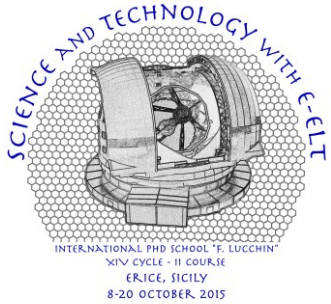

International PhD School 'F.Lucchin'

Science and Technology with E-ELT

XIV Cycle II Course

Abstracts

Day 2, Friday, Oct. 9

09:15-10:15 Roberto Gilmozzi
The E-ELT precursor(s)

10:15-11:00 Suzanne Ramsay
Science drivers for E-ELT

This talk will summarise the science cases that have been developed for the E-ELT and describe the way in which these ideas influence the development of the project. The process followed will be discussed.

11:45-12:45 Livia Origlia
E-ELT HIRES and exoplanets

HIRES is the project of a high resolution spectrograph with wide, simultaneous spectral coverage from the optical to the near infrared for the E-ELT. An overview of the science case, of the top level requirements, and of the modular instrument concept will be presented. Then, the HIRES most important contribution in the context of exoplanet science, will be discussed in more detail, with some emphasis on the Doppler technique for their detection and on the characterization of their atmospheres and host/environment.

12:45-13:45 Roberto Ragazzoni
Adaptive optics: past present and future

15:30-16:30 Santi Cassisi
Synthetic color magnitude diagrams: ingredients

We will review the main physical ingredients needed in order to "build up" a synthetic Color-Magnitude Diagrams (CMD), by discussing their current uncertainties and how their variations affect the obtained CMDs.

We will discuss how to build up a synthetic CMD by using some updated numerical tools available on the WEB, and will run some numerical experiments.

16:30-17:30 Tom Herbst
Infrared Astrophysics and Natural Limits to Observing

This lecture will underline the importance of infrared astrophysics to our understanding of the Universe. It begins with a brief history of man's exploration of this wavelength domain and our motivation for doing so. A review of infrared continuum and spectral line emission helps relate astrophysical objects to our observations of them. The Orion star forming region and the Galactic Center provide two illustrative case studies of these phenomena. The lecture concludes with an introduction to noise sources in infrared observations and the methods we have developed for dealing with them.

18:00-19:00 Patricia Sanchez-Blasquez
Unresolved Stellar Populations in the E-ELT era

The lectures summarize our current understanding of the stellar population properties of galaxies and the main techniques that we use to derive these properties when we cannot resolve individual stars. The lectures will outline important future research directions in the era of the ELT.

Day 3, Saturday, Oct. 10

09:00-10:00 Roberto Gilmozzi
E-ELT and the future

10:00-11:00 France Allard
Indirect Imaging of Ultra-Cool Dwarfs

A nearby, 2 pc, brown dwarf has been imaged indirectly by the technique of Doppler imaging, revealing dark patches covering a large fraction of the surface of Luhman 16b (Crossfield et al. 2014). Recent Spitzer survey of more than 44 L3-T8 dwarfs revealed that 80% of L-type Ultra-Cool Dwarfs (UCDs) are variable with amplitudes from 0.2−1.5%. It shows also that 36% of T-type UCDs were variable with amplitudes from 0.8 − 4.6% (Metchev et al. 2014). The presence of inhomogeneous thin and thick clouds, the thick

clouds being associated with lower effective temperature, could explain most of the observed variabilities. But clouds are not the only hypothesis to explain brightness heterogeneities. Plausible alternatives are magnetic spots on one hand, and temperature fluctuations driven by deep atmospheric instabilities on the other hand.

The former phenomenon is believed to happen in late-M and early-L UCD with high level of magnetospheric activity (Berger et al. 2010, ApJ, 700, 332; West et al. 2011, AJ, 141, 97). Indeed, a magnetic field coupled with the atmosphere could produce such hot or cold spots and may not be really distinguishable from cloud structures. The latter phenomenon, jets or eddy circulation in stratified layers, is considered important in late-T UCDs, which radiative time scale is long enough to support temperature fluctuations dissipation on longer time scales than a minute (Zhang & Showman 2014, ApJ, 788, L6). The technique of Doppler Imaging offers therefore the possibility with the E-ELT to help distinguish between these and other physical mechanism of surface inhomogeneities as cause of the observed spectra and photometric variability of UCDs.

