



Frontier Detectors for Frontier Physics

16th Pisa Meeting on Advanced Detectors

26 May – 1 June 2024 - La Biodola, Isola d'Elba (Italy)

In december 2012
we lost a

colleague

scientist

inventor

co-founder of the Pisa meeting

friend

Aldo Menzione



In december 2014

The Executive Board of the
Frontier Detector for Frontier Physics
decided chorally the institution of
the "*Aldo Menzione*" Prize

The Prize is awarded
in coincidence with the
Pisa Meeting on Advanced Detectors,
to distinguished scientists
who have contributed to the
development of detector techniques,
Hard and Soft applications in Physics
with outstanding achievements.



Before to proceed...

Mosè Mariotti

will give us his personal memory of

Aldo

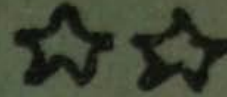
In Honor of Aldo

on the occasion of assigning the
Aldo Menzione Prize 2024

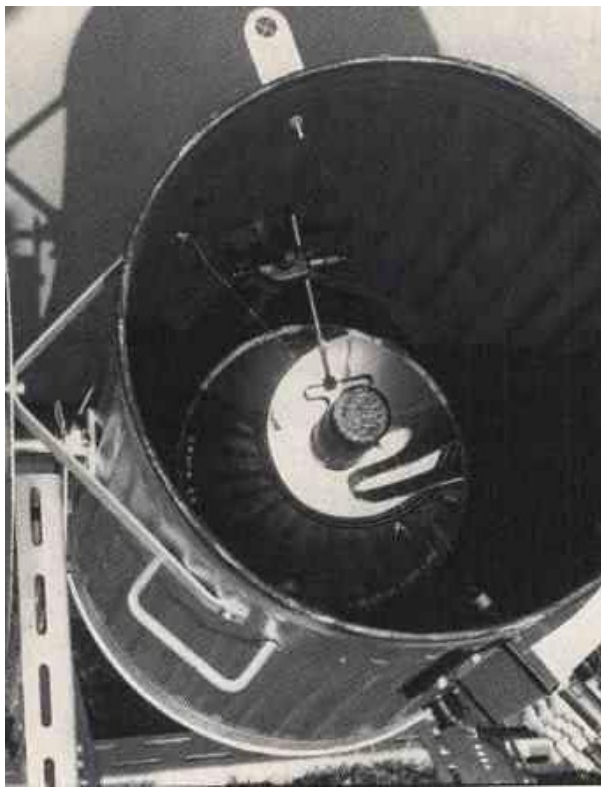
Mosè Mariotti

16th Pisa Meeting on Advanced Detectors
La Biodola, Elba Island
May 26 – June 1, 2024

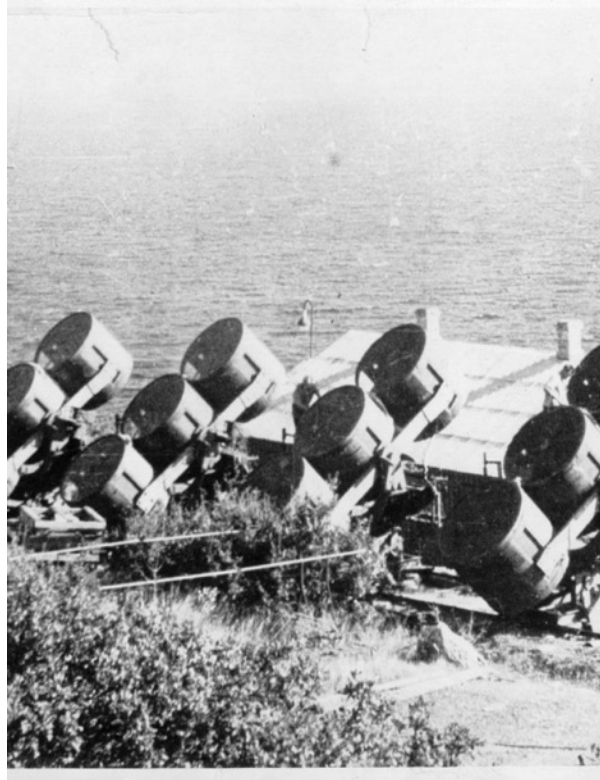
Cherenkov
Light
Ultraviolet
Experiment



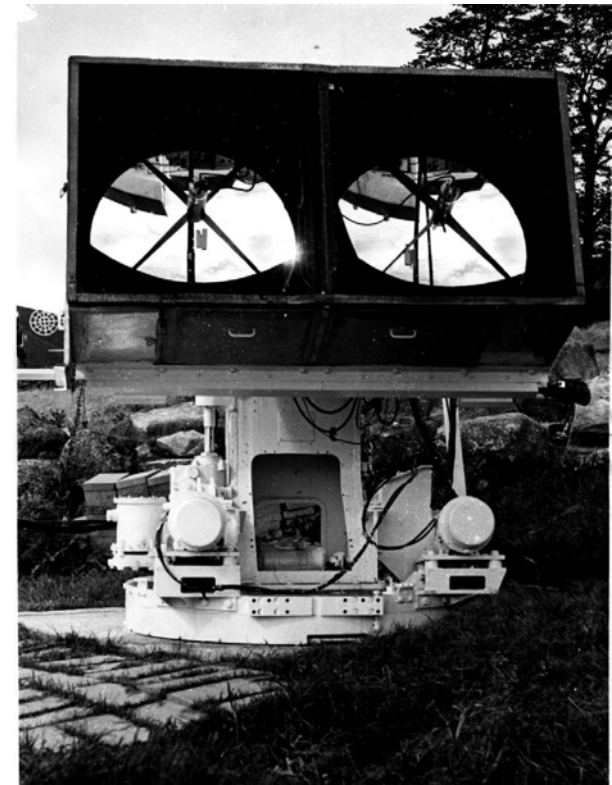
16th Pisa Meeting on Advanced Detectors
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*1953 a trash can,
60 cm mirror
Galbraith and Jelly*



*Crimea Experiment
1959-1965, Chudakov,
et al.,*



*~1962-66 University College,
Dublin group led by Neil
Porter (in collaboration with
J.V.Jelley)*

