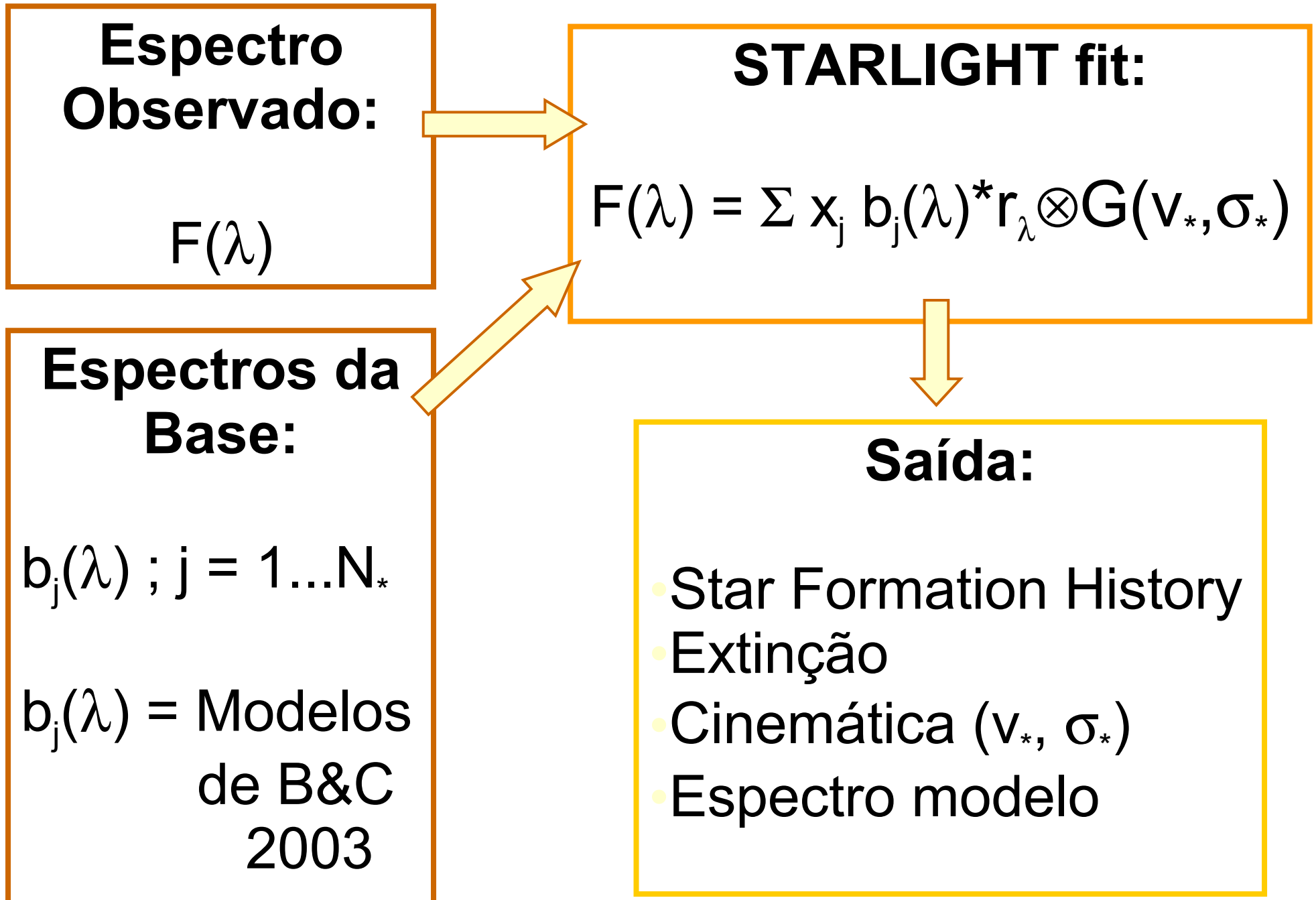


# Um VO para o Estudo da História de Formação Estelar e Propriedades Físicas de 573141 galáxias do SDSS

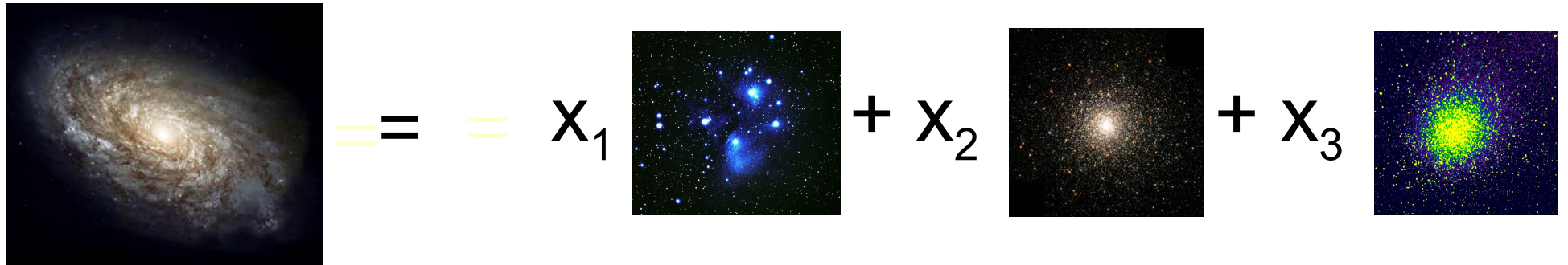
William Schoenell



