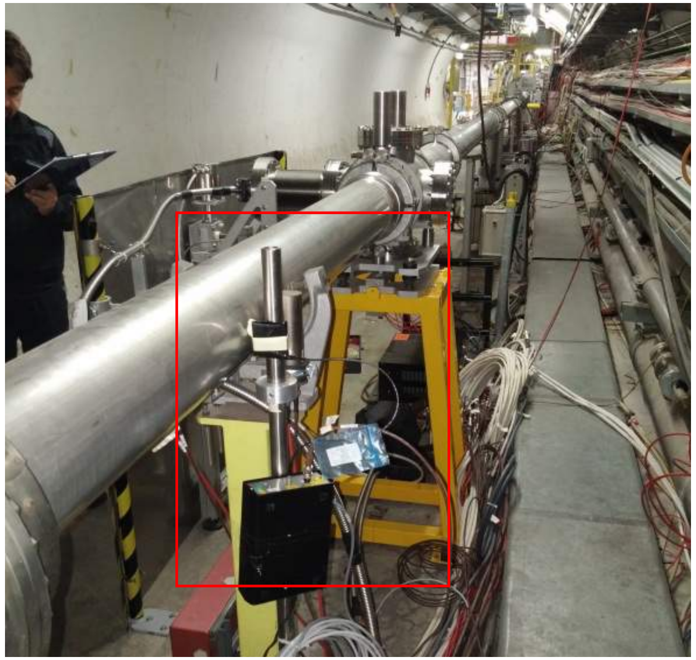
- Radioguided **intraoperative beta probe**, with scintillation material coupled with SiPM detector.

Application Example 2: Use of ArduSiPM in the CERN UA9 and CRYSBEAM activity

(substitute old Scintillator and electronics for PM)



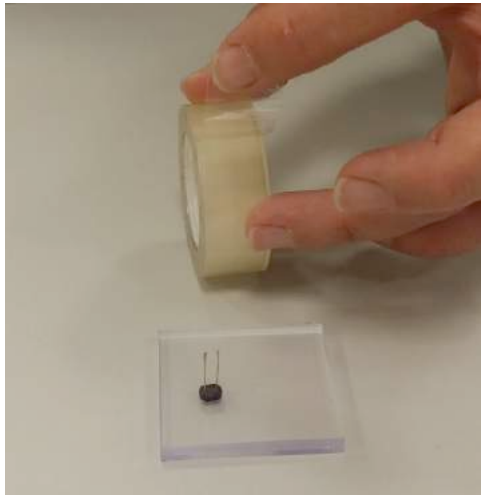
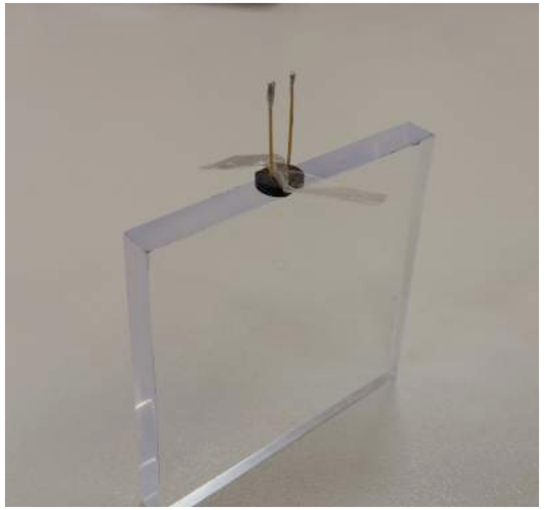
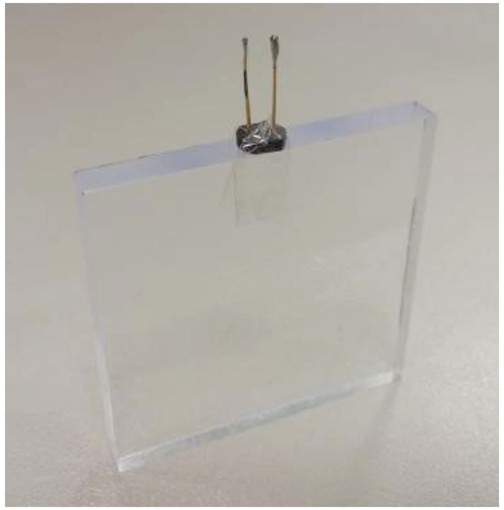
- As beam trigger @ extracted beam line H8 (CERN)



- As beam losses counter @ SPS

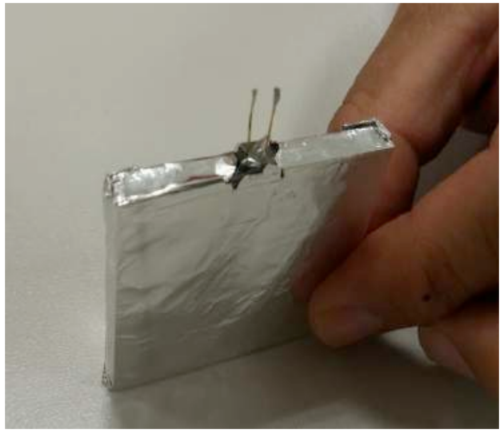
- *This work has been supported by the ERC Ideas Consolidator Grant*
- *No.615089 "CRYSBEAM".*

How to build a Scintillation detector with SiPM(1/2)

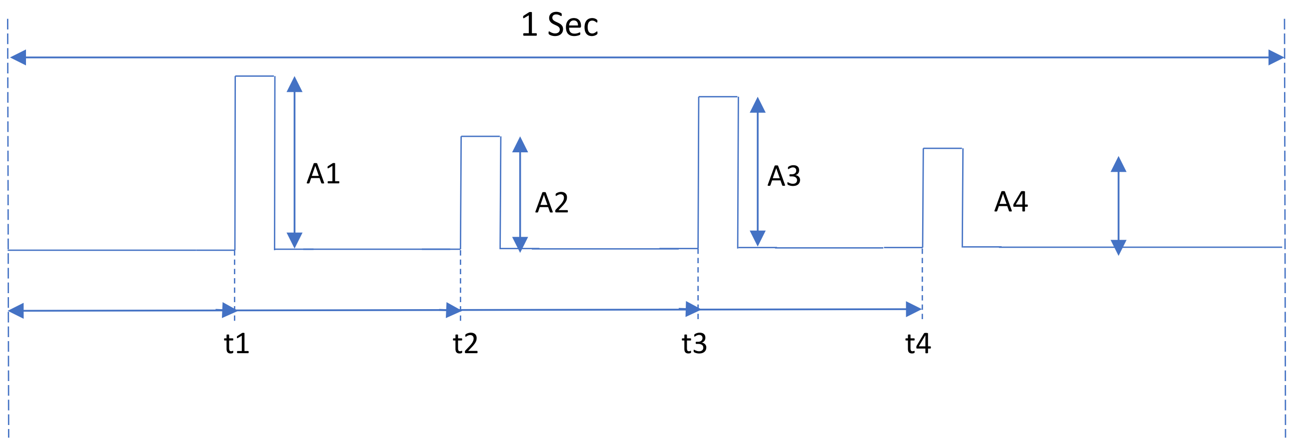
Attaching a SiPM to the scintillator with the scotch





Package with cooking alluminium foil

ArduSiPM measuraments



We split the measuraments in 1 second windows,
acquiring number of pulses, amplitude and time of each one.

