

“Procedura valutativa per la copertura di n. 1 posto di Professore Universitario di seconda fascia per il Settore concorsuale 02/A2 – Settore scientifico disciplinare FIS/02 presso il Dipartimento di Fisica – Facoltà di Scienze Matematiche Fisiche e Naturali – codice concorso 2020PAR022”

Allegato B

Decreto Rettore Università di Roma “La Sapienza” n 2307/2020 del 18.09.2020

ROBERTO MAOLI Curriculum Vitae

Rome
October, 2nd 2020

Part I – General Information

Full Name	Roberto Maoli
Citizenship	Italian
Spoken Languages	Italian, English, French

Part II – Education

Type	Year	Institution	Notes (Degree, Experience,...)
University graduation	1990	University of Rome La Sapienza	Master degree in Physics (Laurea in Fisica) – 110/110 <i>cum laude</i>
PhD	1994	Université de Paris VI	PhD in Physics – grade: <i>Très honorable avec les félicitations du jury</i>
Qualification	2014	Ministero dell’Istruzione, dell’Università e della Ricerca	Associate Professor – National Scientific Qualification, 02/A2 (Abitolazione Scientifica Nazionale) valid from 08/01/2014 to 08/01/2023

Part III – Appointments and other activities

IIIA – Academic Appointments

Start	End	Institution	Position
05/2000	now	University of Rome La Sapienza	Researcher (Ricercatore Tempo Indeterminato)
05/1998	04/2000	Institut d’Astrophysique de Paris	Postdoc (CEE fellowship – TMR Lensing)
01/1995	04/1998	Observatoire de Paris	Postdoc (ESA fellowship, CNR-NATO fellowships)
10/1991	12/1994	Observatoire de Paris-Meudon - École Normale Supérieure	PhD student

IIIB – Other Appointments

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Start	End	Institution	Position
10/2004	02/2005	Institut d'Astrophysique de Paris	Bourse Ville de Paris
03/2005	03/2005	Space Telescope Science Institute - Baltimore	Visitor
04/2005	04/2005	Institut d'Astrophysique de Paris	Bourse Ville de Paris

IIIB – Other Activities

11/2017	Knight, Jones, Field – Fondamenti di Fisica (Piccin ed.)		Editor of the italian edition
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Part IV – Teaching experience and other Academic duties

IIIA – Teaching experience

Year	Institution	Lecture/Course
From 2005-06 to now	University of Rome La Sapienza	Theoretical Cosmology / Master Degree in Astronomy and Astrophysics
From 2010-11 to now	University of Rome La Sapienza	Physics / Bachelor in Biology
From 2000-01 to 2009-10	University of Rome La Sapienza	Assistant in Mechanics, Thermodynamics or Electromagnetism courses

IIIB – Academic duties

Year	Institution	Activity
From 2016 to now	University of Rome La Sapienza	Member of <i>Commissione di Gestione dell'Assicurazione Qualità</i> at Department of Physics
From 2016 to now	University of Rome La Sapienza	Member of <i>Commissione per la verifica dei requisiti per l'ammissione alla Laurea Magistrale</i> at Department of Physics
From 2016 to now	University of Rome La Sapienza	Member of <i>Commissione per la pianificazione della didattica della Fisica</i> at Department of Physics
2013-14	University of Rome La Sapienza	Member of <i>Giunta di Dipartimento</i> at Department of Physics
2013-14	University of Rome La Sapienza	Member of <i>Giunta di Facoltà</i> at Faculty of Science
From 2000 to now	University of Rome La Sapienza	Member of the Qualification Committees for the selection of several postdoc positions
From 2010 to now	INAF – Rome observatory	Member of the Qualification Committees for the selection of several postdoc positions
From 2015 to now	University of Rome La Sapienza	Tutor of the Master in Astronomy & Astrophysics (Laurea magistrale in Astronomia e Astrofisica)

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Part V - Society memberships, Awards and Honors

