



# Star Formation Activities in Brightest Cluster Galaxies (BCGs)

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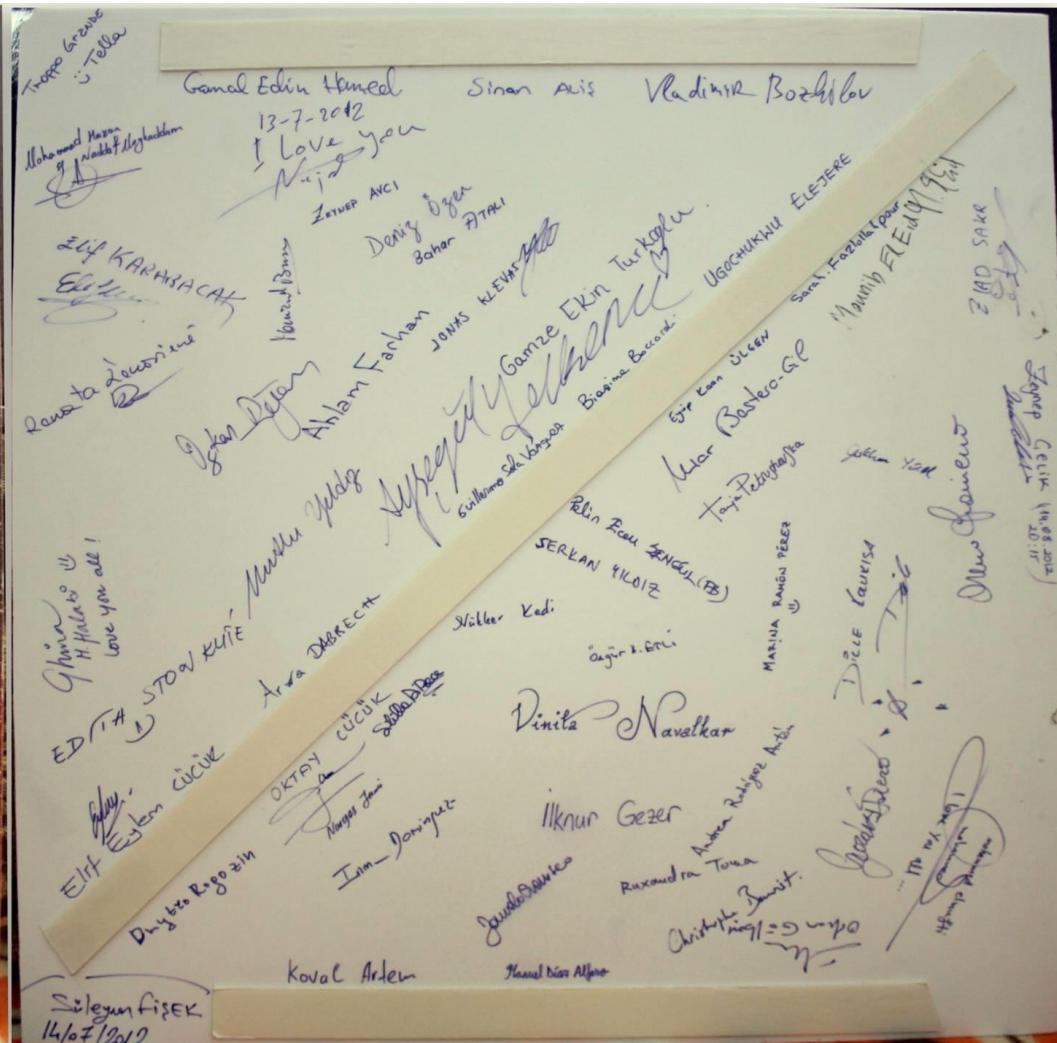
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<http://cosmology.istanbul.edu.tr>

