



CURRICULUM VITAE

Prof. Helios Vocca

1. Personal details

Surname: Helios

First names: Vocca

Sex: Male

Nationality: Italian

Place and date of birth: Rome, 29/12/1970

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2. Academic education (at university level)

Degree in physics

Title of degree at master level: Propagation of cosmic rays in the galactic disk

Institution: University of Perugia

Year: 1997

Title of diploma: Advanced course in Physics of aggregate materials

Institution: University of Perugia

Year: 1998

PhD in physics

Title of the dissertation: Thermal noise in stationary and non-stationary conditions for the Virgo interferometer

University: University of Perugia

Date awarded: 13/12/2002

3. Full career

| <i>Function or duty</i> | <i>Institution or employer</i> | <i>from (d/m/y)</i> | <i>to (d/m/y)</i> |
|---|--|---------------------|-------------------|
| Postdoc (on the development of the monolithic suspension for thermal noise minimisation for gravitational waves detectors). | Physics Department, University of Perugia | 01/11/2002 | 31/12/2005 |
| Researcher (not permanent) | INFN (Istituto Nazionale di Fisica Nucleare) | 01/01/2006 | 15/06/2009 |
| Researcher (not permanent) | Physics Department, University of Perugia | 16/06/2009 | 14/03/2012 |
| Researcher (permanent) | Physics Department, University of Perugia | 15/03/2012 | 27/12/2017 |
| Visiting Researcher | Tokyo University | 01/07/2016 | 31/08/2016 |
| Associate Professor | Physics Department, University of Perugia | 28/12/2017 | 8/11/2023 |
| Visiting Professor | Tokyo University | 10/07/2017 | 10/09/2017 |
| Visiting Researcher | KEK (Tsukuba) | 03/09/2018 | 13/10/2018 |
| R&D Director | Wisepower srl (Physics Dept. Spinoff) | 01/07/2007 | Present |
| Responsible of the Virgo Perugia group | INFN | 15/06/2012 | Present |
| Responsible of LUNA laboratory (Laboratory on Nano Advanced materials) | University of Perugia | 01/07/2012 | Present |
| Responsible of the Kagra Perugia group | ICRR (Institute for Cosmic Ray Research) | 01/02/2016 | Present |
| Italian National Responsible | IBR (International Board of Representatives) for Kagra | 01/07/2018 | Present |
| Member of the Management Team | Virgo Collaboration | 01/03/2019 | Present |
| Member of the Executive Office | Kagra Collaboration | 23/08/2019 | Present |
| Deputy Rector for Research, Rating and Fund-Raising | University of Perugia | 1/10/2019 | Present |
| Full Professor | Physics Department, University of Perugia | 6/12/2023 | Present |

4. Teaching

➤ EXPERIENCE WITH COURSES ORGANISED OR TAUGHT

| <i>Institution</i> | <i>Duration</i> | <i>Subject; course title</i> |
|---|---------------------------------------|---|
| University of Perugia, Department of Physics | 2003/2004, 2004/2005 | Principles of general informatics; "Informatics for Physics" |
| University of Perugia, Department of Primary Education Sciences | 2007/2008, 2008/2009 | Experiments in physics for primary schools; "Didactic Physics II" |
| University of Perugia, Department of Mathematics | 2008/2009, 2009/2010 | Laboratory experiments on mechanics and statistical analysis; "Physical Experimentation I" |
| University of Perugia, Department of Primary Education Sciences | 2011/2012 | Theory and experiments in physics for primary schools; "Didactic Physics" |
| University of Perugia, interfaculty degree course in Animal Production (Department of Agrarian and Department of Veterinary Medicine) | 2012/2013 | A complete course on physics, Mechanics, Thermodynamics and Electromagnetism; "Elements of Physics" |
| University of Perugia, Department of Physics | 2013/2014, 2014/2015, 2015/2016 | Experiments in particle physics and material science; "Physics Laboratory" |
| University of Perugia, Department of Veterinary Medicine | From 2012/2013 to 2020-2021 | A complete course on physics, Mechanics, Thermodynamics and Electromagnetism; "Physics applied to Biology and Medicine" |
| University of Perugia, Department of Physics | From 2016/2017 to 2020-2021 | From the first experiments about gravitation to gravitational waves detectors; "Gravitational Waves" |
| University of Perugia, Department of Chemistry | From 2018/2019 to today | Mechanics; "Physics I" |
| University of Perugia, Department of Physics | 2021/2022 | Mechanics and Thermodynamics; "Physics I with laboratory activity" |
| University of Perugia, Department of Engineering | From 2022/2023 to today | GW detectors; "High sensitivity detectors" |

