



Observatoire astronomique  
de Strasbourg

# The Star Formation History of NGC 4388

Combined spectral and photometric analysis

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# Virgo, A Laboratory for Studying Galaxy Evolution

Virgo distance

$D \sim 17$  Mpc

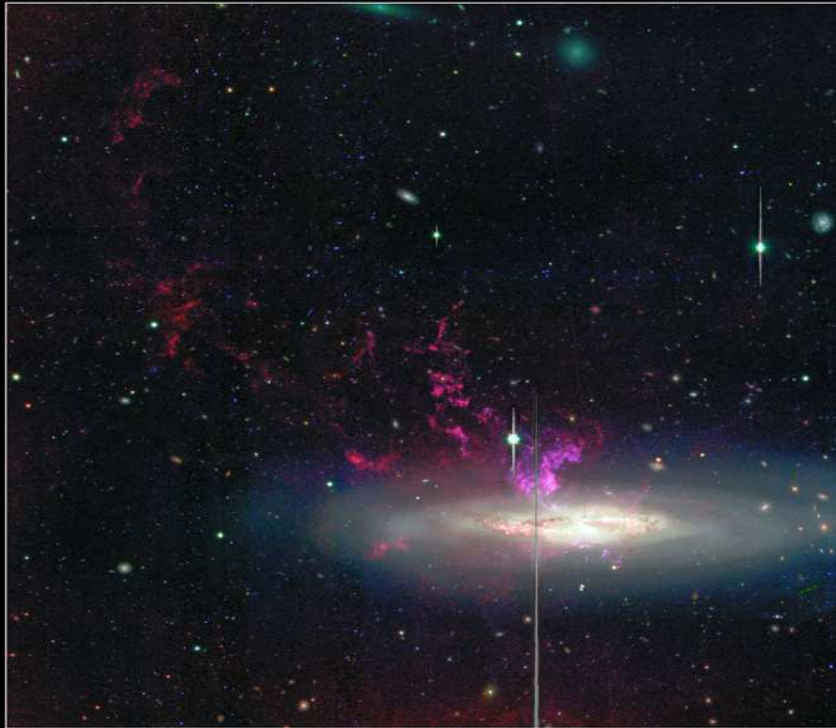
○ NGC 4388  
 $d \sim 400$  kpc

●  $V < 500$  km/s  
●  $600$  km/s  $< V < 1300$  km/s  
●  $1400$  km/s  $< V < 2000$  km/s  
●  $V > 2000$  km/s