Using a 200KBits/s serial stream

We can meausure and dump (depending from amplitude and distribution of pulses):

- Only the frequency up to 40 MHz
- ADC value up to 4-6 KHz
- ADC,TDC and rate 1 -2 KHz

Using the SAM3X8 built-in ethernet it is possible to increase data acquisition performance.

Data Stream example:

```
Only rate:
$10
$50
$244

ADC+Rate:
v1Fv1Dv22v27v1Dv19v20v23v20v1Cv19v1F$12
v18v1Ev1Ev1Bv19v1Bv29v19v1Av1Dv1Bv1Dv2Av18v1B$15
v15v20v21v21v1Dv1Fv1Av1Av1A$9
v19v17v1Bv18v1Cv1Dv1D$7

TDC+ADC+RATE:
taedvataf0v7tv9v3$3
```

Legend:
vXXX ADC Value in HEX MSB zero suppressed
tXXXXXXXX TDC value in HEX MSB zero suppressed
$XXX rate in Hz

Tecnology transfer -> It is possible to buy (non exclusive producer)

ROBOT DOMESTICI
www.robot-domestici.it

Nome utente | •••••••• | Login
Utente dimenticato? Password dimenticata? Registrati

Prodotti Idea Chi siamo Contatti MEPA Supporto KIT Sviluppo progetti | Cerca prodotto

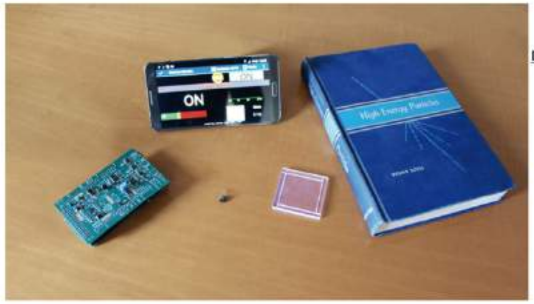
Categorie ▸ Arduino ▸ Arduino Kit ▸

Sistema di misura ArduSiPM Shield KIT

ArduSiPM - Un rivelatore di raggi cosmici e radiazioni nucleari

COD : RD-ArduSiPMKIT

596,83 € (excl. VAT)
728,13 € (incl. IVA)



Disponibilità : in arrivo in magazzino

728,13 € 1 Aggiungi

Chiedi informazioni per questo prodotto (Ask a question about this product)

PRODOTTO DISPONIBILE SUL MEPA CON IL SEGUENTE CODICE : RD-ArduSiPMKIT

scrivere a commerciale@robot-domestici.it per ricevere l'offerta per pacchetti multipli