The context of gamma ray Astro-
particle physics

telescopes
made by
searchlight
reflectors

Trevor weeks



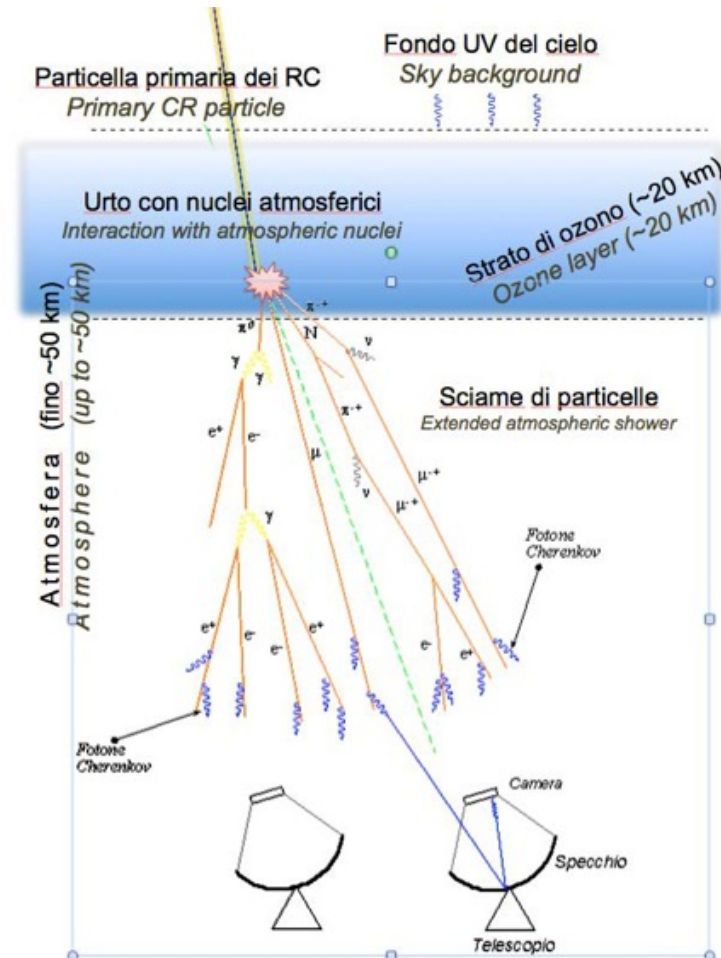
It. Hopkins Observatory proceeds at an astonishing pace. Per-Nunn systems are now installed and operating and the truck is scheduled to arrive by the end of next month. In preparation for installation, Trevor Weekes (above, left) and George Riek are conducting tests with two movable searchlight reflectors. Looking through the reflectors, rock droppings at the base of Mt. Hopkins are visible upside

the CLUE idea

Cherenkov Light Ultraviolet Experiment



- take a “modern” RICH detector
- put in the focal plane of telescope and create an imaging detector
- If it is **sensitive only in the UV is even better** thanks to the ozone layer the atmosphere will be a calorimeter background free from starlight
- An array of 64 telescope at high altitude can be feasible with modest investments telescopes will do a great job!



Very personal interlude

- **1986/87: In search of a "beautiful and exciting" master thesis.**
- I was drawn to the idea of CLUE, also because of the possibility of doing a nice and complete experimental thesis... from mechanics electronics optics to data analysis.
- However also work in in the first silicon vertex detector in hadron colliders wea exciting.
- Aldo's words that definitively convinced me were:.....



Nastassja Kinski is filming a movie at “Campo Imperatore”



the CLUE experiment will be done in Hawaii

Here the site of “Campo Imperatore”



