80th Anniversary of the Specola Vaticana in Castel Gandolfo

Internal Symposium

14-18 September 2015

SPECOLA VATICANA

Internal Symposium celebrating the

80th anniversary

of the

Specola Vaticana in Castel Gandolfo

14-18 September 2015

LIST OF PARTICIPANTS

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Vatican Observatory

Fr. David Brown, S.J.
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Fr. Richard D'Souza, S.J.
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Fr. José G. Funes, S.J.
Vatican Observatory

Fr. Paul Gabor, S.J.
Vatican Observatory

Fr. Matteo Galaverni
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Fr. Gabriele Gionti, S.J.
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Fr. Michael Heller
Copernicus Institute, Cracow

Fr. Robert Janusz, S.J.
Ignatianum, Cracow

Fr. Jean-Baptiste Kikwaya Eluo, S.J.
Vatican Observatory

Fr. Giuseppe Koch, S.J.
Jesuit High School "Il Massimo"

Br. Robert Macke, S.J.
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Fr. Sabino Maffeo, S.J.
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Fr. Józef M. Maj, S.J.
Vatican Observatory

Prof. Tomasz Miller
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Prof. Dante Minniti
Universidad Andrés Bello

Fr. Paul Mueller, S.J.
Vatican Observatory

Fr. Alessandro Omizzolo
Vatican Observatory

Br. Jonathan Stott, S.J.
Fairfield University

Fr. Giuseppe Tanzella-Nitti
Santa Croce University

PROGRAM

Monday, 14th September

9:00-9:30 *General Address* from the director José G. Funes

Planetary Science and Instrumentation
(Chairperson: Guy Consolmagno)

9:30-10:00 108 Years of Meteorites at the Vatican Observatory (Robert Macke)
10:00-10:30 Coffee Break
10:30-11:00 Physical characterization of fast rotator NEOs (Jean-Baptiste Kikwaya)
11:00-11:30 Exoplanet Radial Velocity Program with VATT – PEPSI (Paul Gabor)
11:30-12:00 Round table on Planetary Science and Instrumentation

13:00 Lunch

Stellar evolution and Stars
(Chairperson: Aldo Altamore)

15:30-16:00 The Enigmatic Lambda Boötis Stars (Chris Corbally)
16:00-16:30 A new near infrared survey of the inner regions of the Milky Way (Dante Minniti)
16:30-17:00 Coffee Break
17:00-17:30 Some Recent Investigations in Stellar Evolution at the Specola Vaticana (David Brown)
17:30-18:00 Identification of star cluster members: a quantitative approach (Jonathan Stott)

19:30 Dinner

Tuesday, 15th September

9:00-9:30 The Vilnius Photometry System at the Vatican Observatory (Robert Janusz)
9:30-10:00 What are the colors of the stars and derivative information? (Richard Boyle)
10:00-10:30 Coffee Break
10:30-11:00 Round Table on Stellar evolution and Stars

Galaxies
(Chairperson: David Brown)

11:00-11:30 WINGS, a wide field nearby galaxy cluster survey: some results (Alessandro Omizzolo)
11:30-12:00 The Stellar Haloes of Galaxies (Richard De Souza)
12:00-12:30 Round Table on Galaxies

13:00 Lunch

Cosmology
(Chairperson: Paul Gabor)

15:30:16:00 A String Theory Based f(R)-Gravity with Duality Transformations (Gabriele Gionti)
16:00-16:30 Creation of Matter in a Noncommutative Universe (Michael Heller)
16:30-17:00 Coffee Break
17:00-17:30 Testing new physics with polarized light: cosmic birefringence. (Matteo Galaverni)
17:30-18:00 Round Table on Cosmology

19:30 Dinner

Wednesday, 16th September

Education and Outreach
(Chairperson: Jean-Baptiste Kikwaya Eluo)

9:00-9:30 Some Rules for Interacting with Journalists (Guy Consolmagno)
9:30-10:30 Round Table on Education
10:30-11:00 Coffee Break

13:00 Lunch

16:30 Coffee Break
17:00 Visit to the domes in the Papal Palace and in Villa Barberini

Thursday, 17th September

History of Astronomy
(Chairperson: Robert Macke)

9:00-9:30 The Rome historical Cauchoix telescope recovered (Aldo Altamore)
9:30-10:00 Stellar Populations: The Vatican Meeting in 1957 (José Funes)
10:00-10:30 Coffee Break
10:30-11:00 The Leap Second Debate and the Lessons from Timekeeping History (Paul Gabor)
11:00-11:30 A Short History of the Vatican Observatory (Ileana Chinnici)
11:30-12:00 Round Table on History of Astronomy

13:00 Lunch

Science-Philosophy-Theology
(Chairperson: Gabriele Gionti)

15:30-16:00 Some Reflections on the Influence and Role of Scientific Thought in the Context of the New Evangelization (G. Tanzella-Nitti)
16:00-16:30 The philosophy of expertise: the case of Vatican astronomers (Louis Caruana)
16:30-17:00 Coffee Break
17:00-17:30 Furnishing Creation (Paul Mueller)
17:30-18:00 Round Table on Science-Philosophy-Theology

18:30 *Mass at the Churc of La Rotonda celebrated by Mons. Marcello Semeraro, Bishop of Albano Laziale*

