



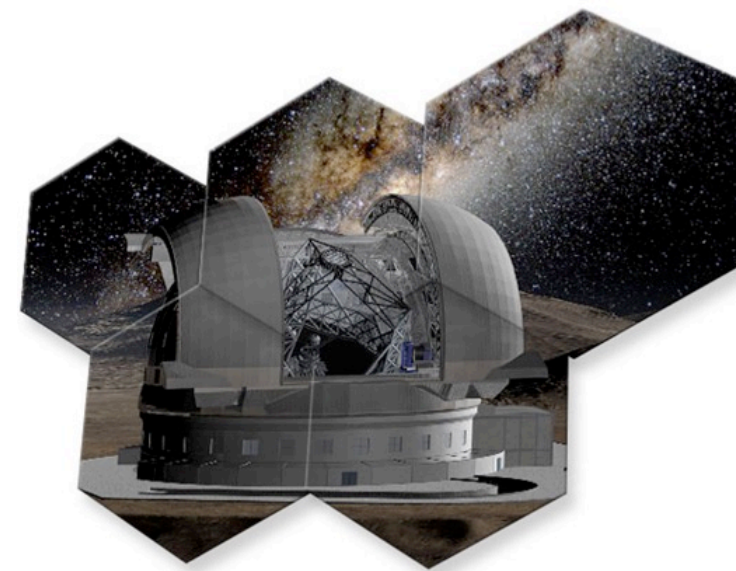
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ISTITUTO NAZIONALE DI ASTROFISICA
NATIONAL INSTITUTE FOR ASTROPHYSICS

T-REX: education and formation



Alessandro Marconi

Department of Physics and Astronomy, University of Florence

INAF-Arcetri Astrophysical Observatory, Florence

Bruno Marano

Department of Physics and Astronomy, University of Bologna

THE OUTCOME OF THE T-REX PROJECT, the Italian
Progetto premiale for E-ELT
Sexten Center for Astrophysics, July 20-23, 2015





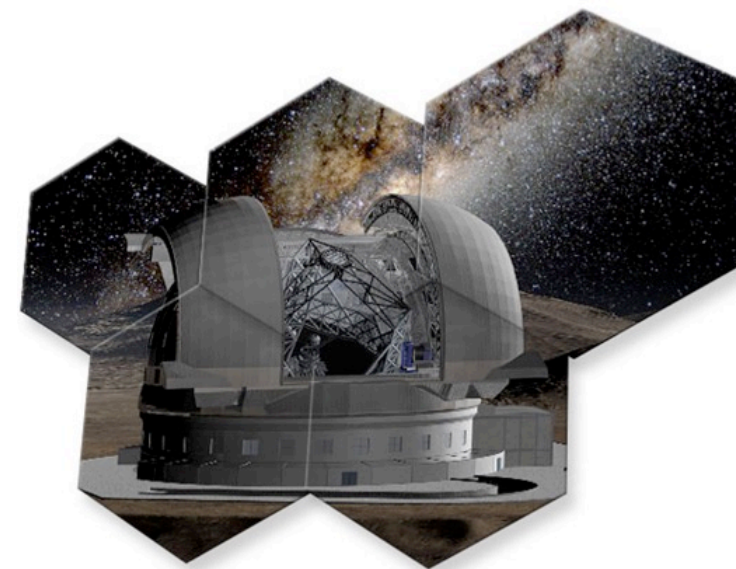
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not to blame for content!

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Education and training in T-REX



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 - first full AO telescope, advanced instrumentation
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- ★ It is recognised that development of advanced instrumentation must rely on researchers educated starting from the PhD level



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 - ★ Osservatorio Astronomico di Catania
University of Catania
 - ★ Osservatorio Astrofisico di Arcetri
University of Florence
 - ★ Osservatorio Astronomico di Brera, IASF-Milano
University of Insubria
 - ★ Osservatorio Astronomico di Padova
University of Padua

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University of Insubria
 - ★ Osservatorio Astronomico di Padova
University of Padua

only for the T-REX project!



Astronomy in the T-REX Universities

University	Laurea Triennale (Bachelor)	Laurea Magistrale (Master)	Dottorato (PhD)
Bologna (Dept. Physics & Astronomy)	Astronomia	Astrofisica e Cosmologia	Astrofisica
Catania (Dept. Physics & Astronomy)	Fisica	Fisica	Fisica
Florence (Dept. Physics & Astronomy)	Fisica e Astrofisica	Scienze Fisiche e Astrofisiche	Fisica e Astronomia
Insubria	Fisica	Fisica	Fisica e Astrofisica
Padua (Dept. Physics & Astronomy)	Astronomia	Astronomia	Astronomia



