RED: Reading the Evolution of Dirty stellar systems

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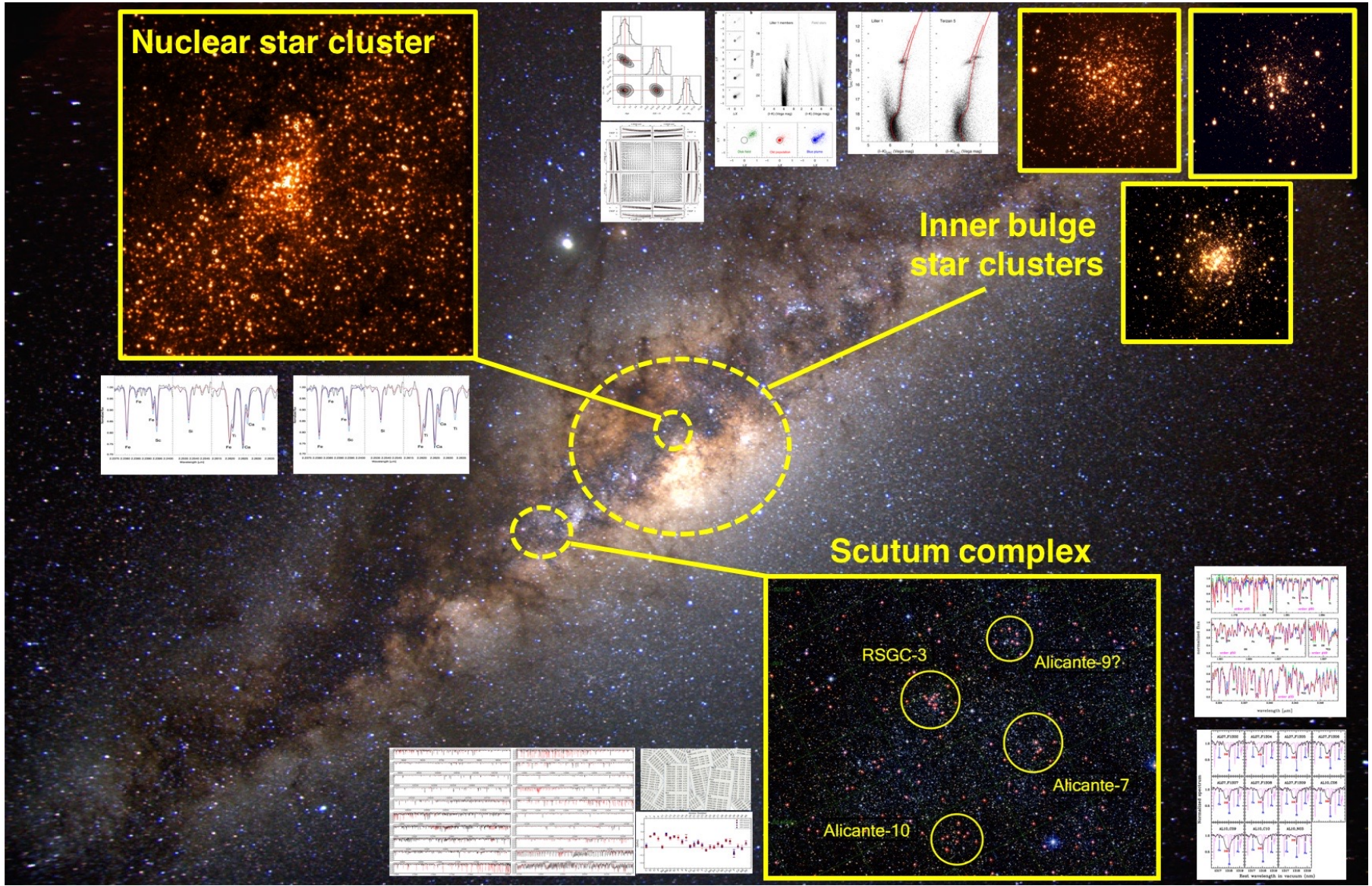


RED science objectives

long term program (2015-2028) to coordinate and run specific projects that are synergic in terms of science, expertise, exploitation of facilities, tools and resources