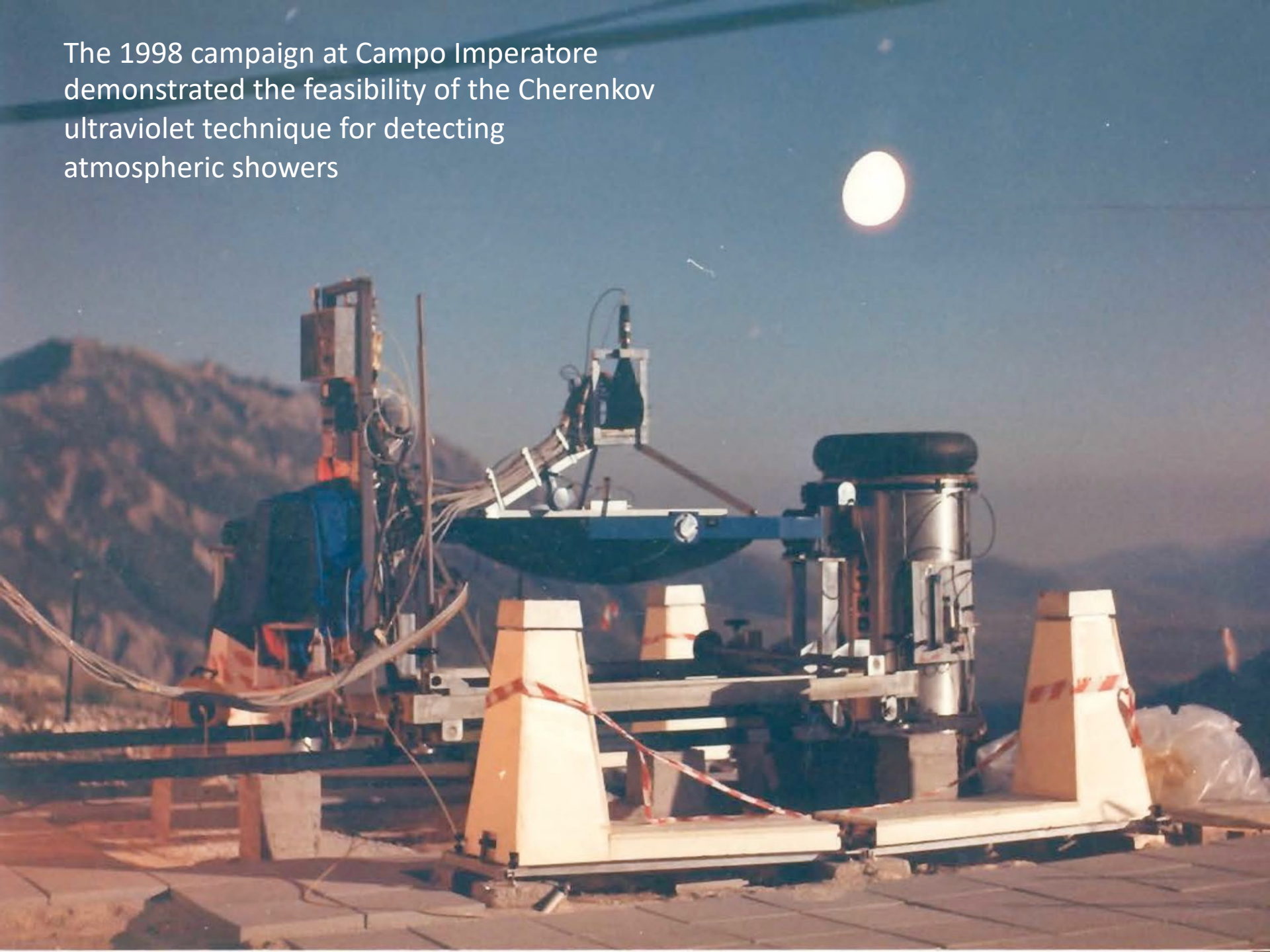
Campo Imperatore after a month





ATHOS

The 1998 campaign at Campo Imperatore demonstrated the feasibility of the Cherenkov ultraviolet technique for detecting atmospheric showers





The original proposal was a 64 telescope in Hawaii: here the Site survey made by Aldo, Gigi et al



It was commissioned and paid an environmental impact study however did not work for the permission

In the mean time..

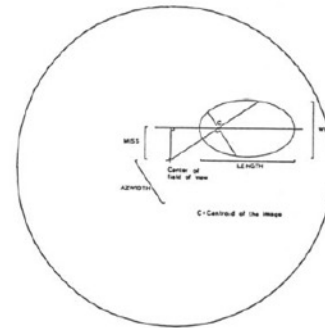


Fig. 2. Definition of image parameters.

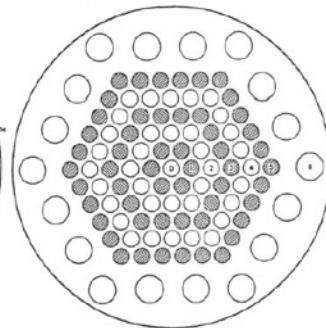


Fig. 3. The layout of the photomultipliers in the focal plane of the reflector. The inner pixel spacing is 0.25° . The numbers refer to the zones, the convention used to designate the position of the images relative to the center of the camera.

Observations of TeV Photons at the Whipple Observatory

R. C. Lamb,¹ C. W. Akerlof,² M. F. Cawley,³ E. Colombo,⁴ D. J. Fegan,⁵ A. M. Hillas,⁶
P. W. Kwok,⁴ M.J.Lang,⁴ D. A. Lewis,¹ D. J. Macomb,¹ D. I. Meyer,² K. S. O'Flaherty,⁵
P.T.Reynolds,⁴ G. Vacanti,¹ and T.C.Weekes⁴

¹Iowa State University, Ames, IA 50011 USA

²University of Michigan, Ann Arbor, MI 48109 USA

³St. Patrick's College, Maynooth, Co. Kildare, IRELAND

⁴Harvard-Smithsonian Center for Astrophysics, P.O. Box 97, Amado, Arizona 85645 USA

⁵University College, Dublin, IRELAND

⁶University of Leeds, Leeds, UK

Abstract

The Whipple Observatory 10 m gamma-ray telescope has been used to search for TeV gamma-ray emission from a number of objects. This paper reports observations of six galactic and three extragalactic objects using the Cherenkov image technique. With the introduction of a high-resolution camera ($1/4^\circ$ pixel) in 1988, the Crab Nebula was detected at a significance level of 20σ in 30 hours of on-source observation. Upper limits at a fraction of the Crab flux are set for most of the other objects, based on the absence of any significant dc excess or periodic effect when an *a priori* Monte Carlo determined imaging selection criterion (the "azwidth cut") is employed. There are weak indications that one source, Hercules X-1, may be an episodic emitter. The Whipple detection system will be improved shortly with the addition of a second reflector 11 m in diameter (GRANITE) for stereoscopic viewing of showers. The combination of the two-reflector system should have a signal-to-noise advantage of 10^3 over a simple nonimaging Cherenkov receiver.

*First gamma ray source ever
detected 1989*

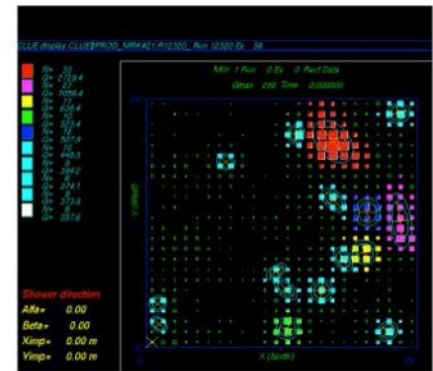
INFN answer : 9 telescopes in Canarian Island



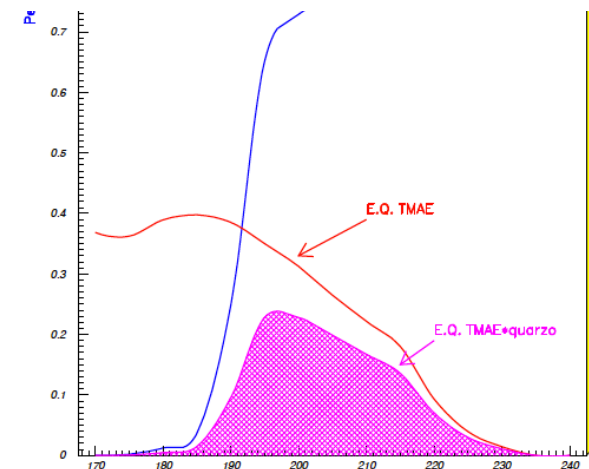
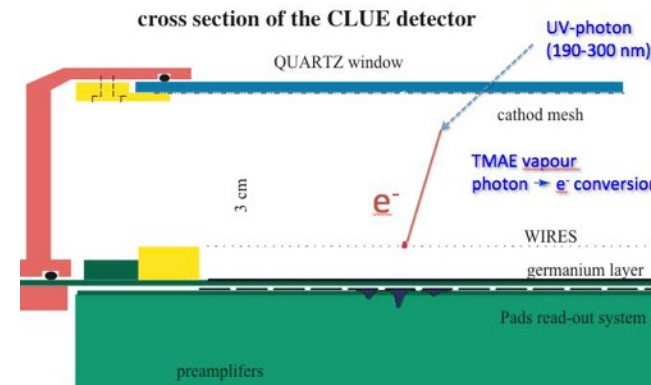