## Parte 1: Método de Síntese Espectral de galáxias: STARLIGHT



## Parte 1: Método de Síntese Espectral de galáxias: STARLIGHT

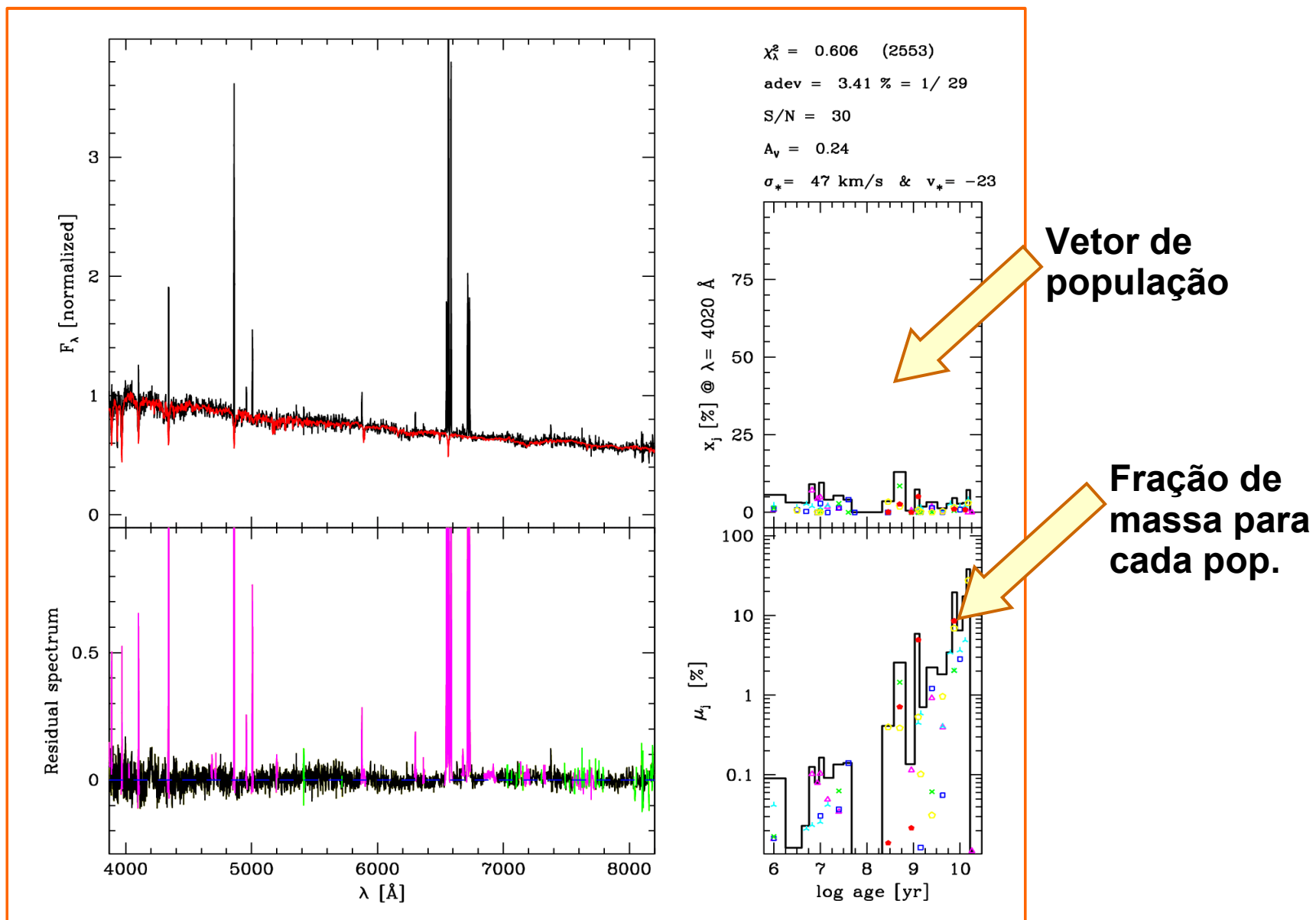


( $\mathbf{x}$  = frações de luz no comprimento de onda de normalização - vetor de população)