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Catania (Dept. Physics & Astronomy)	Fisica	Fisica	Fisica
Florence (Dept. Physics & Astronomy)	Fisica e Astrofisica	Scienze Fisiche e Astrofisiche	Fisica e Astronomia
Insubria (Dept. Physics & Mathematics)	Fisica	Fisica	Fisica e Astrofisica
Padua (Dept. Physics & Astronomy)	Astronomia	Astronomia	Astronomia



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Catania (Dept. Physics & Astronomy)	Astronomia	Fisica	Fisica
Florence (Dept. Physics & Astronomy)	Astronomia	Fisica	Fisica e Astronomia
Insubria (Dept. Physics & Mathematics)	Astronomia	Fisica	Fisica e Astrofisica
Padua (Dept. Physics & Astronomy)	Astronomia	Astronomia	Astronomia

INAF researchers provide a strong and much needed support to didactic activities by teaching in master courses being master and PhD thesis advisors being part of PhD supervising committees (Collegi dei Docenti)



Education and training in T-REX



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 - Physics and Astronomy students *know* about E-ELT since Bachelor
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 - Bachelor and Master Thesis on Scientific and Technical Topics related to E-ELT



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- ★ Italian PhD in a nutshell:
 - Access through open competition (concorso)
 - Three years duration (PhD Thesis must be submitted at the end of third year; *unpaid* extension of 1 or 2 years can be requested)
 - Based mostly on research activity under the supervision of a tutor (some courses mostly during first year, depending on university; participation to national & international schools strongly encouraged)
 - Total PhD Grant cost is ~60 KEUR

- ★ Initial request of 7 PhD grants (only during 2nd year, in first year they were not specifically mentioned by call):
 - University of Bologna: 1 for OU3
 - University of Catania: 1 for OU4
 - University of Florence: 2 for OU4
 - University of Insubria: 2 for OU2
 - University of Padua: 1 for OU3 and 1 for OU6

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 - University of Insubria: 2 for OU2
 - University of Padua: 1 for OU3 and 1 for OU6
- ★ After budget cuts 4 PhD Grant assigned
 - University of Bologna: 1 for OU3
 - University of Florence: 2 for OU4 (1 during first year of project)
 - University of Insubria: 1 for OU2



T-REX PhD @ Bologna

★ PhD Student:
Mauro Patti

★ Thesis:
New concepts and technologies for adaptive optics on the European Extremely Large Telescope

★ Supervisor:
Emiliano Diolaiti (INAF - Bologna)

★ PhD program

Development of a laboratory prototype for experimental investigation of specific algorithms and calibration strategies for laser guide star wavefront sensing.

Design of a turbulence simulator that reproduces the E-ELT optical train in order to test the adaptive optics performances of the multi-conjugate adaptive optics relay (MAORY).



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Mauro will present his work Tuesday afternoon



T-REX PhD @ Insubria

★ PhD Student:
Matteo Genoni

★ Thesis:
Strumentazione E-ELT Sviluppi tecnologici, strumentali ed interpretativi

★ Supervisor:
Filippo Zerbi, Marco Riva (INAF - Brera)

★ PhD program

■ Optical parametric evaluation for a broadband HIRES at E-ELT

■ ...



T-REX PhD @ Insubria

University of Insubria allows any INAF Researcher to be formal supervisors of PhD Student;
4 INAF Researchers are part of the PhD committee

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Matteo Genoni

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★ PhD program

■ Optical parametric evaluation for a broadband

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**Matteo will present his
work Thursday afternoon**



T-REX PhD @ Firenze (1)

- ★ PhD Student:
Sara Faggi
- ★ Thesis:
HIRES - E-ELT Science Case for astrobiological relevant targets: comets
- ★ Supervisor:
J. R. Brucato, G. P. Tozzi, E. Oliva (INAF - Arcetri)
- ★ PhD program
 - Science Case for Solar System:
 - “Origin of Earth's oceans” (isotopic ratio of water (D/H), ortho-para ratio (OPR) to evaluate origin of water on Earth)
 - “Comets as vectors of organic compounds” (CN, C₂, C₃, NH... to evaluate delivering of organic molecules on young Earth)
 - “Classifications of comets” (parent molecules and radical species to characterize chemical diversity → Solar System form. and evol.)
 - Operative setup to develop the science case:
 - Observations of comets and data reduction with GIANO-TNG
 - R=50000 , $\lambda=(0.9 - 2.5) \mu\text{m}$
 - Analysis of cometary emission in collaboration with NASA GSFC



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Analysis of cometary emission in collaboration with NASA GSFC

**Sara will present his work
Thursday morning**



T-REX PhD @ Firenze (2)

★ PhD Student:
Mirko Curti

★ Thesis:
Dynamical and Chemical Evolution of Galaxies with Adaptive Optics
Observations

★ Supervisor:
S. Esposito, F. Mannucci (INAF - Arcetri)