# 3rd Azarquiel School

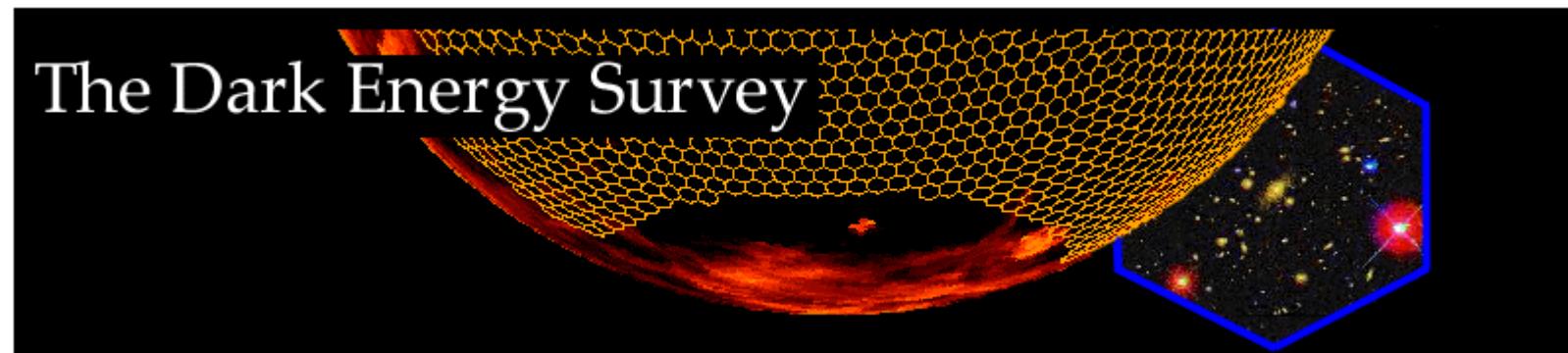


# 3rd Azarquiel Sch



# Motivation

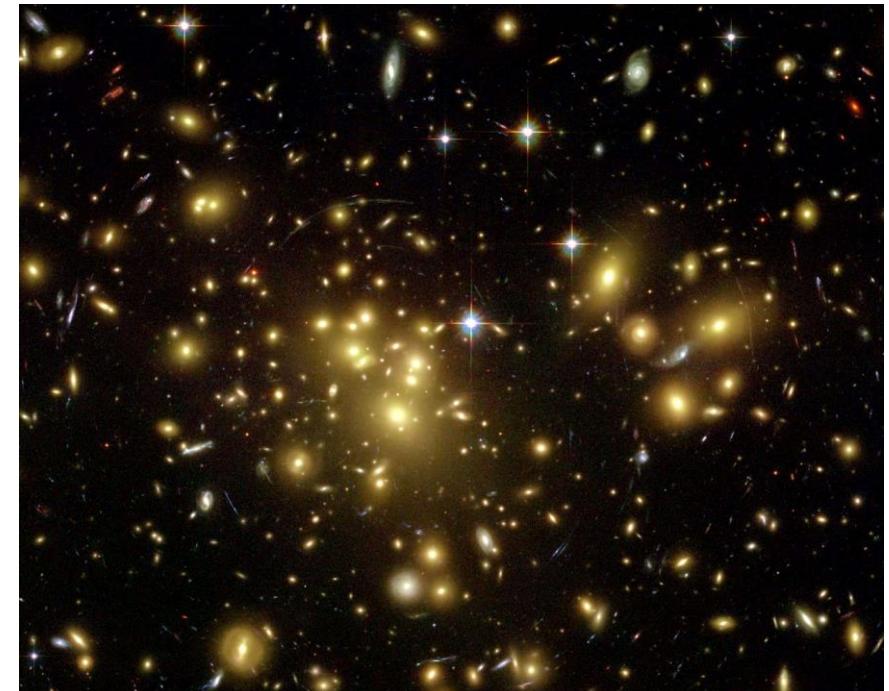
- Sky Survey Projects



# Motivation

## - Galaxy Clusters

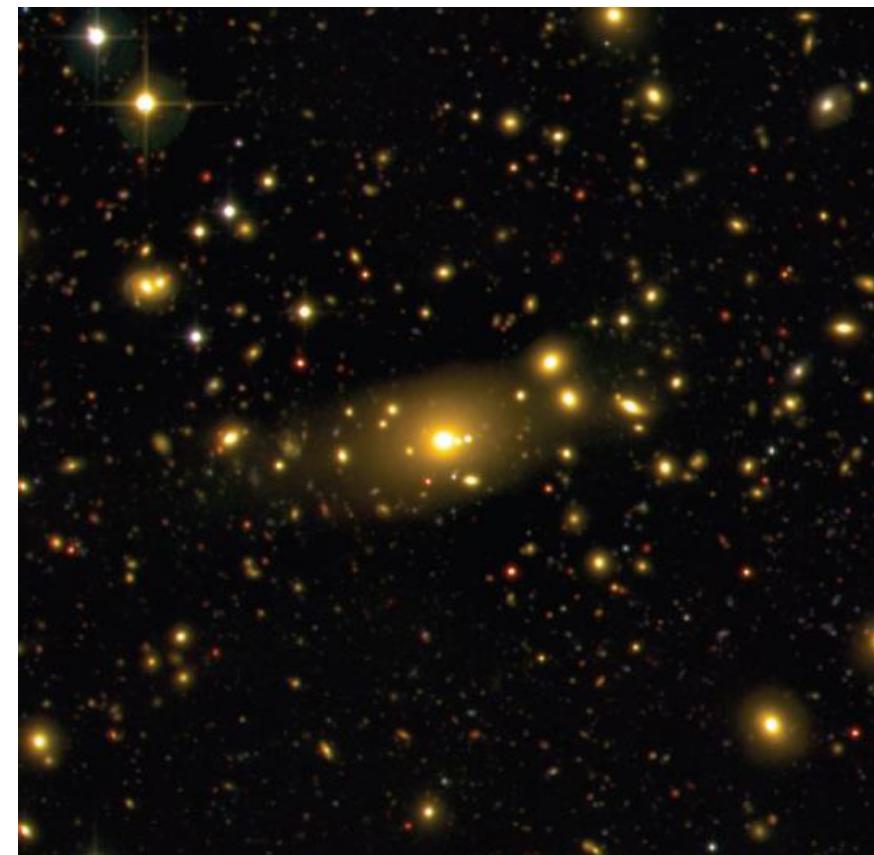
- \* Hundreds or thousands of galaxies that are bound together by gravity
- \* The largest known gravitationally bound structures in the universe
- \* Diameter ranges from 2 to 10 Mpc and total masses of  $10^{14} – 10^{15} M_{\odot}$



# Motivation

## - BCGs

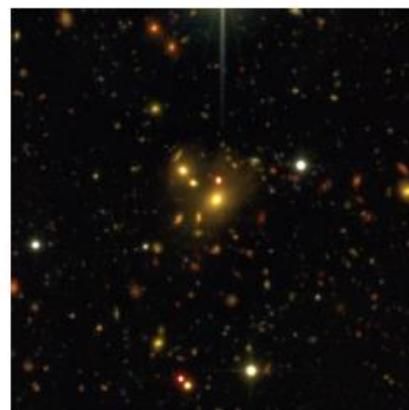