+ Lei de extinção (Cardelli, Calzetti, LMC, SMC, ...)

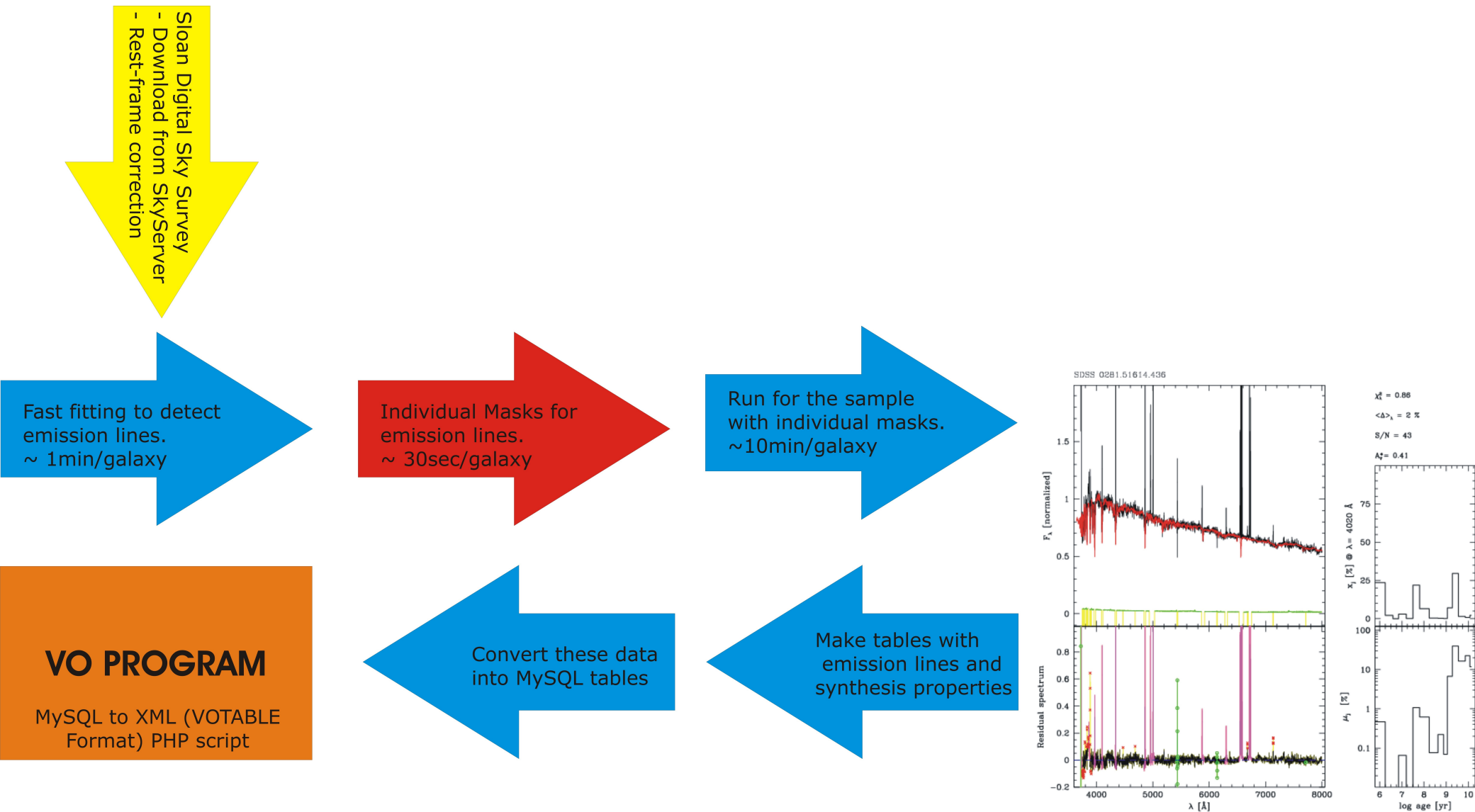
+ Gaussian LOSVD:  $G(v_*, \sigma_*)$

# Parte 1: Método de Síntese Espectral de galáxias: STARLIGHT



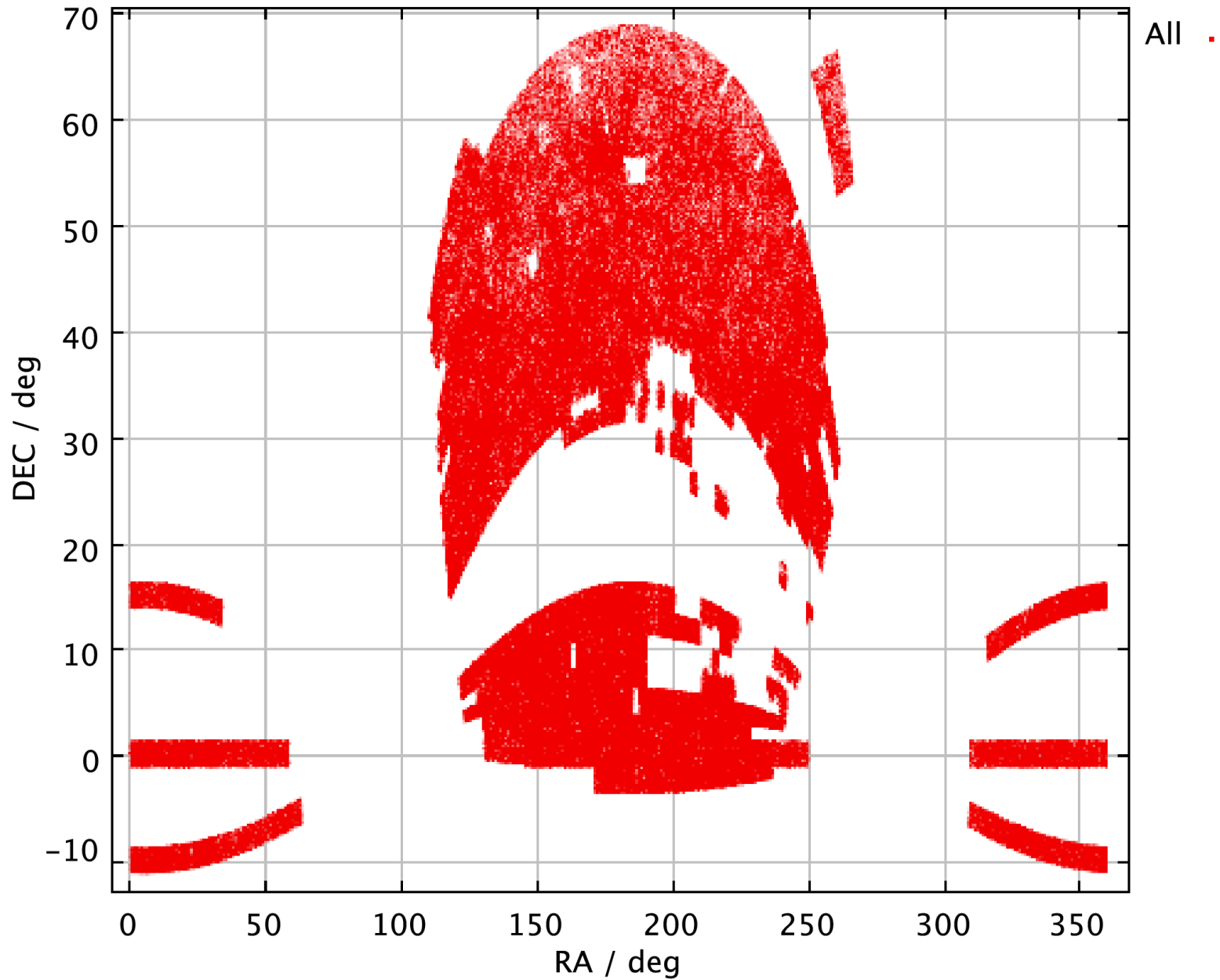
**Gráfico 1:** Típico output do programa. Em preto o espectro observado, em vermelho o melhor modelo calculado e em magenta as linhas de emissão mascaradas. À direita, vetor de populações e idades.

