Nordita Program “Advances in Theoretical Cosmology in Light of Data”
Week 1/Messengers: Astroparticles and Gravitational Waves
Scientific program

Titles and abstracts by author. The schedule can be found at http://cosmo-nordita.fysik.su.se/schedule_w1.html.

FRANK AVIGNONE, University of South Carolina
The present and future of Neutrinoless double-beta decay experiments
Neutrino less double-beta decay has been a subject of interest since the 1930s. It is the only “practical” way to determine that neutrinos are Majorana particles. A direct observation would demonstrate the violation of lepton-number conservation, and a measurement of its half-life would determine the masses of all three neutrino mass eigenstates. There are many experimental efforts underway; however, this talk will concentrate on the half dozen that are expected to make an earliest impact, and which are the most probable candidates for a future down select. Those selected are taking data, and those which have specific proposals for upgrades aimed towards probing the complete inverted neutrino-mass hierarchy.

CSABA BALAZS, Monash University
Gravitational waves at aLIGO and vacuum stability with a scalar singlet extension of the Standard Model
Contrary to popular belief, stochastic gravitational waves might exist in reach of aLIGO (in operation by about 2020). I present a scenario, based on a scalar singlet extension of the Standard Model, that generates such gravitational waves.

DANIEL HOLZ, University of Chicago
LIGO's Black Holes
LIGO has ushered in the era of gravitational-wave astrophysics. We will summarize the results to date, focusing on the detections of binary black hole coalescences. After a brief overview of the LIGO instruments and analysis pipelines, we will explore some of the insights from these first detections, including tests of general relativity, event rates, and astrophysical formation mechanisms. We will also discuss the near future of gravitational-wave astrophysics.

MASSIMILIANO LATTANZI, INFN and Universita' di Ferrara
Quantifying the sensitivity to the neutrino mass hierarchy: role of the prior choice and interplay between cosmology and laboratory physics
Abstract TBA

ALVISE RACCANELLI, University of Barcelona
Cosmological tests with Multi-Messenger Astronomy
Abstract TBA

TANIA REGIMBAU, Cote d'Azur Observatory
The quest for the Gravitational-Wave Stochastic Background
A primary target for gravitational wave astronomy is the detection of a stochastic background formed by the superposition of many unresolved independent sources at different stages of the evolution of the Universe. The recent observations of GW150914 and GW151226 imply that the contribution of binary black hole mergers up to a redshift z~20 may be detectable by Advanced LIGO and Advanced Virgo in the coming years. In this talk, I will give an overview of the different sources and present the data analysis methods used in the LIGO/Virgo collaboration to measure the strength of the GW stochastic background. I will also discuss how the future generation of detectors can be used to remove the astrophysical contribution in order to observe the signal of cosmological origin.

SUBIR SARKAR, University of Oxford and NBI Copenhagen
Probing new physics with high energy cosmic neutrinos
I will discuss measurement of the neutrino deep inelastic scattering cross-section at energies far above that available at accelerators using astroparticle experiments like Auger and IceCube to study neutrinos from ultra-high energy cosmic ray interactions. We are about to publish a new measurement from IceCube using atmospheric neutrinos upto ~1000 TeV (so far consistent with pQCD). At higher energies there are expected signals of new dimensions, leptoquarks, colour glass condensate etc.

NINETTA SAVIANO, Mainz
Constraining sterile neutrinos with multi-survey approach
Abstract TBA

NICOLA TAMANINI, CEA Saclay
Late time cosmology with LISA: probing the cosmic expansion with massive black hole binary mergers as standard sirens
I will summarize the potential of the LISA mission to constrain the expansion history of the universe using massive black hole binary mergers as gravitational wave

standard sirens. After briefly reviewing the concept of standard siren, I will outline the analysis and methodologies to use LISA as a cosmological probe, and present estimates for the power of LISA in constraining cosmological parameters for both standard and alternative cosmological models.

SUNNY VAGNOZZI, Stockholm University
Unveiling neutrino secrets with cosmological data: mass and mass hierarchy
Cosmological datasets provide the tightest constraints on the absolute neutrino mass scale to date, and a combination of some of the next-generation cosmological surveys is expected to provide the first robust detection of neutrino masses. In this talk, I will discuss the latest and tightest constraints in the literature, obtained by considering some of the most recent measurements from the Planck satellite, the BOSS survey, and the Hubble Space Telescope, and other external datasets. A proper model comparison treatment shows that these results begin favoring the normal hierarchy mass ordering, with the inverted hierarchy excluded at a significance of 70% CL or more, depending on the datasets adopted. Moreover, our results begin to display a mild sensitivity to assumptions on the neutrino mass spectrum, suggesting that current datasets are sensitive to the distribution of hot dark matter in the late Universe. Finally, our work also suggest that current large-scale structure data is still sensitive to massive neutrino through background rather than perturbation effects, although this situation could be reversed by improving our understanding of the galaxy bias and the non-linear regime of the matter power spectrum.

JOSE W.F. VALLE, IFIC, Valencia
Neutrino pathways to cosmology
Abstract TBA

DAVID WEIR, University of Helsinki
Gravitational waves from first-order phase transitions
Abstract TBA

MARTIN WINKLER, Nordita
Searching Dark Matter with Charged Cosmic Rays
Abstract TBA