Year	Title
03/2017	Award for excellent university teaching for 2015-16 from the Faculty of Science of Sapienza
02/2020	Award for excellent university teaching for 2018-19 from the Faculty of Science of Sapienza

Part VI - Funding Information [grants as PI-principal investigator or I-investigator]

Year	Title	Program	Grant value
2018-21	Manager of Weak Lensing WP	ASI agreement for Euclid	118.344 € for my WP
2015-18	Manager of Weak Lensing WP	ASI agreement – phase B2/C for Euclid	121.300 € for my WP
2019 (I)	Tracing Dark Matter distribution in the Universe by indirect observations and numerical simulation	Ricerche Universitarie Sapienza	14.000 € + 1y postdoc (23.787 €)
2018 (I)	Cosmology at a Crossroads: clarifying tensions between cosmic microwave background, cosmic shear and galaxy clusters data	Ricerche Universitarie Sapienza	14.000 €
2017 (I)	Probing the nature of dark matter with current and future cosmological data	Ricerche Universitarie Sapienza	14.000 € + 1y postdoc (23.787 €)
2016 (I)	Cosmic complementarity: using Cosmic Microwave Background anisotropies, Weak Lensing and Clusters to constrain Dark Matter and Dark Energy	Ricerche Universitarie Sapienza	15.000 €
2017-2020 (I)	Cosmology and Fundamental Physics: illuminating the Dark Universe with Euclid	MIUR PRIN 2015	619.822 €
2015 (I)	Precision Cosmology and fundamental Physics	Ricerche Universitarie Sapienza	
2014 (I)	Precision Cosmology and fundamental Physics	Ricerche Universitarie Sapienza	
2013 (I)	Precision Cosmology and fundamental Physics	Ricerche Universitarie Sapienza	
2013-2016 (I)	The dark Universe and the cosmic evolution of baryons: from current surveys to Euclid	MIUR PRIN 2010-2011	840.040 €
2012 (I)	Precision Cosmology and fundamental Physics	Ricerche Universitarie Sapienza	
2010-2012 (I)	Energia oscura da grandi survey di galassie: effetto ISW e ammassi di galassie	PRIN 2008	

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2011 (I)	Precision Cosmology and fundamental Physics	Ricerche Universitarie Sapienza	
2010 (I)	Precision Observational Cosmology	Ricerche Universitarie Sapienza	
2009 (I)	Cosmologia Osservativa di Precisione	Ricerche Universitarie Sapienza	
2009 (PI)	Lensing gravitazionale e cosmologia	Ricerche di Facoltà Sapienza	
2008 (I)	Cosmologia Osservativa di Precisione	Ricerche Universitarie Sapienza	
2007 (I)	Misure di precisione sul fondo cosmico a microonde	Ricerche Universitarie Sapienza	
2007 (PI)	Lensing gravitazionale e cosmologia	Ricerche di Facoltà Sapienza	
2007-2010 (I)	PI of WP "Osservazioni dallo spazio di effetti di lensing gravitazionale e ricadute cosmologiche"	COFIS ASI 2006	
2006 (I)	Misure di precisione sul fondo cosmico a microonde	Ricerche Universitarie Sapienza	
2006 (PI)	Lensing gravitazionale e cosmologia	Ricerche di Facoltà Sapienza	
2005 (PI)	Lensing gravitazionale e cosmologia	Ricerche di Facoltà Sapienza	
2004 (PI)	Lensing gravitazionale debole e cosmologia	Ricerche di Facoltà Sapienza	
2004-2005 (I)	GEMINI-OLIMPO (unita' di cosmologia spaziale): misure di effetto Sunyaev-Zel'dovich nei due emisferi, da pallone stratosferico	PRIN 2004	
2003 (I)	Anisotropie primarie e secondarie del fondo cosmico: sviluppi tecnologici	Ricerche Universitarie Sapienza	
2002 (I)	Misura della dipendenza della temperatura del fondo cosmico dal redshift	Ricerche Universitarie Sapienza	
2002-2003 (I)	Polarizzazione del fondo cosmico: predizioni teoriche e analisi dati	PRIN 2001	
2001	Misura della costante di Hubble mediante osservazioni di Ammassi di Galassie nel Lontano Infrarosso	Ricerche Universitarie Sapienza	
2000-2002 (I)	Ecografia dell'Universo Primordiale: Sviluppo del Mosaico di bolometri multicanale e misure a Mito	PRIN 2000	