Femmina di evento rivelato da CLUE. Ogni fotone Cherenkov





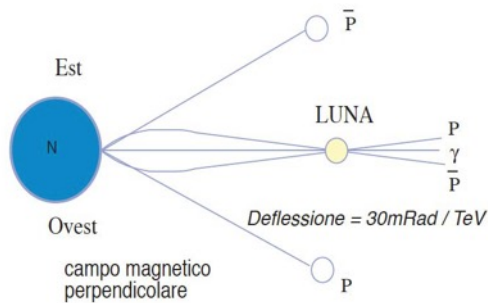


Figura 7.1: Lo spettrometro formato dalla Luna e dal campo geomagnetico

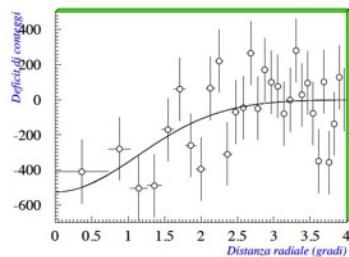


Figura 7.3: Deficit di conteggi intorno la posizione dell'ombra della Luna, ottenuto dalla simulazione sottraendo gli eventi ricostruiti con l'assorbimento della Luna (on-source) e senza (off-source).

CRAB

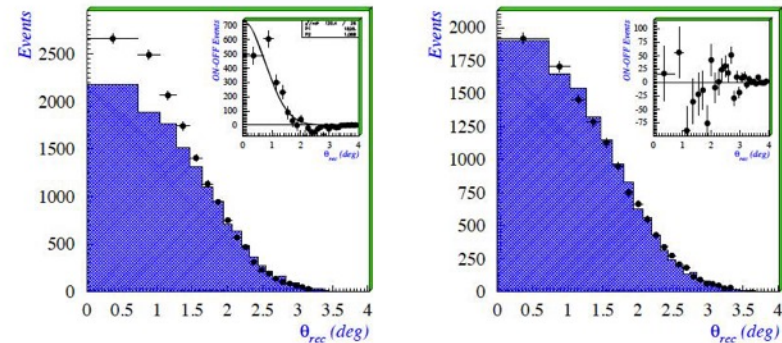
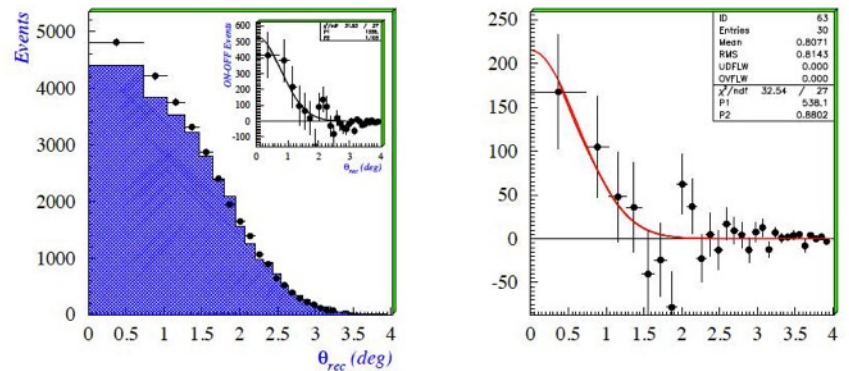


Figura 6.4: Analisi Mrk421: a) Distribuzione dell'angolo θ per eventi ON e OFF-source in un periodo di attività della sorgente. La figura piccola mostra la differenza ON-OFF. a) Distribuzione dell'angolo θ per eventi ON e OFF-source in un periodo di non attività. La figura in piccolo mostra la differenza ON-OFF.

Mrk421

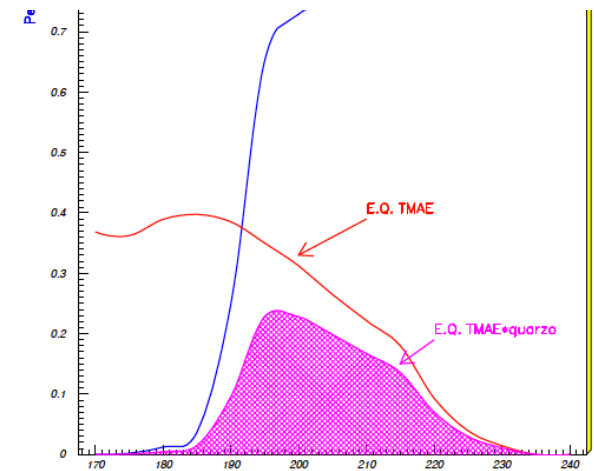


The pilot experiment concluded in 1998, having demonstrated that the reconstruction of atmospheric showers through the detection of ultraviolet Cherenkov light was indeed possible



Conclusion of CLUE:

If TMAE had been sensitive up to 300 nm...



CLUE would have made history in the field of ground based cosmic ray detectors

ALDO Legacy:

The Italian "Cherenkov" community is undoubtedly a product of the CLUE experiment, having emerged as a prominent player in the international Astro-Particle physics scene since 2003 with the MAGIC experiment (I was the spokesman of the MAGIC experiment when Aldo leaved us)



ALDO Legacy:

The future goes towards Aldo suggestions

- Modern camera with more advanced detectors for better imaging
- Advanced Trigger
- A large array





16th Pisa Meeting on Advanced Detectors 26 May – 1 June 2024



Selection Procedure

A Search Committee is appointed by the *Frontier Detectors for Frontier Physics* Executive Board in order to select a Research field and to identify possible candidates in that field.

