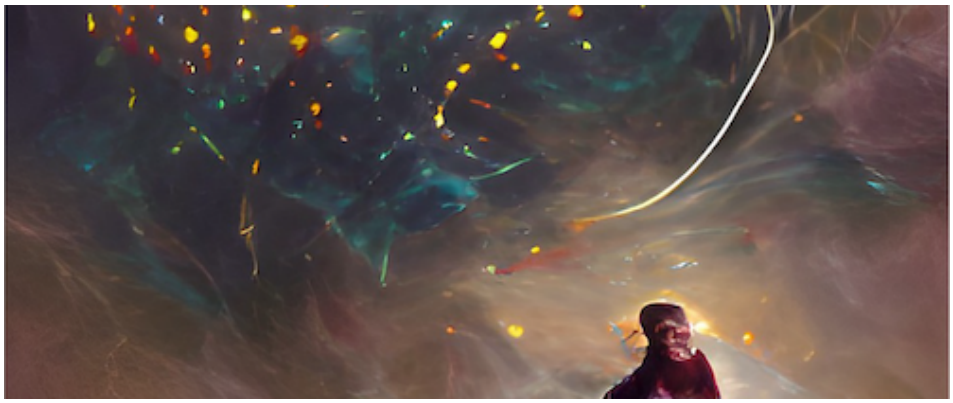
Cosmic Cartography 2022: Exploring the Cosmic Web and Large-Scale Structure



Report of Contributions

https://indico.ipmu.jp/e/cosmic2022

Contribution ID: **1** Type: **not specified**

Introduction/Logistics

Monday 7 March 2022 14:00 (15 minutes)

Presenter: LEE, Khee-Gan (Kavli IPMU)

Session Classification: Day 1 Afternoon

Contribution ID: **2** Type: **not specified**

Mapping the Circumgalactic Medium Through the Diffuse Emission

Monday 7 March 2022 14:15 (30 minutes)

In this talk, I will present our survey of enormous Lya nebulae at z=2. These enormous Lya nebulae reside in the density peak of large-scale structures. Using Keck Cosmic Web Imager, combined with the Subaru/HSC, ALMA and VLA, we studied the detailed properties and kinematics of the circumgalactic medium (CGM) through the emission. Combined with simulations, our observations are able to compare with detailed modeling and probe how galaxies are fed by the intergalactic medium and circumgalactic medium.

Presenter: CAI, Zheng (Tsinghua University)

Session Classification: Day 1 Afternoon

Contribution ID: **3** Type: **not specified**

Field Variation in LAE-IGM HI Correlation at Cosmic Noon Mapped by Subaru/HSC

Monday 7 March 2022 14:45 (20 minutes)

The correlation between HI in the IGM and galaxies now attracts great interest. We have found a positive LAE-IGM HI correlation based on a 5.4 deg^2 narrowband survey targeting IGM HI overdense regions (Liang+2021). Compared with simulations, this relation provides us with an instructive probe to unveil pristine HI gas assembly and galaxy formation. However, lines-of-sight around a 17σ quasar overdensity can significantly alter this relation's trend, which addresses the possible existence of field variation. Therefore, we extend our correlation analysis to the latest z=2.2 LAE catalog surveyed over the areas of 20 deg^2 from the Subaru HSC-SSP. With this four times larger sample, we find the slope of the relation is flatter in general fields. For the first time, we confirm the LAE-IGM HI correlation on a large-scale HI environment of >100 cMpc. The LAE overdensity is more sensitive to IGM HI in regions with denser HI, except for the unique environments where clustering quasars emerge.

Presenter: LIANG, Yongming (SOKENDAI/NAOJ)

Session Classification: Day 1 Afternoon

Contribution ID: **4** Type: **not specified**

Multi-wavelength detection of filaments

Monday 7 March 2022 15:05 (20 minutes)

Missing baryon problem is a long standing issue. Hydrodynamical simulations predict that the majority of the missing baryons is contained in the filaments of the cosmic web in the form of a plasma, called the warm-hot intergalactic medium (WHIM). So far, the direct measurement of the WHIM in cosmic filaments has been a challenge due to the weak signal and the entangled shape of cosmic filaments. I will present the multi-wavelength detection of the WHIM in the cosmic filaments using combined optical(galaxy), millimeter(SZ), and X-ray data.

Presenter: TANIMURA, Hideki (L'Institut d'Astrophysique Spatiale (IAS))

Session Classification: Day 1 Afternoon

Contribution ID: **5** Type: **not specified**

The Diversity of IGM-galaxy connection among galaxies at redshift z = 2-3

Monday 7 March 2022 15:25 (30 minutes)

The matter in the Universe is distributed like a network called the large-scale structure or the cosmic web. The observational probe of the cosmic web is the large-scale distributions of galaxies and the intergalactic medium (IGM). Because they trace the same underlying dark matter, one can expect their spatial correlation. Nonetheless, we cannot currently make their direct comparison due to the lack of either galaxy catalogs or IGM data, or both. Instead, we conducted the cross-correlation analysis and investigated the spatial connection between galaxies and the IGM. In this talk, I will present our latest results on the IGM-galaxy connection and its variety obtained from the Lyα forest tomography data, CLAMATO (Lee et al. 2016, 2018), and several galaxy catalogs at z = 2 in the archive.

Presenter: MOMOSE, Rieko (Kavli IPMU)

Session Classification: Day 1 Afternoon

Contribution ID: **6** Type: **not specified**

Evidence for the cold-stream to hot accretion transition as traced by Lya emission from groups and clusters at 2<z<3.3

Monday 7 March 2022 16:10 (30 minutes)

One key question encompassing galaxy formation and evolution and the growth of structures is how galaxies get their gas from the cosmic web. Our ongoing survey for distant group and clusters can be used to study these aspects, based on various observables. I will report current results based on KCWI observations of Lya halos in our groups and clusters over 2<z<3.3, as well as multiwavelength studies of their star formation and AGN content. We find evidence for a modulation of the share of baryonic accretion that remains cold as dark matter halos evolve and growth, as well as distinctive galaxy growth modes connected to accretion in the most distant structures.

Presenter: DADDI, Emanuele (CEA Paris Saclay)

Session Classification: Day 1 Afternoon

Contribution ID: **7** Type: **not specified**

Galaxy Evolution in the Cosmic Web: The Baryon Content of Field Galaxies in a High-Resolution Cosmological Simulation

Monday 7 March 2022 16:40 (20 minutes)

It is known from theory and observations that galaxy evolution can be influenced by environmental effects. Processes like ram pressure stripping in groups, clusters or the cosmic web as well as tidal stripping can affect the final properties of galaxies. However, until now no estimates exist on the relative importance of different processes for the final properties of field galaxies. Based on a high-resolution cosmological simulation I will show how a non negligible (25 %) galaxy population is affected by environmental processes connected with ram pressure stripping in different environments. I will further discuss the role of the cosmic web and galaxy groups in ram pressure stripping events as well as the effect of tidal stripping on the final properties of this sub-population. The results I present will provide a theoretical framework for observers to interpret their studies of how galaxies interact with their environment and how the cosmic web contributes in galaxy evolution.

Presenter: HERZOG, Georg (University Milano-Bicocca)

Session Classification: Day 1 Afternoon

Contribution ID: **8** Type: **not specified**

Cosmic metals and missing baryons in EAGLE filaments

Monday 7 March 2022 17:00 (20 minutes)

With the use of the EAGLE simulation, I will present the spatial and thermal distribution of the baryons within the filaments of the Cosmic Web. In particular, I will characterise the properties of the hottest (log T(K) > 5.5) Warm-Hot Intergalactic Medium (WHIM), which remains largely undetected and is a candidate to solve the cosmological missing baryons problem. Due to its high temperature, the hot WHIM can be traced by OVII absorption in the X-ray range. For this end, I will introduce observation predictions for future X-ray instruments.