5. TOP 5 MOST IMPORTANT PUBLICATIONS OR OTHER ACADEMIC ACHIEVEMENTS

“GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence”, B. P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration), Phys.Rev.Lett. 119, 141101, (2017)

“GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral”, B. P. Abbott et al. (LIGO Scientific Collaboration and Virgo Collaboration), Phys. Rev. Lett. 119, 161101, (2017)

Both the above articles are massively important because have been the first two papers where a GW detection has been performed with three detectors with the possibility to localize spatially the events opening in the first case the field of the “gravitational astronomy” and in the second one the field of the “multimessenger astronomy”. The previous works have been important collaboration papers, in which my contribution was mainly twofold, on one side I was one of the coordinators of Virgo in the Virgo Steering Committee and on the other I was the responsible of the design and construction of the monolithic suspensions of the Virgo optics.

“KAGRA: 2.5 generation interferometric gravitational wave detector”, T. Akutsu et al. (KAGRA Collaboration), Nature Astronomy, 3 35-40 (2019)

This is the first work describing the Kagra detector after its completion. It is an important step because this will hopefully bring the Japanese detector to join the Ligo and Virgo detectors in O3 (the third observation run). The Kagra detector is a step forward the next generation detectors (like ET) since it is an underground and cryogenic detector. The realization of the monolithic sapphire suspension has been the reason why I joined the Kagra collaboration. To design and realize the suspensions of the Kagra optics, the experience acquired in the present detectors and mainly in Virgo was important. The Virgo know-how was transferred increasing the mechanical precisions. My contribution (coordinating also the scientists and the technicians of my research group) could bring to the development of the mechanical tools used to assemble the last stage sapphire suspension. Being also the coordinator of the Italian community in Kagra, I was involved in various experiment organizations like the commissioning strategies.

“Nonlinear Energy Harvesting”, F. Cottone, H. Vocca and L. Gammaitoni, Physical Review Letters, 102, 080601, (2009)

“Nonlinear oscillators for vibration energy harvesting”, L. Gammaitoni, I. Neri and H. Vocca, Appl. Phys. Lett. 94, 164102 (2009)

The two above manuscripts are an important example on how the experiences acquired studying the basic principles of the physic of noise useful to minimize the effects of the noise in Virgo could be transfer to (apparently) different physic fields. In fact, using the know-how developed for the minimization of the noises for the highly sensitive detectors like the GW interferometers, we studied the possibility to extend the nonlinear dynamics to the field of the mechanical energy harvesting. Up to that period this field was “dominated” by many engineers’ groups that used resonant oscillators to transform the mechanical vibrations, present in the environment, into electrical energy for powering small electronic devices. With these two manuscripts we demonstrated that the energy present in the environment, which is generally distributed in a wide frequency range, could be transformed more efficiently into electrical energy by the use of nonlinear oscillators. This approach permits to increase the performances of the harvesters opening the energy harvest strategy also to the micro and nano scale.

This work gave us the possibility to open a spinoff company (Wisepower srl, in Italy and Wisepower corp., in US) and to deposit few national/international patents. Further, we coordinated few European projects (i.e. NANOPOWER and ZEROPOWER) to study the energy harvesting at nanoscale. This experience gave us the possibility to collaborate also with various big companies like a F1 team, ST Microelectronics, IMEC etc.