The final decision is taken during a plenary session of the *Frontier Detectors for Frontier Physics* General Assembly.



Aldo Menzione Prize

1st edition - 2015

13th Pisa Meeting on Advanced Detectors

The Executive Board
of the Frontier Detector for Frontier Physics Association
is proud to announce that
the "Aldo Menzione" Prize for 2015
has been awarded to

David R. Nygren

for the Time Projection Chamber (TPC)

and

Fabio Sauli

for the Gas Electron Multiplier (GEM)

Frontier Detectors for Frontier Physics



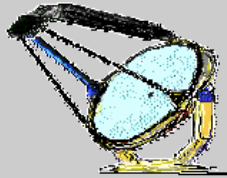
13th Pisa Meeting on Advanced Detectors
La Biodola - Isola d'Elba - May 24-30, 2015

"Aldo Menzione" Price

awarded to

David R. Nygren

for the Time Projection Chamber (TPC)



Frontier Detectors for Frontier Physics



13th Pisa Meeting on Advanced Detectors
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for the Gas Electron Multiplier (GEM)





Aldo Menzione Prize

2nd edition - 2018

14th Pisa Meeting on Advanced Detectors

The Executive Board
of the Frontier Detector for Frontier Physics Association
is proud to announce that
the "Aldo Menzione" Prize for 2018
has been awarded to

Marcello Giorgi

*for the silicon minivertex systems devoted to $e+e-$ physics
(ALEPH and BaBar)*

and

Carl Haber

*for the silicon minivertex tracking system in p - \bar{p} collider
(CDF)*

Frontier Detectors for Frontier Physics



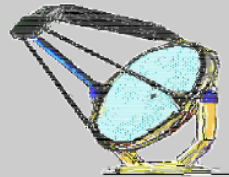
14th Pisa Meeting on Advanced Detectors
La Biodola - Isola d'Elba - May 27-June 2, 2018

"Aldo Menzione" Prize

awarded to

Marcello Giorgi

for the silicon minivertex systems
devoted to e^+e^- physics (ALEPH and BaBar)



Frontier Detectors for Frontier Physics



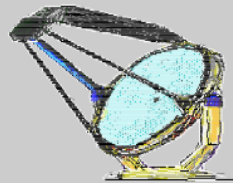
14th Pisa Meeting on Advanced Detectors
La Biodola - Isola d'Elba - May 27-June 2, 2018

"Aldo Menzione" Prize

awarded to

Carl Haber

for the silicon minivertex tracking
system in $p\text{-}\bar{p}$ collider (CDF)



14th Pisa Meeting on Advanced Detectors – 22-28 May 2022



Aldo Menzione Prize

3rd edition - 2022

15th Pisa Meeting on Advanced Detectors

The Executive Board
of the Frontier Detector for Frontier Physics Association
is proud to announce that
the "Aldo Menzione" Prize for 2022
has been awarded to

René Brun

for *PAW & ROOT*, fundamental tools for experimental data handling

and

Pantaleo Raimondi

for *Crab Waist*, a crucial tool for microbeams in e⁺ e⁻ colliders

Frontier Detectors for Frontier Physics



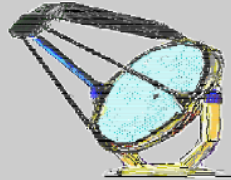
15th Pisa Meeting on Advanced Detectors
La Biodola - Isola d'Elba - May 22-28, 2022

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awarded to

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for *Crab Waist*, a crucial tool
for microbeams in $e^+ e^-$ colliders



Frontier Detectors for Frontier Physics



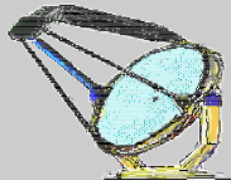
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La Biodola - Isola d'Elba - May 22-28, 2022

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for experimental data handling





Aldo Menzione Prize

4th edition - 2024

16th Pisa Meeting on Advanced Detectors

As per tradition

Donata Foà (*Bichina*)

the wife of Aldo

will deliver the commemorative plates
to the winners
and they will be introduced
by friend colleagues

**The winners will be invited on the stage
at the end of presentations**



Aldo Menzione Prize

4th edition - 2024

16th Pisa Meeting on Advanced Detectors

The Executive Board
of the Frontier Detector for Frontier Physics Association
is proud to announce that
the "Aldo Menzione" Prize for 2024
has been awarded to

Ugo Amaldi

Pier Andrea Mandò

Kent Irwin



Frontier Detectors for Frontier Physics

"Aldo Menzione" Prize
awarded
to

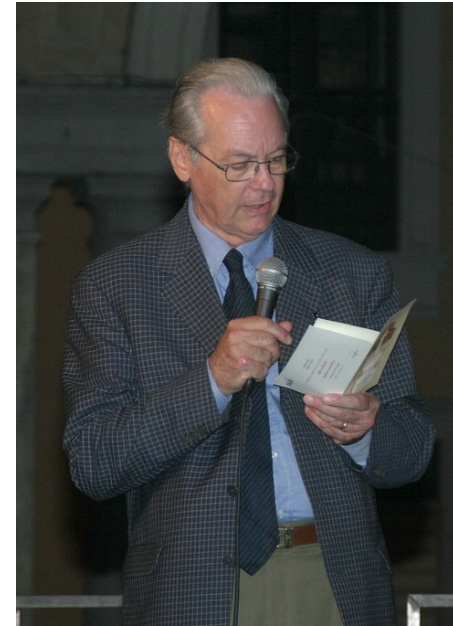
Ugo Amaldi
for applications of nuclear techniques
to oncological hadrontherapy
(CNAO - Pavia)

Introduced by Giusy Bisogni



Aldo Menzione Prize 2024

- Ugo Amaldi graduated at the Sapienza University in 1957
- Director of research at the Istituto Superiore di Sanità (ISS), where he has worked on research in nuclear and subnuclear physics and **on the use of X rays in the therapy of tumours**
- Appointed at CERN in 1973 as Senior Scientist, he has studied for twenty years the properties of protons and neutrinos and the unification of fundamental forces
- Between 1980 and 1993 he has founded and directed, at the CERN LEP accelerator, the DELPHI Collaboration composed of about 500 physicists from 40 laboratories of 20 countries
- Since 1991 full professor at the University of Florence and then Milan. Until 2006 he has taught Medical Physics at the University of Milano Bicocca