19:30 Dinner

Friday, 18th September

- Papal Audience
- Lunch at the Pontifical Academy of Science

ABSTRACTS

Monday, 14th September
Room: Aula Gabriele Buffetti

A. Planetary Science and Instruments
(Chairperson: Guy Consolmagno)

Symposium Abstract #01
108 Years of Meteorites at the Vatican Observatory
Robert J. Macke (Curator of Meteorites)

Beginning with a small donation of 104 pieces by Adrian-Charles Marquis de Mauroy in 1907, the Vatican Meteorite collection now boasts more than 1100 meteoritic samples of all major meteorite types including meteorites from Mars and the Moon. The majority of the pieces was donated by the Marquis' widow in 1935, the year that the Specola moved to Castel Gandolfo. The collection has been used in research from very early on, contributing to early work in spectroscopy [1,2] that ultimately led to the foundation of the journal Spectrochimica Acta [3]. Meteoritic samples continue to be used by scientific collaborators and researchers at other institutions for spectroscopic, isotopic, chemical, and other research. One-third of papers involving research on the martian meteorite Chassigny are based on samples from the Vatican collection.

The Vatican Observatory boasts a laboratory dedicated to the study of meteorites. Research at the Specola today focuses primarily on meteorite physical properties: density, porosity, magnetic susceptibility, and thermal properties. Our research techniques are non-destructive and non-contaminating, thus enabling the survey of large numbers of meteorites. The Archimedean glass-bead technique for measuring bulk densities was pioneered using the Vatican collection [4], and quickly

became the standard method for this measurement. This, combined with ideal-gas pycnometry for grain densities, provides meteorite porosities. Today, the glass-bead method is being superseded by more sophisticated techniques such as computer-aided tomography (CT) and 3d laser scanning. The Observatory has recently acquired a 3d laser scanner for this purpose.

Recently the Vatican Observatory meteorite laboratory has pioneered the liquid nitrogen immersion technique for measuring low-temperature meteorite heat capacities [5], which has been applied extensively on the Vatican collection. This is part of a study of meteorite thermal properties, including thermal conductivity measurements of Vatican meteorites at the laboratory of Cy Opeil SJ at Boston College [6].

With the addition of new equipment, new measurement techniques, and the gradual growth of the meteorite collection as new scientifically interesting meteorites become available, the Vatican meteorite collection promises to continue as a significant contributor to our scientific knowledge of meteorites and their parent bodies.

REFERENCE

[1] Gatterer A. and Junkes J. (1940). Über den Steinmeteoriten von Rio Negro. Comunicazioni della Pontificia Accademia delle Scienze 4:191-223.

[2] Salpeter E. W. 1952. Spectroskopische Chlorbestimmung in Steinmeteoriten. Ricerche Spettroscopiche: Pubblicazioni del Laboratorio Astrofisico della Specola Vaticana, 1938-1978 v.2, n.1.

[3] Consolmagno G. (2006) A Brief History of the Vatican Meteorite Collection. Geological Society of London, Special Publications. 256:205-217.

[4] Consolmagno G. J. and Britt D. T. (1998) The density and porosity of meteorites from the Vatican collection. Meteoritics & Planetary Science 33:1231-1241.

[5] Consolmagno G. J. et al. (2013) The Measurement of Meteorite

Heat Capacity at Low Temperatures Using Liquid Nitrogen Vaporization. Planetary and Space Science 87:146-156.
[6] Opeil C. P. et al. (2012) Stony meteorite thermal properties and their relationship with meteorite chemical and physical states. Meteoritics & Planetary Science 47:319-329.

Symposium Abstract #02

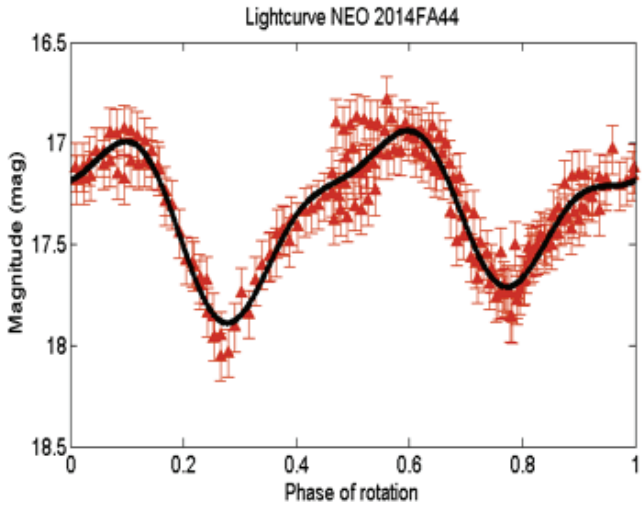
Physical characterization of fast rotator NEOs