Part VII – Research Activities

Keywords

Brief Description

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Cosmology
Clusters
CMB
Gravitational lensing

EUCLID

Euclid is an ESA medium class space mission that will be launched in 2022. It will use a 1.2 meter telescope to observe 15000 square degrees of the sky. Euclid primary goal is to map the geometry and evolution of the dark universe with unprecedented precision. The aim is to place high accuracy constraints on Dark Energy, Dark Matter and Gravity using two independent cosmological probes: cosmic shear and baryonic acoustic oscillations. For this purpose, Euclid will measure the shape and spectra of galaxies in the visible and NIR, out to redshift 2, thus covering the period over which dark energy accelerated the universe expansion.

Cosmic shear is the gravitational distortion of the shape of background galaxies by the large scale structure of the universe. It is considered one of the most promising probe to determine the distribution of the dark matter in the universe and the equation of state and its time evolution of the dark energy. For cosmic shear measurements is mandatory to have very deep high quality images. Euclid will measure the shape of 2 billions galaxies with the image quality of a space telescope.

I am member of the Euclid collaboration and I am particularly involved in the lensing part being responsible of the Italian weak lensing working package in the frame of the ASI contract for this mission.

High order statistic of lensing fields

The unprecedented high quality and large quantity of Euclid data will allow to have access to information which is typically buried into noise in present day data. On the contrary, Euclid will make it possible to probe the non Gaussianity of the lensing convergence field thus opening the way to higher than second order statistics.

With the lensing group of Rome observatory, we explore the use of higher order moments (HOM) of the convergence field as a way to increase the lensing Figure of Merit (FoM). The main problem we have addressed has been how to match theoretical predictions (based on idealistic noiseless conditions) and actual measurements (with realistic noise and map reconstruction issues). Calibration strategies have been worked out and tested against MICE simulations. This has also allowed to make Fisher matrix forecasts showing how much the Figure of Merit is increased when high order statistics is added to the standard shear power spectrum analysis. This general project have been carried on for different estimators. In particular, we have considered high order moments and Minkowski functionals, while the analysis of other probes (both topological as Betti numbers and local as three – points correlation function) is in progress. As a side project, moreover, we have also investigated higher order moments of the shear field in order to improve the estimate of clusters mass from weak lensing data.

Systematics of cosmic shear measurements

The goal of Euclid mission to discriminate among different cosmological scenarios and determine the cosmological parameters with unprecedented precision will be reached only if we will be able to keep under control al the systematics associated with galaxy clustering and cosmic shear measurements.

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The wavelength dependence of the compact diffraction limited point spread function (PSF) of space-based observations introduce a subtle effect in shear measurements related to the wide filter adopted in Euclid observations. Since the galaxy has not a constant spectral energy distribution, the effective PSF is no more constant over the galaxy image contrary to what one assumes when performing shape measurements. This introduces a bias referred to as colour gradient (CG) bias. With Rome lensing group, we used HST images to evaluate CG bias and to develop a calibration strategy for Euclid mission. We determined the CG bias using HST observations in the F606W and F814W filters and observe a correlation with the colour, in line with expectations, whereas the dependence with redshift is weak. The biases for individual galaxies are generally well below 1%, which may be reduced further using morphological information from the Euclid data. Our results demonstrate that CG bias should not be ignored, but it is possible to determine its amplitude with sufficient precision, so that it will not significantly bias the weak lensing measurements using Euclid data.