Presenter: TUOMINEN, Toni (Tartu observatory, University of Tartu)

Session Classification: Day 1 Afternoon

Contribution ID: **9** Type: **not specified**

Forecast for WEAVE-QSO: 3D clustering and connectivity of critical points with Lyman-alpha tomography

Monday 7 March 2022 17:20 (30 minutes)

Presenter: KRALJIC, Katarina

Session Classification: Day 1 Afternoon

Contribution ID: **10** Type: **not specified**

Large Scale Structure with the Prime Focus Spectrograph

Tuesday 8 March 2022 09:00 (30 minutes)

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The Prime Focus Spectrograph will be an incredibly powerful instrument for large-area surveys of galaxies over most of cosmic time. With its wide wavelength coverage and multiplexing capabilities, it will be a powerful redshift machine. I will briefly describe the Strategic Survey Plan, and then focus on the Galaxy Evolution survey. With our Main survey, we will define the anisotropic cosmic web with unprecedented sampling at z>1. With our Deep spectra, we will then study the star formation histories, outflow rates, and chemical enrichment of these galaxies as a function of their location in the large scale structure.”

Presenter: GREEN, Jenny (Princeton University)

Session Classification: Day 2 Morning

Contribution ID: **11** Type: **not specified**

Chrono-Cosmographic Analysis of the Cosmic Web with TARDIS

Tuesday 8 March 2022 09:30 (30 minutes)

Recent Lyman-α forest tomography measurements of the intergalactic medium (IGM) have revealed a wealth of cosmic structures at high redshift (z ~ 2.5), including detection of large voids and protoclusters. In this talk, I will discuss ongoing work on the Tomographic Absorption Reconstruction and Density Inference Scheme (TARDIS), a chrono-cosmographic analysis tool for understanding the formation and evolution of these observed structures. We use maximum likelihood techniques with a fast non-linear gravitational model to reconstruct the initial density field of the observed regions. This allows us to not only accurately reconstruct the cosmic web at z~2.5 from the observed Lyman-alpha forest, but also to track the trajectories of coeval z = 2.5 galaxies to their z = 0 cosmic web environments and shed new insight in galaxy formation and evolution. I will also highlight a recent application of this technique to the COSMOS field as part of the CLAMATO survey.

Presenter: HOROWITZ, Benjamin (Princeton University)

Session Classification: Day 2 Morning

Contribution ID: **12** Type: **not specified**

Cartography of the Forming Galaxy Clusters: Proposal for a NIR spectroscopic campaign on IGM tomography map by PFS-SSP

Tuesday 8 March 2022 10:00 (20 minutes)

We will present highlights of our past deep Hα imaging and follow-up spectroscopy to dense forming proto-clusters at the cosmic noon (Shimakawa et al. 2014-18). We found enhanced star formation and gas-phase metallicity in low-mass galaxies in the protocluster cores at z=2-3. Combined with Lyα deficits therein, we suggest the forming cluster cores are associated with lavish gas reservoirs and also enriched by metals and dust. To reach a consensus, we propose an intensive NIR spectroscopic campaign with TAO/SWIMS (and Subaru/MOIRCS), focusing unique IGM environments and control fields probed by the upcoming Lyα tomography with PFS-SSP. This will help us resolve the controversial issues among previous studies of proto-clusters.

Presenter: SHIMAKAWA, Rhythm (NAOJ)

Session Classification: Day 2 Morning

Contribution ID: **13** Type: **not specified**

The Cosmic Web and Galaxy Ecosystems Revealed by Slime Mold

Tuesday 8 March 2022 10:40 (20 minutes)

Gas in the Cosmic Web, long associated with the IGM on large scales and CGM on small scales must fuel galaxy reservoirs and bear the imprint of galaxy feedback and structure formation. However, empirically connecting galaxies, their CGM, and the IGM within a Cosmic Web context has proven elusive. I will present our Cosmic Web reconstruction method Monte Carlo Physarum Machine (MCPM), inspired by the Physarum polycephalum slime mold, as well as new insights to galaxy ecosystems leveraging this methodology. At low and high redshift, I will demonstrate 1) the first conclusive association between the diffuse IGM and large-scale structure traced by galaxies and 2) that the physical conditions of the IGM and CGM depend critically on location within the Cosmic Web. Lastly, I will present our MCPM reconstruction data products covering z=0.01-0.51 that were recently released publicly with SDSS DR17.

Presenter: BURCHETT, Joseph (New Mexico State University)

Session Classification: Day 2 Morning

Contribution ID: **14** Type: **not specified**

The Absorption and Emission of Neutral Hydrogen around Star-Forming Galaxies at Cosmic Noon

Tuesday 8 March 2022 11:00 (20 minutes)

HI is an important component of the CGM/IGM gas. I will present two powerful samples from the KBSS Survey that focus on the Lya absorption and emission around z~2 star-forming galaxies. For absorption, we use the spectra of ~3000 galaxies to assemble ~200,000 foreground-background galaxy pairs. The ensemble is used to construct a 2D map of Lya absorption at 20-4000 kpc. The map suggests that outflow dominates the HI kinematics at <50 kpc, while infall and Hubble expansion dominate at >100 kpc. For emission, we obtain deep IFU observations on ~100 galaxies. We find that the Lya emission is statistically symmetric at <30 kpc, but stable angular momentum may start to establish. Lastly, I will present preliminary results on the connection between the Lya emission and host galaxy properties.

Presenter: CHEN, Yuguang (University of California, Davis)

Session Classification: Day 2 Morning

Contribution ID: **15** Type: **not specified**

Constraining the Cosmic Baryon Distribution with FRB Foreground Mapping

Tuesday 8 March 2022 11:20 (20 minutes)

The FRB can shed light on the ‘missing’baryons problem, because the dispersion of the FRB signals encodes information about the ionized gas along the line-of-sight. The majority of this dispersion is expected to come from the diffuse IGM tracing the cosmic web. However, the cosmic variance significantly decreases the sensitivity of the FRB. We introduce a technique to estimate the density field in FRB foreground to reduce the cosmic variance. Applying Bayesian density reconstruction algorithm to galaxy catalogues in the f/g of localized FRBs allows reconstructing the density field, decreasing the uncertainties in the f/g structures by ~2 compared to the cosmic variance. Using Fisher Matrix, we predict that a sample of 30 FRB constrains the fraction of baryons in the IGM to~10%, and parameters of foreground galaxy halos to~20%. We introduce FLIMFLAM - an ongoing observational campaign to obtain spectroscopic redshifts of galaxies in front of 30 localized FRBs to map out the cosmic web.

Presenter: KHRYKIN, Ilya (Kavli IPMU)

Session Classification: Day 2 Morning

Contribution ID: **16** Type: **not specified**

Foreground halo contributions to FRB dispersion measures: Preliminary constraints from the FLIMFLAM Survey

Tuesday 8 March 2022 11:40 (20 minutes)

Fast radio burst (FRB) dispersion measures (DMs) from radio observations record the presence of ionized baryons that are otherwise invisible to effectively all other techniques. Therefore, with FRBs, we may resolve the matter distribution in the cosmic web offering unique constraints on our cosmological paradigm. The number of FRBs localized to their host galaxies has steadily increased to the point that there are now tens of such FRB sightlines. With these in mind, we have designed the FLIMFLAM survey, primarily aimed at obtaining redshifts of the foreground galaxies proximal to FRB sightlines in order to independently estimate the FRB DM. For a few sightlines, we have already obtained spectra of hundreds of field galaxies using the AAT/AAOmega and the Keck/LRIS and DEIMOS spectrographs. I will present initial model constraints on the contribution of intervening halos to the FRB DM for the sightlines that are analyzed.