## Parte 2: Produtos da síntese: Organização da base de dados



**Diagrama:** Etapas realizadas desde o download dos espectros do SDSS até a apresentação em forma de VO.

## Parte 2: Produtos da síntese: Organização da base de dados



**Gráfico 2:** Gráfico RA versus DEC obtido no TOPCAT da amostra completa (573141 galáxias).

## Parte 2: Produtos da síntese: Organização da base de dados

### **Produtos diretos**

- FPV: Vetor de populações  $x_j$
- Dispersão de velocidades  $\sigma_*$
- Extinção  $A_V$

### **Sub-Produtos:**

- Massa,  $\langle t \rangle$ ,  $\langle Z \rangle$ , SFH, ...

### **Produtos secundários**

- Medidas de linhas de emissão

### **Dados do SDSS**

ra, dec, redshift, magnitudes aparentes, classe espectral, raios, distâncias, etc...

## Parte 2: Produtos da síntese: Uma VOTABLE de síntese típica

TOPCAT(9): Table Columns

Columns Display Help

Columns for 9: index2.php?ra\_min=150&ra\_max=160&dec\_min=-1&dec...

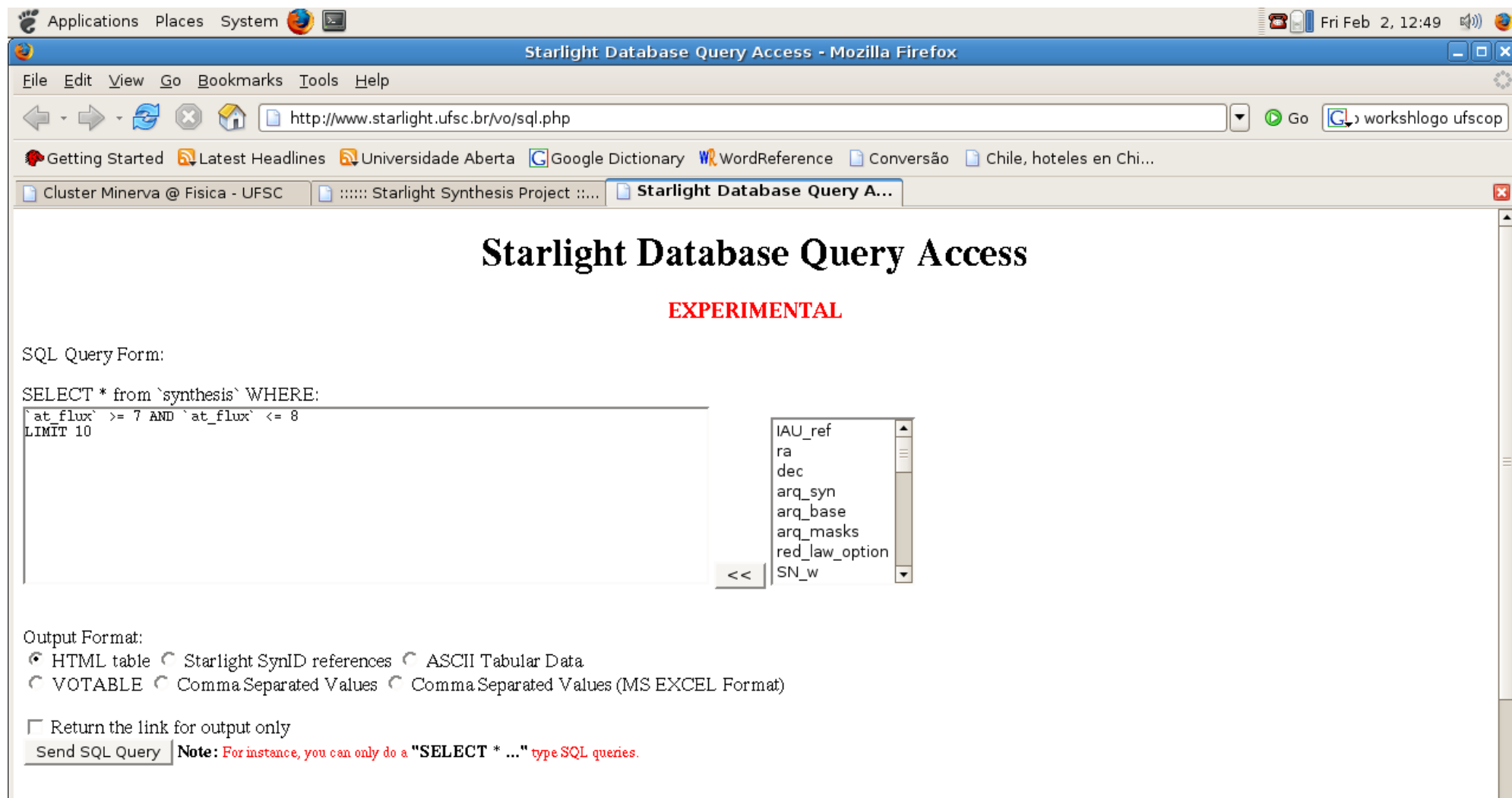
Visible	Name	\$ID	Class	Units	Description	UCD
<input type="checkbox"/>	Index	\$0	Long		Table row index	
<input checked="" type="checkbox"/>	Name	\$1	String		Name of the object from SLOAN	meta.id
<input checked="" type="checkbox"/>	RA	\$2	Float	deg	Right Ascension (J2000)	pos.eq.ra
<input checked="" type="checkbox"/>	DEC	\$3	Float	deg	Declination (J2000)	pos.eq.dec
<input checked="" type="checkbox"/>	arq_syn	\$4	String		Link to synthesis output spectra.	meta.ref.url;meta.table
<input checked="" type="checkbox"/>	SN_w	\$5	Float		Signal to Noise Ratio in SNR window.	stat.snr
<input checked="" type="checkbox"/>	SN_n	\$6	Float		Signal to Noise Ratio in NORMALIZATION window.	stat.snr
<input checked="" type="checkbox"/>	chi2	\$7	Float		Chi2 from the comparison between data and model.	stat.fit.chi2
<input checked="" type="checkbox"/>	adev	\$8	Float	%	Average Deviation of the model - Technical Parameter	stat.stdev
<input checked="" type="checkbox"/>	v0	\$9	Float	km/s	Velocity Shift.	spect.dopplerVeloc
<input checked="" type="checkbox"/>	vd	\$10	Float	km/s	Velocity Dispersion.	phys.veloc.dispersion
