Star Clusters and ASTROVIRTEL

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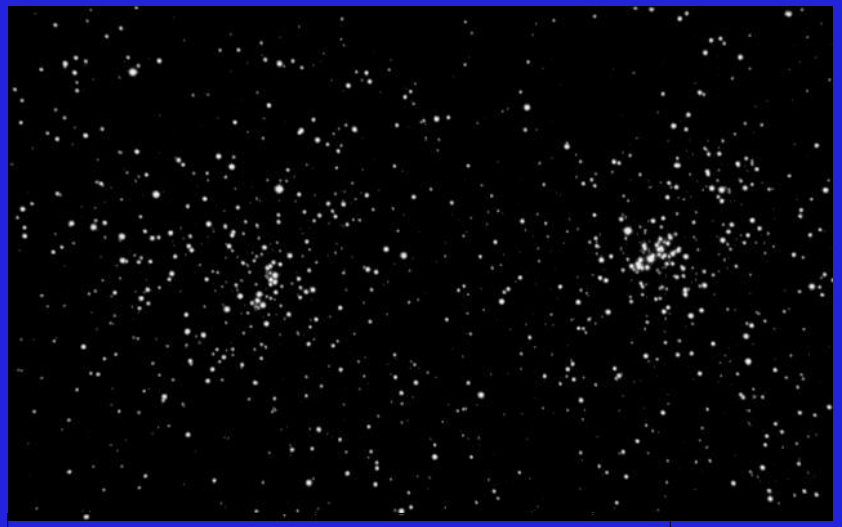
and

ASTROVIRTEL Cycle 2 proposal by PI R. de Grijs
'The Evolution and Environmental Dependence of
Star Cluster Luminosity Functions'

Introduction to star cluster astronomy

- An accumulation of stars, formed out of the same gas cloud
- GCs in the Milky Way among the oldest objects - galaxies' building blocks?
- Easy to model and to observe efficient tracers of basic physical properties during formation

M80, Milky Way GC

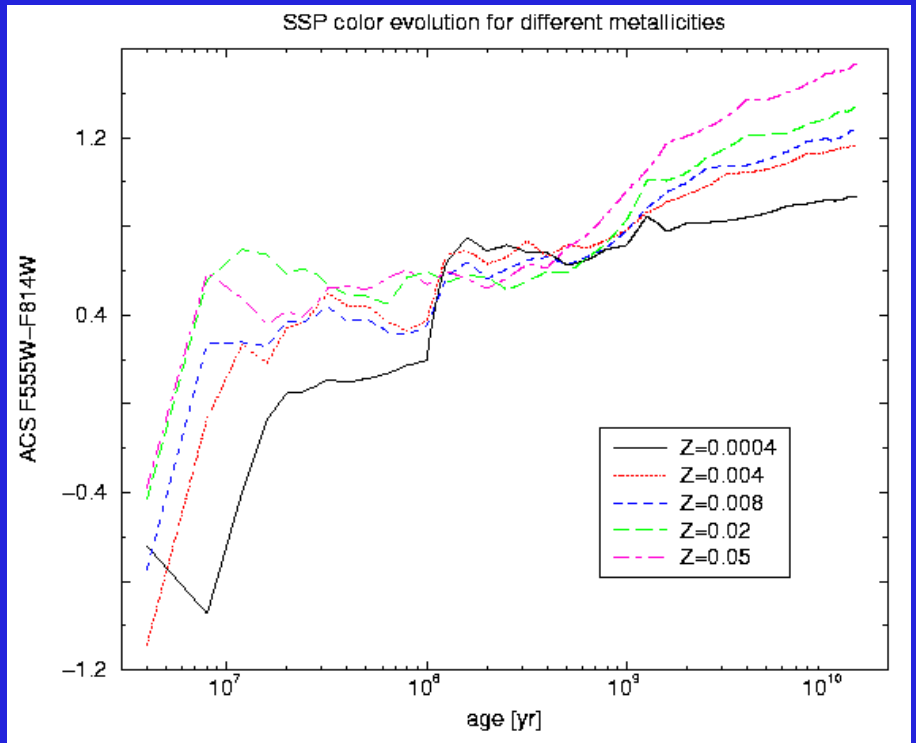


Double open clusters in Perseus
NGC 869 and NGC 884

Introduction to star cluster astronomy

Modelling of cluster systems

- Age/metallicity/extinction determination (by comparison with models)
- ➔ Comparison with galaxy formation models predictions, cluster evolution models (cluster IMF)



Proposal's aims

- Is the *initial* cluster LF always a power-law?
- Is the *old GC* LF universal? (Hubble constant)
- What are the time-scales for the evolution from the 'young' power-law to the 'old' gaussian?
- Is there an environmental dependence of the LF and/or the evolutionary time-scales?
- Will currently forming cluster systems (e.g. in mergers) evolve into MW-type old systems?
- Determine the star formation history, based on integrated cluster colors, for given galaxies

Proposal's requirements

- Data mining tool to:
  - get multi-color (UV-NIR) observations
    - to disentangle degeneracies [age Z E(B-V)]
  - of high-resolution / in a defined search radius
    - to resolve the clusters
  - large depth
    - to observe the full expected mass range of clusters
  - for various galaxy morphologies
    - to probe the environmental dependence

Work done by

- Refined the existing mining tool QUERATOR for our purposes
- Developed the LISTATOR for spectroscopic data
- Combined the archives of ESO, HST and UKIRT
- unprecedented homogeneous database with uniform calibration, deep imaging and high spatial resolution

QUERATOR

Querator Query Builder

This pages will guide you in the creation of a Querator query.