OFFERTA PER 2 ARDUSIPM 1.149,50 € + iva

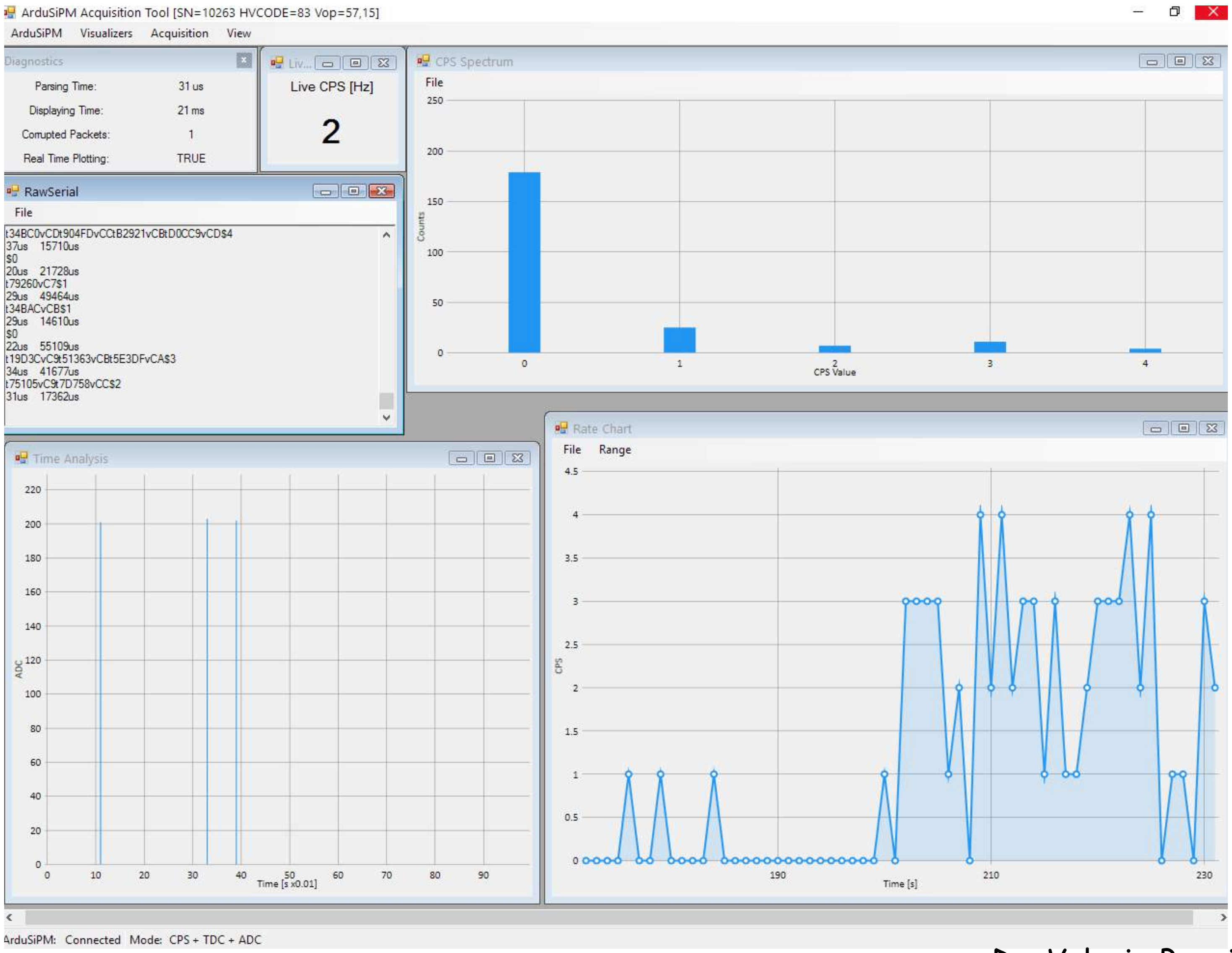
OFFERTA PER 4 ARDUSIPM 2.179,50 € + iva

OFFERTA PER 8 ARDUSIPM 3.878,50 € + iva

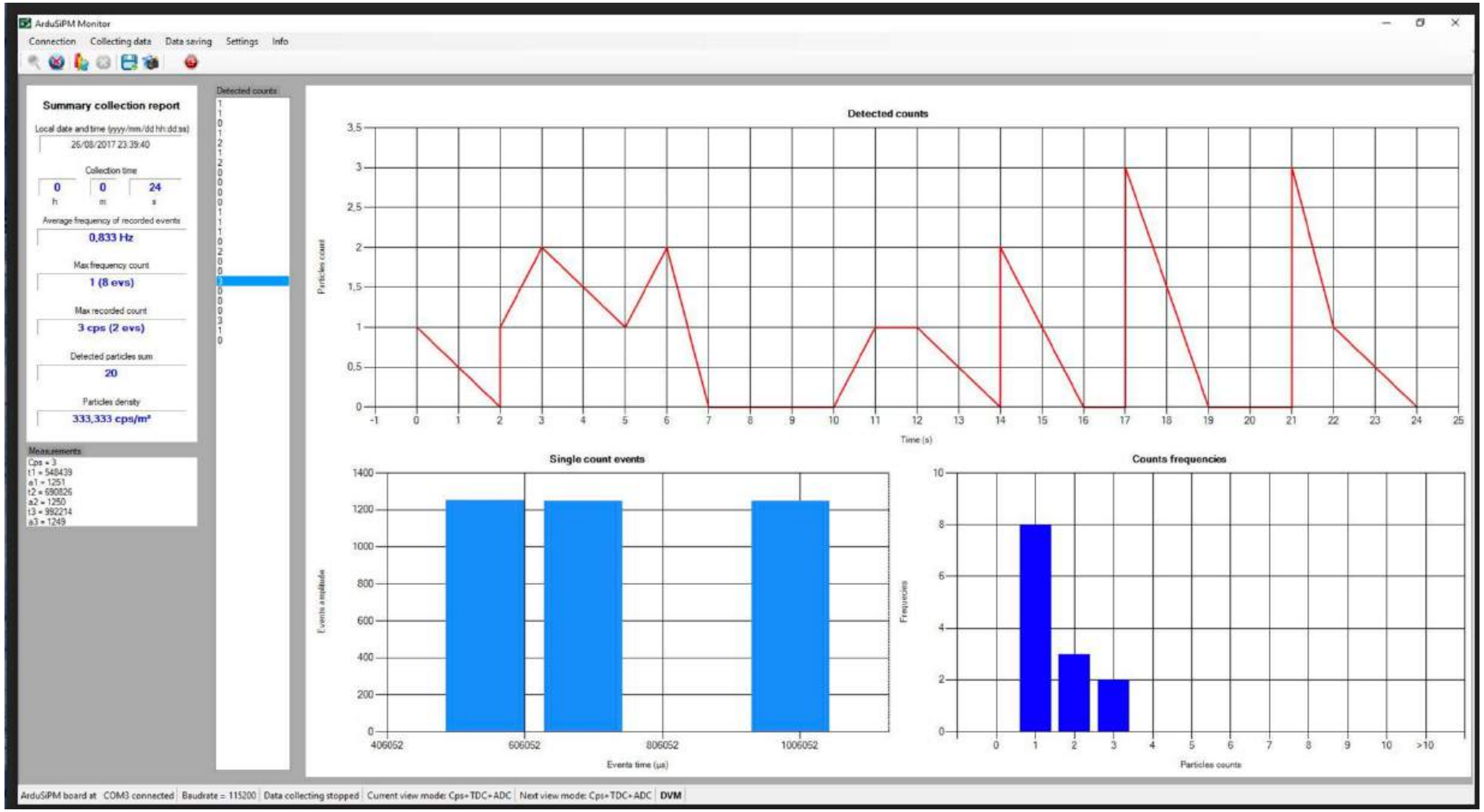
OFFERTA PER 16 ARDUSIPM 6.786,50 € + iva

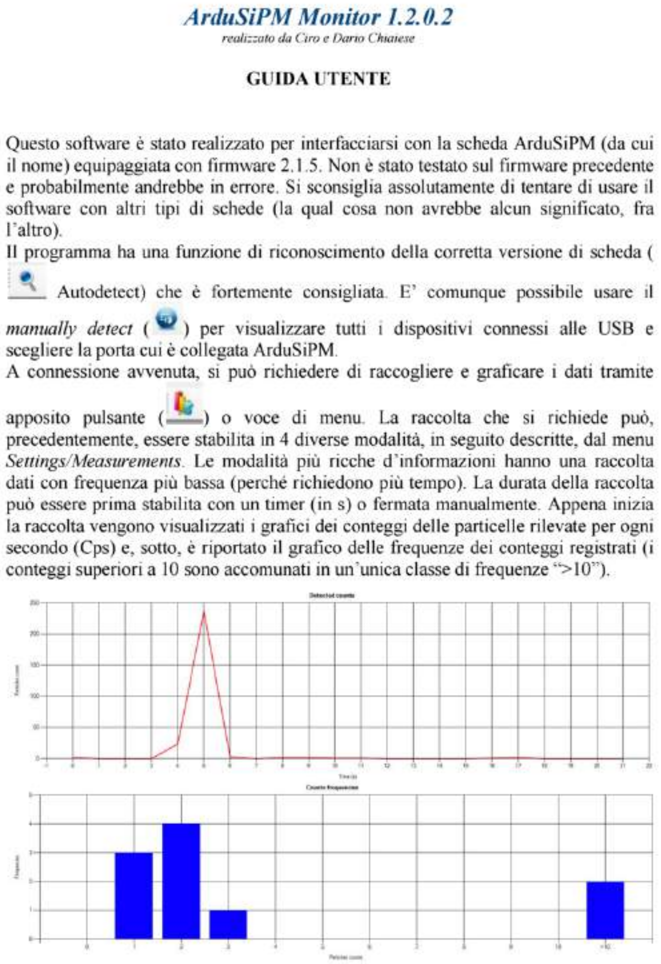
The ArduSiPM Data format is open…Users can write custom programs for data aquisition and visualization.

Example 1. **ArduSiPM Acquisition Tool** by Filippo Curti (Filippo.curti1@gmail.com)
(written in C#, fast running also with high rate, at the moment poor in documentation freeware)



Example 2. **ArduSiPM Monitor** by Ciro e Dario Chiaiese (cirochiaiese@gmail.com)
Written in VisualBasic (slow good for cosmic and low rate source) well documented.