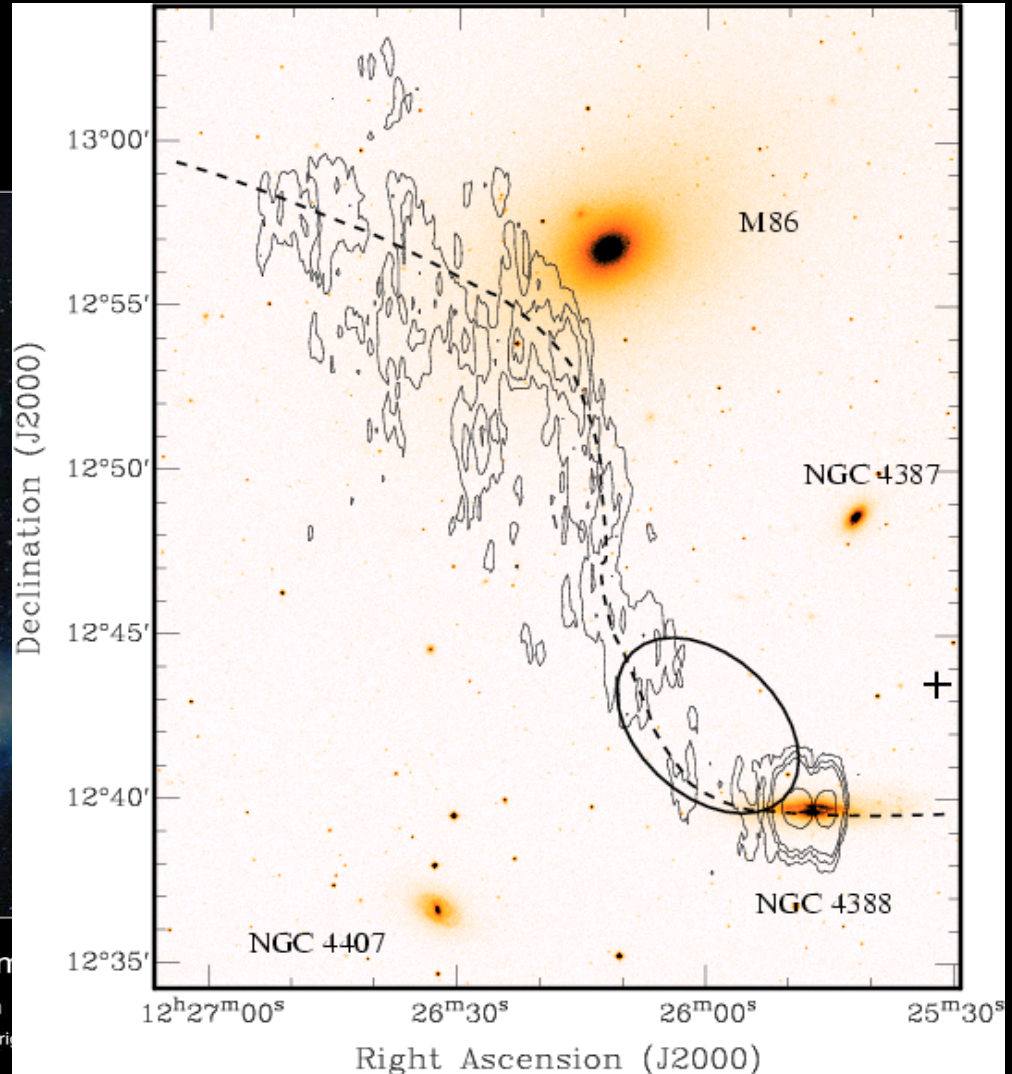
Chung et al. 09

# NGC 4388

H-alpha on optical (SUBARU,  
Yoshida et al. 02)



HI emission  
(WSRT, Oosterloo & van Gorkom 05)