Ugo Amaldi



Aldo Menzione Prize 2024

- Since 1992 Ugo Amaldi has been President of TERA Foundation, which aims at developing, in Italy and in Europe, **hadrontherapy**, a special radiotherapy that spares healthy tissues and can control (with carbon ions) radioresistant tumours.
- With TERA he worked for ten years on the project of the National Centre of Adroterapia Oncologica (CNAO).
- In 2008 he contributed to create A.D.A.M. (Applications of Accelerators and Detectors to Medicine), for the construction of linacs for hadron therapy, and EBAMed (External Beam Ablation Medical) for the cure of heart arrhythmias.

CERN/PPE/UA/eo

25 Maggio 1991

Per un Centro di
Teleterapia con Adroni

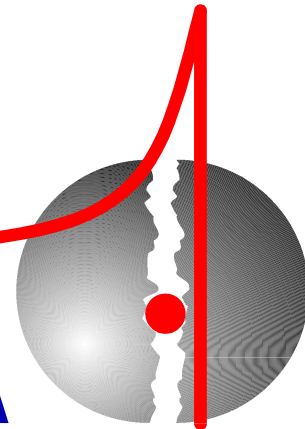
Ugo Amaldi

CERN e Università di Milano

Giampiero Tosi

Ospedale di Niguarda, Servizio di Fisica Sanitaria,
e Università di Milano

TERA





Obtained in 2002 the approval from the Ministry of Public Health, the construction of CNAO began in 2005 and it started operating in Pavia in 2010, with INFN playing a key role in its establishment.

Since the first patient underwent irradiation in September 2011, over 5000 patients have received treatment thus far.





Frontier Detectors for Frontier Physics

"Aldo Menzione" Prize
awarded
to

Pier Andrea Mandò
for applications of nuclear techniques
to environmental pollution and cultural heritage studies
(LABEC - Firenze)

Introduced by Valeria Rosso

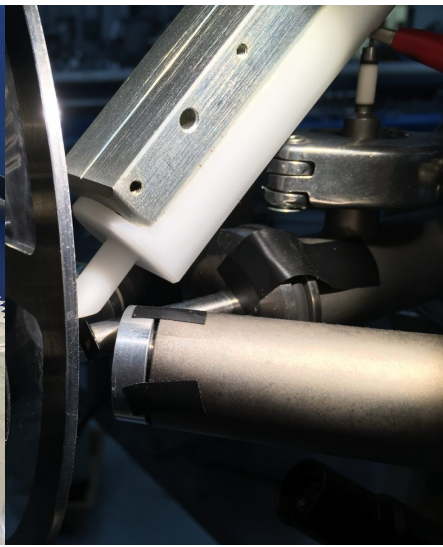
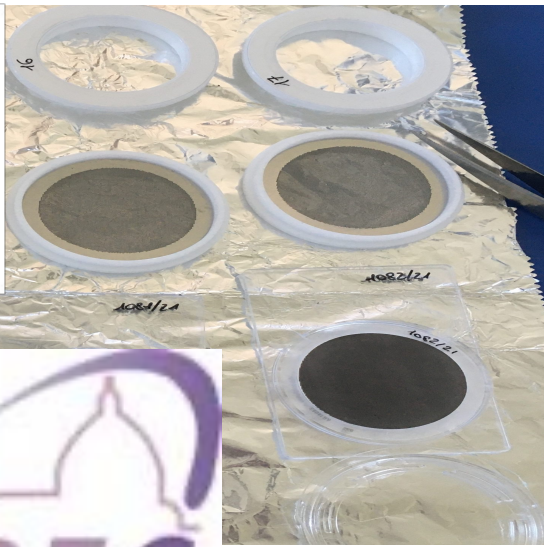


Aldo Menzione Prize 2024



mid-80s in Arcetri: the re-located KN3000 required an ongoing maintenance!

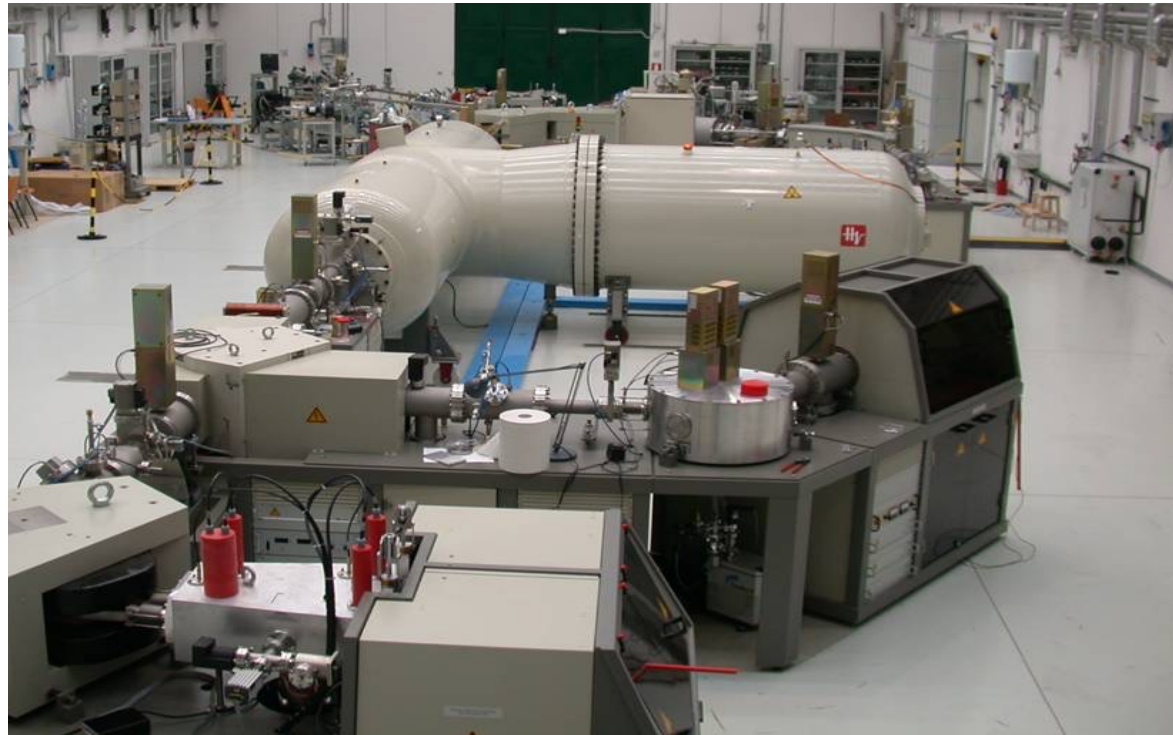
16th Pisa Meeting on Advanced Detectors 26 May – 1 June 2024