We will review the technique and its limitations in this context.

11:30-12:30 Tom Herbst
Infrared Telescopes, Instrumentation, and Detectors

Harnessing and maximizing the diagnostic power of infrared observations requires carefully optimized telescopes, instrumentation, and detectors. This lecture begins with an examination of telescope design with a particular focus on proper thermal control and placement of the pupil. Infrared instrumentation presents a particular challenge and opportunity, and the middle portion of the lecture will focus on proper design principles and infrared optical material selection. The revolution in infrared astronomy in the last 40 years has been enabled largely by improvements in detector technology. After reviewing the various types of IR detector and their advantages, the lecture will conclude with an explanation of observational techniques designed to maximize scientific return.

12:30-13:30 Laura Schreiber
Mapping the PSF across Adaptive Optics images

Adaptive Optics (AO) has become a key technology for all the main existing telescopes (VLT, Keck, Gemini, Subaru, LBT..) and is considered a kind of enabling technology for future giant telescopes (E-ELT, TMT, GMT).

AO increases the energy concentration of the Point Spread Function (PSF) almost reaching the resolution imposed by the diffraction limit, but the PSF itself is characterized by complex shape, no longer easily representable with an analytical model, and by sometimes significant spatial variation across the image, depending on the AO flavour and configuration.
The aim of this lesson is to describe the AO PSF characteristics and variation in order to provide (together with some AO tips) basic elements that could be useful for AO images data reduction.

15:30-16:30 Simone Esposito

The E-ELT and SCAO observing mode

The lecture describes briefly the basic concepts of Single conjugate Adaptive Optics Systems in Astronomy. Then it introduces and describes the main design elements of the SCAO systems for an ELT. Finally the performance of SCAO mode for the E-ELT are presented and discussed with examples taken from numerical simulations.

16:30-17:30 Fiorentino & Schreiber

Guess Who?

Several images, taken with different AO instruments, will be available for students to play with. The estimation and characterization of the FWHM across the Field of View will be hopefully performed by students themselves accordingly to their personal experience with some software for image analysis (e.g. IDL, IRAF,or whatever they want...). Laptops with your favorite software already installed are very welcome!

18:00-19:00 Sebastian Kamann

Introduction to integral field spectroscopy

Over the past two decades, integral field spectroscopy has undergone a remarkable development from the first science demonstrations to powerful instruments at the worlds largest telescopes. In this session, I will give a general introduction to the work with integral field spectrographs. With my presentation, I want to give answers to the following questions: What is integral field spectroscopy? Why has it become such an important technique? How can I use it for my science? Are there any tips, tricks, or drawbacks I should now about? How will we use integral field spectrographs in the era of the E-ELT? A second session that is focussed on the actual science that can be done with integral field spectrographs will follow towards the end of the summer school.

Day 4, Sunday, Oct. 11

9:00-10:00 Enrico Marchetti

Multi-conjugate Adaptive Optics: widening the sharpness in astronomical observations

Classical Adaptive Optics suffers from the small size of the corrected field of view due to atmospheric anisoplanatism. To overcome this limitation a new concept has been proposed: Multi-conjugate Adaptive Optics (MCAO). This lecture will explain what is MCAO, how it works, its strengths, its weaknesses and its demonstration on sky following a timeline starting from the first idea to its final realization passing through the milestones that enabled the concept to become a reality. We will start introducing the atmospheric anisoplanatism concept and then moving to the MCAO theory detailing the working principle and its main supporting pillars. Then we will move to the MAD project, the MCAO demonstrator built by ESO that proved the concept feasibility on sky. MAD design, construction and testing will

be briefly outlined and the on-sky results will be extensively presented. A short reminder to extension of MCAO to ELTs will be also given.

10:00-11:00 Roberto Ragazzoni
Adaptive optics for ELTs

11:30-12:30 Patricia Sanchez-Blazquez
Unresolved Stellar Populations in the E-ELT era

The lectures summarize our current understanding of the stellar population properties of galaxies and the main techniques that we use to derive these properties when we cannot resolve individual stars. The lectures will outline important future research directions in the era of the ELT.