ArduSiPM Monitor 1.2.0.2

realizzato da Ciro e Dario Chiaiese

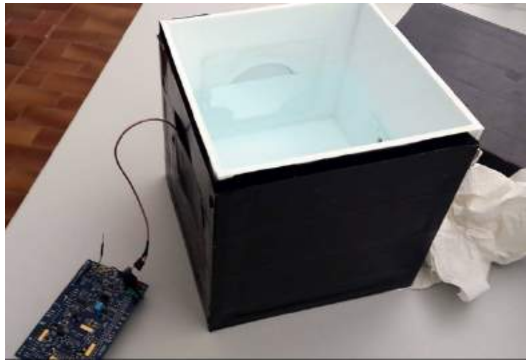
GUIDA UTENTE

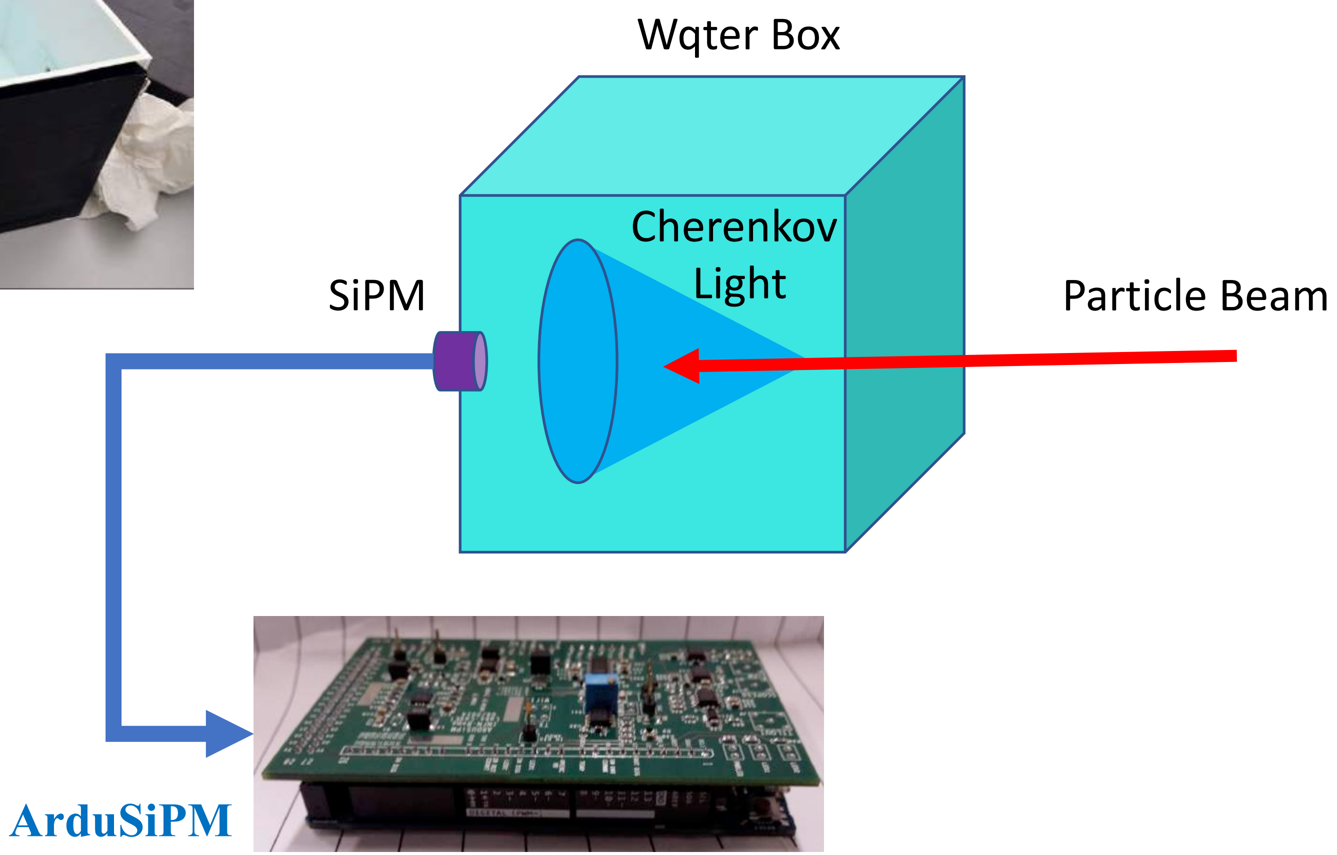
Questo software è stato realizzato per interfacciarsi con la scheda ArduSiPM (da cui il nome) equipaggiata con firmware 2.1.5. Non è stato testato sul firmware precedente e probabilmente andrebbe in errore. Si sconsiglia assolutamente di tentare di usare il software con altri tipi di schede (la qual cosa non avrebbe alcun significato, fra l'altro).
Il programma ha una funzione di riconoscimento della corretta versione di scheda (Autodetect) che è fortemente consigliata. E' comunque possibile usare il *manually detect* ( ) per visualizzare tutti i dispositivi connessi alle USB e scegliere la porta cui è collegata ArduSiPM.
A connessione avvenuta, si può richiedere di raccogliere e graficare i dati tramite apposito pulsante ( ) o voce di menu. La raccolta che si richiede può, precedentemente, essere stabilita in 4 diverse modalità, in seguito descritte, dal menu *Settings/Measurements*. Le modalità più ricche d'informazioni hanno una raccolta dati con frequenza più bassa (perché richiedono più tempo). La durata della raccolta può essere prima stabilita con un timer (in s) o fermata manualmente. Appena inizia la raccolta vengono visualizzati i grafici dei conteggi delle particelle rilevate per ogni secondo (Cps) e, sotto, è riportato il grafico delle frequenze dei conteggi registrati (i conteggi superiori a 10 sono accomunati in un'unica classe di frequenze ">10").

A School made Cherenkov light detector

(Winner of CERN "A beamline for schools"2017)

LICEO SCIENTIFICO STATALE T. C. ONESTI (prof Maria Rita Felici)





What time is it ?

UTC(2017)=TAI+37 sec

GPS=TAI+19 sec

International Atomic Time

From Wikipedia, the free encyclopedia

International Atomic Time (**TAI**, from the French name ***Temps Atomique International***[1]) is a high-precision atomic coordinate time standard based on the notional passage of proper time on Earth's geoid.[2] It is the basis for Coordinated Universal Time (UTC), which is used for civil timekeeping all over the Earth's surface, and for Terrestrial Time, which is used for astronomical calculations. As of 31 December 2016 when another leap second was added,[3] TAI is exactly 37 seconds ahead of UTC. The 37 seconds results from the initial difference of 10 seconds at the start of 1972, plus 27 leap seconds in UTC since 1972.