6. Academic curriculum

- For my thesis work, from 1995 to 1997, and later on to 1999, I worked on a project for the development of a simulation code with the Montecarlo method for studying the Cosmic Rays propagation in the galactic disk. The aim of the project was to calculate the averages of time spent by Cosmic Rays in the Galaxy and the distribution of arrival directions, and energies in the solar cavity. This project was presented in 1995 at the ICRC (International Cosmic Ray Conference) in Rome and in 1997 at the ICRC in Durban (South Africa).
- Starting with the PhD my research interests have focused on the role of noise and fluctuations in physical systems. From this point of view, I have developed studies in a wide range of topics as diverse as the detection of gravitational waves, and energy harvesting from vibrations.
- Since its foundation (1999) I am a member of the Laboratory Noise in Physical Systems (NIPS), Department of Physics, University of Perugia, directed by Prof. L. Gammaitoni.
- For the role of noise in limiting the sensitivity of gravitational wave detectors, I attended (since 1999) the French-Italian Virgo project in which I led an international team of research aimed at minimizing the effects of thermal noise on the optical elements. Since 2012, I am the supervisor of the Perugia group and I am a member of the Virgo Steering Committee.
- I participated in the international project LISA (Laser Interferometer Space Antenna) from 2001 to 2009 to minimize the effects of thermal noise on the detector. I also dealt with the simulation of the process of charging the test mass itself caused by the flow of cosmic rays to which the three satellites of LISA would be subjected. The results of these studies were presented at various international collaboration meetings and conferences.
- In 2004 I proposed, in collaboration with Prof. Catia Grimani of the University of Urbino, a project to use the hardware available on the LISA experiment for measurements of the Solar Physics. In particular, we proposed to use the cosmic ray detectors placed on the three satellites (used to determine the noise due to the cosmic rays to which the test masses are subjected), to study the dynamics of the Coronal Mass Ejections coming from the Sun and to obtain measurements of the Space Weather. This project (PHOEBUS - PHYSICS OF EVENTS BURSTED BY THE SUN) was presented at the Lisa Symposium and at the LIST (Lisa International Scientific Team) and became a parallel experiment in LISA. Because of this project we joined the Action COST 724 (European Space Weather Network) of the European community, included in the long-term program of Space Physics for the EXPLORATION of SOLAR SYSTEM presented at ASI. From June 2007 to June 2010 the project "Exploration Studies of the Solar System" was funded by ASI (ASI Contract No. I/015/07/0) and I was therefore the manager of Perugia for Subtask 2610 - "Missions for measurements of solar particles and high energy photons".
- I have been a member of the scientific team of NIPS for the European project (FPVI) SUBTLE (Sub KT Low Energy Transistors and Sensors) from 2007 to 2010.
- In 2004 (together with Dr. P. Amico and Prof. L. Gammaitoni from the University of Perugia) I have developed a generator of new concept for micro-power electronic devices exploiting the vibrational noise environment, using non-linear piezoelectric oscillators. In 2006 I founded (together with prof. L. Gammaitoni and Dr. P. Amico) the Spin-off Wisepower srl of the University of Perugia in Italy, dedicated to the design and prototyping of micro-power generators for mobile communications and in 2009 (together with prof. L. Gammaitoni and Dr. Joseph Kovalik from JPL) I founded Wisepower Corp. in Arcadia, California.
- I have been part of the collaboration and task coordinator in the European projects NANOPOWER FET Proactive VII FP and ZEROPOWER CA VII FP FET on energy harvesting and smart ICT from 2010 to 2014.
- I have been the coordinator of an Italian-French project on micro energy harvesting in 2013 funded by the Université Franco Italienne with my colleagues at the Université Paris-Est.

- I won a three years project for the Hong Kong Science and Technology Parks Corporation on micro and nano energy harvesting in 2014.
- Since February 2016, I am member of the KAGRA collaboration coordinating the group of the University of Perugia. I am a member of the KSC (Kagra Scientific Congress) and I am the Italian delegate at the IBR (International Board of Representatives).
- In 2016, I won a European Project NEWS - New windows on the Universe and technological advancements from trilateral EU-US-Japan collaboration (H2020-MSCA-RISE) coordinating the University of Perugia group and the WP on GW detectors.
- In February 2017 I was the Proponent of the Laurea Honoris Causa of the University of Perugia for the Nobel Laureate in Physics 2015 Takaaki Kajita.
- From April 2018 I am a member of the Einstein Telescope collaboration and my group is the only Italian group to join the Einstein Telescope Pathfinder in Maastricht.
- From March 2019 I am part of the Management Team for the Advanced Virgo collaboration.
- From August 2019 I am part of the Executive Office for the Kagra collaboration.
- From November 2019 I am the Deputy Rector for Research, Rating and Fund-Raising of the University of Perugia

Since my graduation on ISI I published as an author 366 scientific publications, with a total of 63366 citations and an H-index of 90 and I am the author of 4 national/international patents

In the last ten years I have been invited speakers at the following:

1. Gravitational Wave Advanced Detector Workshop (Elba 2008)
2. 12th Marcel Grossmann Meeting (Parigi 2009)
3. ENERGY EFFICIENT ICT Networking Session (Brussels 2010)
4. TNA 2013 Conference (Bilbao)
5. LSC-VIRGO Meeting (Nice 2014)
6. Kagra International Workshop (Beijing 2016)
7. Kagra F2F Meeting (Toyama 2017)
8. Kagra F2F Meeting (Toyama 2019)

Last ten years scientific organizer at:

1. Workshop on Charging Issues in Experimental Gravity (2007 MIT)
2. Stochastic Resonance (2008 Perugia)
3. Summer School: Energy Harvesting at micro and nanoscale (2010 Avigliano Umbro)
4. Workshop: Noise in dynamical systems at the micro and nanoscale (2010 Avigliano Umbro)
5. Summer School: Energy Harvesting at micro and nanoscale (2011 Perugia)
6. Workshop: Noise in dynamical systems at the micro and nanoscale (2011 Perugia)
7. Summer School: Energy Harvesting at micro and nanoscale (2012 Erice)
8. Workshop: Energy Harvesting: models and applications (2012 Erice)
9. NANOENERGY2013 (2013 Perugia)
10. 3rd Kagra International Workshop (Taipei 2017)
11. 4th Kagra International Workshop (Seoul 2018)
12. 5th Kagra International Workshop (Perugia 2019)
13. 1st Kagra, Virgo and 3G Detectors Workshop (Perugia 2019)
14. 8th Kagra International Workshop (Daejeon 2021)
15. 9th Kagra International Workshop (Beijing 2022)

Obtained research fundings:

1. INFN (Istituto Nazionale Fisica Nucleare), funds for the Virgo activity in Perugia and at the Virgo site: around 150 k€/year from 2012 to 2020;
2. EGO (European Gravitational Observatory), funds for the laboratory activity aimed at the study of the dissipations in materials: around 250 k€ from 2012 to 2020;
3. Project GALILEO (Università Italo-Francese): Micro Renew Energy: a one-year project to cover the traveling expenses to design, implement and test hybrid collector vibrations to power wireless smart sensors and low power electronics, 5 k€, 2013.
4. Hong Kong Soft-landing Program for Technology and Innovation Collaboration (Hong Kong Science & Technology Parks Corporation), aimed to the technology transfer on micro and nano energy harvesting in Hong Kong, 10 k€, from 2014 to 2016.
5. Fondazione Cassa di Risparmio di Perugia, funds for co-funding the realisation of the LUNA laboratory (laboratory for advanced nano-materials) at the University of Perugia, 200 k€.
6. NEWS - New windows on the Universe and technological advancements from trilateral EU-US-Japan collaboration, (H2020-MSCA-RISE), 2017-2020, 250 k€ for networking activity between European, US and Japanese research institutions (for GW: Caltech, ICRR and NAOJ) in some key areas of fundamental physics (GW detectors workpackage leader and coordinator for the University of Perugia).
7. ICRR Inter-University program: "Cryogenic test masses, isolation, suspension and coatings", 15 k€, 2019
8. CAOS Laboratory (ETIC Project), 7 M€, 2022

7. Academic distinctions, awards, prizes

In 2000 I won a prize through the Young Researchers Fund of the University of Perugia as a research contribution.

In 2004 I won the first prize of a Spin-Off competition of the University of Perugia with the WisePower project.

In 2009 I won the first prize of a national competition for science communication promoted by APRE (Agenzia per la Promozione della Ricerca Europea).

In 2010 the Spin-Off company Wisepower (<http://www.wisepower.it/>) has been selected among other Italian companies to represent Italy as an example of innovation at the expo Shanghai and in the following years won 6 national and international competitions: e-qube Startup&Idea Challenge, Next Energy, ERG Re-Generation Challenge, TechGarage Digital Energy, Hong Kong Soft Landing Program, ENEL Lab

In 2016 as part of the LIGO-Virgo collaboration I won the Breakthrough Prize in Fundamental Physics and the Gruber Cosmology Prize.

In 2017 I was awarded with the “Baiocco d’oro” from the Comune di Perugia “for his contribution to the cultural growth of the city of Perugia through the scientific research on the gravitational waves of which he is a protagonist”

In 2017 as part of the LIGO-Virgo collaboration I won:

- the Royal Astronomical Society Group Achievement award
- the Princess of Asturias Award for Technical and Scientific Research
- the Albert Einstein Medal
- the Bruno Rossi prize.

Date and signature

9/02/2024