12:30-13:30 Bruno Leibundgut
Supernovae and Cosmology

Mapping the cosmological expansion is one of the main goals of cosmology. The expansion history of the universe is determined by its contents. Measuring the expansion rate, the Hubble parameter, as a function of lookback time provides an indication what energy contents are present in the universe. Supernovae have been among the main tools to measure the cosmic expansion directly. Their luminosity and variability make them detectable out to redhifts beyond 1 and a lookback time of more than half the age of the universe. The current status of supernovae as distance indicators and their cosmological applications are reviewed.

15:30-16:30 Andrew Shearer
High Time Resolution Astrophysics : Science now and in the ELT era.

This talk will examine the current status of short time domain astrophysics. HTRA is primarily concerned with condensed objects such as neutron stars, black holes and white dwarfs. It also concerns planetary scale objects through transits and occultations. Optical HTRA has contributed to several important astrophysical and physical processes; these include the extreme gravity conditions around neutron stars and stable orbits around stellar mass black holes. Transits, involving fast timing, can give vital information on the size of, and satellites around exoplanets. In the realm of fundamental physics interesting applications lie in the regime of ultra-high time resolution, where quantum-physical phenomena, currently studied in laboratory physics, may be explored. HTRA science covers the full gamut of observational optical/IR astronomy from asteroids to γ-rays bursts, contributing to four out of six of AstroNet's fundamental challenges described in the Science Vision for European Astronomy. ELTs have the capability of making a significant contribution to HTRA through either dedicated instruments or within the proposed first light or second generation instruments. HTRA requires fast, sensitive and low detectors - exactly what a perfect astronomical detector should be.

The two talks will look firstly at existing HTRA science and then onto the technological possibilities of E-ELT proposed and future instruments and detectors.

16:30-17:30 Suzanne Ramsay

E-ELT Instrumentation

In this lecture, the instrument programme for the E-ELT will be presented. An overview of the science drivers, scientific capabilities and instrument concept for each instrument will be given. I will also discuss the process of arriving at the selection of instruments for the new telecope.

18:00-19:00 *Students' talks*

Day 5, Monday, Oct. 12

09:00-10:00 Benoit Carry

Solar system in the E-ELT era

Study of our Solar System yields many constrains on planets formation and evolution. After reviewing current understanding of the events that shaped our planetary system, we will discuss some of the main open questions in the field, in particular what are the expectation for the next decade, thanks to the upcoming all-sky surveys such a LSST and the large aperture E-ELT.

10:00-11:00 Maurizio Salaris

Advanced evolutionary phases of low- and intermediate-mass stars: current status and open problems

These lectures describe the final evolutionary stages of low- and intermediate-mass stars. Objects in this mass range constitute the majority of stars in the universe, and modelling their final evolutionary stages is crucial to study resolved and unresolved stellar populations in both UV and IR wavelengths.

The structure and evolution of Asymptotic Giant Branch (AGB), post-AGB and White Dwarf (WD) stars is described in some detail. Emphasis is given to the discussion of the major uncertainties in modelling these evolutionary stages and how E-ELT can impact their study.

11:30-12:30 Enrico Marchetti

AO for the ELTs: Physical and Technological challenges

Building an Adaptive Optics system for an ELT is not straightforward. Applying simple scaling laws to the 8-m class facilities to adapt to the much larger telescope size often does not work. In some cases the larger size helps, in others it works against. This lecture will present a non-exhaustive overview of how the physical principles can challenge the AO at the ELTs and what are the technological solutions attempting to overcome the limitations. In some cases a solution exists in some others we have only ideas and concepts. We will talk

about the outer scale of the atmosphere and how it is good for the ELTs, how large deformable mirrors became reality, what we can do to calibrate large dimensioned AO systems, the pain of using laser guide stars with large apertures and large size detectors for wavefront sensing.

12:30-13:30 Jochen Liske
Precision cosmology in the E-ELT era

15:30-16:30 Norbert Przybilla
Blue super-giants in the E-ELT era

Massive blue supergiants are among the visually brightest normal stars in spiral and irregular galaxies. They can rival entire globular clusters or even dwarf galaxies in integrated light. This makes them primary candidates for quantitative spectroscopy at large distances. A brief overview will be given, how blue supergiants contribute to our understanding of galaxy evolution and the cosmic distance scale already today.