Please, choose one of the following options:

- **A general introduction to Querator**
- object name search
- sky box search
- external server (e.g. LEDA) search
- user file upload

this is an experimental service: handle with care!

author: f. pierfederici

http://archive.eso.org/querator/

Optional Constraints

1:Exclusion_of_non_scientific_exposures

Target Information

Target Name: NGC 1569 *(resolved by SIMBAD)* [help]

RA, Dec: *(hours, J2000)* *(deg, J2000)* [help]

l2, b2: *(hours)* *(deg)* [help]

Radius: 200 *(search radius in arcsec)* [help]

Observation Parameters

Instrument: UKIRT UFTI, UKIRT IRCAM3, HST FOC, HST NICMOS, HST WFPC2, ESO WFI [help]

Min. Exp. Time: 100 *(secs)* [help]

Exp. Date: *(dd/mm/yyyy)* [help]

Wavelengths: 2000..20000 *(space separated list of values in Å)* [help]

Min. Filter Nr.: 3 *(minimum number of filters)* [help]

Filter Type: broad band only [help]

Optional Constraints

Total Exp. Time (per filter) > *(secs)* [help]

☐ **FoV Check** [help]

☐ **Max. Seeing:** 1.00 *(arcsec)* [help]

Search Reset

query Help Home

Querator Search Results

Usage

To request off–line datasets/associations mark them by selecting the checkbox in the first column, and press button **Request Marked Datasets**.
(You will be prompted for an archive username and password. Click here to register as new archive user.)

Define new query

MarkAll UnMarkAll (Only JavaScript enabled browsers)

Request Marked Datasets Reset

Tot. exp. time in F555W: 8970 seconds
Tot. exp. time in F439W: 11280 seconds
Tot. exp. time in F380W: 9720 seconds
Tot. exp. time in F814W: 550 seconds
Tot. exp. time in F336W: 800 seconds

M	Dataset	P	Ra (hours)	Dec (deg)	l2 (hours)	b2 (deg)	Filter	Instr.	Target Name	Exp Time (sec)	Exp. Date	Seeing	Bib
☐	U32F011EB		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F555W	WFPC2	NGC1569A	2500	Jan 10 1996 3:40:16:000PM	0.11	
☐	U32F010WB		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F439W	WFPC2	NGC1569A	2800	Jan 10 1996 12:13:16:000PM	0.11	
☐	U32F011OT		04 30 44.00	64 51 14.00	09 34 41.00	11 14 20.00	F439W	WFPC2	NGC1569A	700	Jan 10 1996 1:12:16:073PM	0.11	
☐	U32F010EB		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F380W	WFPC2	NGC1569A	2400	Jan 10 1996 8:18:16:000AM	0.11	
☐	U32F010IT		04 30 44.00	64 51 14.00	09 34 41.00	11 14 21.00	F380W	WFPC2	NGC1569A	600	Jan 10 1996 9:13:16:073AM	0.11	
☐	U32F0119B		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F555W	WFPC2	NGC1569A	2020	Jan 10 1996 2:51:16:000PM	0.11	
☐	U32F010RB		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F439W	WFPC2	NGC1569A	2840	Jan 10 1996 11:12:16:000AM	0.11	
☐	U32F0115B		04 30 44.00	64 51 14.00	09 34 41.00	11 14 21.00	F555W	WFPC2	NGC1569A	2000	Jan 10 1996 2:04:16:000PM	0.11	
☐	U32F0112B		04 30 44.00	64 51 14.00	09 34 41.00	11 14 21.00	F555W	WFPC2	NGC1569A	1520	Jan 10 1996 1:31:16:000PM	0.11	
☐	U32F0109B		04 30 44.00	64 51 15.00	09 34 41.00	11 14 21.00	F380W	WFPC2	NGC1569A	2460	Jan 10 1996 7:20:16:000AM	0.11	
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☐	U54G010BB		04 30 51.00	64 51 17.00	09 34 43.00	11 15 00.00	F814W	WFPC2	NGC1569–CLUSTERS	550	Oct 21 1998 9:26:14:000AM	0.13	
☐	U54G0107B		04 30 51.00	64 51 17.00	09 34 43.00	11 15 00.00	F336W	WFPC2	NGC1569–CLUSTERS	800	Oct 21 1998 9:01:14:000AM	0.11	
☐	U54G010CB		04 30 51.00	64 51 17.00	09 34 43.00	11 15 00.00	F555W	WFPC2	NGC1569–CLUSTERS	930	Oct 21 1998 9:35:14:000AM	0.11	