Presenter: SIMHA, Sunil (University of California Santa Cruz)

Session Classification: Day 2 Morning

Contribution ID: **17** Type: **not specified**

Cosmic Web in Diffuse Light Data

Tuesday 8 March 2022 14:00 (20 minutes)

The cosmic web emits photons at all wavelengths. Immediately beyond the local Universe, an increasing fraction of these photons would be in the diffuse radiation field as opposed to individually detected sources. This is especially true in relatively shallow, wide-field surveys. Thanks to the collective effort of the community, all-sky images, or intensity maps, now exist in over 18 orders of magnitude in wavelength from radio to gamma-ray. In this talk, I will introduce a tomographic intensity mapping technique that can unlock the use of a large number of diffuse photons in legacy or future sky survey datasets. I will demonstrate with intensity maps from GALEX, IRAS, and Planck to probe the cosmic Ultraviolet, Infrared, and the Sunyaev–Zeldovich effect background originated from different sources in the large-scale structures over the history of the Universe.

Presenter: CHIANG, Yi-Kuan (ASIAA)

Session Classification: Day 2 Afternoon

Contribution ID: **18** Type: **not specified**

Galaxy Formation Simulations for Galaxy Clustering with Emission Line Galaxies

Tuesday 8 March 2022 14:20 (20 minutes)

In order to investigate the structure formation and evolution at the distant Universe, emission line galaxies (ELGs) are suitable targets for upcoming spectroscopic surveys (PFS, Euclid, DESI). In order to address clustering properties of ELGs, we utilise galaxy formation hydrodynamical simulations: IllustrisTNG. We have developed the method to simulate emission line intensity with stellar population synthesis code. In simulations, we can directly investigate the relation between properties of ELGs and host halos and measure the cosmological statistics, e.g., correlation function. We address how biased inferred cosmological parameters are with the measured correlation function when the standard analysis is employed and scrutinize galaxy-halo connection, e.g., halo occupation distribution.

Presenter: OSATO, Ken (Yukawa Institute for Theoretical Physics, Kyoto University)

Session Classification: Day 2 Afternoon

Contribution ID: **19** Type: **not specified**

Galaxy intrinsic alignment in large scale structure

Tuesday 8 March 2022 14:40 (20 minutes)

The intrinsic alignment of galaxy shapes and spins originate from large-scale tidal field, which is a main contamination of the cosmic shear analysis. However, galaxy intrinsic alignment also carries useful information about both large scale tidal field and galaxy evolution. I will introduce how to exploit galaxy intrinsic alignment as a probe in the context of incoming surveys.

Presenter: SHI, Jingjing (Kavli IPMU)

Session Classification: Day 2 Afternoon

Contribution ID: **20** Type: **not specified**

Forecasting high-redshift intrinsic galaxy-cosmic web alignment for Subaru-PFS

Tuesday 8 March 2022 15:00 (20 minutes)

I will review some recent work in measuring intrinsic alignments between large-scale structure (LSS) and galaxy angular momenta and shapes, using hydrodynamic cosmological simulations. I will then preview an upcoming forecast of the LSS-galaxy alignment signal which will be measured by the Subaru Prime Focus Spectrograph (PFS), with data from the IllustrisTNG simulation and LSS reconstruction through IGM tomography.

Presenter: ZHANG, Benjamin (UC Berkeley, Kavli IPMU)

Session Classification: Day 2 Afternoon

Contribution ID: **21** Type: **not specified**

the Cosmic Web: Structural Complexity, Connectivity and Dynamics of the Megaparsec Universe

Tuesday 8 March 2022 15:35 (30 minutes)

To study the dynamical evolution and connectivity of the cosmic web, we describe our adhesion model of cosmic structure formation based on Voronoi and Delaunay tessellations. Subsequently, we describe how a phase-space analysis allows us to assess the growth of structural complexity in terms of the emergence of singularities and caustics. We indicate how the connections that emerge out of this hierarchically evolving weblike network can be quantified in terms of persistent homology. W ith our Nexus multiscale morphology formalism we explore the gravitational influence of structural components of the cosmic web. Filaments represent the most outstanding force in the Universe. However, it is the dynamical influence of voids that determines the pattern and connectivity of the cosmic web.

Presenter: VAN DE WEYGAERT, Rien (Kapteyn Astronomical Institute, Univ. Groningen)

Session Classification: Day 2 Afternoon

Contribution ID: **22** Type: **not specified**

Spinning filaments: the largest rotation in the universe

Tuesday 8 March 2022 16:05 (20 minutes)

How rotation is generated in a cosmological context is one of the key unsolved problems of cosmology. In the standard model of structure formation there is no primordial rotation and rotation must be generated as structures form. The cosmic web in general, and filaments in particular, are intimately connected with galaxy formation and have a strong effect on galaxy spin, regulating how they rotate. By focusing on filaments, we hope to identify how spin arose in the Universe. To do so, the motion of hundreds of thousands of galaxies was mapped and examined to see if these long tendrils spin on the scale of hundreds of millions of light years. A rotation on such enormous scale has never been seen before. By approximating filaments as cylinders the mean redshift difference (the Doppler shift) between galaxies on the receding (red) and approaching (blue) side of the filament tube was measured. A rotation signal was identified, opening a new door in understanding why everything in the universe spins.

Presenter: LIBESKIND, Noam (Leibniz Institute for Astrophysics Potsdam)

Session Classification: Day 2 Afternoon

Contribution ID: **23** Type: **not specified**

The caustic web and non-linear constrained Gaussian random fields

Tuesday 8 March 2022 16:25 (20 minutes)

The comic web consists of voids, walls, filaments, and clusters, formed from Gaussian fluctuations. Understanding under what conditions these different structures emerge is central to the study of the large-scale structure. Here, we present a general formalism for setting up Gaussian random initial conditions satisfying non-linear. These allow us to link the non-linear conditions on the eigenvalue and eigenvector fields of the deformation tensor, as specified by caustic skeleton theory, to the current day cosmic web. Applied to cosmological N-body simulations, the proposed techniques pave the way towards a systematic investigation of the evolution of the progenitors of the present-day walls, filaments, clusters, and the embedded galaxies, putting flesh on the bones of the caustic skeleton.

Presenter: FELDBRUGGE, Job (University of Edinburgh)

Session Classification: Day 2 Afternoon

Contribution ID: **24** Type: **not specified**

Critical event theory: towards a multiscale and anisotropic description of the cosmic web

Tuesday 8 March 2022 16:45 (30 minutes)

There are increasing evidences that the cosmic web biases galaxy formation. In particular, the cosmic web contributes to the modulation of galaxy properties with their spatial location. However, modeling these effects is made complex by the multiscale and anisotropic nature of the cosmic web. In this talk, I will present recent progress made towards providing a comprehensive and physically-motivated description of the evolution of the cosmic web using the so-called "critical event" theory. I will show how the theory encodes the hierarchical assembly of the bricks of the cosmic web – voids, walls, filaments and nodes. I will then discuss how this can then be employed as a middle ground to 1. predict the cosmic web evolution and 2. be used as input to galaxy formation models. I will also discuss possible applications of the theory as an efficient tool to describe the multiscale nature of cosmic web, complementing more classical one- and two-points statistics.

Presenter: CADIOU, Corentin (University College London)

Session Classification: Day 2 Afternoon

Contribution ID: **25** Type: **not specified**

Inferring the origin of the cosmic structure via Bayesian Forward modelling of galaxy surveys

Tuesday 8 March 2022 17:15 (30 minutes)

Presenter: JASCHE, Jens

Session Classification: Day 2 Afternoon

Contribution ID: **26** Type: **not specified**

Resimulating gas components of of the local cosmic web

I will describe a method to reconstruct the initial conditions responsible for the cosmic web observed in the low-z universe, and present results of hydrodynamic simulations using these initial conditions. These simulations can be used to understand how the gas components in the local cosmic web evolve with time to produce the gaseous structures we see today.