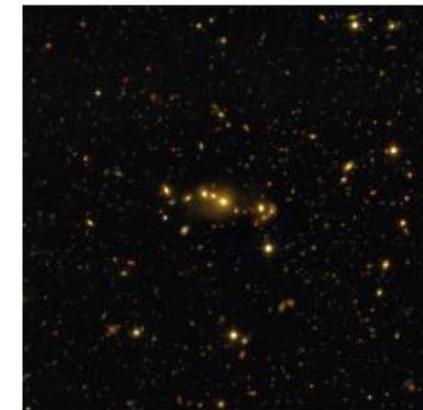
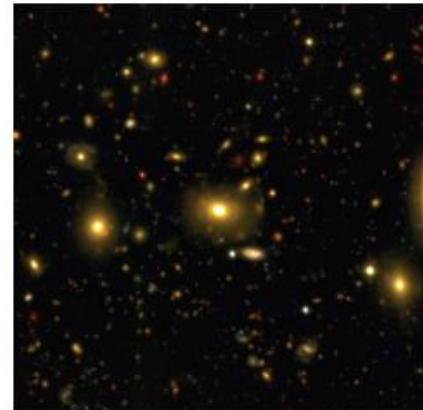
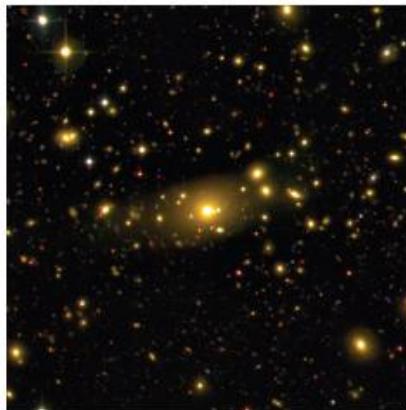
- \* Brightest and most massive galaxies in the universe
- \* Located in the center of their host galaxy cluster
- \*  $\leq 100 \text{ Kpc}$ ,  $\leq 10^{12} M_{\odot}$



# Motivation

## - BCGs

Example for BCGs which were detected in CFHTLS-Deep (D1, D2, D3, D4)



# Goals

- Calculate SFR in selected BCGs
- Investigate correlation between SFR with galaxy colors and redshifts
- Examine correlation between SFR and richness of the host clusters