Active Galaxy NGC 4388

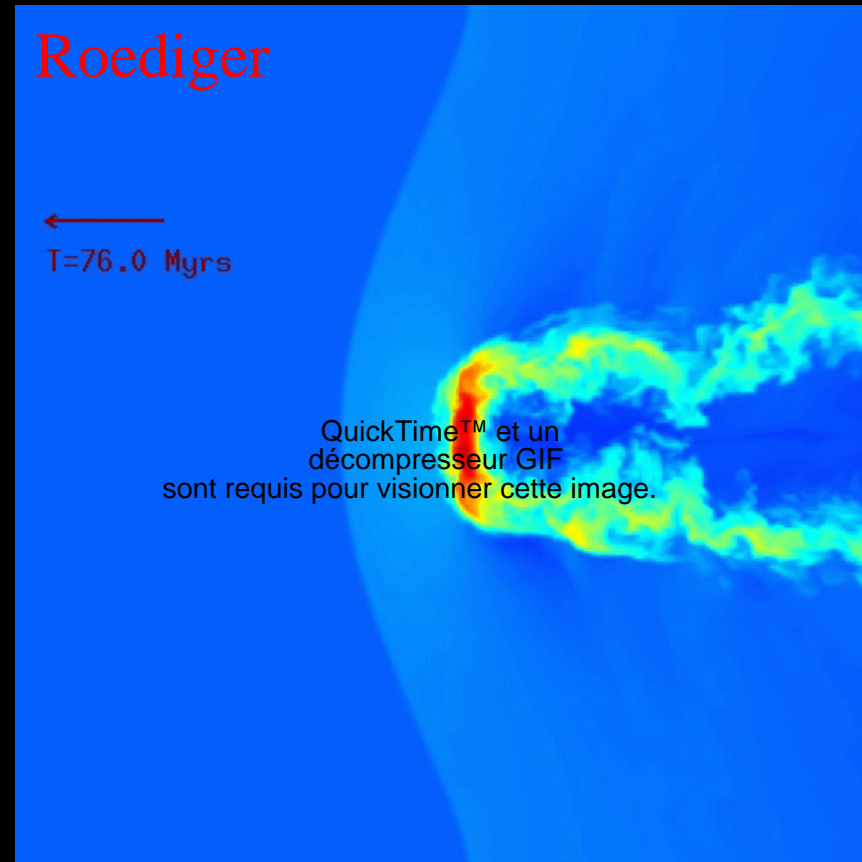
Suprim

Subaru Telescope, National Astronomical Observatory of Japan

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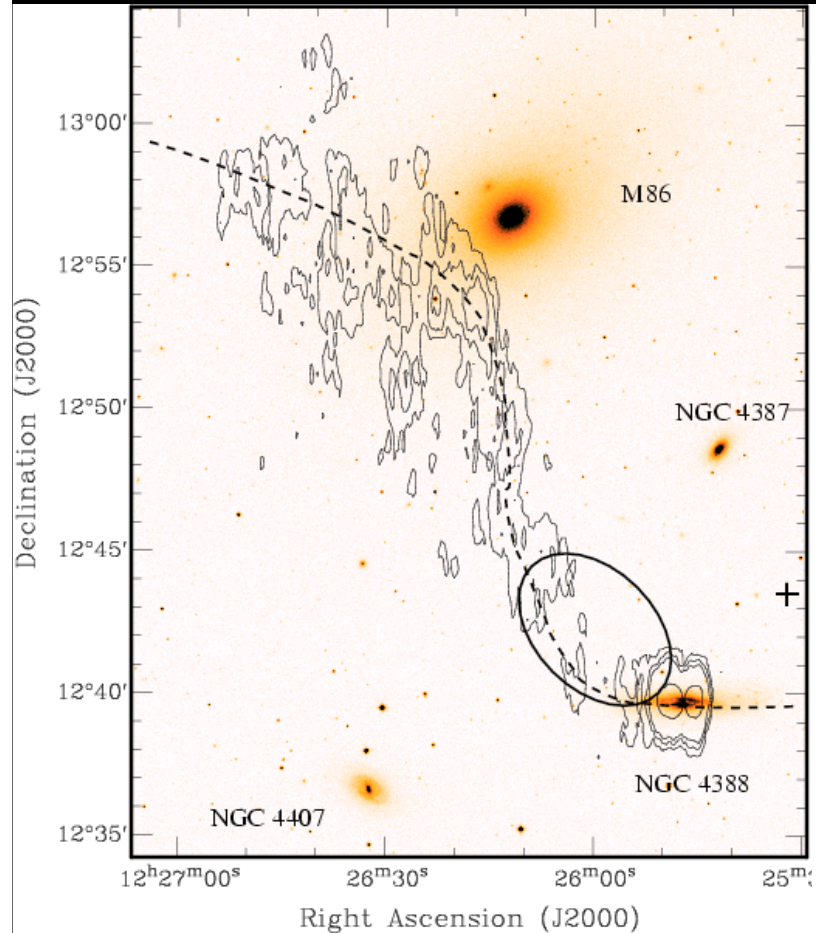
# RAM PRESSURE STRIPPING

The galaxy is moving in the hot intracluster medium

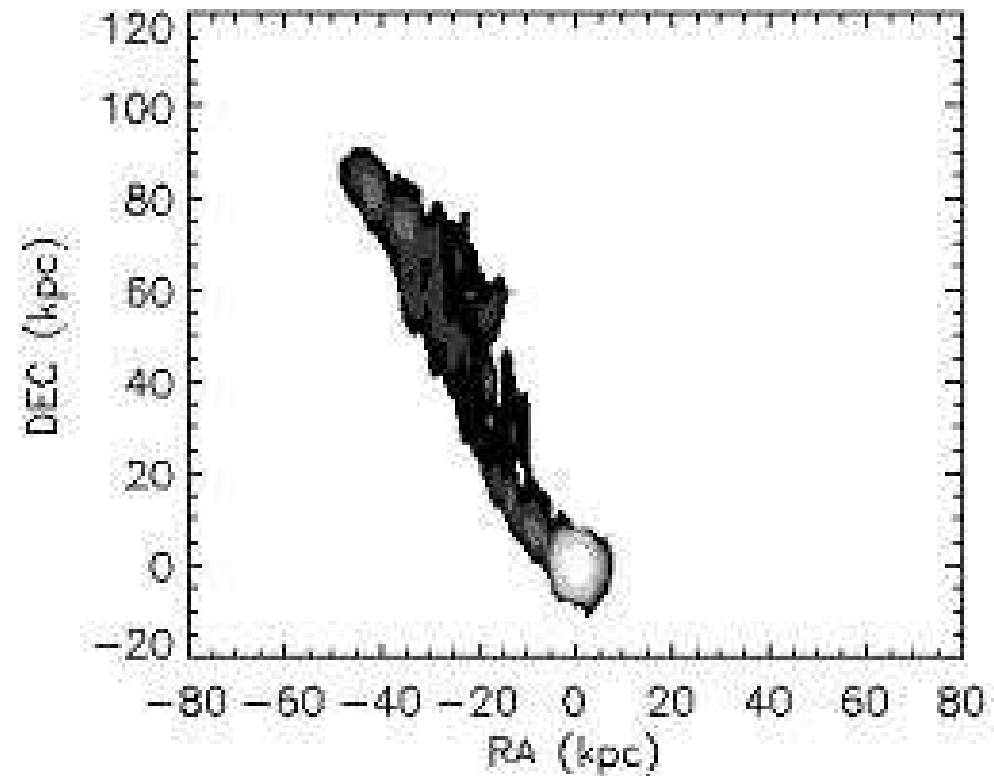


# RAM PRESSURE STRIPPING

The galaxy is moving in the hot intracluster medium



Vollmer (2009)