Impact on our models

- Multi-color fitting algorithm, based on a least-squared fit
- Inclusion of internal dust extinction
- Multi-color observations are biased towards short exposures
  - ➔ only highest luminosities are observed
  - ➔ very young systems (due to mass-to-light ratio)
  - ➔ gaseous line and continuum emission is vital
  - ✔ is now included, in contrast to other codes

Impact on our models

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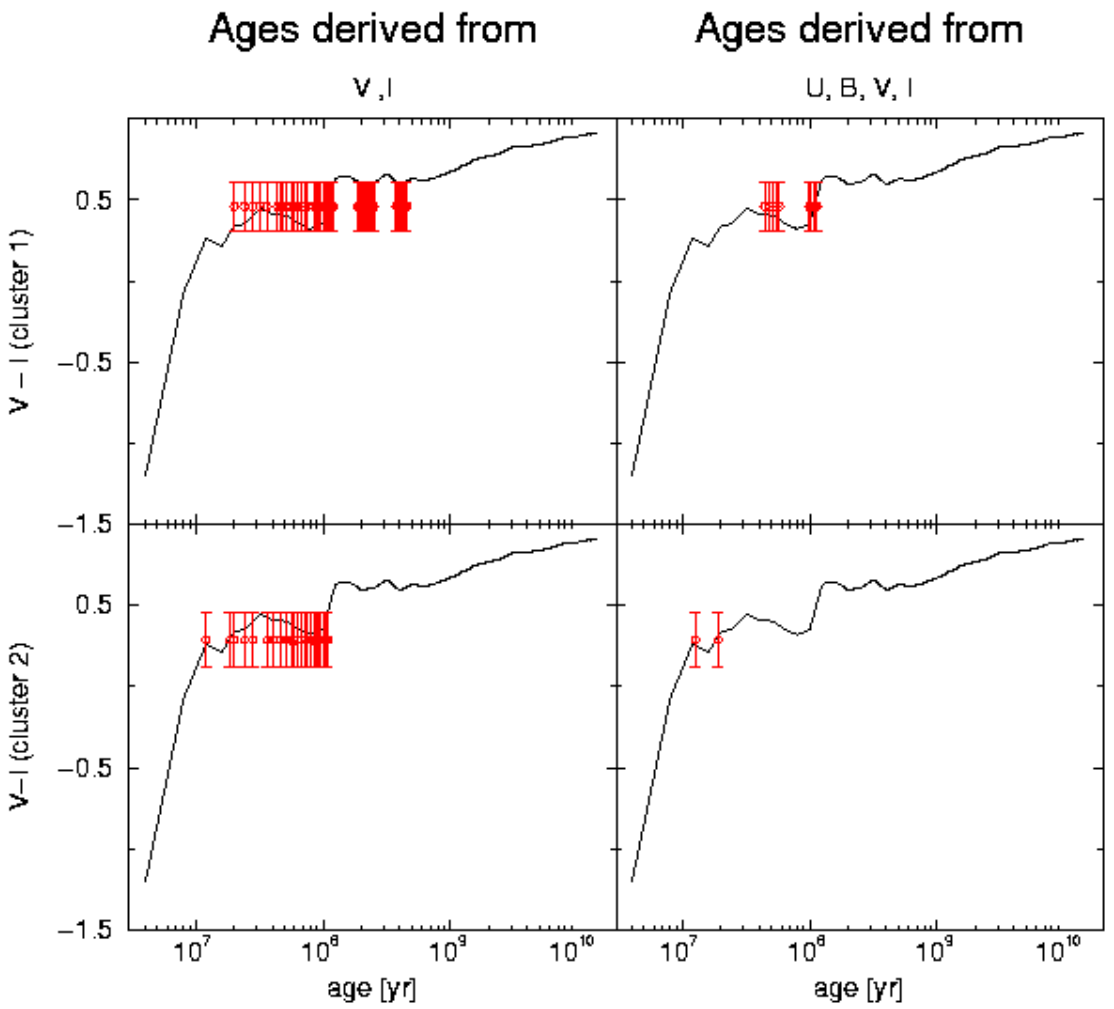
  exposu
  - ➔ only
  - ➔ very
  - ➔ gaseo
  - ✔ is nov