# Data

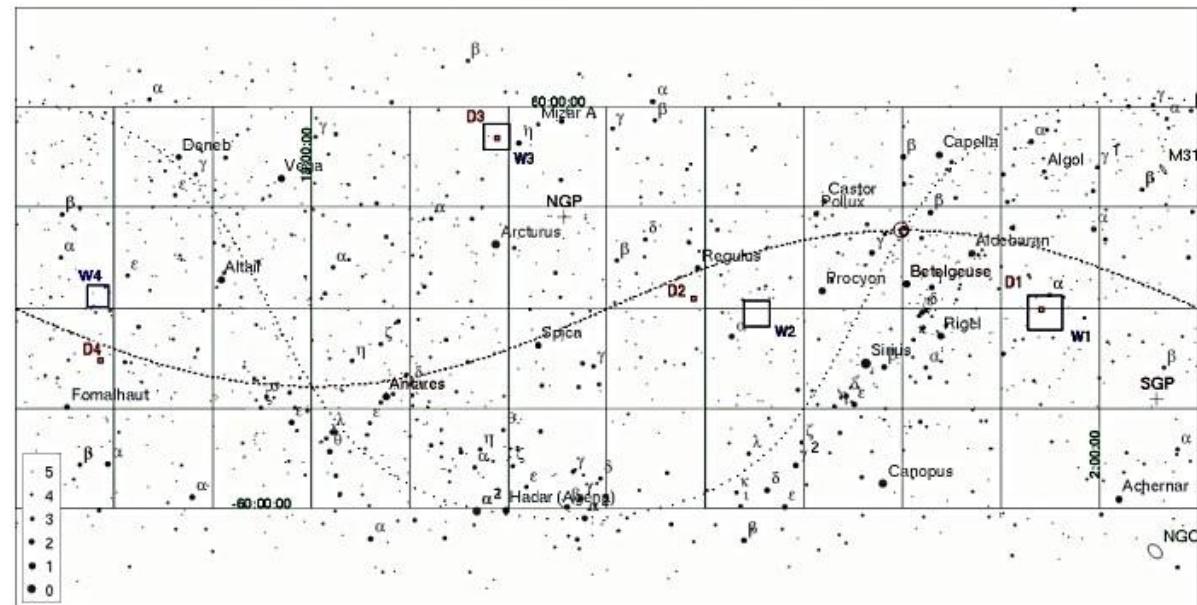
- Photometric data:

CFHTLS ( Canada – France – Hawaii Telescope Legacy Survey )