Stripping age ~ 120 Myr

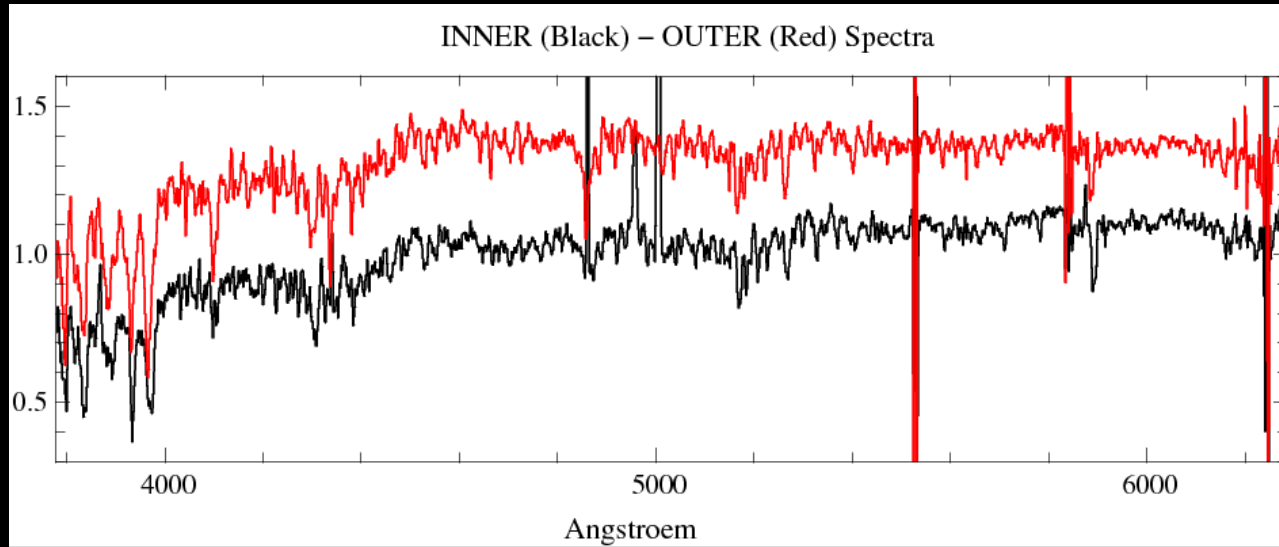
## Goal & Outline

Gas has left the disk  $\longrightarrow$  Star Formation STOPS

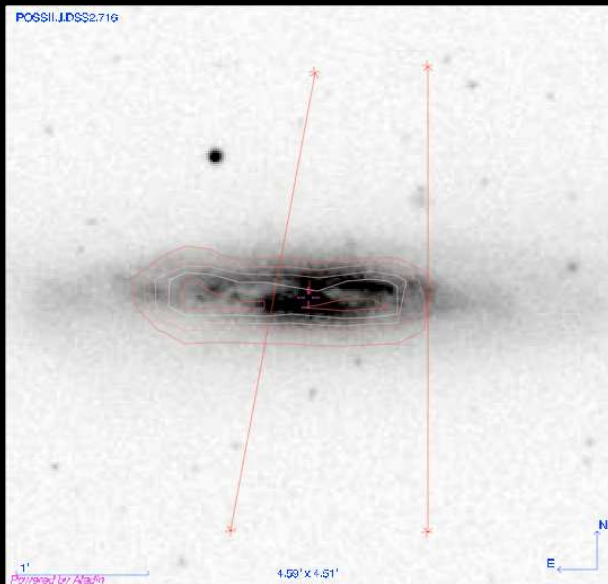
STRIPPING AGE = time elapsed since the halt of star formation

1. Optical spectroscopy and Photom. data of NGC 4388
2. Non parametric inversion tool to reconstruct SFH
3. Parametric method to refine the results

# DATA



Inner = typical star forming disk  
 Outer = post starburst galaxy without emission line



Filter	<i>FUV</i>	<i>NUV</i>	<i>u'</i>	<i>g'</i>	<i>r'</i>	<i>i'</i>	<i>z'</i>	<i>J</i>	<i>H</i>	<i>K</i>
<i>m<sub>AB</sub></i>	—	—	16.78	15.06	14.35	14.69	14.07	13.08	12.65	12.52
$\sigma_{tot}$	—	—	0.025	0.034	0.017	0.002	0.016	0.021	0.03	0.024
Inner	20.40	19.95	18.45	17.10	16.37	16.03	15.76	14.38	13.60	13.32
$\sigma_{SLIT}$ -Inner	0.17	0.04	0.01	0.02	0.04	0.04	0.04	0.04	0.02	0.05
Outer	22.21	21.30	19.49	18.07	17.47	17.18	17.03	16.08	15.06	14.75
$\sigma_{SLIT}$ -Outer	0.31	0.07	0.08	0.06	0.07	0.07	0.03	0.33	0.04	0.12
$\sigma_{TOT}$ -Inner	0.27	0.14	0.03	0.05	0.06	0.04	0.06	0.06	0.05	0.07
$\sigma_{TOT}$ -Outer	0.41	0.17	0.1	0.09	0.09	0.07	0.05	0.35	0.07	0.14