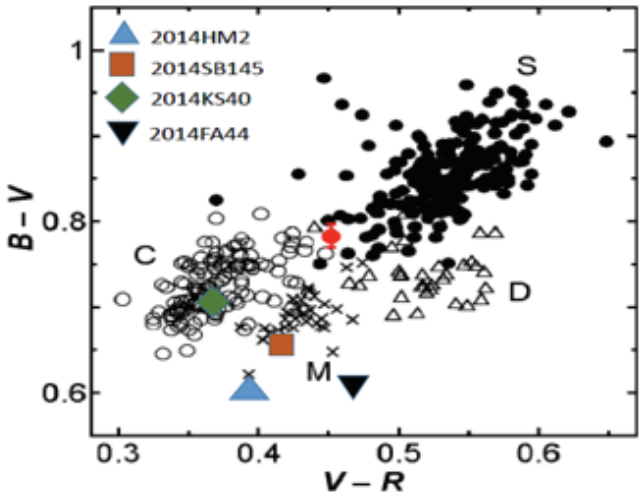
Jean-Baptiste Kikwaya Eluo

NEOs cannot only be studied dynamically to address their impact hazard, but also physically to understand various properties important to constrain models of their potential hazard, and also to know what they can tell us about the origin of the solar system and its ongoing processes. But this can only efficiently be done if NEOs are observed with different instruments to cover as much as possible a large portion of the electromagnetic spectrum. Therefore setting up a network of telescopes to observe simultaneously Near-Earth Objects with different instruments in different bands will provide complementary properties that will help to understand them.

Our project is to take advantage of the two-meter-class telescopes around Tucson, in Arizona in USA to observe fast rotator NEOs (H $>$ 22) synoptically at three different locations: VATT (Vatican Advanced Technology Telescope) at Mount Graham (longitude: -109.8719, latitude: 32.7016, elevation: 10469 feet), Bok 2.3 m at Kitt Peak (longitude: -111.6004, latitude: 31.9629, elevation: 6795 feet) and Kuiper 1.5-m at Mount Bigelow (longitude: -110.7345, latitude: 32.4165, elevation: 8235 feet). All three telescopes will aim simultaneously at the same object, each with a different instrument. Since 2013, The VATT-4K, optical imager mounted on the VATT, is used for photometry. In the future we plan to utilize the BCSpec (Boller & Chivens Spectrograph) for visible spectroscopy on the Bok 2.3 meter and a near-infrared instrument on the Kuiper 1.5 meter.

We report here the preliminary results of several NEOs whose rotation rate, color, and type have been estimated using photometry with images recorded with VATT-4K. 2009 SQ104 has a rotation rate of 6.85+/- 0.03 h, 2014 AY28 has a rotation rate of 0.91 +/- 0.02 h, 2014 EC of 0.54 +/-0.04 h, 2014 FA44 of 3.45 +/- 0.05 h, 2014 KS40 of 1.11 +/- 0.06 h, 2011 PT of 0.17 +/- 0.05 h, 2014 SC324 of 0.36 +/- 0.43 h, 2014 WF201 of 1.00 +/- 0.03 h. Of these objects, 2014 HM2, 2014 FA44, 2014 SB145, 2011 PT fall among X-type asteroids; 2014 KS, 2014 WF are likely to be C-type; and 2014 SC 324 is a D-type.





Symposium Abstract #03

Exoplanet Radial Velocity Program with VATT-PEPSI

Paul Gabor

The huge success of transiting exoplanet detection, with the remarkable contribution of the Kepler space telescope, has generated a target list of a few thousand objects awaiting radial velocity follow-up measurements. Future missions, notably Tess, Cheops, and Plato, as well as ground-based transit factories, represent additional thousands of targets for radial velocity studies. The scientific community needs new facilities to undertake this work.

The PEPSI (Potsdam Echelle Polarimetric and Spectroscopic Instrument) spectrograph is a PI instrument installed in the pier of the LBT (Large Binocular Telescope) on Mt Graham in a temperature- and pressure-stabilized (<mK, <mbar) chamber. It is an ultra-high-resolution spectrograph (maximum specified resolution of 320,000). Considering that PEPSI is one of a number of LBT instruments, it will only receive light from the LBT approximately ten nights a year. This represents an opportunity for a VATT – PEPSI project. In 2014, an optical fiber link of 410 meters was installed, connecting PEPSI and a dedicated fiber injection unit in VATT's focal plane. In this paper we shall discuss the opportunity provided by the VATT – PEPSI optical fiber link, the inherent limitations and technical requirements, as well as the status of the project, and future milestones.

B. Stellar evolution and Stars
(Chairperson: Aldo Altamore)

Symposium Abstract #04
The Enigmatic Lambda Boötis Stars
Christopher Corbally

Lambda Boötis stars have been an enigma since they were first isolated as a class in 1943. They seem part of the Sun's generation, yet they also masqueraded as an older population in the Galaxy. What gives them their unique spectral characteristics? How long do they retain these? Does where we find them make a difference? What is their connection with exoplanets and young stars? A hopeful team of astronomers is trying to convert our partial answers into a full scenario.

Symposium Abstract #05
A new near infrared survey of the inner regions of the Milky Way
Dante Minniti

Vista Variables in the Vía Láctea (VVV) is a public ESO near- infrared (near-IR) variability survey aimed at scanning the inner Milky Way (Minniti, et al. 2010, New Astronomy, 15, 433). The observations are acquired with the VISTA 4m telescope at ESO Paranal Observatory. The VVV survey covers an area of 562 sqdeg in the inner Galaxy, containing more than a billion point sources in total. The VVV database now contains multicolor (ZYJHKs) photometry, and multiple epochs in the Ks-band, monitoring more than a billion sources in total (Saito, et al. 2012, A&A, 537, 107). The Ks-band observations continue, and the variability light curves so far span from 2010 to 2015.

This large database enables a number of studies of different variable objects and also star clusters in the Milky Way (Hempel, M., et al. 2014, Messenger, 155, 29).