In a second step, it will be discussed, which scientific prospects extragalactic stellar astronomy with blue supergiants will offer.

in the era of the E-ELT.

16:30-17:30 Fabrizio Fiore
AGN & SN feedback: from galaxy evolution to the reionization epoch

18:00-19:00 Livia Origlia
Spectroscopy of stars and stellar populations: from spectra to chemical abundances

Spectroscopy of stars and stellar populations is a fundamental technique to obtain detailed information on their chemical composition. The route to chemical abundances from observed spectra is intricate but intriguing. The main purpose of this lecture is to provide a critical overview of
1) the basics of spectral and chemical analysis;
2) the space of astrophysical and instrumental parameters;
3) some modelling concepts.

Day 6, Tuesday, Oct. 13

09:00-10:00 Jochen Liske
Precision cosmology in the E-ELT era

10:00-11:00 France Allard
Indirect Imaging of Ultra-Cool Dwarfs

A nearby, 2 pc, brown dwarf has been imaged indirectly by the technique of Doppler imaging, revealing dark patches covering a large fraction of the surface of Luhman 16b (Crossfield et al. 2014). Recent Spitzer survey of more than 44 L3-T8 dwarfs revealed that 80% of L-type Ultra-Cool Dwarfs (UCDs) are variable with amplitudes from 0.2−1.5%. It shows also that 36% of T-type UCDs were variable with amplitudes from 0.8 − 4.6% (Metchev et al. 2014). The presence of inhomogeneous thin and thick clouds, the thick clouds being associated with lower effective temperature, could explain most of the observed variabilities. But clouds are not the only hypothesis to explain brightness heterogeneities. Plausible alternatives are magnetic spots on one hand, and temperature fluctuations driven by deep atmospheric instabilities on the other hand.

The former phenomenon is believed to happen in late-M and early-L UCD with high level of magnetospheric activity (Berger et al. 2010, ApJ, 700, 332; West et al. 2011, AJ, 141, 97). Indeed, a magnetic field coupled with the atmosphere could produce such hot or cold spots and may not be really distinguishable from cloud structures. The latter phenomenon, jets or eddy circulation in stratified layers, is considered important in late-T UCDs, which radiative time scale is long enough to support temperature fluctuations dissipation on longer time scales than a minute (Zhang & Showman 2014, ApJ, 788, L6). The technique of Doppler Imaging offers therefore the possibility with the E-ELT to help distinguish between these and other physical mechanism of surface inhomogeneities as cause of the observed spectra and photometric variability of UCDs.

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The two talks will look firstly at existing HTRA science and then onto the technological possibilities of E-ELT proposed and future instruments and detectors

16:30-17:30 Eline Tolstoy
Resolved stellar populations in the nearby Universe

I will talk about how resolved stellar populations in the nearby Local Group dwarf galaxies have been used to study the detailed chemical, kinematic and star formation history of these nearby small systems, and the implications for our general understanding of galaxy formation and evolution. I will talk mainly about the observational results from relatively large VLT/FLAMES spectroscopic surveys and work combining spectroscopy with colour-magnitude diagram analysis to measure the time scale for chemical evolution in the same dwarf galaxies. I will look forward to what we can expect from similar techniques applied to large facilities that are just coming online, like GAIA and beyond to the E-ELT.

18:00-19:00 Maurizio Salaris
Advanced evolutionary phases current status and open problems

Day 7, Wednesday, Oct. 14

09:00-10:00 Roberto Tamai
E-ELT project current status and future plans

The E-ELT was formally approved by ESO Council back in 2012, however the required funding level for starting construction was actually only reached in 2014, leading to a Green Light to start large procurement in December of that year. Since then, the programme has entered a very busy phase leading to the recent signature of the first major industrial contracts as well as the agreements with scientific institutes in ESO Member States to design and built the first suite of science instruments.

The current status of the E-ELT Programme will be presented as well as some of the Managerial Tools and procurement strategies put in place to achieve the goal of the Programme: building the 'world's biggest eye on the sky' in the next decade.