★ PhD program

■ Science commissioning of ARGOS+LUCIFER@LBT

■ Extragalactic MOS Observations with ARGOS+LUCIFER

■ Towards E-ELT



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T-REX PhD @ Firenze (2): PhD Program

■ Science commissioning of ARGOS+LUCIFER@LBT

ARGOS is the Ground Layer Adaptive Optics (GLAO) system for LUCIFER 1&2 at the LBT (3 Rayleigh Lasers, 3 Shack Hartmann WFS, LBT adaptive secondary mirror, NGS for tip-tilt correction)

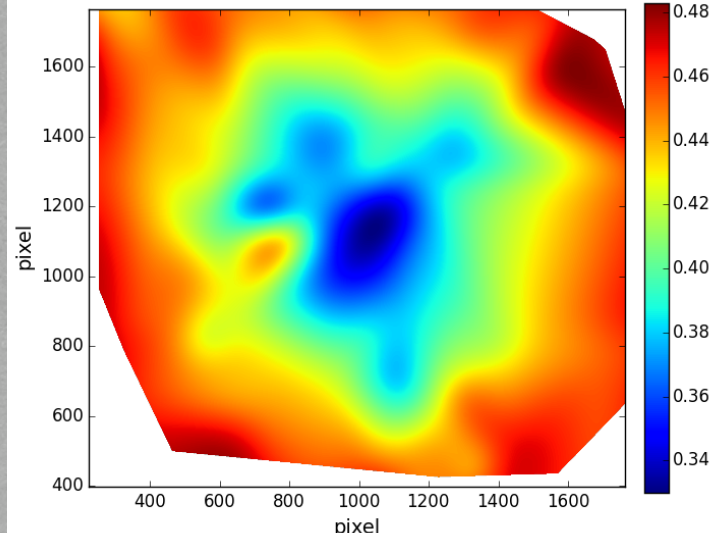
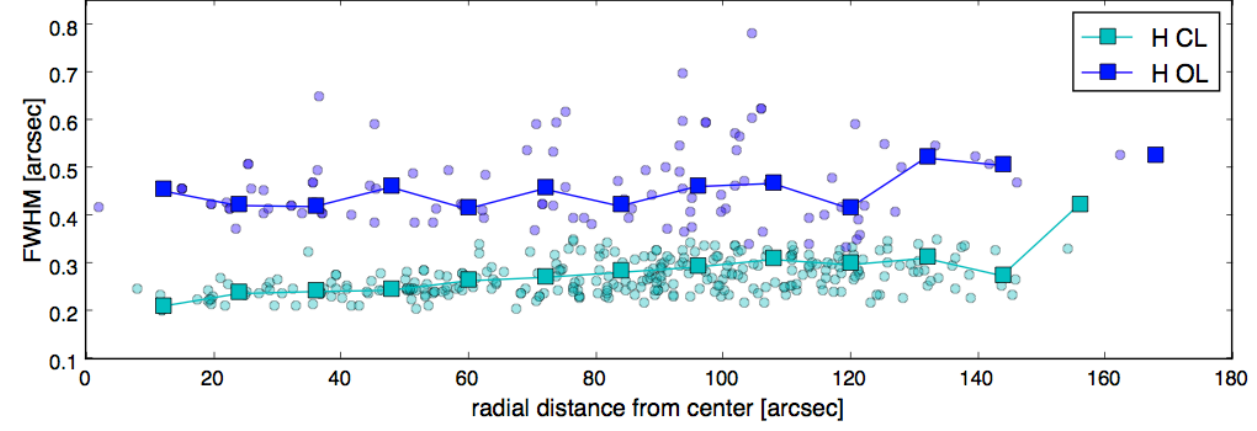
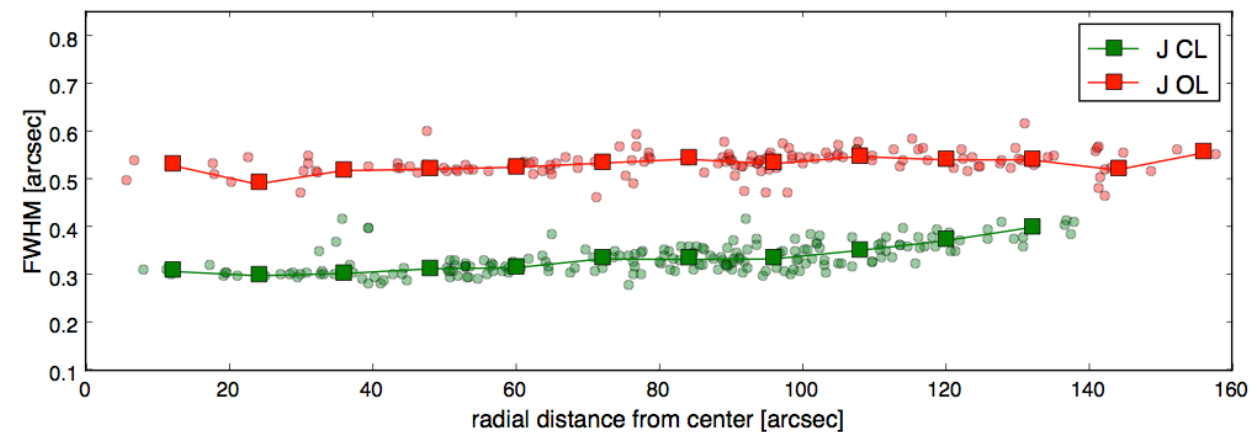
■ Extragalactic MOS Observations with ARGOS+LUCIFER to study:

Galaxy assembly over cosmic time; Physical processes which drive the relationships with gas metallicity; Role of stellar and AGN feedback

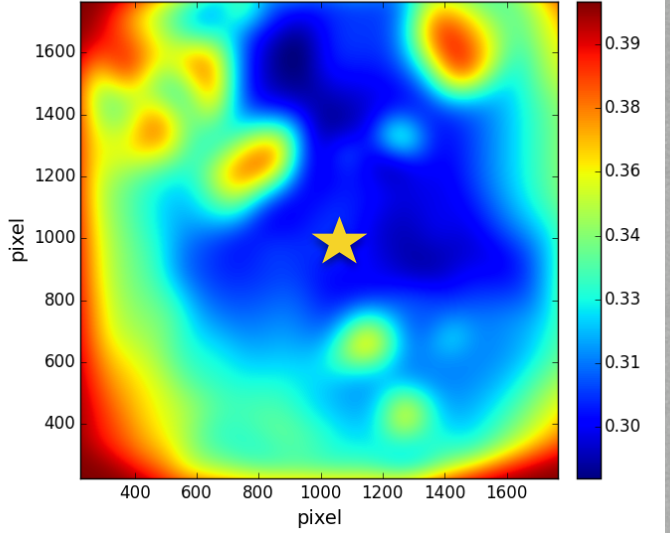
■ Towards E-ELT

■ Optimization of data analysis methods for AO observations → Accurate PSF characterization over the full FOV

■ Scientific Cases for ELT-CAM and ELT-MOS instruments:
spatially resolved maps of diagnostic emission lines for high-z galaxies (down to ~ 60 pc at diffraction limit) → gas metallicity maps, ionization state, gas inflows/outflows;
Z-Evolution of Mass-SFR-Metallicity Relations (intermediate and low mass galaxies)



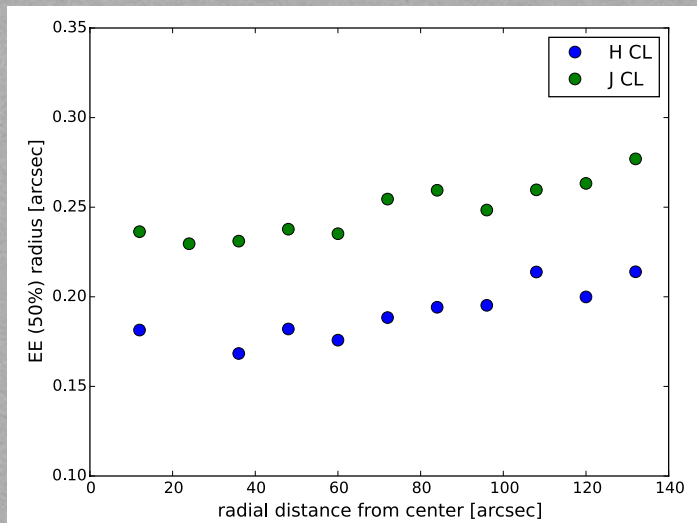
J Band FLAO



J Band GLAO Closed Loop

FWHM gain of
1.5-2 in J & H
band

50% Encircled
Energy within 2
pixel (0.25" slit)



- ★ Wide involvement of younger generations, graduate and postgraduate students required to prepare tomorrow astronomers and instrument scientists that will take full advantage of E-ELT
- ★ Important goal of T-REX is the creation and formation of new experts and professional profiles of extremely high specialization
- ★ Tight interaction/integration between INAF institutes and universities (Bologna, Catania, Florence, Insubria, Padua for T-REX)
Astronomy is still (?) alive in universities
- ★ After budgetary cuts, 4 PhD Grant assigned in the T-REX project
1 for OU3 (Bologna), 2 for OU4 (1 during first year of project, Firenze), 1 for OU2 (Insubria)
- ★ Mauro Patti (Bologna), Matteo Genoni (Insubria), Sara Faggi, Mirko Curti (Firenze)
- ★ See their talks in the next days!