

Cosmological Correlators



Report of Contributions

Contribution ID: 1

Type: **not specified**

Live Talk 1: Building a Boostless Bootstrap [Enrico Pajer]

Monday 7 September 2020 14:00 (1 hour)

Abstract: Cosmological surveys are believed to measure the future value of quantum correlators in a theory of gravity around quasi de Sitter spacetime. The goal of this talk is to develop a cosmological bootstrap, namely understand how general physical principles such as unitarity, locality and symmetries are encoded in these observables without a reference to the unobservable time evolution that generates them.

I'll show that in single-clock inflation, the only correlators of curvature perturbations that are fully de Sitter isometric are those of the free theory. This provides a strong motivation to develop a "Boostless" Bootstrap that does not assume invariance under de Sitter boosts (generally broken during inflation). I'll show how all tree-level bispectra for a massless scalar and graviton follow from a set of simple boundary Bootstrap Rules.

To move beyond the bispectrum, I'll derive a Cosmological Optical Theorem (see also Goodhew's talk), which expresses the consequences of unitary time evolution for the spatial correlations dictated by the wavefunction of the universe. This provides a very useful relation between the bispectrum and the (exchange) trispectrum.

Contribution ID: 2

Type: **not specified**

Discussion day 2 [Kostas Skenderis]

Tuesday 8 September 2020 18:00 (1 hour)

Contribution ID: 7

Type: **not specified**

Discussion day 1 [Paolo Creminelli]

Monday 7 September 2020 18:00 (1 hour)

Contribution ID: **8**

Type: **not specified**

Discussion [Nima Arkani-Hamed]

Wednesday 9 September 2020 18:00 (1 hour)

Contribution ID: 9

Type: **not specified**

Conclusion

Wednesday 9 September 2020 19:00 (15 minutes)

Contribution ID: 18

Type: **not specified**

Live Talk 2: Multipoint Correlators in Multifield Cosmology: formal structure and applications [Eva Silverstein]

Monday 7 September 2020 16:00 (1 hour)

Abstract: Connected N -point amplitudes in quantum field theory are enhanced by a factor of $N!$ in appropriate regimes of kinematics and couplings, but the non-perturbative analysis of this for collider physics applications is subtle. We will start by briefly reviewing this effect and related developments in large-charge sectors of quantum field theory. We then resolve the question in the affirmative for N -point correlation functions of cosmological perturbations in multifield inflation, and comment on its application to primordial non-Gaussianity. We find that they are calculably $N!$ -enhanced using a simple model for the mixing of the field sectors which leads to a convolution of their probability distributions. This effect leads to model-dependent but interesting prospects for enhanced observational sensitivity. Additional spinoffs include applications to primordial black hole production and a new inflationary model with a controlled resummation of derivative interactions.

Contribution ID: 19

Type: **not specified**

Live Talk 3: Spinning Cosmological Bootstrap [Hayden Lee]

Tuesday 8 September 2020 14:00 (1 hour)

Abstract: In this talk, I will describe recent developments in the bootstrap approach to cosmological correlators, extended to correlators of massless spinning particles. Interactions of massless particles are highly constrained by gauge invariance, which manifests itself as current conservation on the boundary of de Sitter space. I will show that boundary spinning correlators satisfy current conservation only if different channels have correlated couplings to each other, allowing us to rediscover bulk facts such as charge conservation and the equivalence principle from a purely boundary perspective. Moreover, the constraints on the allowed singularities of massless spinning correlators and their residues are often strong enough to fix the answers completely. Based on this, I will describe an efficient way to construct spinning cosmological correlators in terms of lower-point building blocks.

Contribution ID: 20

Type: **not specified**

Live Talk 4: Steinmann Relations, Causality and the Wavefunction of the Universe [Paolo Benincasa]

Tuesday 8 September 2020 16:00 (1 hour)

Abstract: How consistent causal time evolution is encoded in the late time wavefunctions of the universe or correlation functions? This is one of the open question which is crucial for our understanding of the fundamental physics encoded in quantum mechanical observables in cosmology. In this talk I will report on a recent progress in addressing such a question showing how the wavefunction of the universe, with ab-initio description given by the cosmological polytopes, has to satisfy the so-called Steinmann relations, which in the flat space case are an avatar of causality. I will show that the Steinmann relations for both the S-matrix and the wavefunction of the universe arise via the same mechanism and rely on the intrinsic definition of the cosmological polytopes themselves. Finally, such relations constitutes further constraints which can be used in the bootstrap program.

Contribution ID: 22

Type: **not specified**

Live Talk 5: Alternatives to inflation as cosmological particle scanners [Xingang Chen]

Wednesday 9 September 2020 14:00 (1 hour)

Abstract: We show that, while inflation can be regarded as a cosmological collider with fixed energy, possible alternative scenarios to inflation may be viewed as particle detectors with scanning energies. They scan through a tower of massive particles in the primordial universe and leave a series of bursts of oscillatory signals as scale-dependent features in the density perturbations. Besides particle contents, these signals directly record the time evolution of the scale factor of the primordial universe. We discuss observational aspects of these signals.

Contribution ID: 23

Type: **not specified**

Live Talk 6: De Sitter Diagrammar and the Resummation of Time [Matthew Baumgart]

Wednesday 9 September 2020 16:00 (1 hour)

Abstract: Light scalars in inflationary spacetimes suffer from infrared logarithmic divergences at every order in perturbation theory. This corresponds to the scalar field values in different Hubble patches undergoing a random walk of quantum fluctuations, leading to a simple toy landscape” on superhorizon scales, in which we can explore questions relevant to eternal inflation. However, for a sufficiently long period of inflation, the infrared divergences appear to spoil computability. Some form of renormalization group approach is thus motivated to resum the log divergences of conformal time. Such a resummation may provide insight into De Sitter holography. We present here a novel diagrammatic analysis of these infrared divergences and their resummation. Basic graph theory observations and momentum power counting for the in-in propagators allow a simple and insightful determination of the leading-log infrared divergences. One thus sees diagrammatically how the superhorizon sector consists of a semiclassical theory with quantum noise evolved by a first-order, interacting classical equation of motion. This rigorously leads to the Stochastic Inflation” ansatz developed by Starobinsky to cure the scalar infrared pathology nonperturbatively. Our approach is a controlled approximation of the underlying quantum field theory and is systematically improvable.