D1, D2, D3, D4

$u^*$ ,  $g^*$ ,  $r^*$ ,  $i^*$ ,  $z^*$ , photo z

89 BCG ( Alış et al., 2012 )

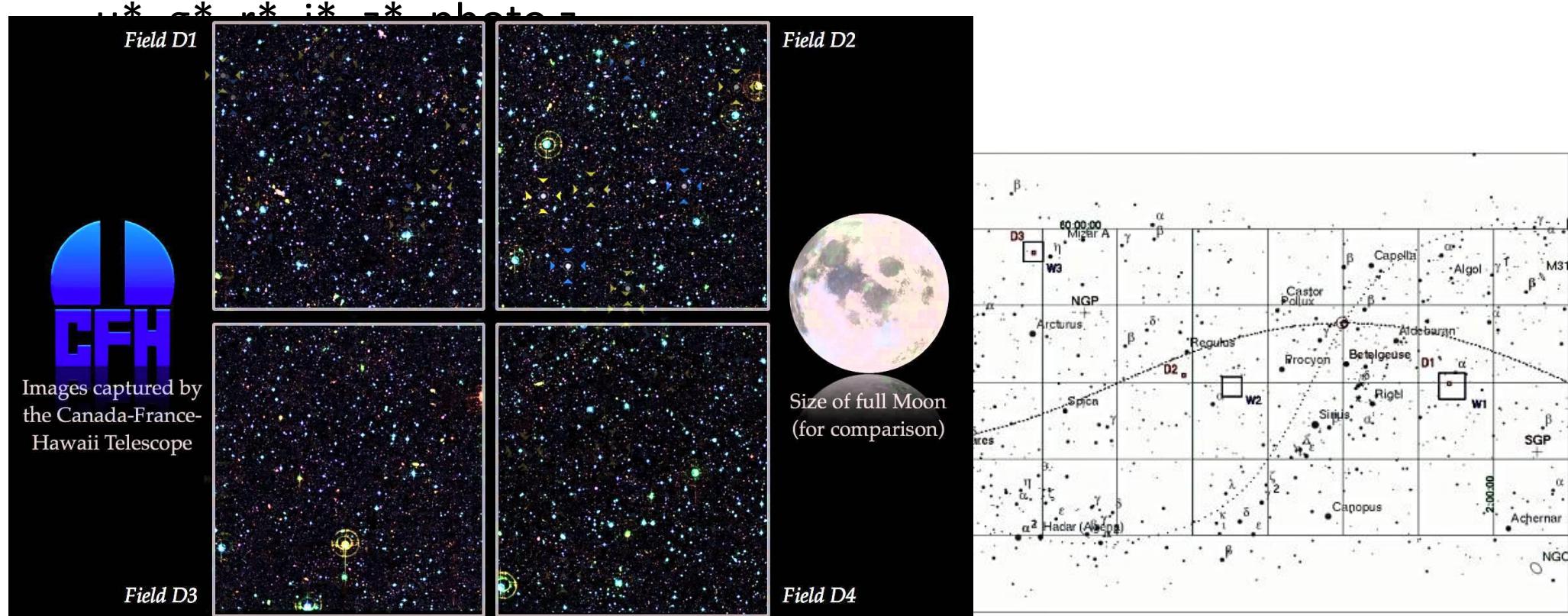


# Data

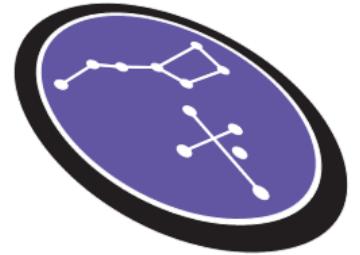
- Photometric data:

CFHTLS ( Canada – France – Hawaii Telescope Legacy Survey )

D1, D2, D3, D4



# Data



## - Spectroscopic data:

SDSS DR12 ( Sloan Digital Sky Survey – DR 12 )

emissionLinePort ( GANDALF, Sarzi et al. 2006 )

GalSpecLine ( Tremonti et al. 2004; Brinchmann et al. 2004 )

**DR12 Tools**

SDSS CrossID for DR12

Scroll down for Help

Getting Started  
Famous places  
Get images  
Scrolling sky  
Visual Tools  
Search  
**Object Crossid**  
CasJobs

Search type

Search scope

Upload type

JOIN with

Images (PhotoObj)

Spectra (SpecObj)

Infrared Spectra (apogeeStar)

Nearest Primary Object  
Nearest Object  
All Nearby Primary Objects  
All Nearby Objects

Nearest Primary Spectrum  
Nearest Spectrum  
All Nearby Primary Spectra  
All Nearby Spectra

Nearest

RA, dec  
run-rerun-camcol-field-obj

RA, dec  
plate-MJD-fiberID

Equatorial (RA/dec)  
Galactic (L/B)

Number of preceding non-data columns

Search radius [arcmin] (Max 3.0 arcmin)

Cut and paste your upload list here:

name	ra	dec
A1	15.5	0.5
A2	14.5	0.6
A3	13.9	0.8

Or upload it as text file

Choose File BCG\_name\_radec.asc

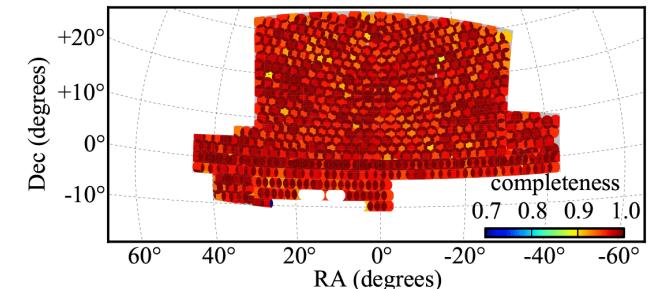
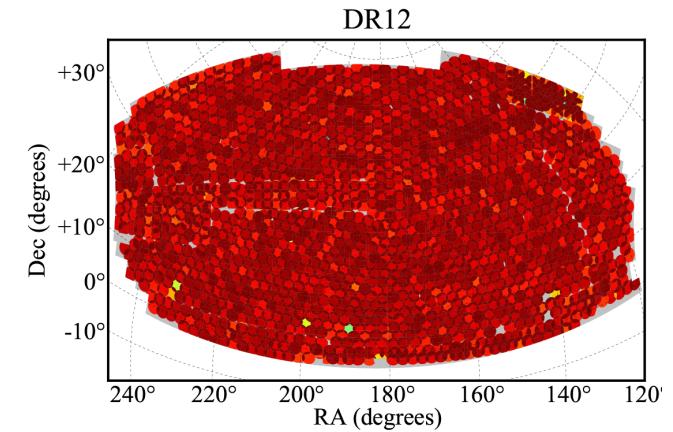
Type your SQL query here (see below for help):

```
SELECT sf.specobjid, sf.SFR, e.bpt, ga.bptclass, s.smMedian, s.class, s.zWarning, s.z
FROM #upload u
JOIN #x x ON x.up_id = u.up_id
JOIN emissionLinesPort.e ON e.specObjID = x.specObjID
JOIN galSpecExtra.ga ON ga.specObjID = x.specObjID
JOIN stellarMassStarformingPort.sf ON sf.specObjID = x.specObjID
JOIN SpecObjAll.s ON s.specObjID = x.specObjID
WHERE
s.zWarning=0 AND
s.smMedian >= 3
```