Presenter: MO, Houjun (University of Massachusetts)

Session Classification: Day 3 Morning

Contribution ID: **27** Type: **not specified**

Galaxy evolution in the cosmic web at z>1.5

The evolution of galaxies is linked to the growth of large scale structure in ways that are still poorly understood. This is, in part, because deep, wide-field spectroscopy is essential for associating individual galaxies with specific environments. I will summarize results from the GOGREEN imaging and spectroscopic survey of 21 galaxy clusters at 1<z<1.5. While we do find evidence that accretion onto massive structures plays a role in quenching star formation for low mass galaxies (M<1e10), it appears that the more massive galaxies ceased forming stars long before their arrival in the cluster. I will conclude by looking forward to what we can learn from protoclusters at 2<z<3, and from the next generation of facilities like the Maunakea Spectroscopic Explorer (MSE).

Presenter: BALOGH, Michael (University of Waterloo)

Session Classification: Day 3 Morning

Contribution ID: **28** Type: **not specified**

Star formation and chemical evolution in plotocluster

The protocluster's (PC's) are the densest region in the early universe, and many of them have recently been discovered. In high-density regions, galaxy formation is faster and star formation is more active than in the low-density environment. Therefore, PC is important for understanding both the evolution of galaxies and the cosmic star formation history in the Universe. We study the PC's star formation and gas metallicity evolution at z~2-10 using the cosmological SPH simulation code GADGET3-Osaka. The total star formation rate in the PC reaches >3000 M_sun yr^-1 at z=3, with the core region accounting for about half of the star formation in the PC at z~2. For the chemical abundance evolution, we find that the effect of Type II supernova (SN) appears at z>3, while that of Type Ia SN appear at z~3 in the core. We also compare the chemical abundance of the gas in individual PC galaxies with observations.

Presenter: FUKUSHIMA, Keita (Osaka University)

Session Classification: Day 3 Morning

Contribution ID: **29** Type: **not specified**

Cosmic cartography with Artificial Intelligence

Wednesday 9 March 2022 09:00 (20 minutes)

Estimating distances to galaxies is one of the key steps in the creation of LSS maps of the Universe. This is however a complex and expensive task and remains the main limiting factor in LSS analysis. In this talk I will show how using techniques based on our knowledge of LSS development and recent advances in artificial intelligence we can create maps of the distribution of galaxies with unprecedented accuracy and completeness. In order to fully appreciate these 3D maps I will present a virtual reality application that allows full interactive exploration of galaxy maps.

Presenter: ARAGON, Miguel (UNAM)

Session Classification: Day 3 Morning

Contribution ID: **30** Type: **not specified**

A muti-wavelength analysis of a protocluster environment at the Cosmic Noon

Wednesday 9 March 2022 09:20 (20 minutes)

The interplay between the large scale structure of the Universe and internal galaxy physical processes is one of the least understood questions in the field of galaxy evolution. Within this context, the study of clusters and protoclusters of galaxies provides crucial insights on the evolution of galaxies at scales and densities where environmental effects are most significant. We performed a muti-wavelength analysis of a protocluster at redshift z=2.3, where the combination of an enhanced cosmic start formation rate in the Universe and extensive data available allows us to perform a detailed study of the properties of protocluster members and their surrounding gas. Our analysis reveals complex morphology and kinematics of the circumgalactic gas, and indications of recent interaction between the galaxies and their surrounding gas up to intergalactic scales, that require state-of-the art physical interpretations.

Presenter: GALLEGO, Sofia (Caltech)

Session Classification: Day 3 Morning

Contribution ID: **31** Type: **not specified**

Accelerated growth of galaxies and super-massive black holes within the cosmic web gas filaments at z=3

Wednesday 9 March 2022 09:40 (20 minutes)

A generic prediction in a cold dark matter universe is the presence of a network of filaments, at the intersection of which galaxies form and evolve. Now the advent of IFU instruments enables us to directly trace the gas filaments and uncover galaxy formation and evolution within the filaments. In this regard, one of the best target is the SSA22 proto-cluster at z=3.1. Our MUSE observations map the gas in filamentary structures on a Mpc-scale. Intense star formation and supermassive black-hole activity is also found to occur within the galaxies embedded in this structure, suggesting that the growth of galaxies and black holes in massive proto-clusters is fed by the gas filaments of the cosmic web. The SSA22 proto-cluster will further provide an invaluable target for PFS to investigate the nature of the cosmic web and the role in galaxy formation, together with the ongoing deep Lyman-alpha mapping with Subaru/HSC.

Presenter: UMEHATA, Hideki (ICRR, University of Tokyo)

Session Classification: Day 3 Morning

Contribution ID: **32** Type: **not specified**

The HectoMAP Redshift Survey: A Platform for studying intermediate redshift Large Scale Structures

Wednesday 9 March 2022 10:00 (30 minutes)

HectoMAP is a dense redshift survey that yields a detailed map of the large scale structures at z < 0.7. HectoMAP is also covered by the Hyper Suprime Cam (HSC) Subaru Strategic Program (SSP) photometric survey enabling a range of applications that combine a dense redshift survey with both strong and weak lensing maps. Based on HectoMAP, we identify 346 galaxy clusters. We use this cluster sample to explore the dynamical connection between clusters and their brightest cluster galaxies by demonstrating the ratio between their velocity dispersions. The HectoMAP cluster catalog provides an important platform for future studies of intermediate redshift clusters. The combination of HectoMAP and future multi-wavelength surveys including e-ROSITA, complete HSC imaging, a Subaru Prime Focus Spectrograph survey will provide opportunities for increasingly sophisticated tests of cluster and large scale structure evolution.

Presenter: SOHN, Jubee (Center for Astrophysics | Harvard & Smithsonian)

Session Classification: Day 3 Morning

Contribution ID: **33** Type: **not specified**

Gas-phase environmental effects in the Spiderweb protocluster at z=2.16

Wednesday 9 March 2022 11:20 (20 minutes)

We use VLT/KMOS to investigate the role of the environment in the evolution of galaxies in the Spiderweb protocluster at z=2.16. Based on Hα and [NII], we measure SFRs and metallicities for 39 protocluster members as a function of local density and global environment properties. Galaxies embedded in this structure display SFRs compatible with the Main Sequence, and slightly enhanced metallicity values (~0.1 dex) compared to their coeval field counterparts. Furthermore, we explore the gas fraction-gas metallicity diagram for a few galaxies with molecular gas masses measured by VLA/ATCA using CO(1-0). In the context of the gas-regulator model, our objects are consistent with relatively low mass loading factors, suggesting lower outflow activity than field samples at similar redshift and hinting at the onset of environmental effects. We discuss the implications of these results on different scenarios of environmentally driven evolution during the early stages of massive cluster assembly.

Presenter: MANUEL PEREZ-MARTINEZ, Jose (Tohoku University)

Session Classification: Day 3 Morning

Contribution ID: **34** Type: **not specified**

Study environment and mass quenching through statistical analysis of RQGs

Wednesday 9 March 2022 11:40 (20 minutes)

In this work, we try to understand the environmental and mass effects of quenching. Recently-quenched galaxies (RQGs) can deliver information about the quenching scenario. A statistical sample of RQGs is necessary for studying mass and environment dependence of quenching. However, the rarity of RQGs hampers statistical spectroscopic analysis. As a pilot work, we conduct a statistical photometric study of RQGs. Using the rest-frame UVJ diagram, we select ~250 RQGs from the centre to the outskirts of clusters and separate them by quenching timescale. This method is consistent with current DEIMOS galaxy spectra. Now, PFS' large FOV can significantly improve the efficiency of the RQG spectroscopic survey. With statistical RQG spectroscopic data, we will interpret the quenching scenario better.

Presenter: MAO, Zhiying (Tohoku University)

Session Classification: Day 3 Morning

Contribution ID: **35** Type: **not specified**

GOODS-ALMA: Optically dark ALMA galaxies shed light on a cluster in formation at z = 3.5

Wednesday 9 March 2022 14:00 (20 minutes)

We study the properties of the six optically dark galaxies detected in the GOODS-ALMA survey. While none of them are listed in CANDELS catalog down to H = 28.16 AB, we were able to de-blend two of them from their bright neighbor and measure an H-band flux. We present the spectroscopic scan follow-up of five of the six sources with ALMA. We show that nearly 70% of them belong to the same overdensity of galaxies at z ~ 3.5 overdensity. AGS24, is the most massive galaxy without an AGN at z > 3 in the GOODS-ALMA field. It falls in the very center of the peak of the galaxy surface density, which suggests that the surrounding overdensity is a proto-cluster in the process of virialization and that AGS24 is the candidate progenitor of the future BCG.