UTC (1958)=TAI Time

Coordinated Universal Time

From Wikipedia, the free encyclopedia

Coordinated Universal Time (French: *Temps universel coordonné*), abbreviated to **UTC**, is the primary time standard by which the world regulates clocks and time. It is within about 1 second of mean solar time at 0° longitude;[1] it does not observe daylight saving time. It is one of several closely related successors to Greenwich Mean Time (GMT). For most purposes, UTC is considered interchangeable with GMT, but GMT is no longer precisely defined by the scientific community.

The first Coordinated Universal Time was informally adopted on 1 January 1960.[2]

The system was adjusted several times, including a brief period where time coordination radio signals broadcast both UTC and "Stepped Atomic Time (SAT)" until a new UTC was adopted in 1970 and implemented in 1972.[2] This change also adopted leap seconds to simplify future adjustments.

Global Positioning System

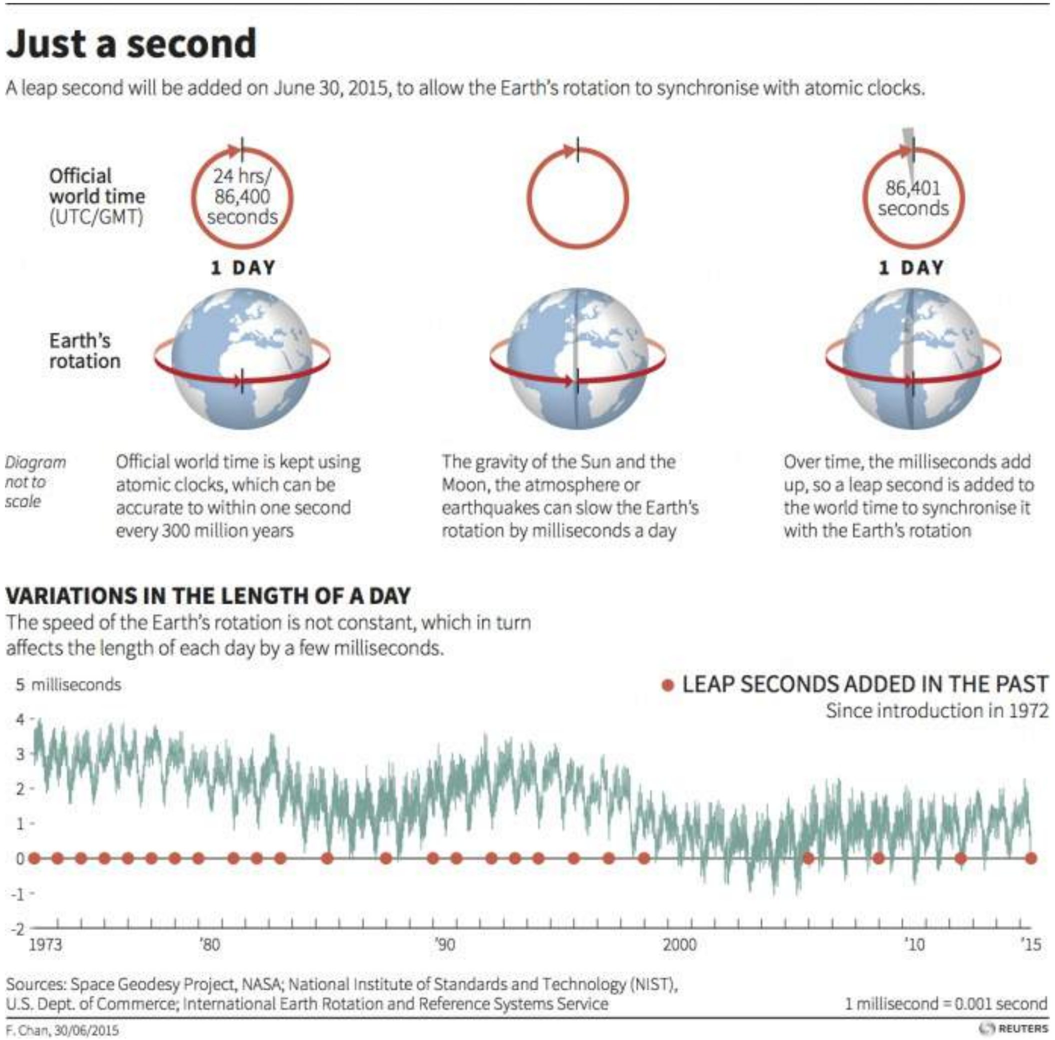
From Wikipedia, the free encyclopedia

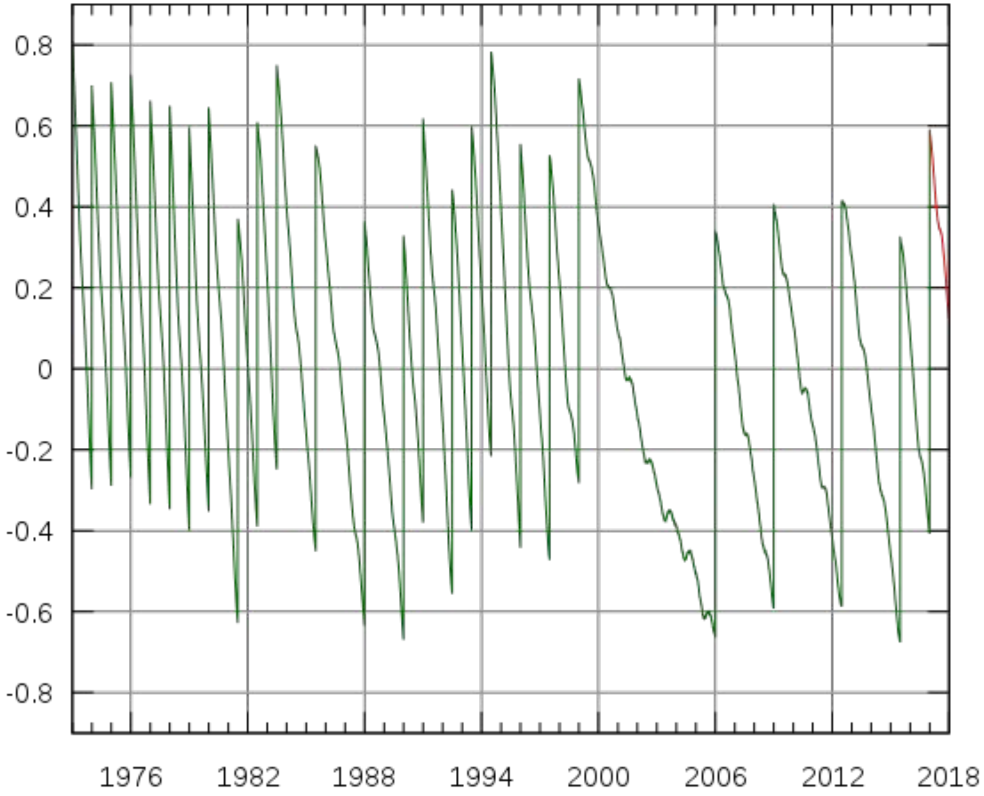
Universal Time (UTC), the atomic clocks on the satellites are set to GPS time (GPST; see the page of United States Naval Observatory). The difference is that GPS time is not corrected to match the rotation of the Earth, so it does not contain leap seconds or other corrections that are periodically added to UTC. GPS time was set to match UTC in 1980, but has since diverged. The lack of corrections means that GPS time remains at a constant offset with International Atomic Time (TAI) (TAI − GPS = 19 seconds). Periodic corrections are performed to the on-board clocks to keep them synchronized with ground clocks.[126]

The GPS navigation message includes the difference between GPS time and UTC. As of January 2017, GPS time is 18 seconds ahead of UTC because of the leap second added to UTC on December 31, 2016.[127] Receivers subtract this offset from GPS time to calculate UTC and specific timezone values. New GPS units may not show the correct UTC time until after receiving the UTC offset message. The GPS-UTC offset field can accommodate 255 leap seconds (eight bits).

