XIX Swieca Summer School on Particles and Fields

Arrival in Maresias - Jan. 30, 2017 - 17:00

~~~~~~~~~~

First week - Jan. 31 to Feb. 4, 2017

Plenary Lecture 1: 9:00 - 10:30
Lecturer: Rogerio Rosenfeld (IFT-UNESP)
Title: Introduction to Cosmology
Summary:
. Brief review of GR
. FLWR
. Background evolution
. Distances
. Thermal history
. BBN
. Dark matter
. Scalar fields in an expanding universe
. Inflation
. Evolution of perturbations
. CMB
. Structure formation (spherical collapse)

Reference: Baumann's lectures
http://www.damtp.cam.ac.uk/user/db275/Cosmology/Lectures.pdf

Coffee break: 10:30 - 11:00

Plenary Lecture 2: 11:00 - 12:30
Lecturer: João Penedones (EPFL)
Title: Introduction to Holography
Summary:
We will introduce the AdS/CFT correspondence as a natural extension of QFT in a fixed AdS background. We start by reviewing some general concepts of conformal field theory (CFT), including the embedding space formalism. We then consider QFT in a fixed Anti-de Sitter (AdS) background and show that one can define boundary operators that enjoy very similar properties as in a CFT, except for the lack of a stress tensor. Including a dynamical metric in AdS generates a boundary stress tensor and completes the CFT axioms. We also discuss some applications of the bulk geometric intuition to strongly coupled QFT.
~~~~~~~~~~

The lectures will follow closely:
https://arxiv.org/abs/1608.04948

It would be useful if the students knew some basics of CFT and the conformal bootstrap. The following lecture notes are a good introduction to the subject:
https://arxiv.org/abs/1601.05000
https://arxiv.org/abs/1602.07982

Lunch: 12:30 - 14:30

Plenary Lecture 3: 14:30 - 16:00
Lecturer: Enrico Bertuzzo (USP)
Title: The Standard Model of Particle Physics
Summary:
1- Construction of the Standard Model
2- The Standard Model and data: tree level predictions
3- The Standard Model and data: loop level predictions
4- Flavor physics: predictions and experimental confirmations

Suggested references
*Matthew Schwartz, "Quantum Field Theory and the Standard Model"
*R. Barbieri, "Ten lectures on Electroweak Interactions"
*Kennedy and Lynn, "Electroweak Radiative Corrections with an Effective Lagrangian: Four Fermion Processes" (http://inspirehep.net/record/260763)
*Z. Ligeti, "TASI lectures on flavor physics" (https://arxiv.org/pdf/1502.01372v2.pdf)

Coffee Break and Exercise Session: 16:00 - 18:00

Discussion Session: 18:00 - 18:30

~~~~~~~~~~

Sunday is free

~~~~~~~~~~

Second week - Feb. 6 to 10, 2017

Parallel Lecture 1A (Particles): 9:00 - 10:30
Lecturer: Adam Falkowski (CNRS Orsay)
Title: Physics Beyond the Standard Model at the crossroads
Summary:
I will present the current status and some new ideas related to physics beyond the Standard Model (BSM). The topics to be covered include:

- what have we learned from not finding new particles at the LHC,
- new ideas about naturalness of electroweak symmetry breaking,
- effective field theory approach to BSM searches,
- constraints on BSM from low-energy precision measurements,
- life after the LHC: future directions in collider physics, precision measurements, and dark matter searches.

Parallel Lecture 2A (Strings): 9:00 - 10:30
Lecturer: Pedro Vieira (Perimeter & ICTP-SAIFR)
Title: The S-matrix bootstrap in two and higher dimensions
Summary:
* Lecture 1:
Exact S-matrices from Patrick Dorey, https://arxiv.org/abs/hep-th/9810026
* Lecture 2:
Chapters 16-18 of Mussardo's book
https://www.amazon.com/Statistical-Field-Theory-Introduction-Graduate/dp/0199547580
* Lecture 3:
Maximum Modulus Principle: https://en.wikipedia.org/wiki/Maximum_modulus_principle
S-matrix bootstrap II paper: http://arxiv.org/abs/arXiv:1607.06110
* Lecture 4
João's Tasi Lectures: https://arxiv.org/abs/1608.04948
S-matrix bootstrap I paper: http://arxiv.org/abs/arXiv:1607.06109
* Lecture 5
Any reference with some partial wave discussion and how unitarity looks in terms of partial waves. An example is: http://inspirehep.net/record/235687/files/fermilab-pub-86-149-T.pdf , see equation (15) therein - disregard the stringy bits which are not really relevant for the lectures. It is probably also in Peskin and Schroeder.