# NON PARAMETRIC METHOD

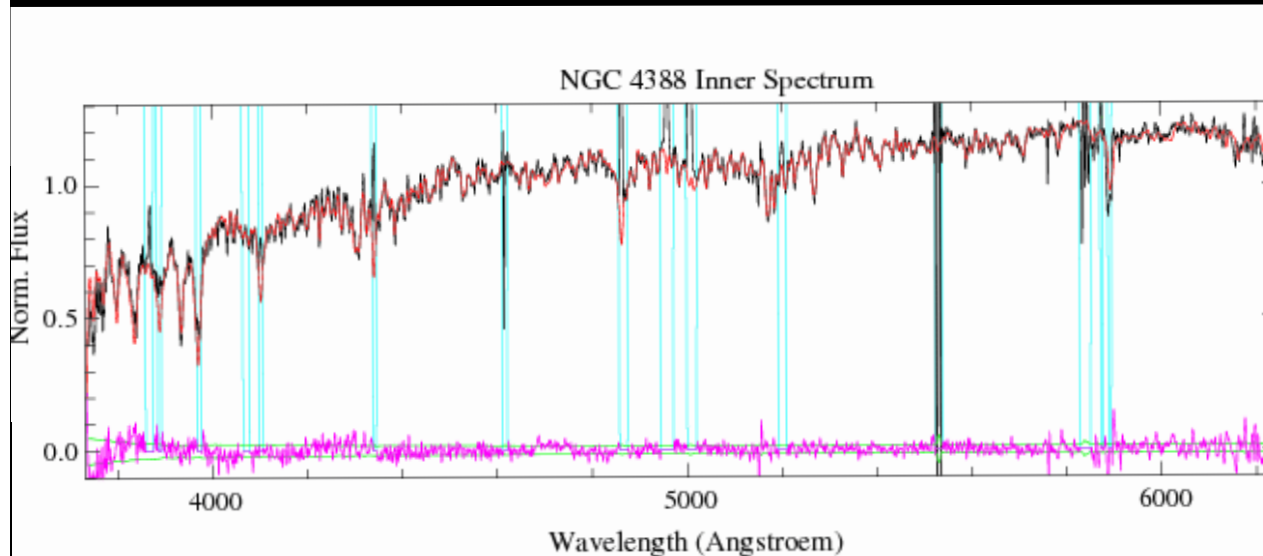
$$F_{rest}(\lambda) = \int_{t_{min}}^{t_{max}} SFR(t) B^0(\lambda, t, Z(t)) dt$$
$$F_{ptm}(\mathbf{y}) = \int_{t_{max}}^{t_{min}} SFR(t) B_{ptm}^0(\mathbf{y}, t, Z(t)) dt$$
$$\longleftrightarrow s_i \approx \sum_{j=1}^n B_{i,j} x_j$$

$$Q(\mathbf{x}) = \chi^2(\mathbf{y} | \mathbf{x}) - 2\log[f_{prior}(\mathbf{x})]$$



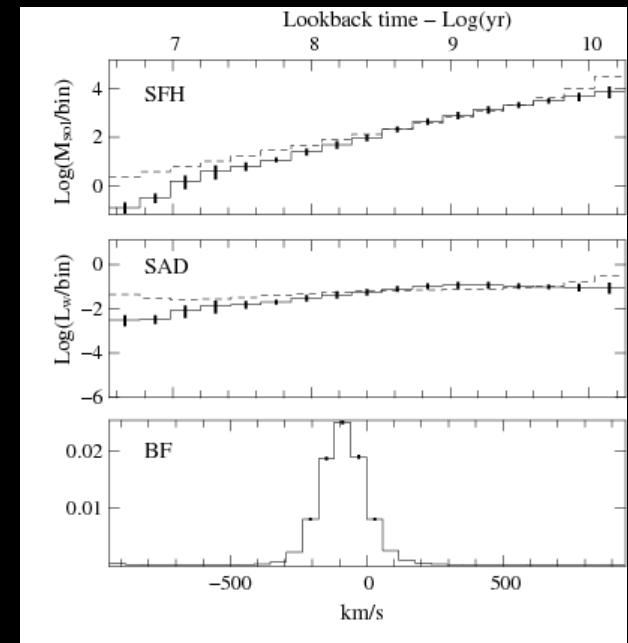
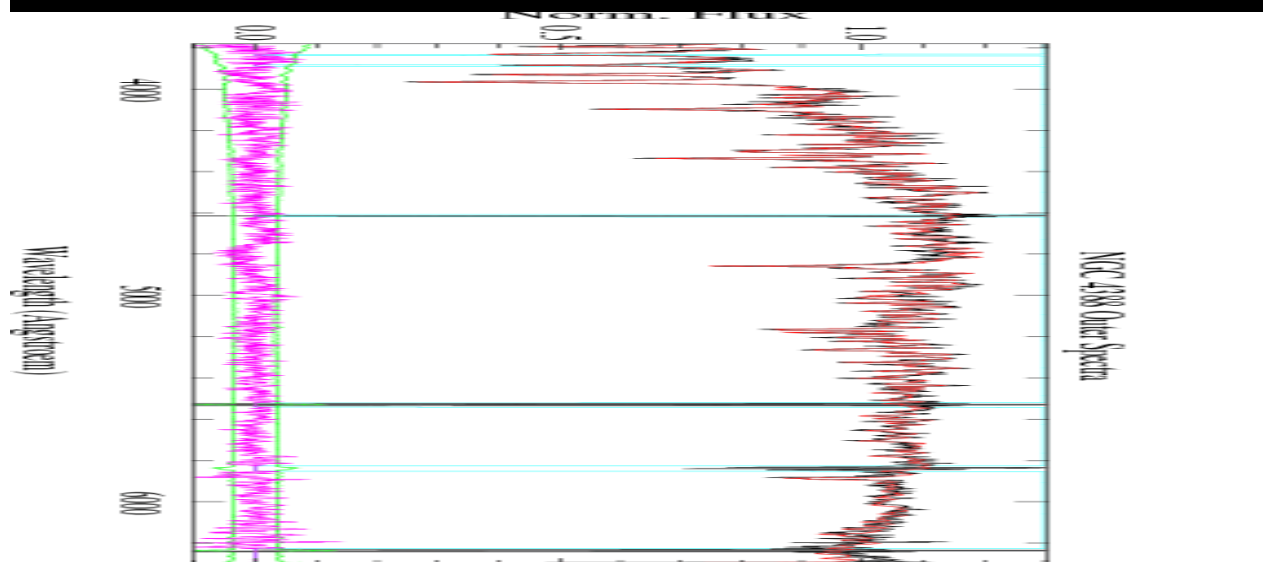
$$Q_{\mu}(X) = (1 - \alpha) \cdot \chi_{spc}^2(X) + \alpha \cdot \chi_{ptm}^2(X) + \mu \cdot P(X)$$