10:00-11:00 Christoph Keller
Polarimetry in the E-ELT era: Fundamentals of Polarized Light

The polarization of light provides information about anisotropies in the universe (e.g. magnetic fields, scattering of light, etc..). I will summarize the most important applications of polarized light with the E-ELT, describe mathematical formalisms to describe polarized light and discuss optical components that are used to measure the polarization of light with astronomical telescopes.

11:30-12:30 Marcella Marconi
Stellar variability in the E-ELT era

Variable stars are important tracers of stellar populations and can play a role as primary distance indicators. To fully exploit their properties an accurate theoretical scenario able to predict all the relevant pulsation observables, namely periods, amplitudes, light curve and radial velocity curves morphology, instability strip boundaries, is needed. On this basis, methods and tools have been developed to interpret the observed behavior of different classes of pulsating stars and to constrain their intrinsic stellar parameters.

Observational and theoretical investigations indicate that several advantages are found when using the Near (and Mid) Infrared filters, both in the case of classical Cepheids and of RR Lyrae stars. In this context the advent of ELT will open a new window not only on the use of variable stars as distance indicators after Gaia absolute calibrations, with the challenge of observing classical Cepheids in the Coma Cluster, but also on their chemical characterization, through medium and high resolution spectroscopy in Local Group and in Local Volume galaxies.

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15:30-16:30 Markus Kasper
Extrasolar planets in the E-ELT era

The existence of extrasolar planets and extrasolar life is one of the fundamental questions with which philosophers, scientists and everyone else have always been engaged. The lecture will start with providing some historical background about this quest and what we knew or believed before the mid 1990s when the first extrasolar planets were discovered. I will then present our current understanding of

planet formation leading to the architecture of planetary systems and provide a short excurse on Earth-like planets and habitability.

Then, the different methods, which are used to discover and characterize extrasolar planets, will be discussed. Here, we start with indirect methods (Pulsar timing, microlensing, radial velocity, astrometric detection, primary transits), and finish with the direct methods (secondary transits, transmission spectroscopy, high-resolution spectroscopy and direct imaging), which are able to detect light from the extrasolar planet itself and provide the means for characterization.
The last part of the lecture will focus on direct imaging of extrasolar planets, which is a great technological challenge, because an enormous contrast gap between star and planet of one part in a million to one part in a billion must be overcome. The required key technologies for this task, extreme adaptive optics (XAO), coronagraphy and wave-front control, will be presented and integrated in a generic instrument concept. Direct imaging, possibly in combination with high-resolution spectroscopy, could - by the time the E-ELT comes along - present the only way for characterizing low-mass extrasolar planets down to Earth size and ultimately lead to the detection of biomarkers, i.e., signatures of extrasolar life.

16:30-17:30 Bruno Leibundgut
The Very Large Telescope

The Paranal observatory with Very Large Telescope (VLT) consisting of four 8m unit telescopes and the VLT Interferometer offers a range of observational capabilities. The different instruments and their scientific goals and results will be highlighted. Paranal also hosts two survey telescopes, which are currently used for massive public surveys providing large coherent data sets for the community. I will present the current status of the surveys, plans for future instruments and upcoming opportunities in the E-ELT era.

18:00-19:00 Simone Esposito
AO observations at the LBT with LUCI2

The lecture introduces the LBT telescopes and its facility instrument LUCI. After this the lecture describes the two adaptive modes of LUCI namely a natural guide star based SCAO mode (FLAO) and a Laser guide star based GLAO mode (ARGOS). The on sky-performance of the two modes SCAO and GLAO are presented and discussed.

Day 8, Thursday, Oct. 15

09:00-11:00 *Student Talks*

11:30-12:00 Marcella Marconi
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Observational and theoretical investigations indicate that several advantages are found when using the Near (and Mid) Infrared filters, both in the case of classical Cepheids and of RR Lyrae stars. In this context the advent of ELT will open a new window not only on the use of variable stars as distance indicators after Gaia absolute calibrations, with the challenge of observing classical Cepheids in the Coma Cluster, but also on their chemical characterization, through medium and high resolution spectroscopy in Local Group and in Local Volume galaxies.