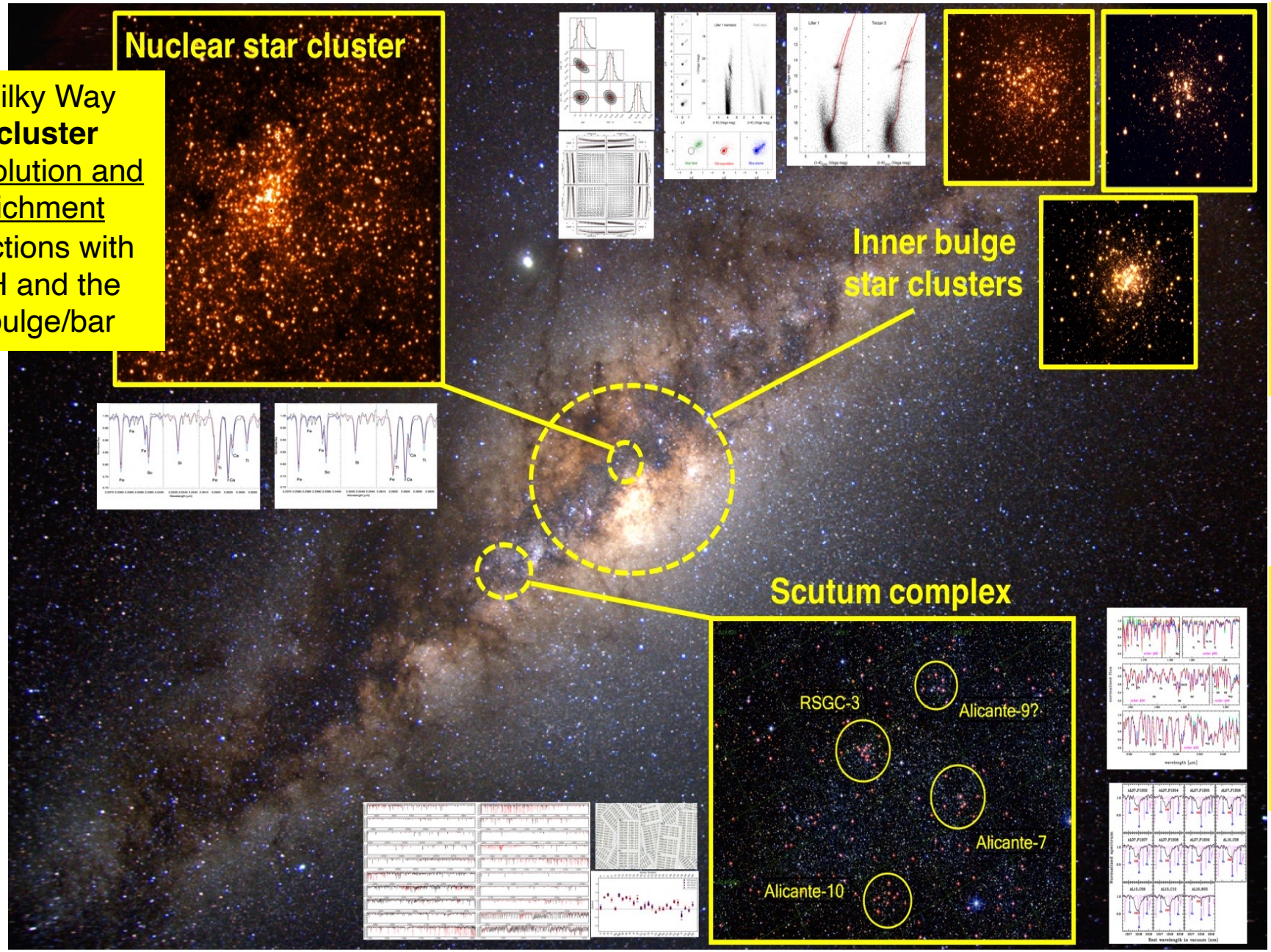
RED is probing Galactic archaeology and evolution in those innermost environments of the Galaxy severely affected by dust extinction (A_V ~5-30 mag!)