We have discovered hundreds of new star clusters, and started to characterize them using the VVV Survey infrared data in the fields towards the Galactic inner disk and bulge. In this talk I will discuss the latest VVV results, and the future plans for extending this survey.

Symposium Abstract #06

Some Recent Investigations in Stellar Evolution at the Specola Vaticana

David Brown

Studies in stellar physics have played a significant role in the ongoing research of the Specola Vaticana, as evidenced by the work of Angelo Secchi in the 19th century and highlighted prominently in the Vatican Conference on Stellar Populations in 1957. Such research continues in present times, one area of this being in the realm of the physics of very blue extreme horizontal branch, or hot subdwarf, stars. These stars are generally thought to be helium burning stars having a mass of 0.5 Msun and temperatures in the range of 50000<Teff<20000, surrounded by very thin hydrogen envelopes. They are observed in all major component stellar populations of the Galaxy, in globular clusters, and also in giant elliptical galaxies. In fact, they are thought to be the principal source of the ultraviolet upturn (UVX) in the latter. In spite of their ubiquity, the formation mechanisms by which hot subdwarf are produced are not yet known with certainty, though a few compelling theoretical explanations have been proposed to explain their origin. One general group of theoretical explanations suggests that such stars arise from single-star progenitors either because of a envelope ejection, high stellar-wind mass loss rates, or because of helium enrichment in such stars. A second group of theoretical explanations suggests that hot subdwarf stars are the products of interactions between two stars in a binary system, the hot subdwarf star product having lost most of its envelope through some form of Roche Lobe.

Overflow. Of crucial importance in the quest to determine the forma-

tion channels of hot subdwarfs is the field of asteroseismology. Recent studies of pulsating sdB stars have used the identification of oscillation modes as a way to help to determine several properties of those stars, one of the most important being their masses. This paper seeks to highlight some of the ongoing research being done in determining the formation of sdB stars, especially using the methods of binary population synthesis from a theoretical point of view. With regard to observations, the VATT telescope (including its use of the GUFI camera: Galway Ultra Fast Imager) has been used in recent times to study pulsating sdB stars such as PG 1419 and PG 1047 in the hope of furthering these studies and exploring continued future use of the telescope for sdB studies.

Symposium Abstract #07

Identification of star cluster members: a quantitative approach

Jonathan Stott

Open star clusters are associations of stars which formed together from the same parent cloud of gas and dust. Because they formed together, these stars are all the same age and have the same initial composition. Open star clusters, thus, are in important tool for improving our understanding stellar evolution. Unfortunately, while the clusters themselves are readily identified in photographic surveys, deciding whether an individual star is a cluster member or simply a random field star is not so easy. The problem is especially acute at low galactic latitudes due to the extremely high density of background stars.

In this talk I will discuss a quantitative scoring method for identifying the likelihood that a particular star is or is not a member of the target stellar cluster. By combining photometric and astrometric information into a single score, we can derive a robust quantitative measure of the probability of cluster membership even at low galactic latitudes. I will then show how it can be applied to actual cluster images.

Tuesday, 15th September
Room: Aula Gabriele Buffetti

Symposium Abstract #08
The Vilnius Photometry System at the Vatican Observatory
Robert Janusz

The Vatican Observatory has contributed to the astrophysics since its beginning. Father Angelo Secchi SJ was a pioneer in stellar classification and development of the 'new astronomy'. Science did enormous steps with understanding of stellar objects, so now we classify stars by their basic characteristics which is the spectra - a fingerprint of what is going on in a particular star. The spectroscopic methods are very accurate, however the measurements can be significant for 'near by' stars. To measure the astrophysical parameters deeper in the sky, we must sacrifice some precision and measure only the most characteristic parts of stellar spectra. For this purpose photometry is of service. It turns out that lot of knowledge can be determine using this method.

It is very important to choose a good photometric system for the observatory. Thanks to our collaborators the Vilnius System was presented to Vatican Observatory, and slowly it became the main system for photometry at the new Vatican Advanced Technology Telescope. This system is able to classify almost all known stars and to determine the basic astrophysical parameters. Therefore we adapted it to the new CCD astronomy and use to study clusters of stars: open and globular. Thanks to the modern computers we model, solve and examine complex astrophysical calculations, impossible to conceive some decades before. Because the Vilnius System can determine the reddening caused by the interstellar dust, we use it - indirectly - to study interstellar matter, especially in some regions where stars are coming to life.

Our data base of photometry observed at the Vatican Telescope is very large. Some areas are just archived for future analysis. The complexity of the star fields and technical details need decades of patient studies. The study of heavens leads us to admiration to the Lord, the Creator.

Symposium Abstract #09

What are the colors of the stars and derivative information?

Richard Boyle

By 1900 it became known that the colored spectra of stars are very similar to black body radiation which is characterized by a single temperature of the body. So calibration schemes were elaborated to set up colored filters to sample certain color bands of stellar light. The first photometric system was the broadband UBV which was one defined conveniently by available detectors, following on the more preliminary use of photographic emulsions. More capable detectors allowed defining a photometric system more suitable to key spectral bands in stars for purposeful astronomy and astrophysics.

The Stromgren System of 1956 can tell spectral type and luminosity class of the hotter set of stars, O to F, and distinguish reddening caused by interstellar dust from colors intrinsic to a star's photosphere. In 1963 V. Straizys and the group at Vilnius, Lithuania improved the capability of spectral classification by defining a seven-color Vilnius Photometric System for mostly all the normal star types even with interstellar dust reddening. Color indices were defined along with color excess (reddening) and over the next several decades a database of several thousand stars was observed and calibrated.