UTC (1980)=GPS Time

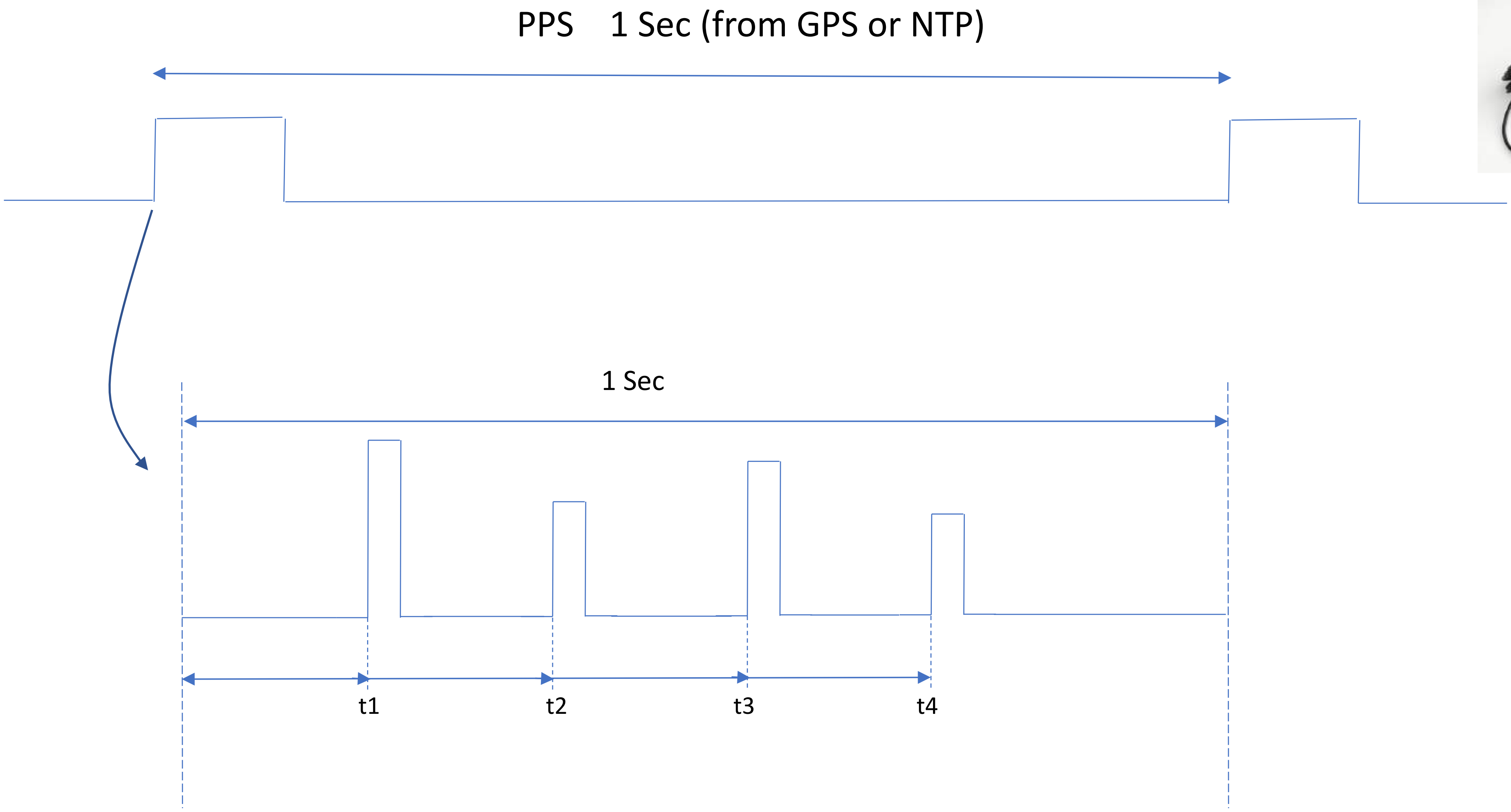
Leap Second





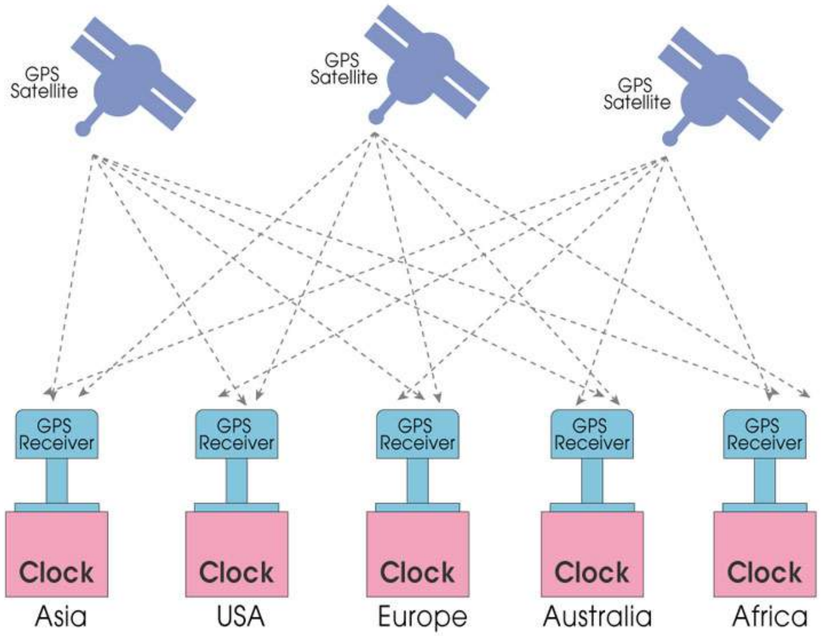
Graph showing the difference between UT1 and UTC. Vertical segments correspond to leap seconds.