- ✓ the bar/bulge
- ✓ the central ~100 pc molecular zone, including the nuclear disk/bulge and the nuclear star cluster
- ✓ regions of recent star formation in the thin disk and spiral arms

RED is providing age, kinematics and chemical composition of the stellar populations hosted in this complex puzzle of sub-structures

RED ongoing focused projects

probing the Milky Way **nuclear star cluster** formation, evolution and chemical enrichment and its interactions with the central BH and the nuclear disc/bulge/bar



probing massive globulars in the inner bulge, with the potential of discovering complex systems with **multi-iron** and **multi-age** pops, as **Ter5** and **Lil1**, possible relics of pristine clumps that survived total disruption and experienced different episodes of SF

probing the inner disc recent evolution and chemical enrichment with **red supergiants** hosted in very young clusters and associations

RED activities

organized in workpackages in order to manage and monitor the projects in all their aspects and development stages,
from initial design and planning of the necessary dataset and models to the final delivery of astrophysical quantities and ultimate products

WP1 - Strategy and resources
coordination unit for an efficient management and monitoring of activities, resources, deliverables and future planning

WP2 - Science cases

definition of the science cases, analysis and monitoring of the current knowledge, recent developments and open questions

WP3 - Observation proposal preparation and execution
planning and execution of state-of-the-art observations at the major space and ground-based facilities

WP4 - Data reduction and analysis
multi-wavelength, multi-technique tools and pipelines to set the observational framework (multi-band photometry, kinematics, stellar parameters and chemical abundances) for its science

WP5 - Path to science from observations
comparison of model predictions with observations to deliver suitable scenarios for the physical, chemical and dynamical evolution of the studied stellar systems

WP6 - Publication of the results
publications in major International Journals, conference proceedings and scientific reports, thus maximizing the visibility and impact of RED innovative results within the international Community

develop and proceed according to criteria of scientific readiness and timeliness, in order to maximize the exploitation of the proposed innovative science and promptly publishing the results

RED Team		
Name	**Institute/Position**	**Role in the program**
Livia Origlia	INAF-OAS BO/Dir. Ric.	**PI** – Science Coordinator, stellar pops
Emanuele Dalessandro	INAF-OAS BO/Ric. III liv.	**Co-I** – Stellar photometry, astrometry
Antonio Sollima	INAF-OAS BO/Ric. III liv.	**Co-I** – Stellar kinematics, dynamical models
Davide Massari	INAF-OAS BO/Ric III liv.	**Co-I** – Stellar kinematics, astrometry
Ernesto Oliva	INAF-OAA FI/Dir-Ric	**Co-I** – IR spectroscopy, adaptive optics
Gabirele Cescutti	INAF-OA TS/Ric III liv.	**Co-I** – Chemical evolution
Nicoletta Sanna	INAF-OAA FI/Ric III liv,	**Co-I** – IR spectroscopy, Gaia
Francesco Ferraro	UniBO/FullProf INAF Ass.	**Co-I** – Star clusters, stellar evolution
Barbara Lanzoni	UniBO/Assoc.Prof.INAF Ass.	**Co-I** – Stellar dynamics
Alessio Mucciarelli	UniBO/Assoc.Prof INAF Ass.	**Co-I** – Stellar spectroscopy, chemical evolution
Cristina Pallanca	UniBO/TD-A INAF Ass.	**Co-I** – Star clusters, spectral analysis
Cristiano Fanelli	PhD at UniBO	**Co-I** – Stellar spectroscopy, spectral analysis
Deimer Alvarezgaray	PhD at UniBO	**Co-I** - Star clusters, spectral analysis
Sara Saracino	Liverpool University (UK)	**Co-I** – Star clusters, photometric analysis
Elena Valenti	ESO – Garching (Germany)	**Ext. Coll.** – Galactic Bulge, observing modes
Giacomo Beccari	ESO – Garching (Germany)	**Ext. Coll.** – Star clusters, observing modes
Mathias Schultheis	Nice Observatoire (France)	**Ext. Coll.** – Inner Galaxy, APOGEE
Nils Ryde	Lund University (Sweden)	**Ext. Coll.** – Galactic Center, spectral synthesis
Brian Thorsbro	Lund University (Sweden)	**Ext. Coll.** – Galactic Center, spectral synthesis
Mike Rich	UCLA (US)	**Ext. Coll.** – Galactic Bulge, galaxy evolution
Doug Geisler	Universidad de Conception (Chile)	**Ext. Coll.** – Star clusters, GEMS/GSAOI
Francesco Mauro	Universidad de Conception (Chile)	**Ext. Coll.** – Star clusters, GEMS/GSAOI
Elisabetta Caffau	GEPI (France)	**Ext. Coll.** – Stellar spectroscopy, Galactic disc