Contribution ID: 24

Type: **not specified**

Discussion of talks [Guilherme Pimentel]

Monday 7 September 2020 15:00 (45 minutes)

Harry Goodhew: The cosmological Optical Theorem

Dong-Gang Wang: Excursion in curved field space

Giovanni Cabass: Graviton non-Gaussianity in the EFT of I

Toshifumi Noumi: Country map of the EFT landscape

Contribution ID: 25

Type: **not specified**

Discussion of talks [Austin Joyce]

Monday 7 September 2020 17:00 (45 minutes)

Spyros Sypsas: Primordial statistics from Multifields

Siyi Zhou: Classical String solutions on dS

Leonardo Senatore: Starting inflation from inhomogeneous universe

Kurt Hinterbichler: Shift symmetries on dS

Contribution ID: 26

Type: **not specified**

Discussion of talks [Paul McFadden]

Tuesday 8 September 2020 15:00 (45 minutes)

Austin Joyce: Spinning correlators from the boundary

Carlos Duaso Pueyo: Weight-shifting operators

Paul McFadden: Conformal correlators as simplex in momentum space

Aaron Hilmann: Symbols in the Sky

Contribution ID: 27

Type: **not specified**

Discussion of talks [Leonardo Senatore]

Tuesday 8 September 2020 17:00 (45 minutes)

Dmitri Ponomarev: Spinor helicity formalism in AdS

Hiroshi Isono: Cosmological Witten diagrams

Yasha Neiman: Scattering amplitudes for dS observers

Massimo Taronna: From CFT bootstrap to correlators

Contribution ID: **28**

Type: **not specified**

Discussion of talks [Garrett Goon]

Wednesday 9 September 2020 17:00 (45 minutes)

Dan Green: Soft dS EFT

Victor Gorbenko: IR dynamics of QFT in dS

Mehrdad Mirbabayi: Loss of memory in dS

Skenderis: Inflationary correlators and the solution of conformal Ward identities

Bzowski: TripleK: A Mathematica package for evaluating triple-K integrals and conformal correlation functions

Contribution ID: 29

Type: **not specified**

Discussion of talks [Daniel Green]

Wednesday 9 September 2020 15:00 (45 minutes)

Yi Wang: Non-standard quantum clocks

Soubhik Kumar: extending the reach of the Cosmo Collider

Mark Wise: Galaxy Bispectrum and Conformal Fermi Coordinates

Sebastien Reneaux-Petel: A manifestly covariant theory of multifield stochastic inflation

Contribution ID: 30

Type: **not specified**

Excursion in Curved Field Spaces

Presenter: Mr WANG, Dong-Gang (Leiden University)

Session Classification: Recorded Talks

Contribution ID: **31**

Type: **not specified**

Introductory Remarks

Monday 7 September 2020 12:00 (20 minutes)

Presenters: Dr PAJER, Enrico (University of Cambridge); PIMENTEL, Guilherme

Contribution ID: 32

Type: **not specified**

Primordial Statistics from Multifields

Presenter: SYPSAS, Spyros (FCFM, Universidad de Chile)

Session Classification: Recorded Talks

Contribution ID: 33

Type: **not specified**

Weight Shifting Operators

Presenter: DUASO PUEYO, Carlos (Amsterdam)

Session Classification: Recorded Talks

Contribution ID: 34

Type: **not specified**

Classical string solutions on de Sitter space

Presenter: Ms ZHOU, Siyi

Session Classification: Recorded Talks

Contribution ID: 35

Type: **not specified**

Loss of memory in de Sitter

Presenter: MIRBABAYI, Mehrdad (ICTP)

Session Classification: Recorded Talks

Contribution ID: 36

Type: **not specified**

The Cosmological Optical Theorem

Presenter: GOODHEW, Harry (Cambridge)

Session Classification: Recorded Talks

Contribution ID: 37

Type: **not specified**

A manifestly covariant theory of multifield stochastic inflation

Presenter: RENAUX-PETEL, Sebastien

Session Classification: Recorded Talks

Contribution ID: **38**

Type: **not specified**

Conformal correlators as simplex integrals in momentum space

Presenter: MCFADDEN, Paul (Newcastle University)

Session Classification: Recorded Talks

Contribution ID: 39

Type: **not specified**

Infrared dynamics of QFT in de Sitter space

Presenter: GORBENKO, Victor (Stanford)

Session Classification: Recorded Talks

Contribution ID: 40

Type: **not specified**

Spinning Cosmological Correlators from the boundary

Presenter: JOYCE, Austin (Amsterdam)

Session Classification: Recorded Talks

Contribution ID: 41

Type: **not specified**

Inflationary correlators and the solution to conformal Ward identities

Presenter: SKENDERIS, Kostas

Session Classification: Recorded Talks

Contribution ID: 42

Type: **not specified**

Spinor helicity formalism in AdS

Presenter: PONOMAREV, Dmitrii (JINR)

Session Classification: Recorded Talks

Contribution ID: 43

Type: **not specified**

Note on cosmological Witten diagrams

Presenter: Dr ISONO, Hiroshi (Chulalongkorn University)

Session Classification: Recorded Talks