Constraints on DHOST theories from clusters of galaxies

Degenerate higher-order scalar-tensor (DHOST) theories are considered the most general class of scalar-tensor theories so that any constraints on them apply to the full set of scalar-tensor models. DHOST theories modify the laws of gravity even at galaxy clusters scale hence affecting the weak lensing (WL), X-ray and Sunyaev-Zel'dovich observables. We derived the theoretical expression for the lensing convergence and the pressure profile of clusters in the framework of DHOST theories, and quantified how much they deviate from their General Relativity (GR) counterparts.

Cluster detection using weak lensing observations:

For its own property, weak lensing can be used to perform a blind search of unknown mass concentrations on wide-field surveys, by searching significant signal peaks in the shear maps. In the last decades weak lensing was shown to be an useful tool for detecting and counting massive halos, particularly galaxy clusters. Their comoving number density as a function of mass and redshift is a powerful cosmological probe and mainly depends on three fundamental parameters: the total matter density of the Universe, Ω_M , the normalization of the power spectrum, σ_8 , and the evolution of DE equation of state w . I used the mass aperture Map-statistics, to predict the detectability and the number density of cluster-sized halos expected from a wide survey optimized for weak lensing. In this way I investigated the capability of peak statistic to discriminate among rival gravity theories, considering both dark energy models and extended theories of gravity.

Cluster Mass and density profile with lensing data:

The only direct method to estimate cluster masses without any assumption about its dynamical state is via measurement of the distortion (shear) of the shapes of background galaxies that are weakly lensed by the gravitational potential of the cluster. I performed a weak lensing analysis of Abell 611 on LBT (Large Binocular Telescope) data in order to estimate the cluster mass and to compare different methods to reconstruct the cluster shear field. With my collaborators we also analyzed the possibility to use strong and

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weak lensing data to optimize the cluster mass reconstruction.

CFHT Legacy Survey:

CFHTLS is a french-canadian project that used the largest field of view CCC camera available at that moment to carry on a sky survey in five optical bands with a very good seeing and high image quality. The large area of 170 square degrees of the WIDE survey made possible for the first time the computation of the cosmic shear spectrum at degree scales, while the high magnitude limit reached in the DEEP survey allowed for the first attempt of lensing tomography. CFHTLS has been for many years the best available measurements of cosmic shear with the best precision in the determination of cosmological parameters (mainly σ_8 and Ω_m).

MITO-Pol polarimeter (2001-2006):

MITO-Pol was a millimeter polarimeter for the 2.6 meter telescope of MITO observatory (Testa Grigia-Cervino). The polarimeter used spider-web bolometers cooled at 0.3 K. The goal of this experiment was the search of calibration sources for the study of the Cosmic Microwave Background (CMB) polarization.

OLIMPO (2001-2006):

OLIMPO is a balloon-borne telescope devoted to the measurement of CMB anisotropies at small angular scale (3-5 arcmin) and the detection of Sunyaev-Zel'dovich effect in a sample of low redshift clusters. In particular I was in charge of the observational planning of cluster detected in lensing survey, either with an optical and γ -ray counterpart or without it (dark clouds).

Cosmic shear (1998-2000):

I participated to the **first detection of cosmic shear** with the research group of the *Institut d'Astrophysique de Paris*.

We used deep optical images obtained with the NTT and VLT ESO telescopes and with the Canada France Hawaii Telescope to study the shape distortion of the background galaxies produced by weak gravitational effect by the foreground galaxies.

The furthest galaxies are deformed due to the curvature that their light rays undergo when passing near large mass structures, placed between the observer and these galaxies. Their shape becomes elliptical with the major axis perpendicular to the gravitational field. This distortion therefore allows us to trace the properties of the large scale structure responsible for the phenomenon with the enormous advantage of being sensitive to the gravitationally active mass and not only to the luminous mass of sources. By observing a large number of galaxies (over 200,000) to counteract the statistical noise given by their intrinsic ellipticity, it is possible to establish the value of some cosmological parameters related to the formation and evolution of structures, such as Ω_0 and σ_8 .