RED Team

11 staff people

- INAF (7, ~1 FTE/yr)
- UniBO (4, INAF Associates, ~0.3 FTE/yr)

two PhD students at UniBO (one of the two PhD fellowship funded by the INAF Premiale FRONTIERA)

external collaborators, either senior astronomers or young researchers from international Universities and Research Institutes in Europe, US and Chile ➔ provide specific scientific expertise and contribute to guarantee maximum international visibility to the program

worldwide recognized expertise in IR astronomy and in the observational study of red stellar populations (more than 70 refereed scientific papers and several technical contributions have been published in the last 3 years)

constantly promoting new collaborations and participation of students and young researchers

RED – funding from INAF

- ✓ partially funded within the PRIN INAF 2014 - Probing the internal dynamics of globular clusters, PI L. Origlia, (CRA 1.05.01.94.11) until 2018
- ✓ funded by the Mainstream INAF 2017- Star clusters in the inner 3 kpc, PI L. Origlia, (CRA 1.05.01.86.21) until early 2022

on average and on a year-base, RED would need some financial support for

- ➢ [co-]funding one contract (PhD, AdR or TD)
- ➢ for travels (i.e. for observing runs, meetings and conferences, visiting programs)
- ➢ for supply and publications

RED impact

RED is a challenging program but rewarding in terms of motivation, astrophysical impact and international visibility

science at large of RED has been validated in different peer review processes

i) by observing time allocation committees; **ii)** by funding agencies through financial support; **iii)** by international science teams of future IR instruments (VLT-MOONS, ELT-ANDES), which foresee a major commitment by INAF and the RED team

RED is a program that promotes innovative science and new experiments for the exploration of the unknown

it explores the unexplored stellar content in the central region of the Galaxy

- complementing the mapping of the Milky Way halo and outer bulge/disk with Gaia, LSST and other massive follow-up spectroscopic surveys
- providing key insights for the study of distant galaxy bulges and nuclei

it settles the observational ground to probe the poorly understood physics and nucleosynthesis of red supergiant stars

it uses state-of-the-art high resolution instrumentation to study the dense star clusters
(imagers: HST; GSAOI+GeMS, *ERIS@VLT*) and spectrographs (GIARPS@TNG; XSHOOTER+MUSE+CRIRES+@VLT; NIRSPEC+OSIRIS@Keck; *MOONS@VLT*)

it represents a laboratory to probe new science cases and diagnostic tools to measure e.g., reddening, stellar ages, kinematics and chemical abundances, also in view of the next generation of IR instrumentation onboard JWST and at the ELT

RED results are regularly published on major Journals and presented at international conferences
rewarding record of publications ➔ 5+ refereed papers / year

RED and INAF

Galactic archaeology is unanimously recognized to be a main stream research of stellar astrophysics in the current Gaia, LSST and JWST era and many resources are invested by universities, research institutes and space agencies all over the world

INAF is playing a major role, with a massive scientific participation to international programs and investing significant resources in the current and future ground-based instrumentation at the TNG, VLT, LBT and ELT

RED is providing an original contribution by studying Galactic stellar systems in the Galaxy center obscured by dust and poorly explored by other programs

RED is making massive use of IR spectroscopy, HST and ground-based imagers assisted by adaptive optics, giving the INAF and associated researchers within the **RED team** a **worldwide visibility and scientific recognition** in the observational study of dense stellar fields

➔ **leading roles** in instrumental projects with major INAF participation like VLT-MOONS and ELT-ANDES

➔ **at the front in the scientific exploitation** of JWST and ELT-MICADO+MAORY