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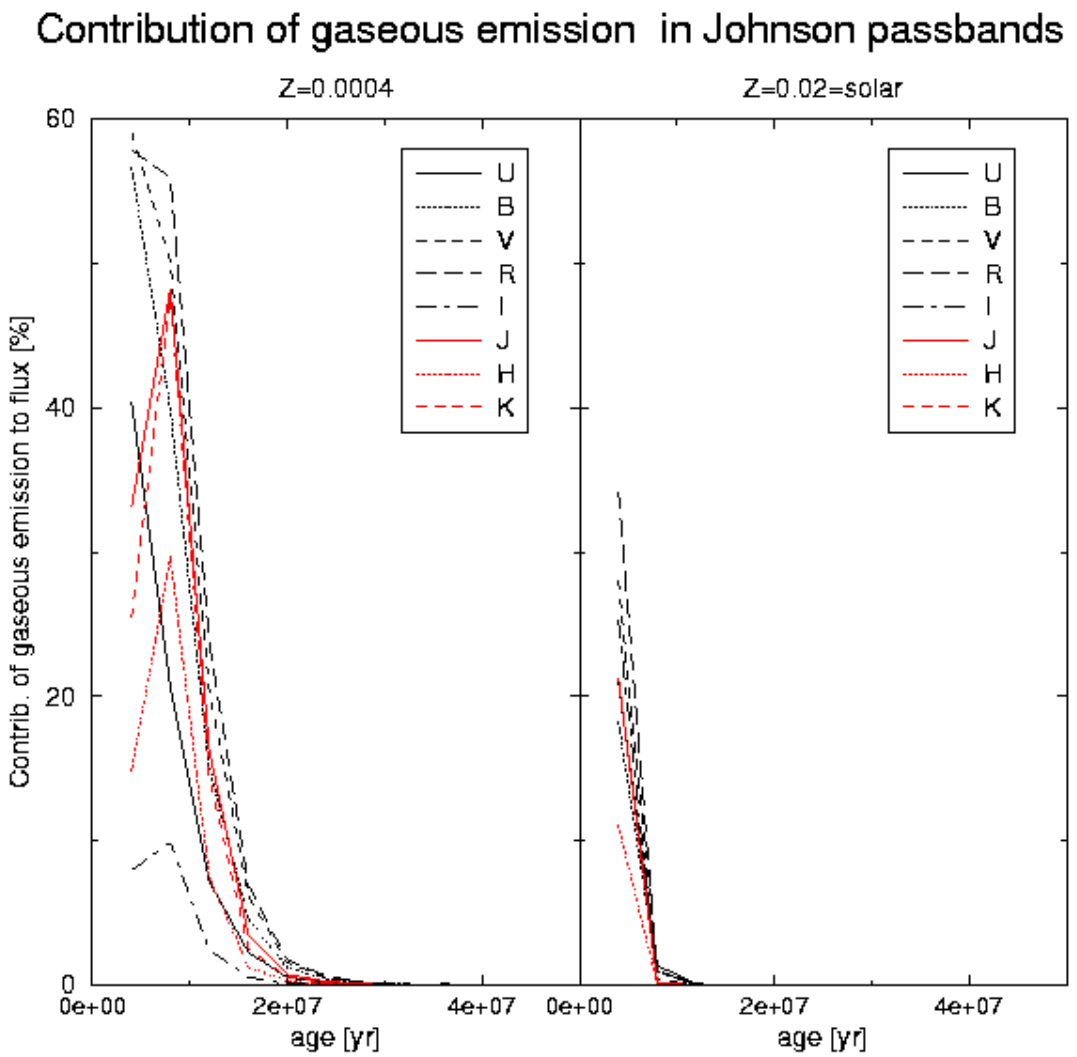
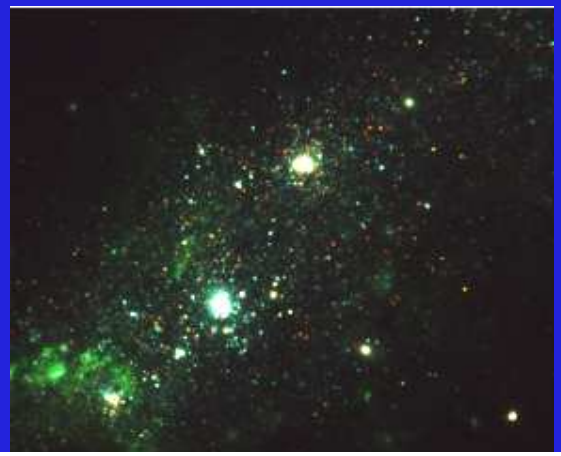


First results: NGC 1569

- 7 HST passbands, from F336W to F160W
- find 114 / 179 clusters (with / without NICMOS coverage)
- determine cluster parameters