IF emission by high-z sources (1998-2000):

I used the bolometer array of the IRAM radiotelescope to search for thermal IR emission produced by dust in radio-quiet quasars and more generally in high redshift sources characterized by an high star formation rate.

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Primordial molecules (1992-1997):

The presence of a primordial molecular medium at high redshift ($z=5-400$) can produce an effect on the CMB spectrum and its anisotropies. In particular I highlighted the role of LiH molecule that can produce via resonant scattering process the dumping of CMB primary anisotropies and the generation of secondary anisotropies associated with primordial clouds with a peculiar velocity in respect to the Hubble flux.

PRONAOS-SMH (1992-1997):

PRONAOS was a balloon borne telescope using an heterodyne radiometer to detect molecular oxygen and water lines in the interstellar medium. I was in charge to develop and characterize the Nb/AlOx/Nb superconductive junctions used in the mixer. The double band noise temperature obtained for the radiometer was 230 K, one of the best sensibility at that time for this kind of detectors.

Part VIII – Summary of Scientific Achievements

Product type	Number	Data Base	Start	End
Papers [peer review]	24	Web of Science	1992	2020
Papers [proceeding]	16	Web of Science	1992	2020

Total Impact factor (IF)	130.293
Average IF per Product	5.429
Total Citations	1541
Average Citations per Product	36,69
Hirsch (H) index	15
Normalized H index*	0.54

Product type	Number	Data Base	Start	End
Papers [peer review]	15	Web of Science	2005	2020
Papers [proceeding]	4	Web of Science	2005	2020

Total Impact factor (IF)	81.534
Average IF per Product	5.436
Total Citations	637
Average Citations per Product	35.89
Hirsch (H) index	8
Normalized H index*	0.53

*H index divided by the academic seniority.

Part IX– Selected Publications

List of the publications selected for the evaluation. For each publication report title, authors, reference data, journal IF (if applicable), citations, press/media release (if any).