Coffee break: 10:30 - 11:00

Parallel Lecture 1B (Strings): 11:00 - 12:30
Lecturer: Rob Myers (Perimeter)
Title: Entanglement in Quantum Field Theory and Holography
Summary:
Entanglement is a key feature which distinguishes quantum and classical physics. Over the past 25 years, an important role has emerged for entanglement in quantum information science and condensed matter theory, however, it is only recently that the importance of entanglement in quantum field theory and quantum gravity has become widely appreciated. In particular, entanglement entropy is now seen as an important diagnostic of entanglement in both of these arenas. These lectures will examine entanglement entropy, as well as some other diagnostics of entanglement, in quantum field theory and holography. In particular, the lectures will start with a discussion of the basics of entanglement entropy in both quantum field theory and holography and then move on to more advanced topics, such as applying entanglement entropy to study renormalization group flows and deriving Einstein's equation from the properties of relative entropy.

Parallel Lecture 2B (Cosmology): 11:00 - 12:30
Lecturer: Raul Abramo (USP)
Title: Structure formation in theory and in practice
Summary:
- Statistics of Gaussian fields in real and Fourier space
- Density fields and galaxy counts; galaxy bias
- The halo model; HODs
- Power spectrum and correlation function
- Redshift-space distortions; linear (Kaiser) and non-linear effects; some GR effects
- 2-point functions in the past light-cone
- Statistics of the 2-point function; 3- and 4-point functions
- The information in galaxy surveys: from maps to spectra
- Real-life effects: survey window, selection function, photometric redshifts
- Comparing theory and data (or simulations); Fisherology v. Monte Carlo
- BAOs
- Modified gravity and RSDs
- A survey of galaxy surveys

Lunch: 12:30 - 14:30

Parallel Lecture 1C (Particles): 14:30 - 16:00
Lecturer: Riccardo Sturani (IIP Natal)
Title: Gravitational waves and effective field theory methods to model compact coalescing binaries
Summary:
- Elements of General Relativity and definition of gravitational waves.
- Interactions of gravitational waves with matter detectors.
- Linearized General Relativity as a field theory. Green functions and two-body problem in the post-Newtonian approximation to General Relativity.
- Introduction to effective field theories (EFT). The post-Newtonian approximation for spinning and non-spinning compact objects.
- EFT derivation of the Einstein-Infeld-Hoffman potential. Feynman integral as basic tools to compute observables in General Relativity.
- The multipole expansion. Emission of gravitational waves. The quadrupole formula and its first order corrections. Tail and memory effects.
- Extraction of fundamental physics parameter from gravitational wave detection.

For a similar course given in the past (notes will be updated), see
http://www.ictp-saifr.org/?page_id=4372

References:
* ”Gravitational Waves", by M. Maggiore, ch. 1-3, 7, 9
* http://arxiv.org/abs/arXiv:1309.3474
* http://arxiv.org/abs/arXiv:1601.04914

Parallel Lecture 2C (Cosmology): 14:30 - 16:00
Lecturer: Luca Amendola (Heidelberg)
Title: Testing gravity with cosmology
Summary:
lecture 1: Introduction to cosmology and gravity
lecture 2: theories of gravity (why modify gravity, classes of models etc)
lecture 3: cosmological observations (clustering, lensing, clusters, CMB/grav. waves, etc)
lecture 4: testing gravity at large scales (how to combine all of the above to test gravity)
lecture 5: The Euclid satellite as a fundamental physics laboratory

References:
* “Cosmology and Fundamental Physics with the Euclid Satellite”
http://inspirehep.net/record/1466603
* Amendola and Tsujikawa, *Dark Energy. Theory and Observations*, Cambridge U. Press.

Coffee Break and Exercise Session: 16:00 - 18:00

Discussion Session: 18:00 - 19:30

~~~~~~~~~~

Poster session: afternoon of Wed. 8.

~~~~~~~~~~

Return to São Paulo/Rio - Feb. 11, 2017 - 10:00