The arrival of the CCD with its high sensitivity to light over the optical spectrum meant progress in,yes, smaller than photographic vistas, but for fainter and so more distant star fields.

With the Vilnius Photometric System implemented at the 2-meter class telescope, VATT on a high, 3km altitude site on Mt. Graham International Observatory, we have for about 20 years observed and analyzed many stellar regions in the Galaxy at distances local to the Sun, up to about 2 kpc, even in the dust dimmed and reddened Galactic plane for new results about star clusters and stellar evolution in the Galaxy.

C. Galaxies

(Chairperson: David Brown)

Symposium Abstract #10

WINGS, a wide field nearby galaxy cluster survey: some results

Alessandro Omizzolo

My research field is twofold: clusters of galaxies and Jellyfishes galaxies. The study of clusters of galaxies is done by participating in an international research group whose acronym is WINGS: a nearby sample (z=0.04-0.07) of x-ray selected clusters of galaxies both in the north and south hemispheres. Nobody studies the clusters in this low z interval, and indeed it is important to study the evolution of galaxies and of the phenomena connected to the star formation, but also to study dark matter.

Inside many if not all the WINGS clusters we found a particular type of galaxies, the so called Jellyfishes galaxies: that is galaxies that are undergoing loss of gas, generating the typical form of a jellyfish. Studying these galaxies helps us to understand the interaction between galaxies and intergalactic media, and the influence of this phenomenon on the star formation rate.

Symposium Abstract #11

The Stellar Haloes of Galaxies

Richard D' Souza

Although the low surface brightness stellar halo of a galaxy contains only a tiny fraction (less than a few percent) of the overall stellar mass and light of the galaxy, its low relaxation time helps preserve a fossil record of its accretion history, and contains vital clues of how galaxies build up over time. Observationally, it is extremely challenging to observe the ultra-faint stellar haloes of galaxies. In the Milky Way and in other nearby disk galaxies, the stellar halo and other tidal features have been directly detected through star counts (Bell et al. 2008; Ibata et al. 2014). For more distant galaxies, integrated light from deep imaging can reveal the structure of the stellar halo (van Dokkum et al. 2014). Finally, stacking images of a large number of similar galaxies from all sky surveys (e.g. SDSS) can reveal the average stellar haloes of statistical samples of more distant galaxies (Zibetti et al. 2005; D'Souza et al. 2014). Today, stellar haloes of galaxies have been observed and confirmed from field early-type and late-type galaxies to large clusters of galaxies (as intracluster light).

Theoretically, this is consistent with our idea that the faint stellar halo is built up from the debris of smaller galaxies and satellites that are tidally disrupted. This has been supported by particle-tagging simulations (Bullock & Johnston 2005 and Cooper et al. 2010: Dark Matter only simulations in combination with semi-analytic models), as well as by cosmological hydrodynamical simulations, which have over the years improved our understanding of how the stellar halo has been built up over time.

In the last decade, efforts have concentrated on deciphering clues in the morphological shape of the stellar haloes (ellipticity, flattening as well as streams and tidal structures). Additional constrains have come from studying the average shapes of large statistical samples of galaxies.

D. Cosmology
(Chairperson: Paul Gabor)

Symposium Abstract #12
A String Theory Based f(R)-Gravity with Duality Transformations
Gabriele Gionti

Extend f(R) theories have been used to "cure" some serious problems of Einstein's General Relativity, which led to the need for introducing concepts like Dark Matter and Dark Energy. In this talk, I study a "special" theory of the gravitational field, which is the low energy limit of a theory of Quantum Gravity called (bosonic) String Theory.

This theory exhibits duality transformations. Using Weyl transformations on the metric tensor, it is shown to be equivalent to two f(R) theories of Gravity, in which the functional forms of the f(R) theories are completely determined. In the framework of f(R) Cosmology, with the use of Noether Symmetry approach, I discuss the possibility to find some particular classes of Lagrangians, which are invariant under the scale factor duality. This duality is, of course, a consequence of duality transformations of the action of the gravitational field theory derived by low energy effective theory of String Theory. As in the Gasperini-Veneziano model, the duality of this model allows the possibility of elaborating a pre Big-Bang model of the universe and shows that F(R) theories of gravity descend from a fundamental theory of physics.

Symposium Abstract #13

Creation of Matter in a Noncommutative Universe

Tomasz Miller and *Michael Heller*

The dark matter and dark energy problem, that is now dominating research in cosmology, makes the question of the origin of the mass-energy content of the universe more urgent than ever. There are two philosophies regarding this question: according to Mach's principle it is matter that generates the geometry of space-time, and according to Wheeler's geometrodynamics some configurations of space-time geometry are to be interpreted as its material content. Neither of these philosophies has led to success. In the present paper, we show that there exists an algebraic generalization of geometry that, in a sense, reconciles these two seemingly opposite standpoints.