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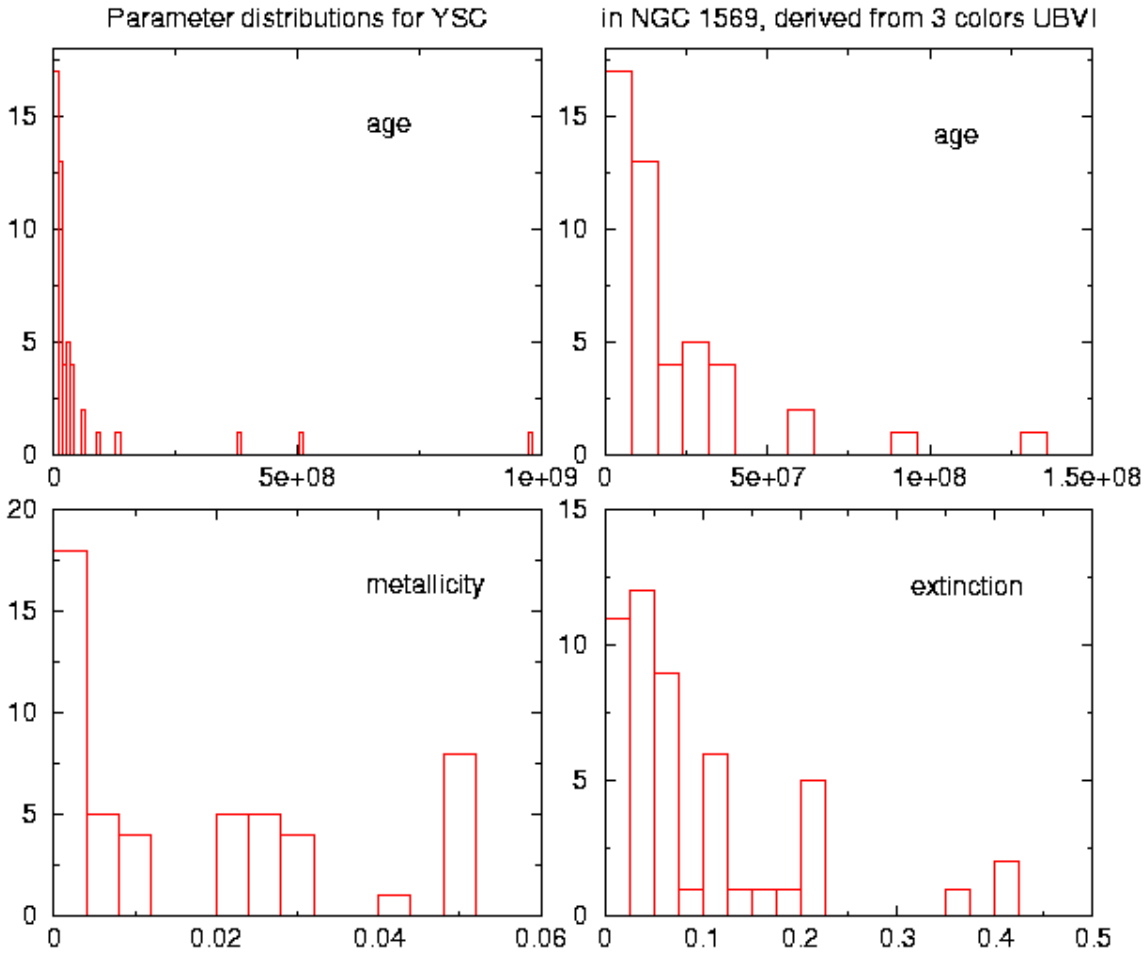