# Inner region

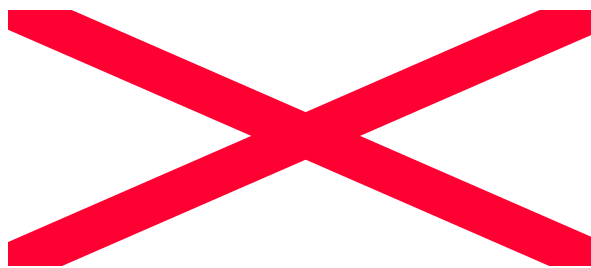


SFH = flat

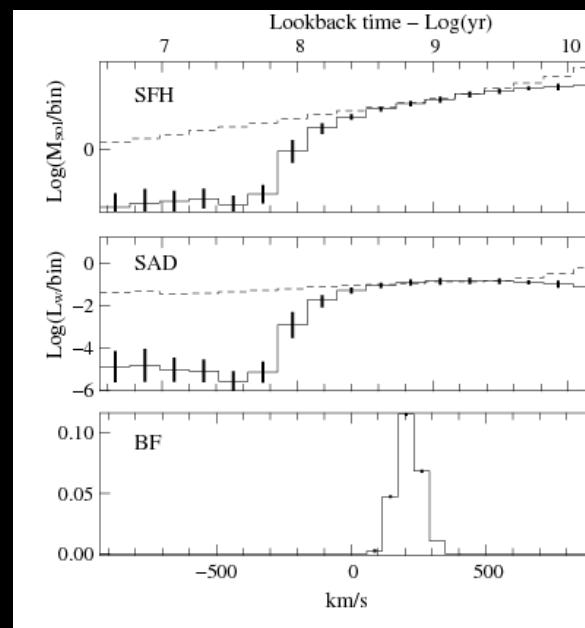
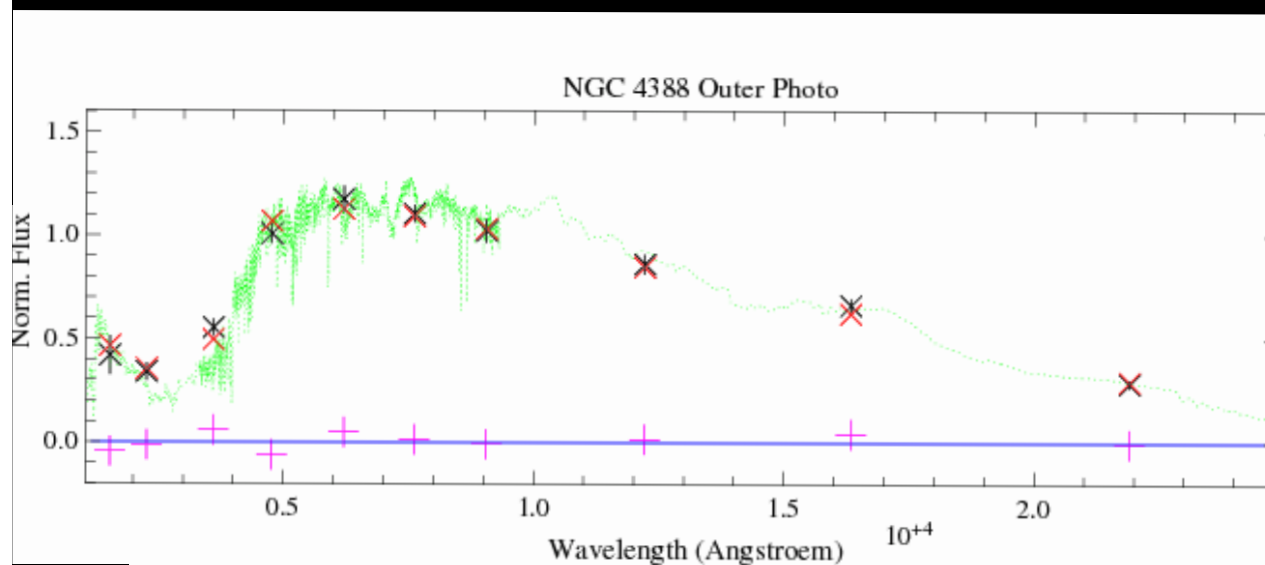
MET = Sun



