Discussione
Barioni
Vicini & Lontani

Contributi di:
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2 temi di ricerca barioniche trasversali : il filo rosso

The cosmic evolution of elements and molecules

The cosmic history of elements and of chemical species is becoming more and more important for the understanding of a broad range of astrophysical and cosmological problems. Starting from the synthesis of the elements in and after the big bang, to the formation of complex molecules in the solar system, chemical elements are ubiquitous

OABologna, IRA, OARoma, IAPS, OAPd, OAArcetri, SNSS, OATs, UniTs, OATe, OATo…

Stellar Populations as tracers of Galaxy Evolution

Stars are among the main ingredients of galaxies: they largely determine galaxy structure and dynamics, provide a substantial part of the energy budget, and are the engine of the chemical evolution. The properties of stellar populations in galaxies (age, metallicity, SFH, chemical abundances, IMF, *stellar* mass) are also invaluable tracers of galaxy evolution, as they

OAArcetri, OAPadova, OACapodimonte, OABrera, IASFMI, OATrieste, OABologna, IAPS…

The cosmic evolution of elements and molecules

Presentato da Raffaella Schneider

1. Francesca Bacciotti
2. Angela Bragaglia
3. Giuseppe Bono
4. Jan Brand
5. Francesco Calura
6. Eugenio Carretta
7. Viviana Casasola
8. Riccardo Cesaroni
9. Giovanni Cresci
10. Sergio Cristallo
11. Claudio Codella
12. Valentina D'Odorico
13. Mariagrazia Franchini
14. Francesco Fontani
15. Anna Gallazzi
16. Simona Gallerani
17. Gian Luigi Granato
18. Raffaele Gratton
19. Valentina Grieco
20. Sara Lucatello
21. Elisabetta Liuzzo
22. Laura Magrini
23. Filippo Mannucci
24. Nuria Marcelino
25. Alessandro Marconi
26. Fabrizio Massi
27. Francesca Matteucci
28. Paolo Molaro
29. Carlo Morossi
30. Luca Moscadelli
31. Luca Olmi
32. Rosita Paladino
33. Elena Pancino
34. Sofia Randich
35. Donatella Romano
36. Kazi Rygl
37. Raffaella Schneider
38. Laura Silva
39. Veronica Sommariva
40. Alessandro Spagna
41. Emanuele Spitoni
42. Oscar Straniero
43. Monica Tosi
44. Claudia Travaglio
45. Antonella Vallenari
46. Stefano Zibetti

AIM: understanding the origin and evolution of chemical elements

Important recent developments have revolutionized the field

Observational side:

- **ALMA** (physics of complex molecules in the solar system and Milky Way; FIR lines in local and distant galaxies)
- **Optical/NIR multi-object medium/high res spectrographs** (large surveys of stars in the Milky Way, SNe, local and distant galaxies)
- **Optical/NIR AO-assisted IFU** (metallicity and ionization gradients, linked to dynamics)
- **X-ray telescopes** (element abundances in the intracluster medium)

Theoretical side:

- **Accurate modeling often with extensive numerical simulations** (impressive agreement with observed properties)

Strong links between apparently different fields

Cosmic dawn and stellar archaeology

Local and distant galaxies

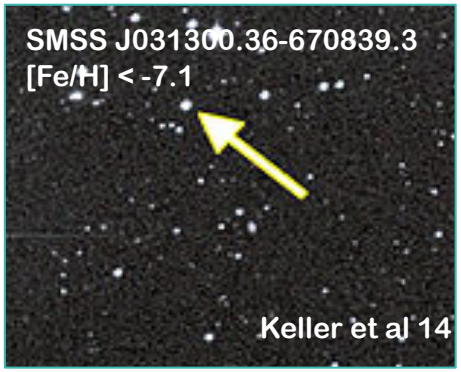
Molecules in local star forming regions and at high-z