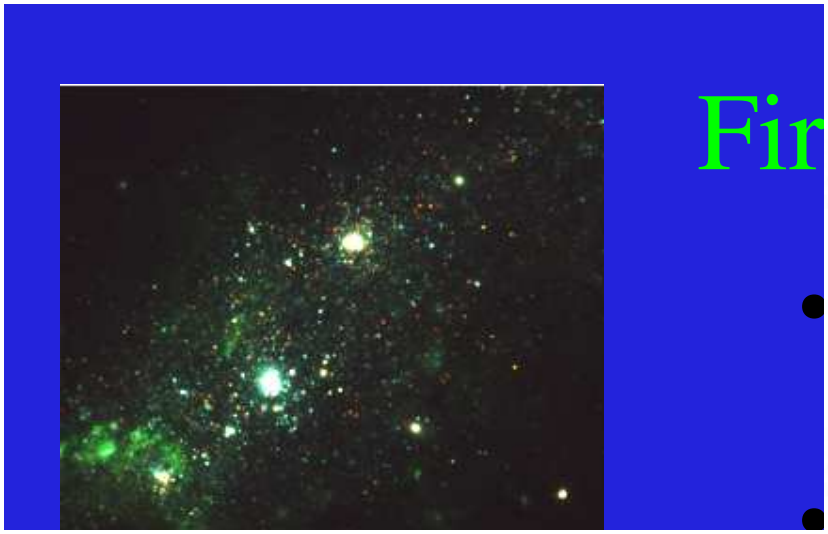

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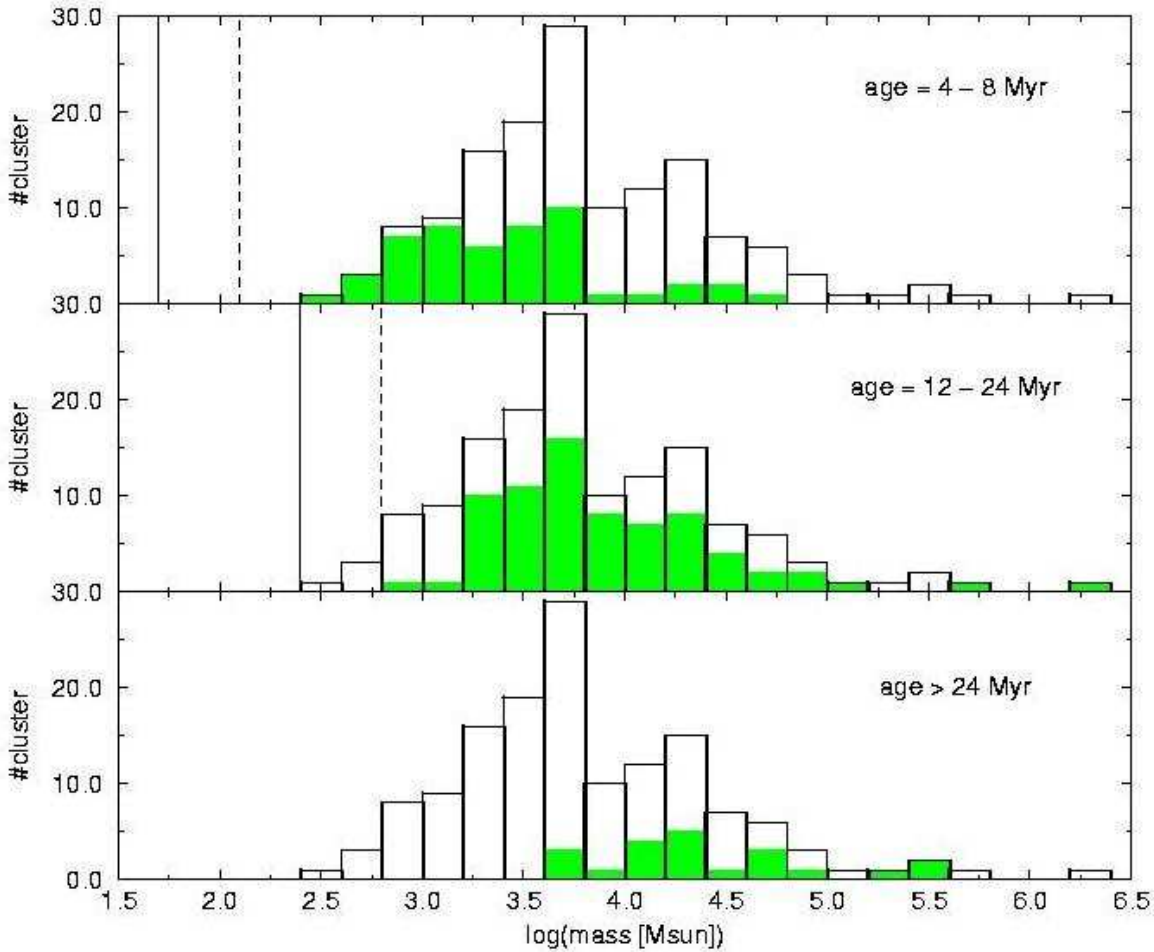
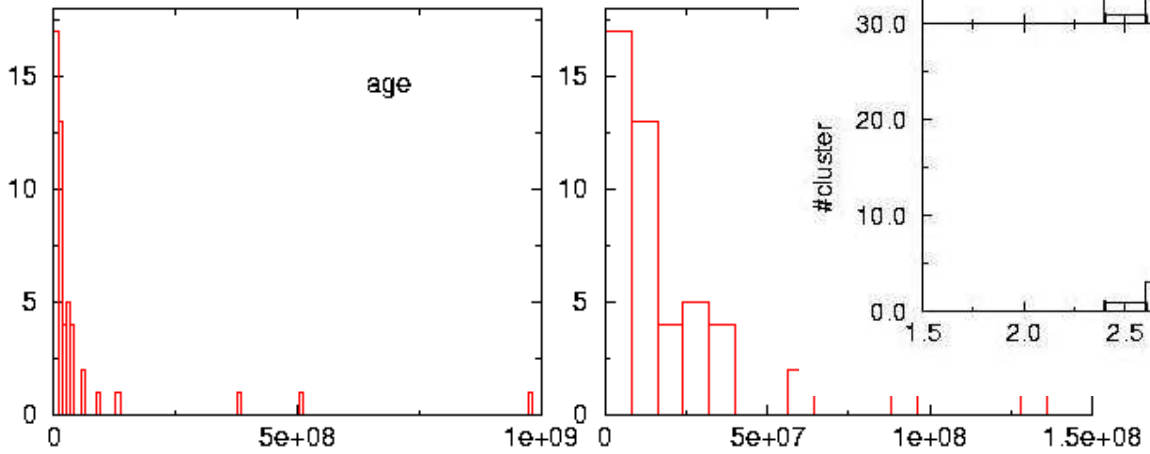
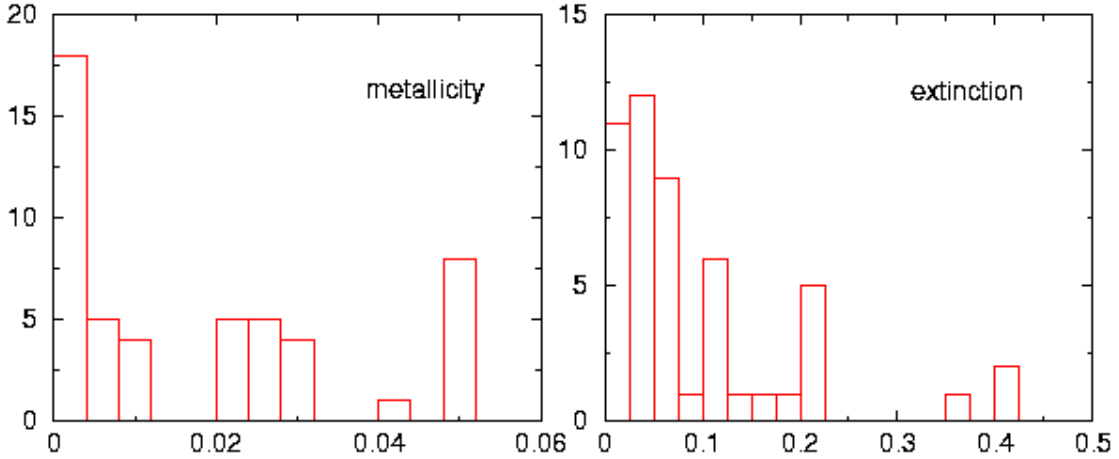