12:00-12:30 Laura Inno
Light-curve templates in the large-surveys era

12:30-13:00 Matteo Monelli
Multi-band photometry to identify and characterize stellar variability

13:00-13:30 Massimo Dall'Ora
Time-series photometry and light curves of periodic and transients phenomena

15:30-16:30 Christoph Keller
Polarimetry in the E-ELT era: Measuring Polarized Light

Polarimeters are specialized instruments to measure the polarization of light. I will describe modern polarimetry and data reduction approaches that are suitable for E-ELT instruments, discuss particular issues presented by the E-ELT and end with a brief description of exoplanet imaging polarimetry with the E-ELT.

16:30-17:30 Norbert Przybilla
Sky emission and telluric absorption lines in NIR spectra: basics and model-based correction

The near-IR spectral range poses challenges for observations which are largely unknown at classical optical wavelengths. Emission by the OH molecule and telluric absorption by water vapour and other molecules plague every science exposure, requiring sky correction techniques to recover the underlying spectrum of the targeted astronomical object. In the past, different correction techniques based on auxillary observations were developed to

perform the task. In the era of extremely large telescopes time on sky will be extremely precious, such that it is aimed for reducing auxiliary on-sky observations to the absolute minimum, substituting them by modelling. We will discuss the basic physics behind sky emission and telluric absorption, and two codes, Skycorr and Molecfit, that facilitate model-based sky correction to be performed.

Day 10, Saturday, Oct. 17

09:00-10:00 TBD

10:00-11:00 Matteo Monelli
Building up star formation histories

11:30-12:30 Carlos Martins
Fundamental Physics and Cosmology

The observational evidence for the recent acceleration of the universe demonstrates that canonical theories of cosmology and particle physics are incomplete (and possibly incorrect) and that new physics is out there, waiting to be discovered. The most fundamental task for the next generation of astrophysical facilities is therefore to search for, identify and ultimately characterize this new physics.

In these lectures I will highlight the E-ELT's key role in this quest. After a very short overview of theoretical motivations for new physics, the discussion will focus on precision sspectroscopy tests of fundamental physics and cosmology. I will discuss the current status of these tests and present some forecasts of the improvements that the E-ELT will enable. Time permitting I might also briefly comment on synergies with other E-ELT instruments, and with other facilities such as ALMA and Euclid.

12:30-13:30 Markus Kasper
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The last part of the lecture will focus on direct imaging of extrasolar planets, which is a great technological challenge, because an enormous contrast gap between star and planet of one part in a million to one part in a billion must be overcome. The required key technologies for this task, extreme adaptive optics (XAO), coronagraphy and wave-front control, will be presented and integrated in a generic instrument concept. Direct imaging, possibly in combination with high-resolution spectroscopy, could - by the time the E-ELT comes along - present the only way for characterizing low-mass extrasolar planets down to Earth size and ultimately lead to the detection of biomarkers, i.e., signatures of extrasolar life.

15:30- 16:30 Maria Bergemann
Atmosphere models the transition from from 1D to 3Ds

16:30- 17:30 *Student talks*

18:00-19:00 Michel Dennefeld
Spectrographs: past present and future

Starting with a "simple" long-slit spectrograph, the parameters to define for the construction of a spectrograph, its adaptation to, and use at, a given telescope will be described. Examples of more complicated, or versatile instruments will then be given, and some recent technological developments for VLT or E-ELT instruments will be presented

Day 11, Sunday, Oct. 18

09:00-10:00 Suzanne Ramsay
The formation of stars as viewed by the E-ELT

In this era of powerful infrared surveys from Herschel and Spitzer, coupled with the angular resolution and sensitivity of ALMA, star formation studies can be seen as the business of observatories at longer wavelengths. In this lecture, the potential for he E-ELT in this area will be presented. The focus will be on the formation of massive stars and the impact of the mature massive stars on star-formation in their environment.