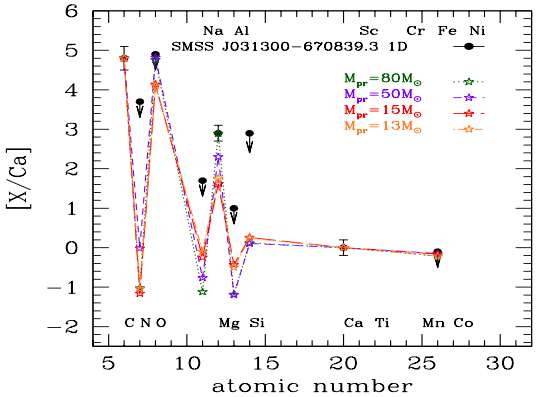
Population III stars and supernovae

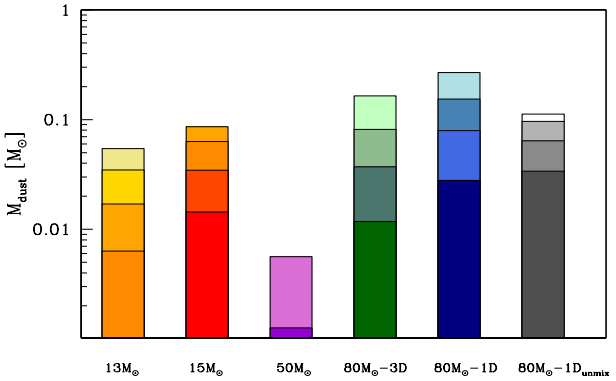
Galaxy clusters and SN rate

…

Constraints on the first SNe from stellar archaeology



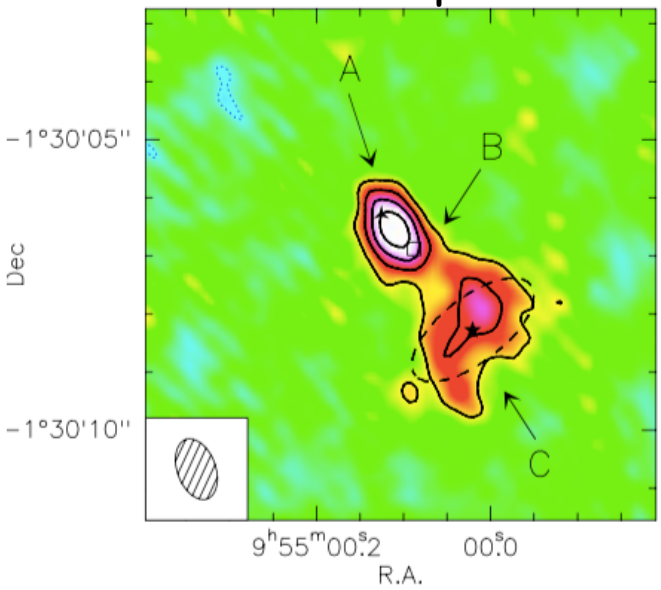




Marassi et al. 2014

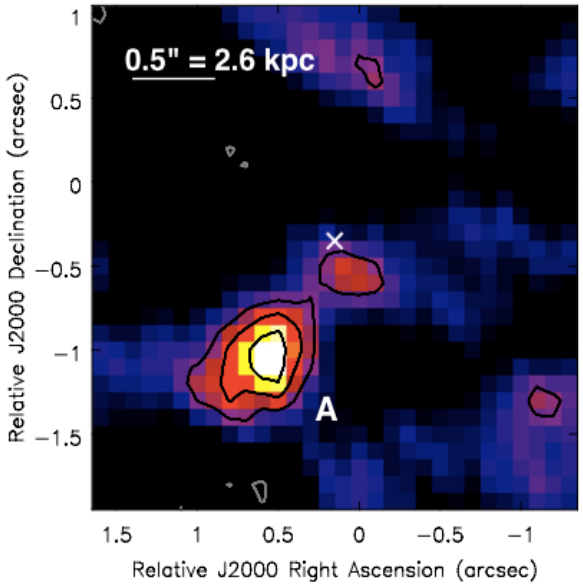
Local and distant galaxies: same diagnostics!