Synchronization with ArduSiPM



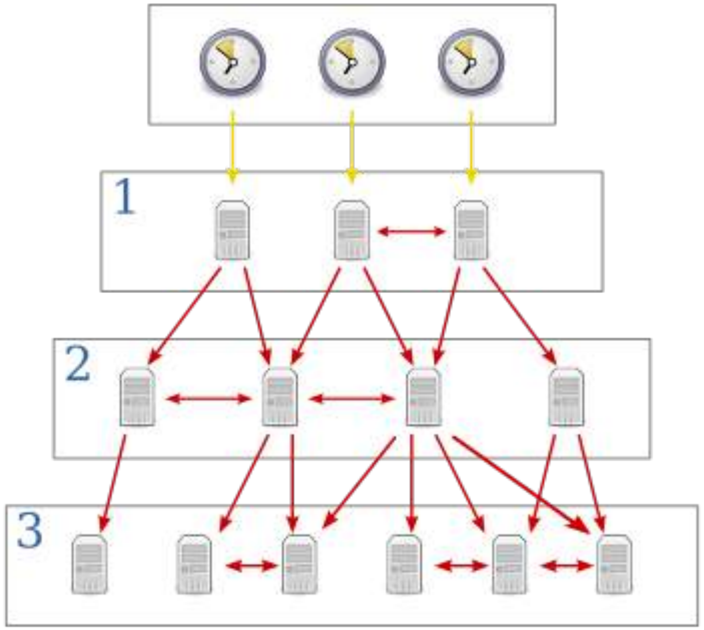
Precise time distribution methods

GPS time (from Global Position Systems satellite)



Low cost GPS module (<30 Euro) 25 ns precision

Network Time Protocol (from internet)