Format:  HTML  XML  CSV  JSON  VOTable  FITS  MyDB NEW!

Table name:

Submit Reset



# SFR

$$\text{SFR}(\text{M}_\odot \text{ year}^{-1}) = 7.9 \times 10^{-42} \times L(\text{H}\alpha) \text{ (ergs s}^{-1}\text{)}$$

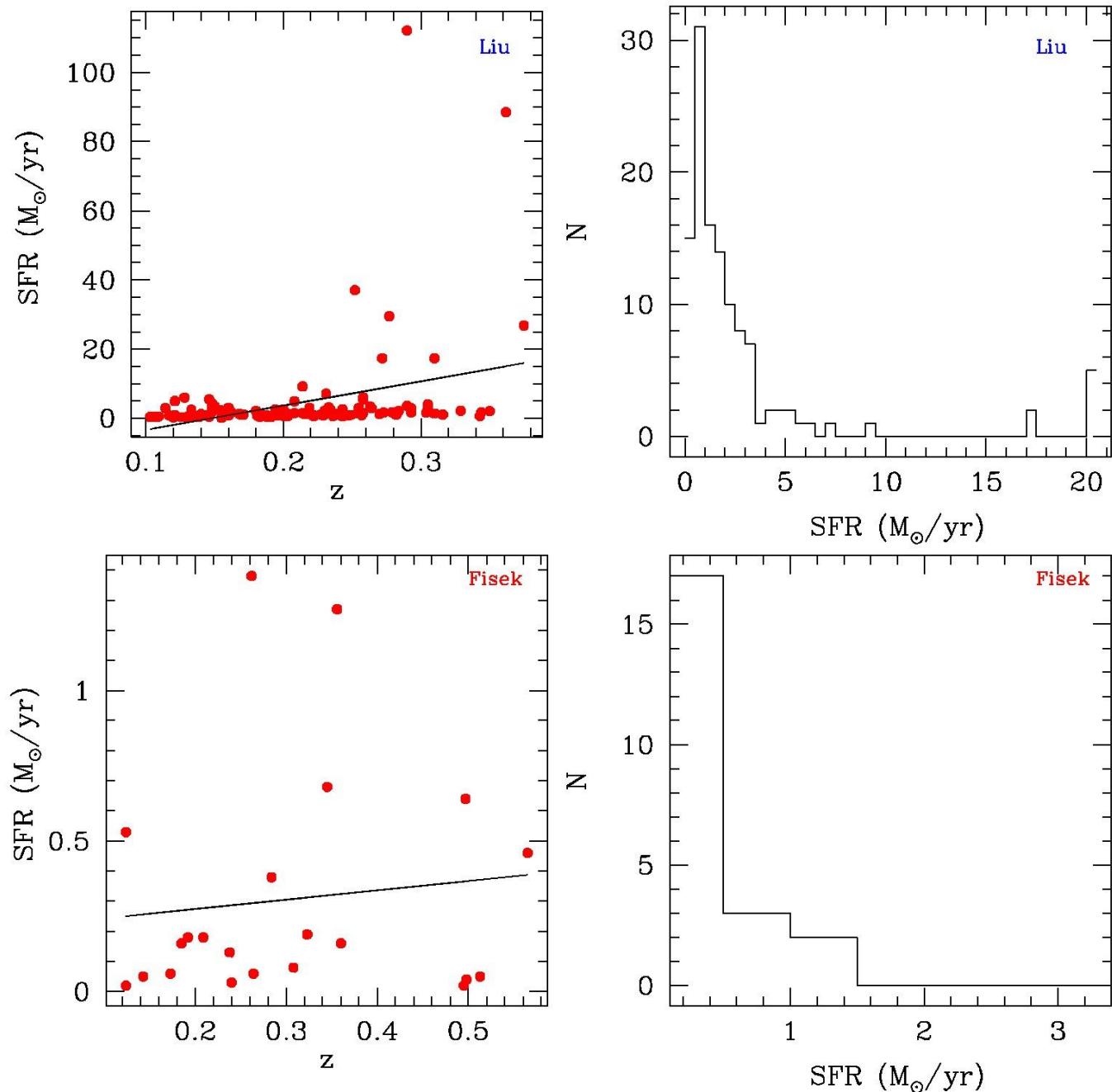
Kennicutt, 1998

Küme Adı	BCG R.A.	BCG Dec.	Photo z	$f_{H\alpha(6562\text{\AA})}$	SFR	R
CFHTLS-CL-J022434-041421	36.1384	-4.2387	0.29	82.23	1.73	59.69
CFHTLS-CL-J022508-040118	36.2937	-4.0305	0.22	9.55	0.11	25.80
CFHTLS-CL-J022523-044049	36.3529	-4.6792	0.31	3.60	0.09	20.92
CFHTLS-CL-J022531-041421	36.3781	-4.2385	0.17	10.90	0.07	34.93
CFHTLS-CL-J022618-035952	36.5756	-3.9994	0.26	17.67	0.29	15.07
CFHTLS-CL-J022629-043153	36.6182	-4.5234	0.25	22.30	0.33	27.21
CFHTLS-CL-J022653-041005	36.7168	-4.1658	0.41	21.70	1.03	17.67
CFHTLS-CL-J022725-043232	36.8584	-4.5372	0.33	3.47	0.10	32.83
CFHTLS-CL-J095943+023537	149.9383	2.5776	0.15	169.16	0.81	13.06
CFHTLS-CL-J100014+021224	150.0758	2.2034	0.19	21.39	0.17	37.74
CFHTLS-CL-J100022+022321	150.0909	2.3912	0.28	0.82	0.02	16.15
CFHTLS-CL-J100142+022510	150.4157	2.4302	0.20	5.66	0.05	34.54