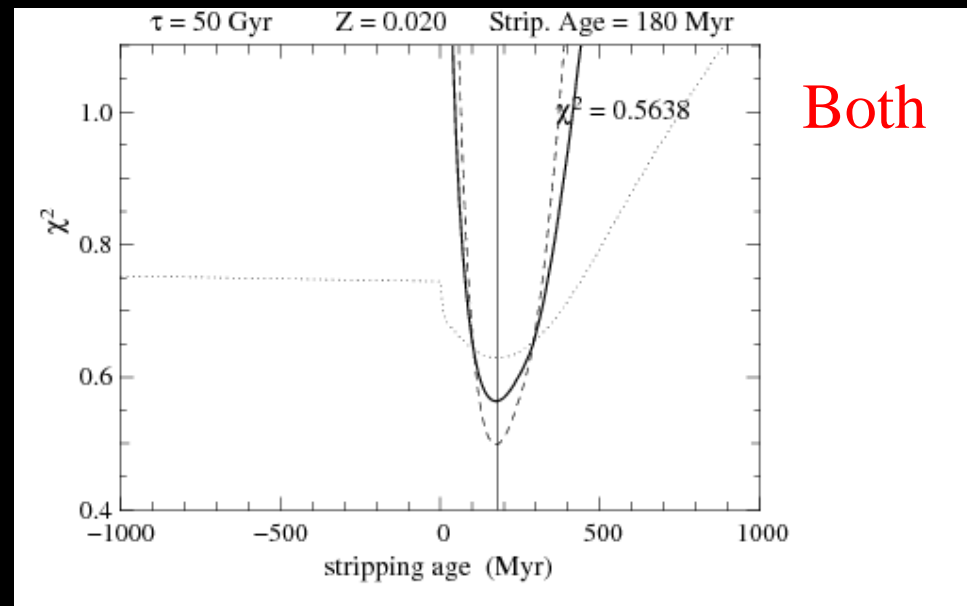
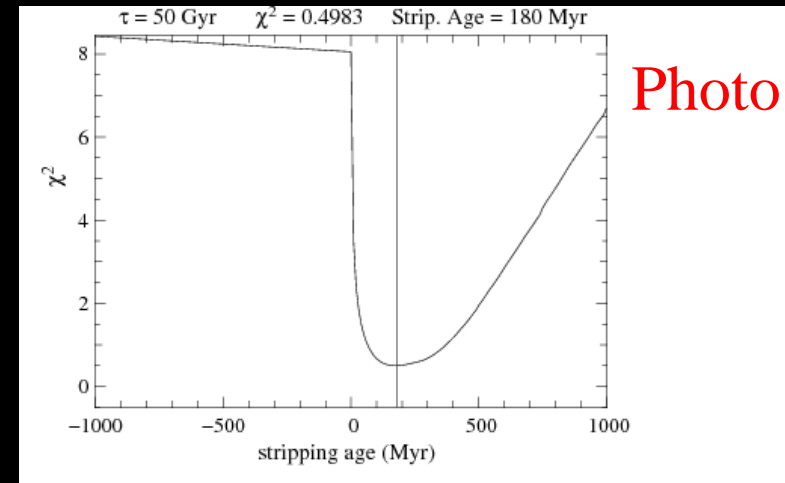
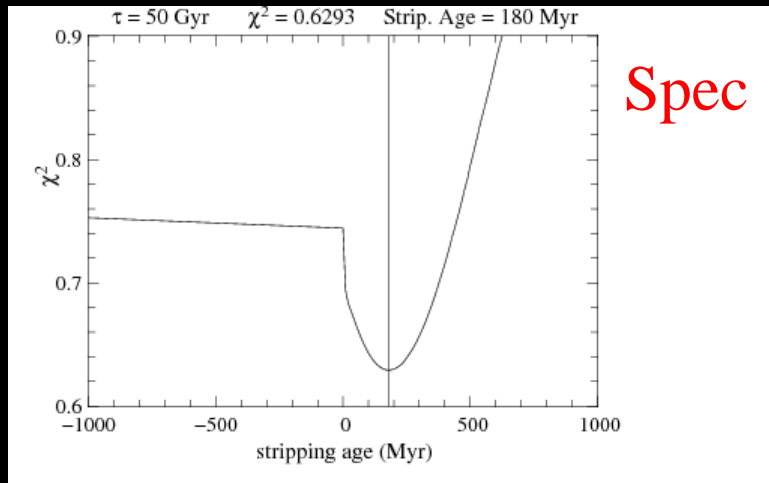
# Outer region