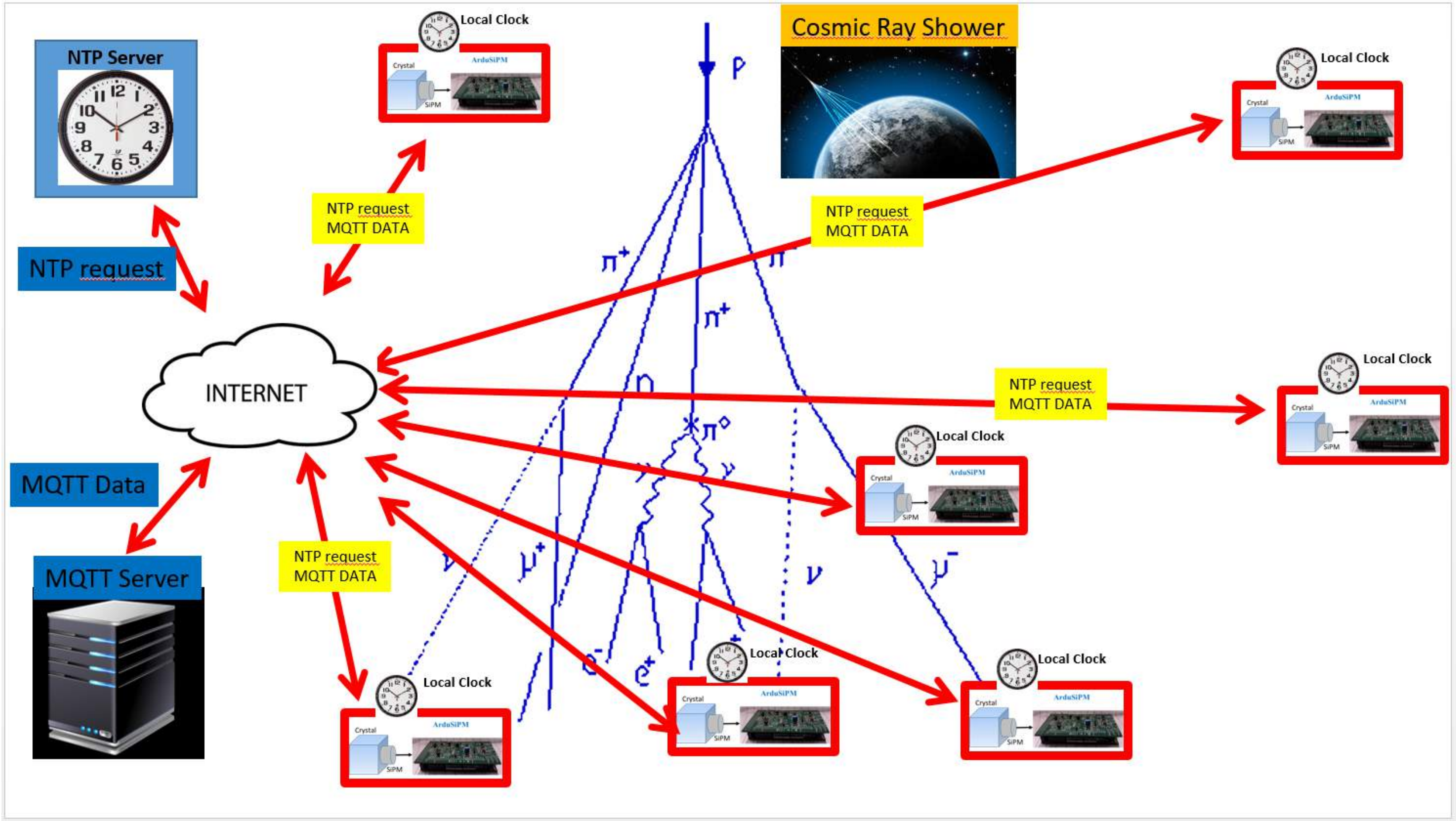


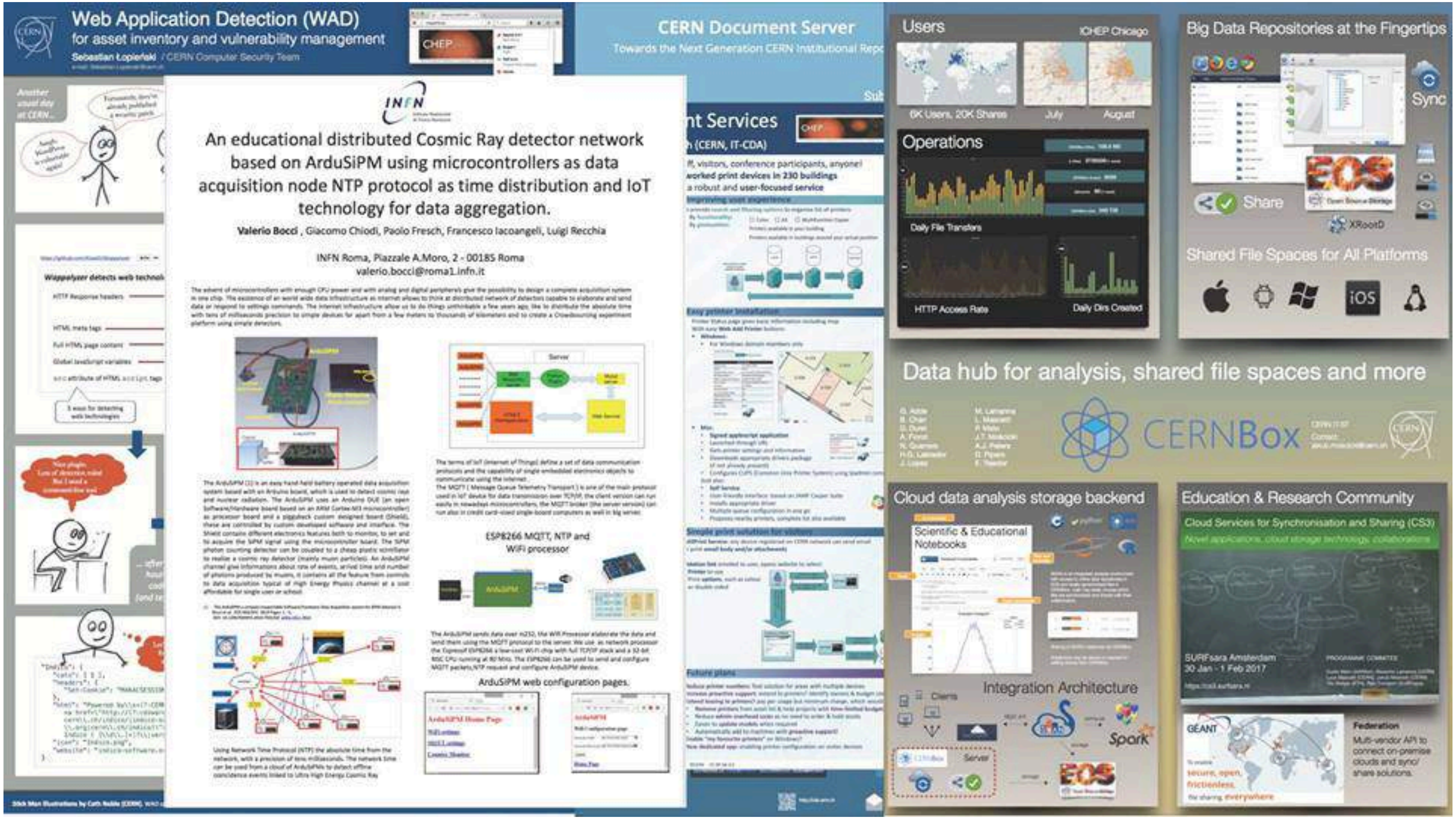
Low cost wi-fi internet processor precision <10 ms

Search of cosmic Airshower in a wide area using ArduSiPM

Multiple ArduSiPM can be used for the research extended AirShower

The advent of microcontrollers with enough CPU power and with analog and digital peripherals give the possibility to design a complete acquisition system in one chip. The existence of an world wide data infrastructure as internet allows to think at distributed network of detectors capable to elaborate and send data or respond to settings commands. The internet infrastructure allow us to do things unthinkable a few years ago, like to distribute the absolute time with tens of milliseconds precision to simple devices far apart from a few meters to thousands of kilometers and to create a Crowdsourcing experiment platform using simple detectors.




Web Application Detection (WAD)
for asset inventory and vulnerability management
Sebastian Łopieński / CERN Computer Security Team
An educational distributed Cosmic Ray detector network based on ArduSiPM using microcontrollers as data acquisition node NTP protocol as time distribution and IoT technology for data aggregation.
Valerio Bocci, Giacomo Chiodi, Paolo Fresch, Francesco Iacoangeli, Luigi Recchia
INFN Roma, Piazzale A.Moro, 2 - 00185 Roma
valerio.bocci@roma1.infn.it
ESP8266 MQTT, NTP and WiFi processor
ArduSiPM web configuration pages.
CERN Document Server
Users
Operations
Big Data Repositories at the Fingertips
Sync
Share
Shared File Spaces for All Platforms
Data hub for analysis, shared file spaces and more
CERNBox
Cloud data analysis storage backend
Scientific & Educational Notebooks
Integration Architecture
Education & Research Community
Cloud Services for Synchronisation and Sharing (CS3)

ArduSiPM Social Media

http://www.roma1.infn.it/conference/ArduSiPM/

https://www.facebook.com/groups/ardusipm/

@ardusipm

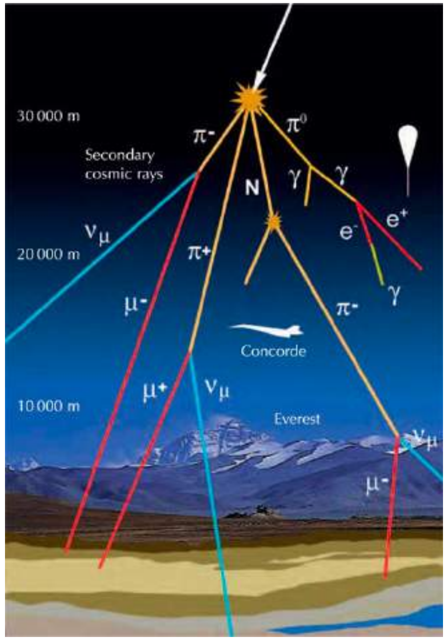
@ArduinoSiPM

https://groups.google.com/forum/#!forum/ardusipm

Exercitation with ArduSiPM

rate Measuraments of Cosmic ray backroud and natural radioactivity of some common objects.

Cosmic Ray



Camping lantern
(Welsbach mantle with Thorium)

Uranium Glass Beads Necklace

Plate with Uranium Glaze

1. Bananas: As mentioned above, bananas contain about 3,520 picocuries of radiation per kilogram (pCi/kg). They are one of the more radioactive foods we eat on a daily basis.
2. Potatoes: Your average white potato contains 3,400 pCi/kg.
3. Carrots: Carrots and potatoes together will net you 6,800 pCi/kg, as carrots carry an equivalent amount of radioactive potassium to potatoes.
4. Lima Beans: Lima beans, like kidney beans, contain 4,640 pCi/kg due to high levels of potassium (as well as a little bit of radium for good measure). Kids, this likely won't be a valid argument against eating them, however.

5. Red Meat: Again, potassium is the culprit here. That steak will get you about 3,000 pCi/kg.
6. Low-sodium Salt: Because it's made with potassium chloride instead of straight sodium, low-sodium salt also contains roughly 3,000 pCi/kg.
7. Beer: Yes, beer. Stay strong, though, as beer only contains a trifling amount -- only 390 pCi/kg -- that's about 10 times less that of a banana.
8. Brazil Nuts: At more than 6,600 pCi/kg, Brazil nuts are the most radioactive food the average person consumes due to their high levels of radium present in the tree's root system, as well as high levels of potassium. Not to fear, though: The human body retains almost none of the radiation consumed while eating Brazil nuts. Paradoxically, these radioactive nuts are thought to help prevent breast and prostate cancer thanks to their high levels of selenium.