#	year	publication data	IF	citation
1	2020	<i>Going deep with Minkowski functionals of convergence maps</i> - Parroni, C.; Cardone, V. F.; Maoli, R.; Scaramella, R.; <i>Astronomy & Astrophysics</i> 603, A71 DOI: 10.1051/0004-6361/201935988	5.636	
2	2019	<i>Minkowski functionals of convergence maps and the lensing figure of merit</i> - Vicinanza, M.; Cardone, V. F.; Maoli, R.; Scaramella, R.; Er, X.; Tereno, I.; <i>Phys. Rev. D</i> 99, 0443534 DOI: 10.1103/PhysRevD.99.043534	4.833	2 WoS
3	2018	<i>Calibration of colour gradient bias in shear measurement using HST/CANDELS data</i> - Er, X.; Hoekstra, H.; Schrabback, T.; Cardone, V. F.; Scaramella, R.; Maoli, R.; Vicinanza, M.; Gillis, B.; Rhodes, J; <i>Monthly Notices of the Royal Astronomical Society</i> , Volume 476, Issue 4, p.5645-5657 DOI: 10.1093/mnras/sty685	5.356	7 WoS
4	2018	<i>Increasing the lensing figure of merit through higher order convergence moments</i> - Vicinanza, M.; Cardone, V. F.; Maoli, R.; Scaramella, R.; Er, X.; <i>Phys. Rev. D</i> 97, 023519 DOI:10.1103/PhysRevD.97.023519	4.833	5 WoS
5	2015	<i>Mass-concentration relation and weak lensing peak counts</i> - Cardone, V. F.; Camera, S.; Sereno, M.; Covone, G.; Maoli, R.; Scaramella, R.; <i>Astronomy & Astrophysics</i> , Volume 574, id.A141 DOI:10.1051/0004-6361/201424699	5.636	3WoS
6	2014	<i>The power spectrum of systematics in cosmic shear tomography and the bias on cosmological parameters</i> - Cardone, V. F.; Martinelli, M.; Calabrese, E.; Galli, S.; Huang, Z.; Maoli, R.; Melchiorri, A.; Scaramella, R.; <i>Monthly Notices of the Royal Astronomical Society</i> , Volume 439, Issue 1, p.202-220 DOI:10.1093/mnras/stt2357	5.356	8 WoS
7	2013	<i>On the shear estimation bias induced by the spatial variation of colour across galaxy profiles</i> - Semboloni, E.; Hoekstra, H.; Huang, Z.; Cardone, V. F.; Cropper, M.; Joachimi, B.; Kitching, T.; Kuijken, K.; Lombardi, M.; Maoli, R.; Mellier, Y.; Miller, L.; Rhodes, J.; Scaramella, R.; Schrabback, T.; Velander, M.; <i>Monthly Notices of the Royal Astronomical Society</i> , Volume 432, Issue 3, p.2385-2401 DOI:10.1093/mnras/stt602	5.356	29 WoS
8	2013	<i>Weak lensing peak count as a probe of $f(R)$ theories</i> - Cardone, V. F.; Camera, S.; Mainini, R.; Romano, A.; Diaferio, A.; Maoli, R.; Scaramella, R.; <i>Monthly Notices of the Royal Astronomical Society</i> , Volume 430, Issue 4, p.2896-2909 DOI:10.1093/mnras/stt084	5.356	11 WoS
9	2008	<i>Very weak lensing in the CFHTLS wide: cosmology from cosmic shear in the linear regime</i> - Fu, L.; Semboloni, E.; Hoekstra, H.; Kilbinger, M.; van Waerbeke, L.; Tereno, I.; Mellier, Y.; Heymans, C.; Coupon, J.; Benabed, K.; Benjamin, J.; Bertin, E.; Doré, O.; Hudson, M. J.; Ilbert, O.; Maoli, R.; Marmo, C.; McCracken, H. J.; Ménard, B.; <i>Astronomy and Astrophysics</i> , Volume 479, Issue 1, February III 2008, pp.9-25 DOI:10.1051/0004-6361:20078522	5.636	343 WoS
10	2006	<i>Cosmic shear analysis with CFHTLS deep data</i> - Semboloni, E.; Mellier, Y.; van Waerbeke, L.; Hoekstra, H.; Tereno, I.;	5.636	127 WoS

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		Benabed, K.; Gwyn, S. D. J.; Fu, L.; Hudson, M. J.; Maoli, R.; Parker, L. C.; <i>Astronomy and Astrophysics</i> , Volume 452, Issue 1, June II 2006, pp.51-61 DOI:10.1051/0004-6361:20054479		
11	2001	<i>Cosmic shear analysis in 50 uncorrelated VLT fields. Implications for Ω_0, σ_8</i> - Maoli, R.; Van Waerbeke, L.; Mellier, Y.; Schneider, P.; Jain, B.; Bernardeau, F.; Erben, T.; Fort, B.; <i>Astronomy and Astrophysics</i> , v.368, p.766-775 DOI:10.1051/0004-6361:20010058	5.636	124 WoS
12	2000	<i>Detection of correlated galaxy ellipticities from CFHT data: first evidence for gravitational lensing by large-scale structures</i> - Van Waerbeke, L.; Mellier, Y.; Erben, T.; Cuillandre, J. C.; Bernardeau, F.; Maoli, R.; Bertin, E.; McCracken, H. J.; Le Fèvre, O.; Fort, B.; Dantel-Fort, M.; Jain, B.; Schneider, P.; <i>Astronomy and Astrophysics</i> , v.358, p.30-44	5.636	398 WoS

Roma, 2 Ottobre 2020

Firma *Roberto Maoli*