The geometry is constructed with the help of a noncommutative algebra of smooth functions on a groupoid and its derivations. The groupoid in question has a nice physical interpretation: it can be regarded as a space of Lorentz rotations. In this way, Lorentz symmetries are inherent to the generalized geometry of space-time. We define the action for this geometry and, by varying it, obtain generalized vacuum Einstein equations (for a simplified model). It turns out that these equations contain additional terms (with respect to the standard vacuum Einstein equations) which are naturally interpreted as the components of the energy-momentum tensor. Matter is thus created out of purely geometric degrees of freedom. We find two exact solutions (for an even more simplified case). We argue that the creation of matter, being a global effect, makes the contrast between Mach and Wheeler philosophies ineffective.

Symposium Abstract #14

Testing new physics with polarized light: cosmic birefringence.

Matteo Galaverni

The main compelling evidences for new physics beyond the standard model are provided by astrophysical and cosmological observations. In particular inflation, and late time acceleration seem to require a new physics beyond general relativity and the standard model of particle physics. We have to constrain few selected models combining CMB and astrophysical data.

Measurements of linear polarization provide an excellent probe to study these models. Indeed several of these theories predict a modification of the dispersion relation for photons. This gives rise to a rotation of linear polarization (cosmic birefringence or cosmic polarization rotation). We have derived stringent limits, looking at the linear polarization rotation angle α for several datasets corresponding to different energies for the photons and different distances of the sources. Different constraints, from several datasets, are discussed (see Figure):

1. Cosmic Microwave Background (CMB).
2. UV emission from radio galaxies.
3. Radio sources.
4. Crab nebula.
5. Gamma-ray bursts.

For each model considered, we combine these datasets by taking into account the peculiar energy and distance dependence. We estimate our constraints and discuss the relative constraining power among our datasets for each theoretical model.

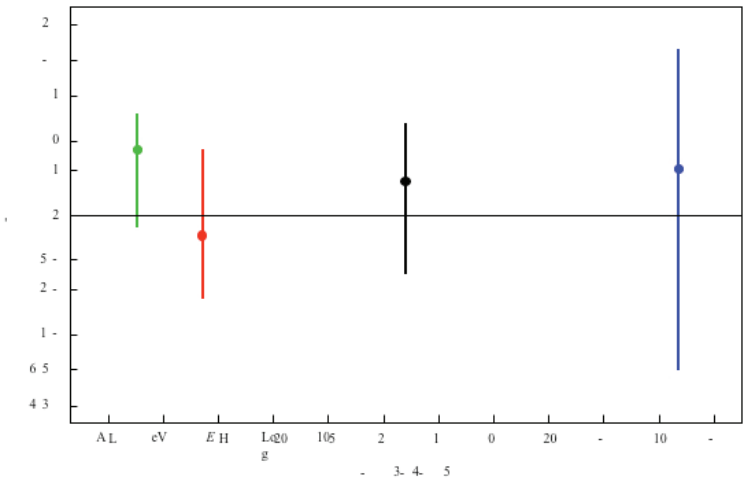


Figure: Energy dependence of constraints for the cosmological birefringence angle α; black, green, red and blue points refer to UV radio galaxies, radio sources, CMB, Crab Nebula respectively.

REFERENCES:

M. Galaverni, G. Gubitosi, F. Paci and F. Finelli, "Cosmological birefringence constraints from CMB and astrophysical polarization data," arXiv:1411.6287 [astro-ph.CO].

Wednesday, September 16th
Room: Aula Gabriele Buffetti

E. Education and Outreach
(Chairperson: Jean-Baptist KIKWAYA ELUO)

Symposium Abstract #15
Some Rules for Interacting with Journalists
Guy Consolmagno

Pope Leo XIII founded the Specola Vaticana so that the world could see that the Church supports science. Obviously, we must do the science, so that we have something to show the world. But "showing the world" is an essential part of our mission. Education and Public Outreach (EPO) is an integral part of our work.

If you are asked for an interview, first find out the title and brief description of the program, who will be on the filming crew, and date and time of the shoot. Be sure to Google them to find out what their agenda might be! (If you see the term UFO anywhere on their site, refuse the interview. Always.) Remind your interviewers that all media reporters who want to film or record at the Specola must have written permission from the Vatican before they can take any sort of pictures or film on site. The address they need to contact is on our web site. until a time that is convenient to you.

You always have the right – and power – to negotiate with interviewers; remember, reporters need you as much as you need them. Ask what the interview is going to be about. Feel free to turn down an interview request if you aren't comfortable with it; or suggest they interview another person; or delay any interview until a time that is convenient to you.

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When being interviewed, have a clear idea of what they are going to ask you, and have a clear idea, ahead of time, of what you want to say. What is your story? Who is your audience? Anticipate the most likely questions, and prepare an initial brief answer (a 7 second sound bite); then prepare a longer answer (30 seconds) just in case you're given time to say more. Be prepared to illustrate your point with examples and analogies. And remember to restate your initial brief answer at the end.

During the interview, answer in complete sentences that make sense even without the question. If you aren't asked the question you prepared, listen to the reporter's question, acknowledge it, then create a "bridge" to the answer you really want to give. Don't be afraid to say you don't know; if you can, refer the reporter to someone who does.

Don't say anything you wouldn't want to see on the front page of the newspaper: nothing is ever "off the record." Avoid any temptation to be clever or sarcastic; it will always backfire. Don't be tricked into saying more than you want to say by fear of "dead air." When you have said your piece, stop. (Filling long pauses of "dead air" is their problem, not yours!) For hostile interviews, never lie or guess; never speculate; never answer a hypothetical "what if" question. If you can't answer, give a reason why you can't answer. Don't respond with hostility or emotion. Instead, speak your message without using the way they framed the question or their hot "bait" words in the answer. Use only your words to convey your ideas, not theirs.