Presenter: ZHOU, Luwenjia (NANJING UNIVERSITY)

Session Classification: Day 3 Afternoon

Contribution ID: **36** Type: **not specified**

Thermal Instabilities and Shattering in the High-redshift Cosmic Web - A Source for Low-metallicity Strong HI Absorbers

Wednesday 9 March 2022 14:20 (20 minutes)

We present a cosmological zoom-in simulation of two 5x10^12 halos and a Mpc-long cosmic filament connecting them at z~2, to study the evolution of the IGM and the cosmic web around this system at unprecedented resolution. At 5>z>3, the halos lie in a cosmic sheet with multiple coplanar filaments which contain most of the halos. The collapse of the sheet at z~5 generates a strong shock that leads to thermal instabilities, shattering, and a multiphase medium of kpc-scale cold clouds pressure confined in a hot medium. These clouds are detectable as LLSs, though they lie well outside halos or filaments. They are metal-free, similar to several recently observed systems. This effect is unresolved in state-of-the-art cosmological simulations, which underestimate the HI content of the cosmic web.

Presenter: MANDELKER, Nir (The Hebrew University of Jerusalem)

Session Classification: Day 3 Afternoon

Contribution ID: **37** Type: **not specified**

HAmiltonian Monte carlo reconstruction of the Local EnvironmenT (Hamlet)

Wednesday 9 March 2022 14:40 (20 minutes)

Our goal is to recover the linear peculiar velocity and density field from observations of galaxy peculiar velocities, specifically the Cosmicflows3 catalog. Our efforts are focused on attempting to recover the posterior probability function of the peculiar velocity field according to the ΛCDM model. By assuming the priors of the Λ CDM model we use a Hamiltonian Monte Carlo technique to sample from the posterior probability function in order to recover the linear peculiar velocity field and the corresponding cosmographic density field.

Presenter: VALADE, Aurelien (IP2I/AIP)

Session Classification: Day 3 Afternoon

Contribution ID: **38** Type: **not specified**

Beyond halo mass: Some clues on how the geometry and vorticity of gas flows shape galaxy mass assembly

Wednesday 9 March 2022 15:00 (30 minutes)

Recent spectroscopic and photometric studies at low and intermediate redshifts (e.g. SDSS, GAMA, VIPERS, COSMOS, etc) have shown evidence that either proximity to cosmic filaments, or the number of filaments a group/cluster is connected to, modulates galaxy mass assembly (mass, star-formation rate, spin) beyond the mere effect of halo mass and local density. I will briefly review some of these results and sketch possible interpretations. In particular, based on our recent measurements from hydrodynamical simulations, I will present a quenching mechanism directly related to the high angular momentum supply in galaxies lying at the vorticity-rich edge of cosmic filaments. I will briefly discuss how we expect future spectroscopic surveys to shed new light on this particular topic.

Presenter: LAIGLE, Clotilde (IAP)

Session Classification: Day 3 Afternoon

Contribution ID: **39** Type: **not specified**

Why does the cosmic web matter for low redshift galactic morphology?

Wednesday 9 March 2022 15:30 (30 minutes)

Why do thin galactic discs survive in the concordance model? This question has long been set aside as an obvious consequence of angular momentum conservation. The true answer is more subtle and enlightening for astronomy and theoretical physics. It must involve capturing gravity-driven processes operating on multiple scales, working to spontaneously set up a remarkably robust level of self-regulation, inherited from the cosmic web.

Presenter: PICHON, Christophe (IAP/CNRS)

Session Classification: Day 3 Afternoon

Contribution ID: **40** Type: **not specified**

Pre-processing galaxies in protoclusters

Wednesday 9 March 2022 16:15 (30 minutes)

Like their lower redshift counterparts, high-redshift clusters host an excess of massive quiescent galaxies. In this talk will explore where these galaxies were quenched. I will present a study of protocluster galaxies that reside in the distant outskirts of 15 galaxy clusters at $0.8 \leq z \leq 1.5$. I will show that the massive protocluster galaxies are already quenched to a similar level as the cluster core, implying that massive galaxies are pre-processed before they fall into the cluster. I will then explore why massive galaxies are quenched to such a high level in the protocluster. I will compare the radial distribution of satellite galaxies around the massive protocluster and field galaxies, which are both are well fit by an NFW profile. We find that protocluster galaxies are surrounded by twice as many satellites and the NFW scale radius of the protocluster galaxies is significantly larger that of the field galaxies. This suggests that the massive protocluster galaxies reside in larger dark matter haloes than similar-mass field galaxies. We interpret these results as evidence that the halos surrounding high-redshift clusters have a top-heavy mass function, which alters the galaxy properties before they become satellites of the clusters.

Presenter: HATCH, Nina (Nottingham University)

Session Classification: Day 3 Afternoon

Contribution ID: **41** Type: **not specified**

MOONS at the VLT: current status and planning for galactic and extragalactic surveys

Wednesday 9 March 2022 16:45 (30 minutes)

MOONS is the new Multi-Object Optical and Near-infrared Spectrograph under construction for the VLT. This remarkable instrument will allow large-scale spectroscopic campaigns needed to study the formation and evolution of stars and galaxies over the entire history of the Universe. I will present the current planning for Galactic and Extragalactic large survey foreseen for MOONS. On a timescale of 5-6 years MOONS will provide radial velocities and detailed chemical abundances for several million stars in the obscured regions of the Bulge and Disk, and beyond our Galaxy; as well as spectra for millions of galaxies at 1<z<10 with all the key spectral diagnostics and environmental information, comparable to what SDSS has done in the local Universe. This will represent a unique data-mine for both for Galactic and Extragalactic studies for years to come. I will also present the current status of the instrument and possible synergies with the ELT.

Presenter: CIRASUOLO, Michele (European Southern Observatory)

Session Classification: Day 3 Afternoon

Contribution ID: **42** Type: **not specified**

Galaxies, clusters, and superclusters: connectivity, collapse, and evolution

Wednesday 9 March 2022 17:15 (20 minutes)

I introduce our studies of the richest galaxy clusters in rich superclusters in the local Universe, in the Corona Borealis supercluster and in the A2142 supercluster, and galaxy transformations in them. The richest clusters in these superclusters are surrounded by the regions of influence with characteristic density contrast $\Delta\rho \approx 30$. The regions of influence passed turnaround and started to collapse at redshift approximately z = 0.4. The richest clusters in the Corona Borealis will merge in the future to form one of the most massive system in the local Universe. The main body of the SCl A2142 is now at turnaround. The connectivity of these superclusters (the number of long filaments connected to them) C = 6. Galaxies with very old stellar populations lie not only in the central parts of clusters and groups in superclusters, but also in the poorest groups in the low-density regions between superclusters (supercluster cocoons or voids).

Presenter: EINASTO, Maret (Tartu Observatory)

Session Classification: Day 3 Afternoon

Contribution ID: **43** Type: **not specified**

TBD

Wednesday 9 March 2022 17:35 (30 minutes)

Presenter: TASCA, Linda

Session Classification: Day 3 Afternoon

Contribution ID: **44** Type: **not specified**

Resimulating gas components of of the local cosmic web

Thursday 10 March 2022 09:15 (30 minutes)

I will describe a method to reconstruct the initial conditions responsible for the cosmic web observed in the low-z universe, and present results of hydrodynamic simulations using these initial conditions. These simulations can be used to understand how the gas components in the local cosmic web evolve with time to produce the gaseous structures we see today.