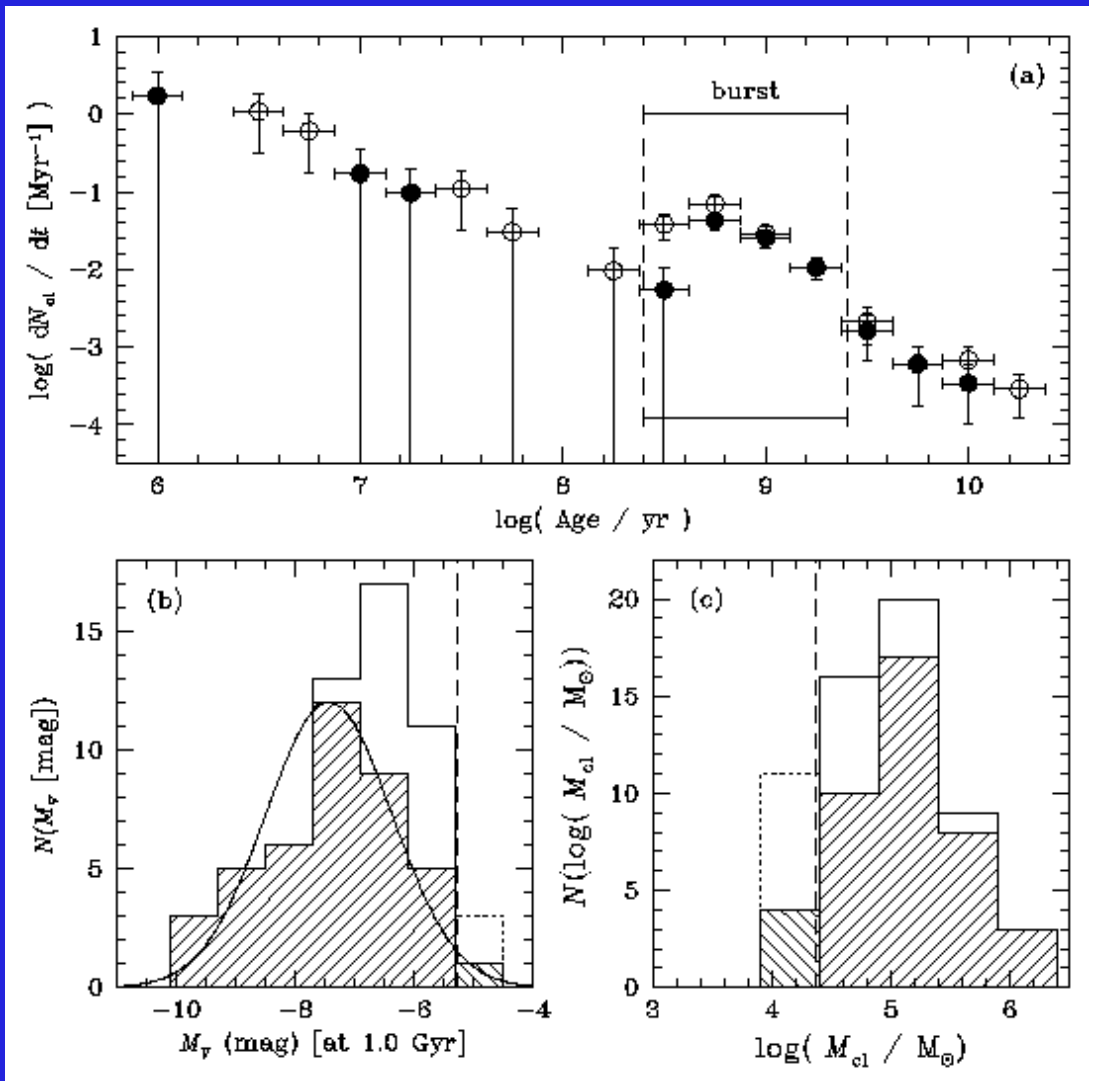
Parameter distributions for YSC in NGC 1569, de