Keep personal opinions to yourself. Understand that if you say "no comment" you convey the idea that their hostile premise is true but that you aren't prepared to admit it! At the end of the day, don't worry if things go wrong. Don't make a big deal of minor errors; trying to make a correction often just spreads the error further. If it is a major error, contact the reporter, not their boss! Learn from your experience: what worked? what didn't?

There is no such thing as bad publicity. Anything that creates awareness of astronomy or your institution is good; more often than not, the reaction even to bad publicity is "gee, I didn't know there was an observatory here!" But popularizing our science is as much work, and just as important, as writing up a scientific paper. It takes a special set of skills. If you aren't good at it, admit it: ask for help. And give help to others who ask. The best scientists are not necessarily the best interviews or popularizers. Know thyself!

Thursday, September 17th
Room: Aula Gabriele Buffetti

F. History of Astronomy
(Chairperson: Robert Macke)

Symposium Abstract #16
The Rome historical Cauchoix telescope recovered
Aldo Altamore and Francesco Poppi

The achromatic refractor Cauchoix was acquired by Astronomical Observatory of the Collegio Romano in the year 1825. In the second half of the Nineteenth Century Angelo Secchi used this 16 cm aperture telescope, coupled with the objective prism, to perform the observations on which was based his pioneering spectral classification of stars.

Assembled on a new equatorial mount in 1885, the instrument was in service at the Astronomical Observatory of Rome until 1980 and then dismantled. Recently, we found the achromatic doublet of this historical instrument, which had gone missing for more than 30 years. The discovery will allow us to reconstruct the configuration of the telescope as it was in Secchi's time.

Symposium Abstract #17

Stellar Populations: The Vatican Meeting in 1957

José Funes

One of the fundamental concepts in Astrophysics is the concept of types of stellar populations that was introduced by Walter Baade in 1944. In 1957 the Pontifical Academy of Sciences and the Vatican Observatory organized a Study Week on Stellar Populations. This meeting had a great impact in the scientific community due to the high level of the participants and the quality of the papers that were presented.

I have had access to all the documents related to the organization of this meeting in the archives in the Secretary of State and the Vatican Observatory. These documents show that Pope Pius XII was personally involved in the decision of organizing the conference and in the invitation of the participants.

The publication of the correspondence related to the organization of the meeting will shred light on this important period of the history of Astronomy as well as on the involvement of the Vatican in astronomical cutting-edge research.

Symposium Abstract #18

The Leap Second Debate and the Lessons from Timekeeping History

Paul Gabor

Timekeeping, together with navigation, is one of the oldest missions of astronomy, originating long before the dawn of written history. The ancient and sacred task of timekeeping, linking the eternal with the everyday, stood at the origin of the Vatican Observatory. The history of timekeeping schemes throughout millennia has been a search for a balance between the practical and the symbolic.

The current debate focuses on the Leap Second, a mechanism introduced in 1972. Atomic clocks and careful observations of distant quasars tells us that the Earth spins somewhat irregularly. The symbolic value of linking civil timekeeping to the heavens is so strong, however, that the international community still requires the International Telecommunication Union to broadcast time signals that follow Earth's rotation. In order to reconcile this symbolically-significant requirement with the practicality of uniformly-flowing atomic time, a leap second is added or subtracted from the otherwise perfectly regular sequence, so that every so often there is a minute with 59 or 61 seconds. This system is currently under review, with a proposal on the table to abandon the leap second, decoupling civil timekeeping from astronomical phenomena. Social mechanisms involved in timekeeping can be studied by examining the historical evidence represented by the various calendric traditions. These lessons may provide a broader context for the Leap-Second debate and they may shed light on it. Calculated timekeeping does not actually agree with the heavens at any given moment, but this does not seem to jeopardize the general perception of its astronomical conformity since it is rightly perceived as way of preserving it on average. The current proposal, however, clearly entails decoupling civil time from Earth's rotation. We argue that it would result in a direct and unprecedented breach with the principle of astronomical conformity. This conformity fulfills its social function even when it is not observed perfectly, because in the realm of symbolism what counts is the general perception, not the fact.

Symposium Abstract # 19

A short history of the Vatican Observatory

Ileana Chinnici

In this talk, the history of the Vatican Observatory will be illustrated, starting with the establishment of the first Specola in the Tower of Winds, the participation to the Carte du Ciel project, the expansion in the Vatican buildings and the move to Castelgandolfo 80 years ago.

Round table on History of Astronomy

G. Science-Philosophy-Theology

(Chairperson: Gabriele Gionti)

Symposium Abstract #20

Some Reflections on the Influence and Role of Scientific Thought in the Context of the New Evangelization

Giuseppe Tanzella-Nitti

The guide-lines prepared for the 2012 Synod of Bishops for the New Evangelization (Lineamenta) explicitly mentioned techno-scientific culture as one of the fields to which Gospel's message deserved to be announced properly. Speaking of science, that document seemed to underline especially the risks brought about by scientific culture. However, Pope Francis' Evangelii gaudium (2013), which was intended to develop the reflections performed by that Synod, offers short but meaningful passages on science and on the role it is called to play in the task of the New evangelization.