Presenter: MO, Houjun (University of Massachusetts)

Session Classification: Day 4 Morning

Contribution ID: **45** Type: **not specified**

Galaxy evolution in the cosmic web at z>1.5

Thursday 10 March 2022 09:45 (30 minutes)

The evolution of galaxies is linked to the growth of large scale structure in ways that are still poorly understood. This is, in part, because deep, wide-field spectroscopy is essential for associating individual galaxies with specific environments. I will summarize results from the GOGREEN imaging and spectroscopic survey of 21 galaxy clusters at 1<z<1.5. While we do find evidence that accretion onto massive structures plays a role in quenching star formation for low mass galaxies (M<1e10), it appears that the more massive galaxies ceased forming stars long before their arrival in the cluster. I will conclude by looking forward to what we can learn from protoclusters at 2<z<3, and from the next generation of facilities like the Maunakea Spectroscopic Explorer (MSE).

Presenter: MICHAEL, Balogh (University of Waterloo)

Session Classification: Day 4 Morning

Contribution ID: **46** Type: **not specified**

Star formation and chemical evolution in plotocluster

Thursday 10 March 2022 10:15 (20 minutes)

The protocluster's (PC's) are the densest region in the early universe, and many of them have recently been discovered. In high-density regions, galaxy formation is faster and star formation is more active than in the low-density environment. Therefore, PC is important for understanding both the evolution of galaxies and the cosmic star formation history in the Universe. We study the PC's star formation and gas metallicity evolution at z~2-10 using the cosmological SPH simulation code GADGET3-Osaka. The total star formation rate in the PC reaches >3000 M_sun yr^-1 at z=3, with the core region accounting for about half of the star formation in the PC at z~2. For the chemical abundance evolution, we find that the effect of Type II supernova (SN) appears at z>3, while that of Type Ia SN appear at z~3 in the core. We also compare the chemical abundance of the gas in individual PC galaxies with observations.

Presenter: FUKUSHIMA, Keita (Osaka University)

Session Classification: Day 4 Morning

Contribution ID: **47** Type: **not specified**

The Lyman-alpha Tomography IMACS Survey

Thursday 10 March 2022 10:50 (30 minutes)

The "cosmic noon"era is recognized as pivotal, but it has been challenging to connect early galaxies'properties to the large-scale structures in which they are growing. An exciting method to chart the z~2.5 universe is to map the intergalactic medium by measuring Lyman-alpha absorption in the spectra of many faint galaxies. These maps provide a unique means to detect and study protoclusters that is largely independent of their galaxy content. We have nearly finished mapping 1.7 sq. deg. of the z=2.2-2.8 universe in several survey fields via the Lyman-alpha Tomography IMACS Survey (LATIS) at Magellan. I will describe the survey, the connection between large-scale Lyman-alpha absorption and the LATIS galaxy density, and most interestingly, the places where this connection breaks down.

Presenter: NEWMAN, Andrew (Carnegie Institution for Science)

Session Classification: Day 4 Morning

Contribution ID: **48** Type: **not specified**

Probing the Morphology-Density Relationship at z ~ 2.3 with MAMMOTH Protoclusters

Thursday 10 March 2022 11:20 (20 minutes)

By analyzing the morphology, color, & distribution of cluster galaxies, we can study the evolution of protoclusters into clusters and determine how environment impacts the transformation of high-z star-forming galaxies into low-z red sequence galaxies. While many high-z red sequence galaxies are found in clusters/protoclusters out to z ~ 2, determining when the protocluster environment impacts morphology is an open question. We present an analysis of galaxies in three MAMMOTH protoclusters at z ~ 2.3. Using HST/WFC3 F160W imaging, we measure the morphology of H-alpha and Ly-alpha galaxies. By comparing the environment and fraction of galaxies with a Sersic index > 2 to the field, we determine if the protocluster environment impacts morphology at z ~ 2.3, or if the morphology-density relationship solidifies later. As we enter the JWST era, understanding the role of the protocluster environment in galaxy pre-processing is vital for completing the picture of cluster galaxy evolution.

Presenter: GOLDEN-MARX, Emmet (Tsinghua University)

Session Classification: Day 4 Morning

Contribution ID: **49** Type: **not specified**

Shape and connectivity of clusters: Impact on gas distribution

Thursday 10 March 2022 11:40 (20 minutes)

In this presentation, I will first present the impact of large scale environment on the recent building-up of about 415 clusters of galaxies from the IllustrisTNG simulation. The mass of clusters mainly influences the geometry of the matter distribution: massive halos are significantly more elliptical and more connected to the cosmic web than low-mass ones. Beyond the mass-driven effect, shape and connectivity of clusters appear to trace different dynamical states, and are the sign of different accretion histories. Secondly, I will present the exploration of gas distribution around clusters. Whereas hot plasma is virialised inside clusters, the warm gas is accumulating and slowly infalling at cluster peripheries. Inside clusters, hot gas is well tracing cluster structural properties: center offsets, substructure fractions and elliptical shapes. Outside clusters, we found that warm gas follows the distribution of DM by tracing cosmic filament patterns.

Presenter: GOUIN, Celine (Korea Institute for Advanced Study)

Session Classification: Day 4 Morning

Contribution ID: **50** Type: **not specified**

Constrained Simulations of COSMOS galaxy protoclusters at high redshifts

Thursday 10 March 2022 14:00 (30 minutes)

Constrained cosmological simulations, are designed to match the observed distribution of galaxies. Here, we present constrained simulations based on spectroscopic surveys at a redshift of z ~ 2.3, corresponding to an epoch nearly 11 Gyrs ago. This allows us to "fast-forward"the simulation to our present day and study the evolution of observed cosmic structures self-consistently. Our simulations confirm and model the fate of already known galaxy protoclusters, additionally finding several new ones. This method will be increasingly important for future deep and dense surveys

Presenter: ATA, Metin (Kavli IPMU)

Session Classification: Day 4 Afternoon

Contribution ID: **51** Type: **not specified**

The Void-Galaxy Cross-Correlation Function In Future Large Scale Structure Surveys

Thursday 10 March 2022 14:30 (20 minutes)

Cosmic voids are vast underdense regions of space in the large scale structure, whose statistical properties we've only recently been able to fully utilize. In particular, the cross-correlation of voids with galaxies allows us to explore redshift-space distortions and use the Alcock-Paczynski effect to constrain the laws of gravity and the expansion history of the Universe. In my talk I will show how different void finding algorithms and void selection affect modeling of the void-galaxy cross correlation function, and what improvements we will need to make in our modeling to account for the increased constraining power of upcoming LSS surveys like Euclid. I will also discuss how to properly account for covariance in cases where the theoretical model depends directly on the data.

Presenter: RADINOVIC, Sladana (Institute of Theoretical Astrophysics, University of Oslo)

Session Classification: Day 4 Afternoon

Contribution ID: **52** Type: **not specified**

Cluster and Void abundance as a probe of the non-linear Universe

Thursday 10 March 2022 14:50 (20 minutes)

A key limitation in advancing cosmology is the poor understanding of structure formation in non-linear regimes. Much information is contained at small scales, where low-redshift power spectra are difficult to model; as we move into an era of high-volume data to reduce statistical errors, modelling uncertainties such as this will become increasingly important. In this talk, I will first show how the BORG (Bayesian Origin Reconstruction from Galaxies) algorithm can be used to accurately estimate the masses of nearby galaxy clusters, and how these masses can be used to perform an independent test of the cosmological model. Secondly, I will show that by defining voids as 'anti-halos' in a density-reversed simulation, we can also use voids to perform the same test, without the modelling difficulties introduced by conventional void finders.

Presenter: STOPYRA, Stephen

Session Classification: Day 4 Afternoon

Contribution ID: **53** Type: **not specified**

How do voids influence galaxy evolution?