10:00-11:00 Sebastian Kamann
From the method to science: Kinematics and abundances with integral field spectrographs

In this presentation I will review the impact that integral field spectroscopy had on various astrophysical science topics. The bread and butter science of integral field spectrographs has always been the study the kinematical and chemical properties of resolved galaxies. While already the first studies yielded remarkable results for individual objects, it was the conduction of larger galaxy surveys that had the biggest impact in this field. Nowadays we are conduction survey that deliver resolved properties for several 1000 galaxies across wide

redshift ranges. However, integral field spectroscopy has become a matured technique and the range of scientific applications has become much wider over the last years. I will also demonstrate its huge potential for studying the properties of individual stars in dense environments, such as the Galactic centre, globular clusters, or nearby galaxies. In particular the third aspect has been identified as a major science driver for the E-ELT.

11:30-12:30 Carlos Martins
Fundamental Physics and Cosmology

The observational evidence for the recent acceleration of the universe demonstrates that canonical theories of cosmology and particle physics are incomplete (and possibly incorrect) and that new physics is out there, waiting to be discovered. The most fundamental task for the next generation of astrophysical facilities is therefore to search for, identify and ultimately characterize this new physics.

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12:30-13:30 Miwa Goto
Protoplanetary disks in the E-ELT era

In the two sequential lectures,
- we will first review the underlying concepts of the current understanding of a protoplanetary disk.
- We will introduce the specific physical scales needed in the observations to step forward from where we are.
- We will discuss what the ELT means for the observations of theprotoplanetary disks. We will identify what to do and what not to do with the ELT.
- We will review what the vibrational transition of carbon monoxide is, and what we could do with them.
- We will continue to the historical account of observing vibrational band of carbon monoxide from protoplanetary disks up to the forefront of the study today.
We will conclude the lecture by discussing what the ELT would likely change.

15:30- 16:30 Maria Bergemann
Atmosphere models the transition from from 1D to 3Ds

16:30- 17:30 Richard Ellis
The high redshift universe in the E-ELT era

17:20-18:40 Santi Cassisi

Synthetic Color - Magnitude Diagrams: ingredients

We will review the main physical ingredients needed in order to "build up" a synthetic Color-Magnitude Diagrams (CMD), by discussing their current uncertainties and how their variations affect the obtained CMDs.

We will discuss how to build up a synthetic CMD by using some updated numerical tools available on the WEB, and will run some numerical experiments.

Day 12, Monday, Oct. 19

09:00-10:00 TBD

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- We will discuss what the ELT means for the observations of theprotoplanetary disks. We will identify what to do and what not to do with the ELT.
- We will review what the vibrational transition of carbon monoxide is, and what we could do with them.
- We will continue to the historical account of observing vibrational band of carbon monoxide from protoplanetary disks up to the forefront of the study today.
We will conclude the lecture by discussing what the ELT would likely change.

11:30-12:30 Richard Ellis
The high redshift universe in the E-ELT era

In my first lecture I will set the scene by introducing our current knowledge of the population of galaxies being studied beyond a redshift of 2, corresponding to the first 2 billion years of cosmic history, as well as the role of the first star-forming galaxies in driving 'cosmic reionization' - the transition from a dark neutral intergalactic medium to one that is fully ionized. The second lecture will discuss the challenges we face in making further progress, highlighting exciting new synergies we can expect between space missions such as the James Webb Space Telescope and Euclid, and powerful instruments on the E-ELT.

12:30-13:30 Miguel Urbaneja-Perez
Red supergiants in the E-ELT era

15:30- 16:30 Giuliana Fiorentino

Accurate and deep NIR photometry in the E-ELT era

I will focus on the importance of deep Colour-Magnitude diagrams for resolved stellar population studies in general with particular attention to Galactic Globular clusters. I will give a general overview of the Today AO instrument capabilities, past, on-going and future experiments as compared with HST. I will conclude with some details describing the future we expect when ELT-like telescopes will be available.

16:30- 17:30 Michel Dennefeld

Optical transients and spectroscopic follow-up

The study of the "Variable Sky" is a rapidly developing field in Astrophysics. While the preparation of the LSST is going ahead for a start in 2021+, many other sky surveys are already operating, providing a large number of sources to characterise. Some examples will be given, but the bottleneck is the availability of telescope time for spectroscopic follow-up; a large coordination needs to be set-up for that purpose.

17:20-18:40 Giuseppe Bono
TBD