In this paper, after discussing how scientific culture shapes the way of thinking of a great part of contemporary society, I briefly investigate the relationship between science and non-believing, showing that the latter cannot be presented as a direct consequence of the former.

It is an ideologically-clothed popularization of science, rather, which presents scientific culture as opposed to Christian faith. In order to evangelize a society highly shaped by the rationality of science, when addressing the relationship between faith/theology and science, a number of clichés must be overcome. At the same time, specific and positive aspects of scientific culture must be highlighted, mainly the humanistic and spiritual dimensions associated to the research activity.

In order to foster the New Evangelization in the world of science, I suggest developing 5 leading ideas on the nature of scientific activity as such, and I propose 4 tasks, addressed to scientists who are also believers, and to pastors and theologians.

Symposium Abstract #21

The philosophy of expertise: the case of Vatican astronomers

Louis Caruana

These last decades, the many contributions to the literary output on science and religion have dealt with topics that are on the cutting edge of scientific discovery, topics mainly in the area of theoretical physics, cognitive science, and evolutionary biology. Philosophers of religion, responding to this trend, have therefore struggled with intricate arguments, and have often made use of the highly technical language of these sciences. The overall result has been that true original philosophical contributions, ones that present new perspectives regarding this area, have been very rare.

Of these few new research programs, one seems to be particularly promising, especially because of the way it has been throwing new light on how science relates to other disciplines. The originality of this research-area lies in the fact that it refers not to particular scientific discoveries, considered individually, but to the general dynamics of the practical side of science.

The crucial concept is expertise, which involves the appeal to authority for the justification of arguments. Many people like to think that scientific knowledge is far from all this, that it is purely objective and that it floats way above the murky waters of subjectivism. Those who are directly involved in scientific practice however know that science is not so clean. Appeal to authority remains very much part of the natural sciences, whether we like it or not. Some philosophers have recently ventured into these somewhat dark caverns of scientific thought and practice, and the result of their work has become very significant.

In this paper, I will first offer a brief overview of this philosophical work, and then explore how the new insights regarding scientific expertise and scientific appeal to authority can throw light not only on how science works but also on the issue of authoritative knowhow within the Church. To avoid getting lost within the dim world of abstract principles, I will focus on one particular concrete case, the one of Vatican astronomers. This is a particularly interesting case because this group's complex role lies precisely at the intersection between theological and scientific expertise.

Symposium Abstract #22

Furnishing Creation

Paul Mueller

During the first part of the 20th century, philosophers of science embraced the idea that scientific observation is essentially simple, passive, and uncontaminated by theory – and that it can therefore yield data which is objective. Later in the 20th century, in response to the writings of Thomas Kuhn and others, many philosophers insisted that scientific observation is complex, active, and "theory laden" – and that it is therefore to some extent subjective. Lorraine Daston points out that these rival perspectives, which have dominated the discourse in philosophy of science for decades, share a neo-Kantian preoccupation with the epistemology of scientific observation – and in parti-

cular with the tension between objective and subjective knowledge [1]. Relying on and developing the seminal but unappreciated work of Ludwig Fleck, [2] Daston proposes that we set aside the preoccupation with epistemology and turn instead to philosophical and historical inquiry into the ontology of scientific observation. By this, she means inquiry into how expert observation discerns and stabilizes scientific objects for a community researchers – that is, inquiry into "how scientists furnish the universe with objects that are amenable to sustained and probing investigation but that rarely correspond to the objects of everyday perception—even if the scientific objects in question are macroscopic, require no instruments in order to be made sensible, and are picked out by plainspoken terms in the vernacular." [3]. Thus, learning to see like a scientist is a matter of accumulated experience – not only of the individual but also of the well-trained collective: "Without acquired habits of perception cultivated by observation, there would not only be no science; there would be no articulated visible (or auditory or tactile) world at all. This is the way perception furnishes the universe. It doesn't create the universe, but it does shape and sort, outlining sharp edges and arranging parts into wholes." [4]

In this paper I will develop and apply Daston's insights concerning scientific experience to religious experience – both in general and in the particular setting of life and research at the Vatican Observatory. In philosophy of religion, inquiry has too often followed the fashion of philosophy of science – too often it has focused on the epistemology of religious experience, and too often it has been dominated by a preoccupation with the gulf between objective and subjective. Following Daston, I propose to look at the ontology of religious experience. "Seeing" as a person of faith is a matter of accumulated experience, both of the individual and of the well-trained collective; religious experience involves "furnishing" creation with objects that may not correspond to objects of everyday perception. Religious experience does not create, but it does "shape and sort, outlining sharp edges and arranging parts into wholes." This path of inquiry opens a door to fruitful

discussion of the sort of "furnishing of Creation" that is involved in (for example) Ignatian prayer and Ignatian discernment of spirits.

REFERENCES:

[1] See for example Daston's edited volume Biographies of Scientific Objects, Chicago: University of Chicago Press, 2000. Also see her article "On Scientific Observation," Isis 99, no. 1 (2008): 97-110.
[2] See especially Fleck, Ludwig, Genesis and Development of a Scientific Fact, Chicago: University of Chicago Press, 1979. This the first English translation of Entstehung und Entwicklung einer wissenschaftlichen Tatsache. Einführung in die Lehre vom Denkstil und Denkkollektiv. Basel: Schwabe und Co., 1935.
[3] Daston 2008, 98. [4] Daston 2008, 100.