CFHTLS-CL-J100151+020341	150.4473	2.0540	0.40	7.02	0.31	39.12
CFHTLS-CL-J141721+523541	214.3328	52.5939	0.31	1.91	0.05	31.13
CFHTLS-CL-J141722+525444	214.3444	52.9142	0.29	9.85	0.21	16.30
CFHTLS-CL-J141729+523819	214.3726	52.6379	0.41	37.49	1.77	29.33
CFHTLS-CL-J141904+530830	214.7728	53.1393	0.33	19.07	0.54	18.75

Unit of H $\alpha$  flux:  $10^{-17}$  erg s $^{-1}$  cm $^{-2}$

# Results

Liu et al. (2002) – 120 BCG  
Fisek (2017) – 24 BCG



# Future goals...

- Calculate the SFR via [OII] flux
- Follow-up of new sky survey projects for new data
- Calculate the SFR via photometric data (LePhare)
- Use same methods to calculate the SFR in CFHTLS W1 ( $72 \text{ deg}^2$ ),  
Benoist, C. ve Aliş, S. ~4000 galaxy clusters

# Future goals...

- Observation in high redshift:



- 1) Spectroscopic observation for selected BCGs
- 2) Photometric observation in **NIR** with J, H, K bands

Thank you!

Grazie!

Teşekkürler!

Faleminderit!

ଚିନ୍ମନହାଳୁକାଲିନରାଜନିଲୁ!

متشكر م

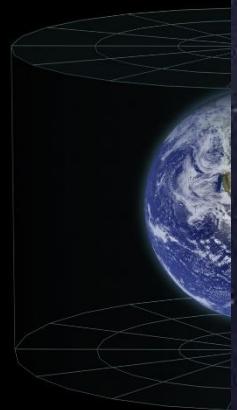
ধন্যবাদ !

Gracias!