IBA analysis of samples of the atmospheric particulate matter

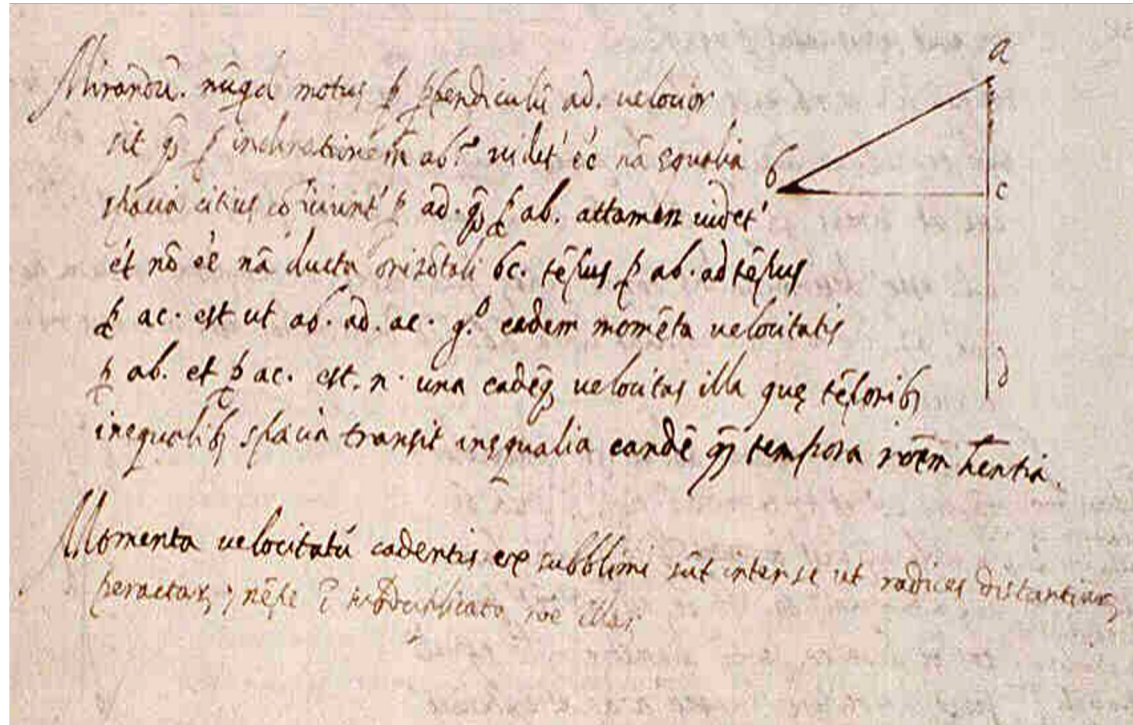


Laboratorio di
Tecniche Nucleari
per l'**A**mbiente e
i **BE**ni **C**ulturali





**Aldo Menzione
Prize 2024**



**Study of Galileo's
manuscript folios on
the subject of motion**

**PIXE analysis of Madonna of
the yarnwinder depicted by
Leonardo da Vinci**



Frontier Detectors for Frontier Physics

"Aldo Menzione" Prize
awarded
to

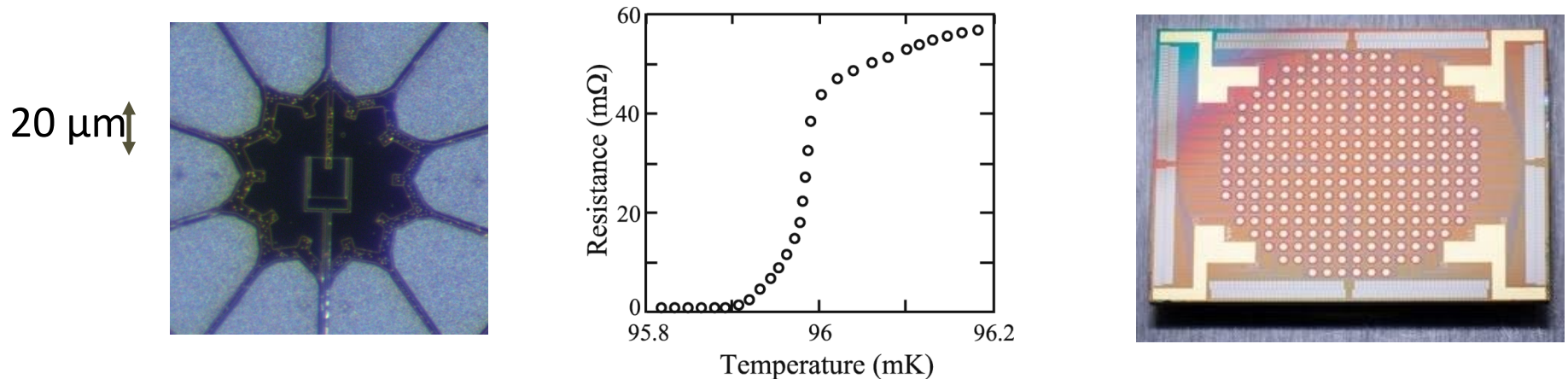
Kent Irwin

for the TES sensors with the negative
electrothermal feedback
and the SQUID multiplexing
(Stanford University)

