



AL MAGNIFICO RETTORE
DELL'UNIVERSITA' DEGLI STUDI DI MILANO

COD. ID: 4759

Il sottoscritto chiede di essere ammesso a partecipare alla selezione pubblica, per titoli ed esami, per il conferimento di un assegno di ricerca presso il Dipartimento di Fisica Aldo Pontremoli

Responsabile scientifico: Prof. Luigi Guzzo

Federico Tosone

CURRICULUM VITAE

INFORMAZIONI PERSONALI

Cognome	Tosone
Nome	Federico
Data Di Nascita	04, 11, 1993

OCCUPAZIONE ATTUALE

Incarico	Struttura
Dottorando	Università di Roma Tor Vergata

ISTRUZIONE E FORMAZIONE

Titolo	Corso di studi	Università	anno conseguimento titolo
Laurea Magistrale	Astrofisica	Università di Roma Tor Vergata	Ottobre 2017

LINGUE STRANIERE CONOSCIUTE:

lingue	livello di conoscenza
Inglese	proficient

ATTIVITÀ DI FORMAZIONE O DI RICERCA

My first research project during my first year of PhD entailed assessing the correct cosmological model to describe the background expansion of the Universe. This gave me the opportunity to learn the mathematical apparatus of field theory to study candidate dark energy models that can drive the late time acceleration of the cosmos. In order to make contact with data, I learned the statistical techniques to infer cosmological parameters from several astrophysical probes such as supernovae type Ia, baryon acoustic oscillations and cosmic chronometers. Ultimately I developed a Bayesian framework to forward model dark energy scalar fields in order to compute the cosmological observables to compare with the data. Not only are we able to estimate the cosmological parameters, but we also infer for the first time the initial conditions of the dark energy field and the parameters of its potential.

Afterwards, most of my PhD research has been devoted to studying the evolution of the cold dark matter distribution in the Universe, with particular emphasis on the connection between theory and simulations. Indeed, one of the most challenging problem of future galaxy surveys is to have accurate predictions for the dark matter distribution. To date, our prediction of structure formation relies on computationally



expensive N-body codes. While they are an irreplaceable reference, they limit our understanding of the underlying physical process. For this reason I devoted most of my PhD research in developing semi-analytical and numerical techniques that produce fast surrogate simulations of the matter distribution, while maintaining as much as possible the same statistical properties of the results from the full numerical code. This is a crucial direction to take, as (1) it improves our theory of structure formation and (2) it can be used to run Monte Carlo realizations of structure formation to compare with data, something which is otherwise prohibitive with an N-body code.

At first, I developed a cosmology independent approach that allows to simulate random fields on a three-dimensional grid with prescribed probability distribution function and two-point correlation function. This technique allows for the fast generation of thousands of surrogate realizations of the density field, through which we can generate covariance matrices for galaxy surveys.

As a final part of my PhD, I have been developing a new Lagrangian approach to approximate the exact evolution of particles in N-body simulations. This approach is based on augmenting perturbation theories, which are successful in approximating the simulations on large scales, with the halo model adapted to the Lagrangian picture to describe the small scales.

Both algorithms are implementable in a Bayesian forward modelling to analyse data from galaxy surveys. In addition to an estimate of cosmological parameters, this approach provides a test of gravity and a reconstruction of the primordial density field.

ATTIVITÀ PROGETTUALE

Anno	Progetto
2017-present	Fast simulations of Cosmological Fields. (PhD project)

CONGRESSI, CONVEGNI E SEMINARI

Data	Titolo	Sede
17/06/20	Beyond the Lognormal Approximation	Invited webinar at Instituto de Astrofísica de Canarias.
18/09/20	Fast simulations of Cosmological Fields.	Workshop of the PhD students of AASS, Università di Roma Tor Vergata.
28/01/20	Fast Eulerian Simulations	Speed Talk at the workshop "The Cosmic Web in the Local Universe" (Leiden).
18/06/19	Cold Dark Matter Simulations Via The Lagrangian Picture	Talk at the 10th Young Researcher Meeting, Villa Mondragone (Rome).
29/05/19	Cold Dark Matter Simulations Via The Lagrangian Picture	"ASI/COSMOS meeting on LambdaCDM", Tor Vergata (Rome)
18/08/19	Cold Dark Matter Simulations Via The Lagrangian Picture	Workshop of the PhD students of AASS, Università di Roma La Sapienza
21-22/01/19	Local Organizing Committee	CMB and the Large Scale Structure of the Universe, January 2019, Villa Mondragone (Rome).
25/09/18	Phenomenology of Dark Energy: Constraints from Low-Redshift Observations	Workshop of the PhD students of AASS, Università di Roma Tor Vergata



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SCUOLE E WORKSHOPS

Data	Titolo	Sede
18-29/06/18	ICTP Summer School on Cosmology	Trieste
01-06/07/18	Paving the way for next generation of cosmological surveys: new results and new methods in galaxy clustering	Sesto Pusteria

Articoli su riviste

Tosone Federico, M. C. Neyrinck, B. R. Granett, L. Guzzo, N. Vittorio. Beyond the log-normal approximation: a general simulation scheme. 2020, *mras*, 498, 2663-2675

Tosone, Federico, B. S. Haridasu, V. V. Luković, N. Vittorio. Constraints on field flows of quintessence dark energy. 2019, *prd*, 99, 043503.

M. Lovric, **Tosone Federico**, E. Pietropaolo, D. Del Moro, L. Giovannelli, C. Cagnazzo, and F. Berrilli. The dependence of the [FUV-MUV] colour on solar cycle. 2017, *swsc*, 7, 8.

ALTRE INFORMAZIONI

I believe that any new algorithm that provides an original result must be available to the community. This is where I maintain my public codes:

<https://github.com/tos-1>

During my PhD, I also spent a couple of months abroad visiting one of my collaborator, Mark Neyrinck, at the University of the Basque Country (Bilbao, Nov-Dec 2019).

Le dichiarazioni rese nel presente curriculum sono da ritenersi rilasciate ai sensi degli artt. 46 e 47 del DPR n. 445/2000.

Il presente curriculum, non contiene dati sensibili e dati giudiziari di cui all'art. 4, comma 1, lettere d) ed e) del D.Lgs. 30.6.2003 n. 196.

Luogo e data: L'Aquila, 14/11/20

FIRMA Federico Tosone