Thursday 10 March 2022 15:10 (20 minutes)

In our work (arXiv:2010.03742), we investigate the influence of voids on galaxy formation. In contrast to the dense environment of galaxy clusters, a galaxy should have difficulty forming in the underdense environment of a cosmic void. The gravitational pull of the void's surroundings should weaken the matter infall onto a dark matter halo located in the void. The effect should be the strongest at the potential hill of the void, which we denote the elaphrocentre. With the aim of testing if voids are a favourable environment for the formation of giant low surface brightness galaxies (LSBGs). I'll present our fully numerical, highly reproducible approach, starting from the initial perturbations through to a galaxy population obtained using semi-analytical galaxy evolution recipes based on the merger-tree histories. We investigate the properties of void galaxies, including the matter infall rate, the size of the galaxy disks, the spin parameter and the formation epoch.

Presenter: PEPER, Marius (Nicolaus Copernicus University)

Session Classification: Day 4 Afternoon

Contribution ID: **54** Type: **not specified**

Hierarchical structure of voids

Thursday 10 March 2022 15:45 (20 minutes)

Voids possess a very complex internal structure and dynamics. Our work studies the hierarchical structure present in the cosmic web identified on a set of numerical simulations. We use the SpineWeb method, which provides a complete framework for the characterization of the cosmic web into its primary constituents: voids, walls, filaments and clusters. We aim to characterize the inner compositions of voids at a given scale by detecting their internal filamentary structure. Even though voids are by definition empty, one can find galaxies in their interior in some cases. We employ a semi-analytical galaxy evolution model to explore the impact of the cosmic web detected inside voids in galaxies' properties. Our work shows the influence of the cosmic web constituents on the void galaxies properties, such as mass, angular momentum, and age. It highlights the importance of considering the substructure of underdense regions to understand the evolution and properties of void galaxies.

Presenter: JABER, Mariana

Session Classification: Day 4 Afternoon

Contribution ID: **55** Type: **not specified**

LyAl-Net: A high-efficiency Lyman-α forest simulation with neural network

Thursday 10 March 2022 16:05 (20 minutes)

The inference of cosmological quantities needs accurate and large cosmological simulations.Yet, the computational time takes millions of CPU hours for a modest coverage in cosmological scales (~(100 Mpc/h)^3). This ML method could have a decisive impact on the results derived from QSO surveys, e.g., SDSS3/4 data, which has a resolution power of R=1500 and R=2000. But it could be critical for upcoming surveys like WEAVE-QSO with R=20000 in high-res mode. We used the Horizon-NoAGN simulation to train the U-net, to predict the neutral hydrogen physical properties; density, temperature, and velocities. The flux derived from the predictions is nearly identical to the original flux from simulation with R ⊠ 30000. More generally, the computation of individual fields from the dark matter density agrees well within regular physical regimes of the cosmological field. This approach provides fast and robust numerical simulations, not only for Lyman-α forest but also a tool for other applications.

Presenter: BOONKONGKIRD, Chotipan (Institut d'Astrophysique de Paris)

Session Classification: Day 4 Afternoon

Contribution ID: **56** Type: **not specified**

Encoding large scale cosmological structure with Generative Adversarial Networks

Thursday 10 March 2022 16:25 (20 minutes)

Recent progresses in Machine Learning have unlocked new possibilities to tackle scientific problems by means of neural networks, and already many applications have been developed both in astrophysics and cosmology. In this presentation, using a Generative Adversarial Network (GAN), an unsupervised learning model, we demonstrate the possibility to learn the distribution of dark matter of the cosmic web, using as input the results of large-scale -dark matter only- simulations. We provide a statistical analysis showing that the neural networks learn the underlying distribution. Finally, we show that, using the generator learned by the GAN it is possible to design an Auto-Encoder. The AE is then capable of both inferring the latent code of the GAN from a snapshot of dark energy density, therefore opening the way to new applications such as inferring missing values on a corrupted dataset or deducing from density distribution at lower z its possible evolution at higher redshift.

Presenter: DECELLE, Aurélien (Universidad Complutense de Madrid)

Session Classification: Day 4 Afternoon

Contribution ID: **57** Type: **not specified**

TBD

Presenter: HAHN, Oliver

Session Classification: Day 4 Afternoon

Contribution ID: **58** Type: **not specified**

Cross-Survey Cross-Correlation Cosmology with AI-Accelerated Forward Modeling of the Galaxy–Halo Connection

Friday 11 March 2022 09:00 (30 minutes)

Cosmological survey data in the 2020s will be characterized by multi-wavelength information from thousands of square degrees of overlapping sky. This opens up the exciting prospect of a new era of multi-wavelength cosmological analyses that use all datasets simultaneously. I will refer to this ambitious program as Cross-Survey Cross-Correlation Cosmology (CSC3). The power of CSC3 will come from maximally utilizing information from multi-survey, same-sky observations across the full range of spatial scales. In this talk, I will give an overview of a new approach to cosmological inference that has potential to achieve the aims of CSC3 by unlocking the predictive power of the world's largest cosmological simulations through targeted application of AI.

Presenter: HEARIN, Andrew (Argonne National Lab)

Session Classification: Day 5 Morning

Contribution ID: **59** Type: **not specified**

The DESI Survey: Strategy and Current Status

Friday 11 March 2022 09:30 (30 minutes)

In this talk I will provide an overview of the strategy adopted for the full DESI Survey, as well as an update on its progress to date. Using a new 5000-fiber instrument at the 4m Mayall Telescope at Kitt Peak National Observatory, DESI should obtain spectra of more than 40 million targets over 14,000 square degrees during the course of a five year survey. Full survey operations began in May of 2021. I will provide a summary of the final selection methods adopted for each target class —stars, nearby bright galaxies, luminous red galaxies, emission line galaxies, and quasars — and describe their characterization using DESI Survey Validation data. I will also summarize the overall survey strategy and its progress to date.

Presenter: NEWMAN, Jeff A. (The University of Pittsburgh)

Session Classification: Day 5 Morning

Contribution ID: **60** Type: **not specified**

Clusters and the (Disperse) cosmic web

Friday 11 March 2022 10:00 (20 minutes)

Clusters are matched to nodes in several versions of the cosmic web created by the Disperse web finder, and filaments between nodes are then assigned to their cluster counterparts. This picks out parts of the underlying cosmic web. Properties of the correspondence and those clusters and nodes which don't have counterparts are described, similarly, cluster pairs with and without web assigned filaments are characterized. As different webs are considered, most clusters continue to have node counterparts, while most cluster pairs do not continue to have filaments.

Presenter: COHN, Joanne (UC Berkeley)

Session Classification: Day 5 Morning

Contribution ID: **61** Type: **not specified**

CLIMBER Mock Catalogs: Optimizing HOD Constraints from Next-Generation Surveys

Friday 11 March 2022 10:50 (20 minutes)

We have generated mock catalogs for the upcoming PFS, MOONS, and WAVES surveys to help quantify and optimize their constraining power on HOD models. To assign photometry into the UniverseMachine empirical model, we have developed the CLIMBER procedure using UltraVISTA photometry. We compare different targeting strategies by varying the area and targeting completeness, and quantify the uncertainty of the two-point correlation function. We demonstrate that the PFS and MOONS measurements will be primarily dominated by cosmic variance, not shot noise, motivating the need for increasingly large survey areas. On the other hand, the WAVES survey, which covers a much larger area, will strike a good balance between cosmic variance and shot noise.

Presenter: PEARL, Alan

Session Classification: Day 5 Morning

Contribution ID: **62** Type: **not specified**

Cosmic Filament Detection Through the Spherically Adaptive Density Ridges

Friday 11 March 2022 11:10 (20 minutes)

In this talk, we will present the methodology of recovering filaments from galaxy samples in the Sloan Digital Sky Survey (SDSS-IV) through directional density ridges, which can be practically estimated via our proposed Directional Subspace Constrained Mean Shift (DirSCMS) algorithm. The algorithm takes into account the nonlinear geometry of a celestial sphere on which the galaxy samples lie and thus potentially yields less biased estimators of the underlying filament structures on any 2D slices of the Universe. Moreover, the entire method can be directly generalized to detect the cosmic filaments in the 3D (RA,DEC,Redshift) space through directional-linear KDE and density ridges. The correlations between some galaxy properties and their proximity to our filaments will be also studied.