SFH drop  
~ 300 Myr



# Parametric Results



## Source of Errors in parametric method

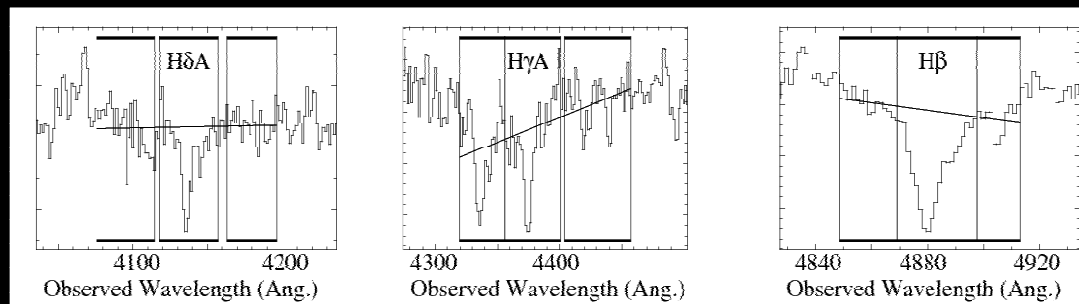
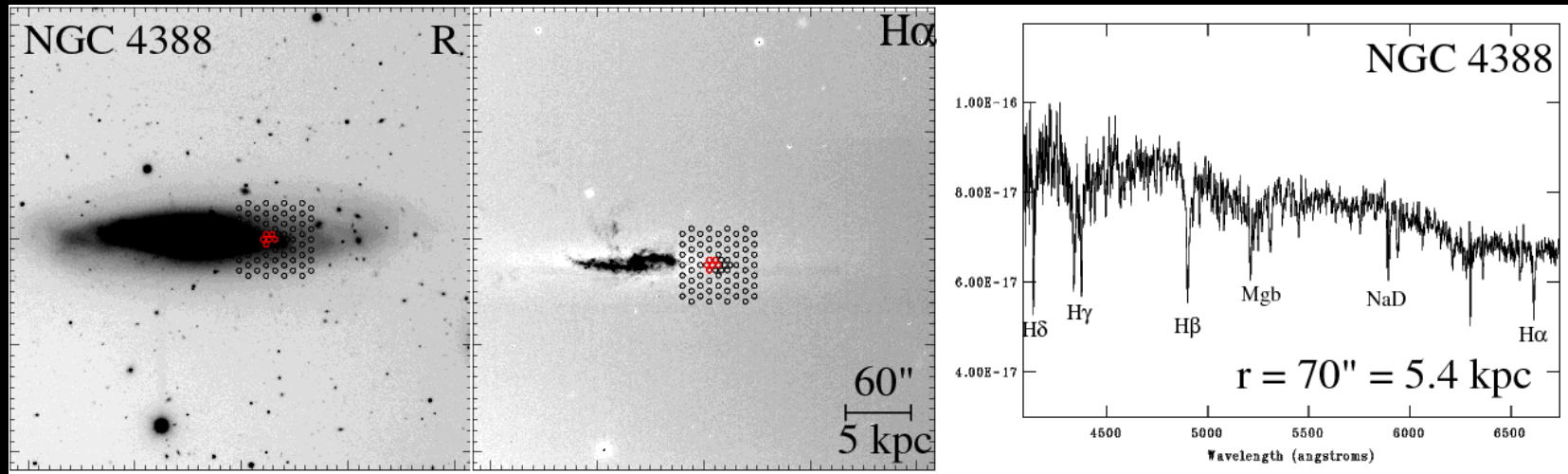
1. Choice of star formation history model : ~ 5/10 Myr
2. Extinction law : ~ 10 Myr
3. Metallicity value : ~ 10 Myr
4. Monte Carlo simulations : ~ 30 Myr

# Conclusions

1. For NGC 4388 the non parametric method recover a flat star formation history.
2. The metallicity of NGC 4388 is solar with a small radial gradient.
3. The non parametric method cannot provide precise stripping ages.
4. The photometric and spectral analysis recover the same stripping age
5. Using the parametric method we recover a stripping age of 180 Myr with an error of 30 Myr.

# Comparison with previous work

Crowl & Kenney 08



Stripp. Age = 225 +/- 100 Myr