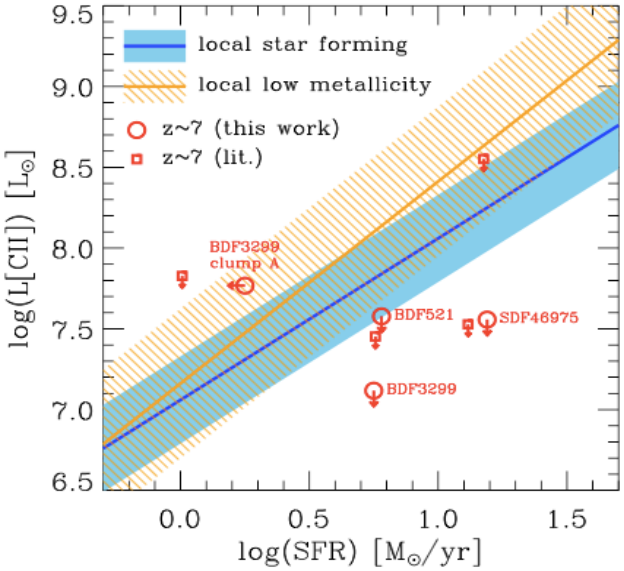
Resolved CII maps at z = 4.4



Gallerani et al. 12

deep upper limits at z ~ 7





Maiolino et al. 15

In many of these subjects the Italian astronomical community has a leading role because of the excellence of its researchers and the quality of its scientific projects.

Current (among many other)

VLT: SINFONI, MUSE, KMOS, VIMOS, X-SHOOTER, FORS, UVES, FLAMES;

LBT: LUCI, MODS

CALIFA MANGA (large optical IFU)

ALMA, NOEMI

near future:

VLT/ESPRESSO (high-res spectrograph)

VLT/MOONS (~2019) NIR multi object spectrograph

VLT/ERIS (AO-assisted NIR IFU spectrograph)

LBT/PEPSI (high-res spec)

Future:

JWST (NIRSPEC)

E-ELT HARMONY/HIRES

GMT + TMT ?

SPICA ?

New simulations based on supercomputer time made available by INAF?

Stellar Populations as tracers of Galaxy Evolution

S. Zibetti

- Key problems (i.e. constraints for galaxy evolution models):
  - Star formation history [SFH] of individual galaxies (not only cosmic average)
  - Chemical enrichment history [CEH], cycle of metals in galaxies
- Observational frontiers
  - ! Medium resolution spectroscopy with high multiplex or IFU !
  - push "archeological" approach to higher and higher z (>2 using VLT-MOONS, JWST... E-ELT-MOS[?!]): constrain SFH and CEH at early times (highly degenerate from low-z alone)
  - spatially resolved stellar pops inside galaxies with IFS (also at z=0!):
    - what ends up in different structural components?
    - how stellar pops "interact" (dynamically, chemically, as SF trigger) inside a galaxy?
- Theoretical frontiers
  - Stellar Population Synthesis, treatment of dust
  - Models of galaxy evolution both for statistical samples (SAM!) and on sub-kpc scale (hydro sims)
- Make choices!!! we cannot do everything, enter each survey/instrument; limit the dispersion of "brain" resources and focus on science questions

(2) Quali sono le infrastrutture e la strumentazione di livello internazionale più determinanti per affrontare tali questioni

Gaia

In Italy: GES processing centers, **ASDC**, and..