Introduced by Giovanni Signorelli

A fantastic detector, impossible to

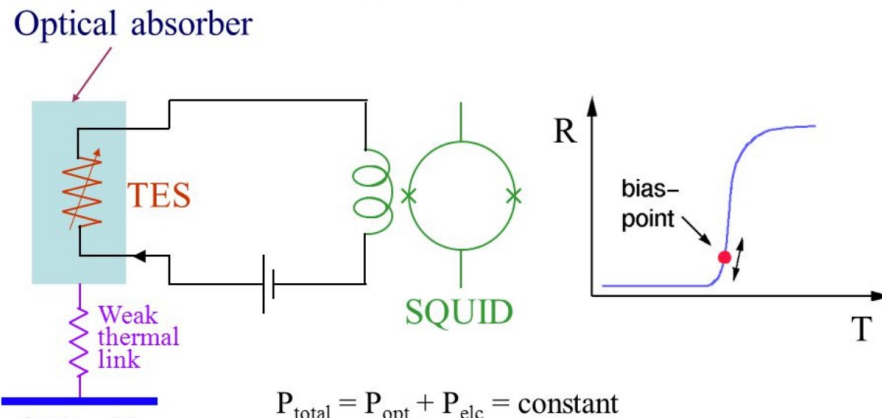
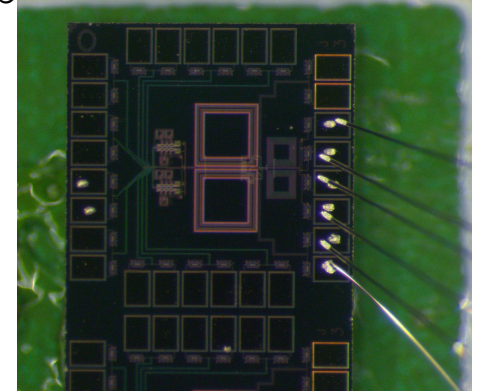
- Suppose you find a **fantastic detector** (ultra sensitive, capable in detecting tiny amount of energy) and at the same time has a **very low noise** because of its intrinsic characteristics
- But: your detector has a few seemingly unavoidable problems:
 - it is **unstable**, i.e. very difficult to read it more than once
 - its characteristics are very sensitive to the **fabrication** procedure
 - it is **extremely tiny** to be of any practical application
- **This was the situation** that Kent Irwin faced when he started his studies of **TES detectors**.
- **TES** (Transition-Edge sensors)



- An extremely sensitive **thermometer**: $R \rightarrow I, V$ $P = I^2 R$
- Ultra-sensitive voltage amplifiers led to an **unstable behavior**, due to a feedback
- Each pixel had its **own transition temperature**
 - large arrays, needed to do “physics” **would not work**

A fruitful synergy

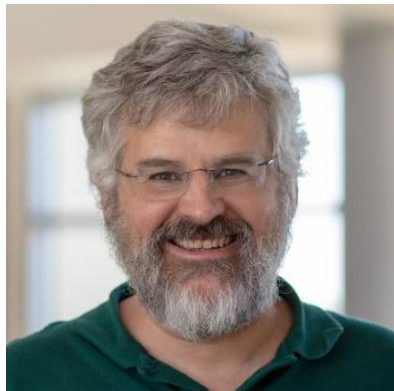
- Kent Irwin realized that using a SQUID amplifier both these problems could be overcome
- A SQUID is an exquisite magnetic field sensor, invented in the '60s, that exploits
 - Josephson Junction
 - Quantum interference
- An extremely small current is amplified to a detectable voltage



$$P_{\text{ott}} + \frac{V^2}{R} = C \frac{dT}{dt} + G(T - T_0)$$

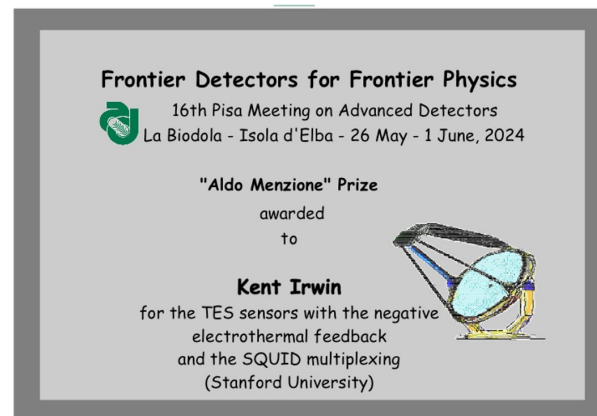
- Voltage-biasing a TES had two breakthrough consequences:
 - A negative feedback stabilizes the TES
 - Through the Joule self-heating each TES is biased on its own transition → possible to use large arrays!
- Found a way to readout many detectors with a single SQUID → Multiplexing
- Led to practical superconducting detectors arrays for
 - neutrino properties measurement, dark matter search, x-ray spectroscopy, CMB Cosmic Microwave Background, quantum information science, etc.
 - CDMS, Athena, APEX-SZ, Atacama Cosmology Telescope, South Pole Telescope, PolarBear, ...

Prof. Kent Irwin



- Kent D. Irwin
 - PhD, Stanford
 - NIST, Boulder
 - former Professor of Astrophysics at University of Colorado Boulder
 - Professor of Physics, Particle Physics and Astrophysics, Photon Science at Stanford University
 - Director of the Hansen Experimental Physics Lab

- Is awarded the **Aldo Menzione Prize** for devising the **TES with negative electro-thermal feedback** and the **SQUID multiplexing** which makes now possible to have large arrays of superconducting detectors for fundamental physics, particle physics, astrophysics and cosmology.





Aldo Menzione Prize


4th edition - 2024

16th Pisa Meeting on Advanced Detectors

Donata Foà (*Bichina*)

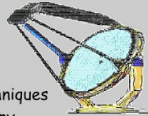
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to the winners

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awarded
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Ugo Amaldi

for applications of nuclear techniques
to oncological hadrontherapy
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Pier Andrea Mandò

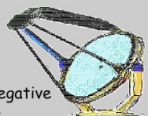
for applications of nuclear techniques
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Aldo Menzione



Aldo Menzione Prize

Thank you

Aldo



Presentazione di Giovanni