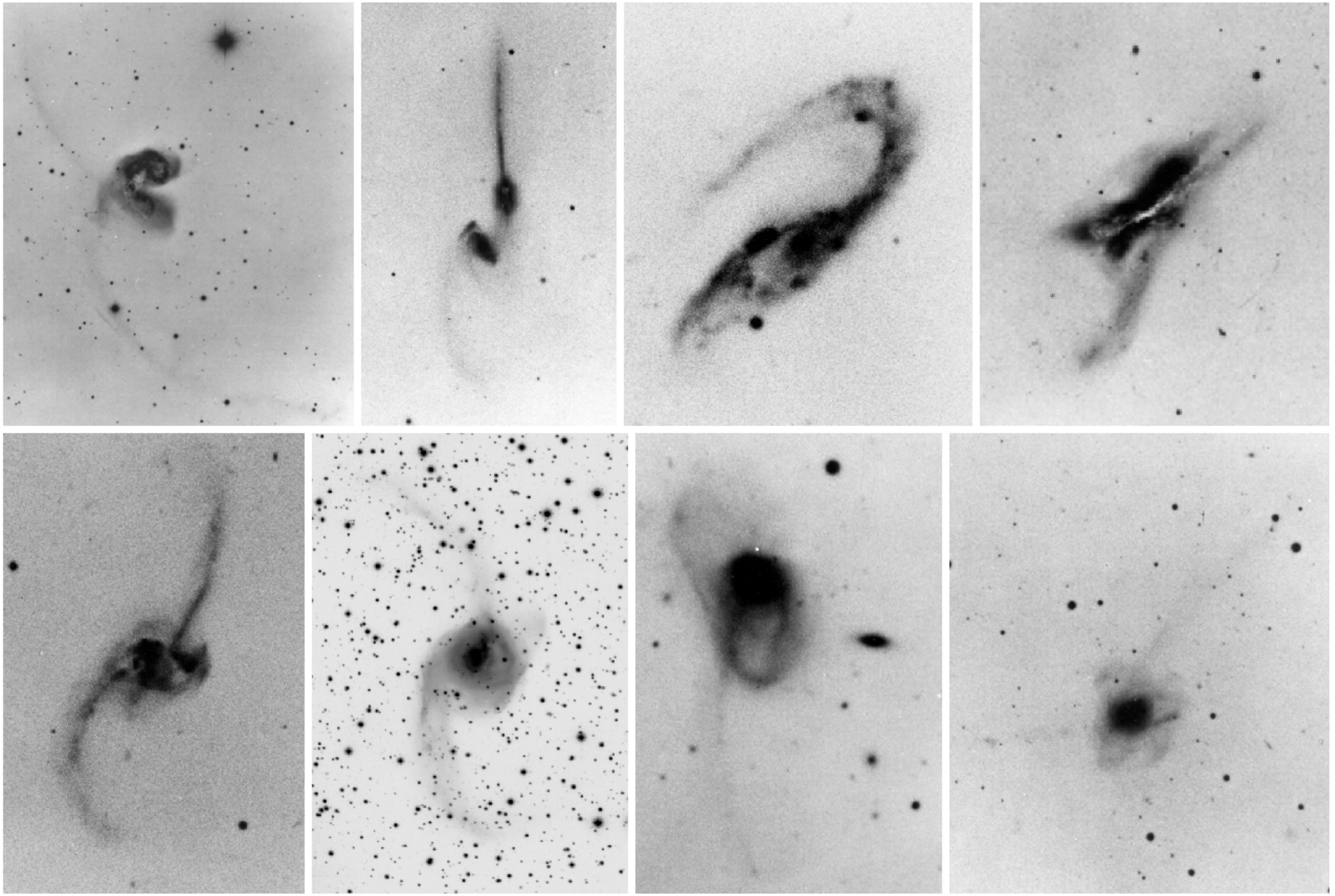
Other projects

Main work by R. de Grijs: NGC 3310, NGC 5253, M82, NGC 1140, „Tadpole“, „Mice“ ...



My future projects

- Mergers originating from different parent galaxies (Sp-Sp, Sp-dwarf, Sp-E)
- Mergers at various stages: probing an age-sequence

➔ All of these projects need efficient data mining tools, especially with the large amounts of survey data coming available

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