Gaia Italian Data Processing Center:

- **300 TB of DB and file storage, system will grow to 1 PB; Oracle-based DBMS, through INAF-Oracle Italia special agreement; High speed connection to ESAC and CINECA (provided by ASI);**
- **Pipeline processing of systems dedicated to astrometric verification throughout DPAC operations (5+3 years since launch)**
- **Host copy of the Gaia Mission Data Base (MDB)**
- **Extended reprocessing capability from MDB and catalog extraction beyond final catalog release (strategic legacy).**
- ***A unique space-like instrument made possible by ASI for the INAF community to continue science exploitation!!***

(3) Quante persone, e in che misura, sono disposte a impegnarsi sia a livello di lavoro scientifico che a concorrere per posizioni di responsabilità…

Partecipazione in Gaia (Operations)

dal 1997 fino a oggi

Time invested

staff INAF ..... **262 staff yrs** (74%)

Non-staff INAF ..... **92,9 years** (26%)
(TD, AR, borse, etc)

Current: **42 staff**, 20 nonstaff
(37 FTE total, 18.5 FTE (50%) non-staff)

Scientific interest

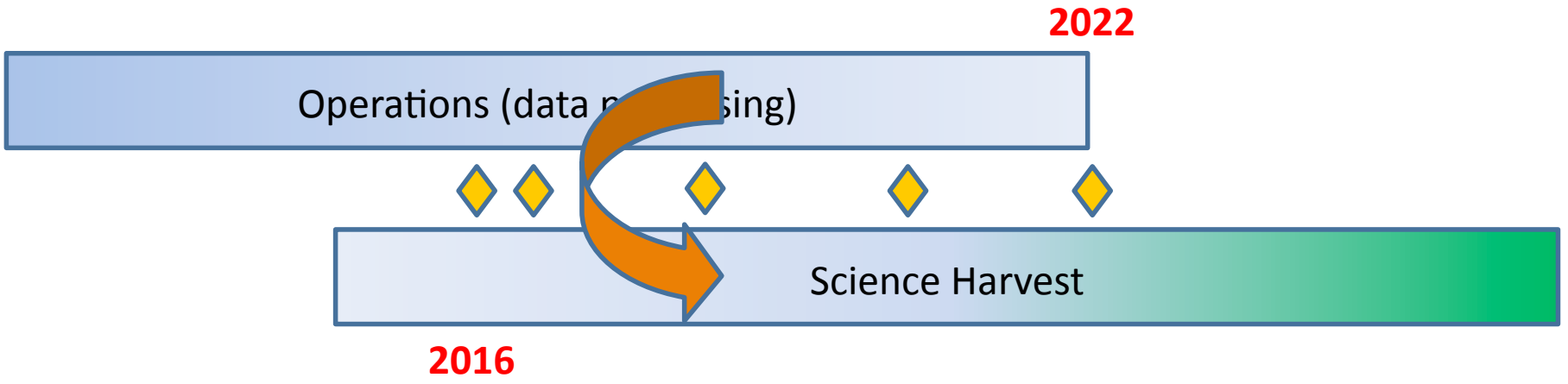
4. Quali dovrebbero essere le strategie di INAF per supportare tale impegno della comunità e massimizzarne il ritorno scientifico?

gaia

Consolidate the expertise acquired

and Support for the scientific exploitation

- **Recruitment and staff promotion**
- PhDs and post-docs: New expertise and the next generation
- Continued support to the participation **of existing** and future international projects at the European level (e.g., **Gaia**, **Gaia-ESO**, GREAT,..);
- Support INAF researchers in new projects/proposals dedicated to exploiting Gaia and GES data, with leading and responsibility roles.



Comments from the IR/(sub)mm community

Presentate da Sergio Molinari

- The IR/mm astronomy community has historically suffered from a very difficult access to observing facilities.

- Among the many negative impacts, a noticeable one is the limited success rate at obtaining ALMA observing time.

- INAF should pursue a new strategy to boost millimeter-wavelength astronomy by seeking partnerships with ground-based facilities like JCMT and ARO: quotas of observing time or a pay-per-time basis.

- The volume and complexity of new Galactic Survey datasets calls for a radical re-evaluation of the current science and data analysis techniques.