გმადლობთ

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LOCAL GAL



M84, M87  
Photogr

© COELUM



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e

# SFR for Milkyway

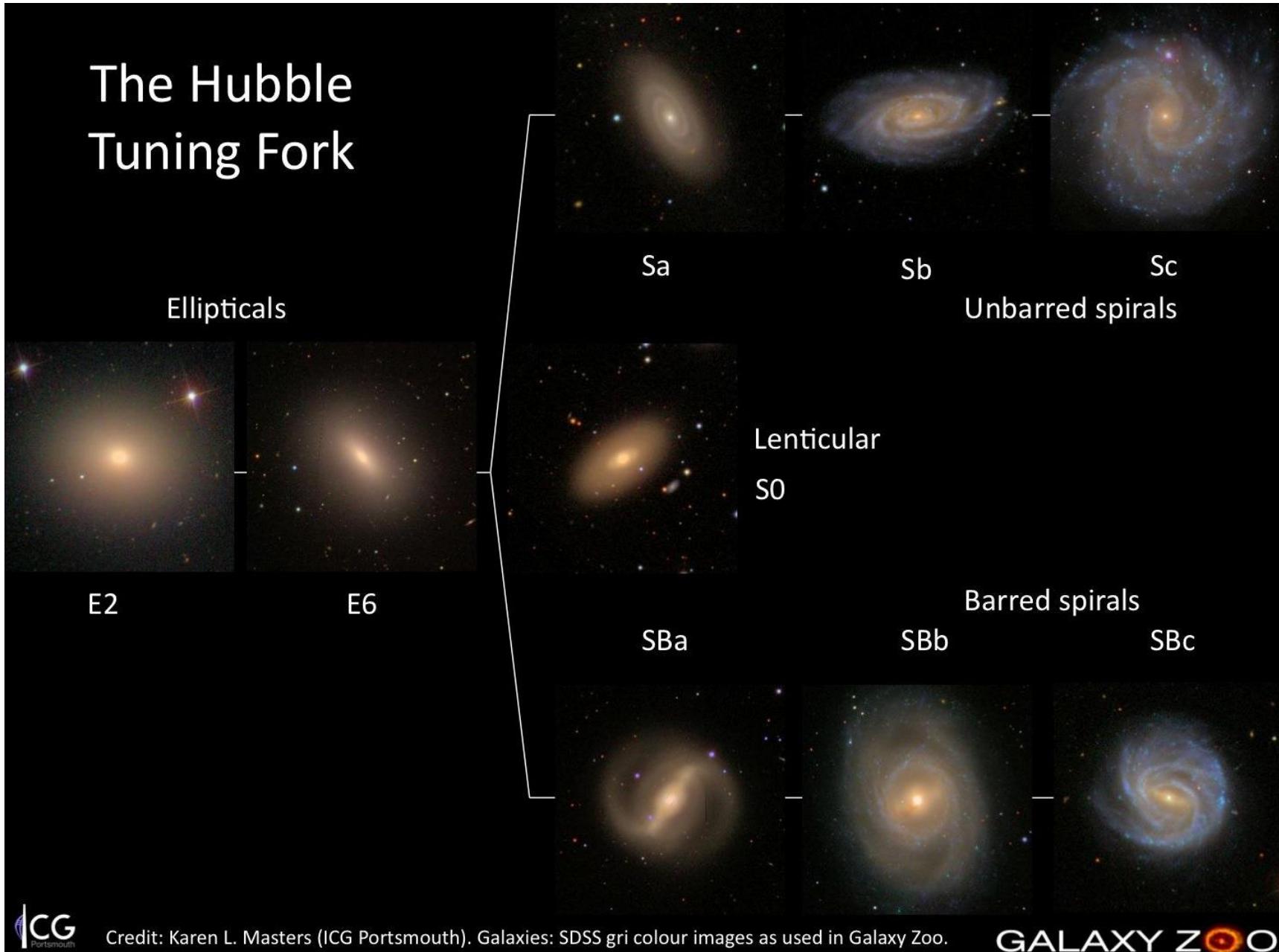
We can measure the Galactic SFR directly from YSOs

0.68-1.45 Msun/yr

(Robitaille et al., 2010)

# Hubble Tuning Fork

## The Hubble Tuning Fork



# Le PHARE



*LePhare Download Install Syntax Examples Acknowledgement*

**Le PHARE**  
*Photometric Analysis for Redshift Estimate*  
*Arnouts S. & Ilbert O.*

**Goal**

Le PHARE is a set of fortran commands to compute photometric redshifts and to perform SED fitting. The last version includes new features with FIR fitting and a more complete treatment of physical parameters and uncertainties based on PEGASE and Bruzual & Charlot population synthesis models

# Eastern Anatolia Observatory