Presenter: ZHANG, Yikun (University of Washington, Seattle)

Session Classification: Day 5 Morning

Contribution ID: **63** Type: **not specified**

The impact of filamentary accretion of subhaloes on the shape and orientation of haloes

Friday 11 March 2022 11:30 (20 minutes)

Anisotropic subhalo accretion through cosmic filaments has an impact on halo structures. Using high-resolution cosmological simulations, we quantify the strength of filamentary subhalo accretion on host haloes and show that, for the first time, the shape and orientation of host haloes weakly correlate with the strength of filamentary subhalo accretion even if the host halo masses are the same. Minor-to-major axis ratios of host haloes tend to decrease as their filamentary accretion gets stronger. Haloes with highly anisotropic accretion become more prolate or triaxial. For host haloes with strong filamentary accretion, their major axes are preferentially aligned with the filaments, while their angular momentum tends to be slightly more misaligned. (https://ui.adsabs.harvard.edu/abs/2020MNRAS.495..502M/)

Presenter: ISHIYAMA, Tomoaki (Chiba University)

Session Classification: Day 5 Morning

Contribution ID: **64** Type: **not specified**

Mapping and characterisation of filaments and filament galaxies feeding clusters

Friday 11 March 2022 14:40 (20 minutes)

We used hydrodynamical zoom-in simulations to describe the geometry, collapse and feeding of clusters via filaments and groups, and to determine the histories of observed cluster galaxies. We created an inventory of galaxies in filaments feeding clusters; a combination of group-, backsplash- and pure filament galaxies, to compare pre-processing signatures to. Almost all galaxy groups become unbound, many return as backsplash galaxies via filaments. We further acted out several scenarios for new cluster programs with WEAVE and 4MOST, including testing the reliability of filament finding in redshift space where Fingers of God dominate. Finally, we compare our detailed cluster infall mapping to much larger-scaled cosmic web reconstructions to understand if and what information we lose.

Presenter: KUCHNER, Ulrike (The University of Nottingham)

Session Classification: Day 5 Afternoon

Contribution ID: **65** Type: **not specified**

Entangled in the cosmic web: probing the success of WEAVE in the extraction of cosmic filaments.

Friday 11 March 2022 15:00 (20 minutes)

The outskirts and infall regions of galaxy clusters act as the points of contact linking the large-scale structure of the Universe to the dense virialized cores of the clusters. In these regions, the underlying dark matter density field manifests itself as the cosmic web, making them crucial in understanding the mass assembly processes of the Universe. Our work involves forecasting the feasibility of the detection of the cosmic web through next-generation spectroscopic surveys using cosmological simulations of cluster and galaxy formation. We provide a framework for creating mock observations mass-matched to the upcoming survey WEAVE, extract cosmic filaments and evaluate their connectivity. We can be confident that we will characterize the cosmic web with a high degree of accuracy.

Presenter: CORNWELL, Daniel (University of Nottingham)

Session Classification: Day 5 Afternoon

Contribution ID: **66** Type: **not specified**

Cloning the local Large-Scale Structure with constrained simulations

Friday 11 March 2022 15:20 (20 minutes)

To study the cosmic web, surveys are designed to acquire a large quantity of spectral and multi-wavelength imaging data. To be fully understood and exploited, these data must be analyzed in combination with advanced cosmological simulations. Ideally the latter must be first calibrated at z=0 with extremely faithful numerical counterparts of the local, best known, cosmic web. I will introduce such simulations for the local Universe, a.k.a. CLONES (Constrained LOcal & Nesting Environment Simulations). I will present a few results, in particular regarding the local galaxy clusters, that promise to tremendously increase our capacity to evade systematics that will matter in analyses in order to reach accurate precision cosmology with future surveys of the cosmic web.

Presenter: SORCE, Jenny (Institut d'Astrophysique Spatiale / Leibniz-Institut fuer Astrophysik, Potsdam)

Session Classification: Day 5 Afternoon

Contribution ID: **67** Type: **not specified**

Nuw Cosmology beyond the average from one-point statistics

Friday 11 March 2022 15:55 (30 minutes)

Nonlinear gravitational collapse shaped the cosmic web and created a plethora of different density environments. To realise the full potential of galaxy surveys, we need to dissect different densities that are lumped together in 2-point statistics. This is particularly important for LCDM extensions including massive neutrinos, dark energy and modified gravity. I will show how to extract information from the one-point statistics of matter densities and galaxy survey observables. We showed that using the lensing PDF jointly with the 2pt correlation can improve parameter constraints on extended models by 40% when combined with Planck. We also developed a bias model for the galaxy PDF that is compatible with 2pt correlations and can extract density-split statistics from galaxy surveys.

Presenter: UHLEMANN, Cora (Newcastle University)

Session Classification: Day 5 Afternoon

Contribution ID: **68** Type: **not specified**

Better cosmological predictions with less effort

Friday 11 March 2022 16:25 (20 minutes)

Next-generation data sets promise 1% cosmology, but 1% predictions from simulations are expensive to build likelihood approximations and inference frameworks. Instead of intensive simulations, we can use approximate solvers, or surrogates, which introduce model error with respect to the simulations, which translates into biased and underestimated confidence bounds on cosmological parameters. To circumvent the dilemma, I proposed the "CARPool"principle that uses both simulations and surrogates to build minimal variance estimators. A Bayesian extension of this method allows to incorporate a priori knowledge. To illustrate the potential of the method, I used Dark Matter N-body simulations from the Quijote suite and surrogates from the Comoving Lagrangian Acceleration (COLA) solver to estimate the covariance matrix of summary statistics. I will also show how to use CARPool to speed up CMB polarization likelihood construction for the South Pole Telescope (SPT-3G) survey by a factor 100.

Presenter: CHARTIER, Nicolas (Laboratoire de Physique de L'Ecole Normale Supérieure (LPENS))

Session Classification: Day 5 Afternoon

Contribution ID: **69** Type: **not specified**

Cosmology with cosmic web environments

Friday 11 March 2022 16:45 (20 minutes)

The distribution of matter in the universe depicts a complex spatial pattern commonly referred to as the Cosmic Web in which massive nodes are linked together by elongated filaments found at the intersection of thin mildly-dense walls, themselves surrounding large and empty voids. Classifying, in simulations, the particles belonging to the several environments depending on level of local tidal anisotropies, we build summary statistics based on the combination of power spectra computed from the environments. Using a Fisher analysis of the constraints put on a set of five cosmological parameters and the summed neutrino mass, we forecast that this cosmic web split break some key degeneracies among parameters of the model and carries significantly (up to an order of magnitude) more information than a classical matter-matter analysis, both in real and redshift space.

Presenter: BONNAIRE, Tony (École Normale Supérieure)

Session Classification: Day 5 Afternoon

Contribution ID: **70** Type: **not specified**

Clustering statistics of Lyman-α forest beyond 2-point

Friday 11 March 2022 17:05 (20 minutes)

Lyα forest provides a unique probe of studying IGM matter distribution at high-z & upto small scales. While its 2-point clustering statistics have been studied widely, higher-order statistics remain largely unexplored. In addition to probing non-gaussianity in the density fields, they can also complement 2-point statistics in constraining cosmological & astrophysical parameters. In this talk, I will summarize my works on 3-point correlation. We study correlation as clustering of Voigt-profile decomposed Lyα lines that allows us to associate it with physical properties of the IGM. Observationally, we study redshift-space clustering at both low-z(z<0.5) & intermediate-z(1.7<z<3.5); wherein we report the first detections of 3-point correlation in Lyα absorbers at scales~1Mpc. We also use simulations to explore effects of various parameters on clustering. I will also talk about transverse clustering studies as a sensitive probe of the thermal history using simulated projected QSO triplets.

Presenter: MAITRA, Soumak (INAF – Osservatorio Astronomico di Trieste)

Session Classification: Day 5 Afternoon