<input checked="" type="checkbox"/>	AV	\$11	Float	mag	Stellar extinction derived by STARLIGHT	phys.absorption;em.opt.V
<input checked="" type="checkbox"/>	at_flux	\$12	Float	yr	Average stellar age weighed by Flux.	time.age;stat.mean
<input checked="" type="checkbox"/>	at_mass	\$13	Float	yr	Average stellar age weighed by Mass.	time.age;stat.mean
<input checked="" type="checkbox"/>	am_flux	\$14	Float	[Sun]	Average metallicity weighed by Flux.	phys.abund.Z;stat.mean
<input checked="" type="checkbox"/>	am_mass	\$15	Float	[Sun]	Average metallicity weighed by Mass.	phys.abund.Z;stat.mean
<input checked="" type="checkbox"/>	M2L_u	\$16	Float	solMass/solLum	Mass to Light ratio in SLOAN U.	phys.composition.massLightRatio;em.opt.U
<input checked="" type="checkbox"/>	M2L_g	\$17	Float	solMass/solLum	Mass to Light ratio in SLOAN G.	phys.composition.massLightRatio;em.opt.G
<input checked="" type="checkbox"/>	M2L_r	\$18	Float	solMass/solLum	Mass to Light ratio in SLOAN R.	phys.composition.massLightRatio;em.opt.R
<input checked="" type="checkbox"/>	M2L_i	\$19	Float	solMass/solLum	Mass to Light ratio in SLOAN I.	phys.composition.massLightRatio;em.opt.I
<input checked="" type="checkbox"/>	M2L_z	\$20	Float	solMass/solLum	Mass to Light ratio in SLOAN Z.	phys.composition.massLightRatio;em.opt.Z
<input checked="" type="checkbox"/>	Mcor_fib	\$21	Float	[solMass]	Mass "currently" in stars (in the fiber).	phys.mass
<input checked="" type="checkbox"/>	Mini_tot	\$22	Float	[solMass]	Mass converted into stars over the galaxy history.	phys.mass
<input checked="" type="checkbox"/>	Mcor_gal	\$23	Float	[solMass]	Mass "currently" in stars (corrected, see manual).	phys.mass
<input checked="" type="checkbox"/>	Mini_gal	\$24	Float	[solMass]	Mass converted into stars over the galaxy history (corrected, see manual).	phys.mass
<input checked="" type="checkbox"/>	Mpho_gal	\$25	Float	[solMass]	Photometric mass (see manual).	phys.mass;phot
<input checked="" type="checkbox"/>	FibCor	\$26	Float		Fiber correction factor (see manual).	meta.misc



## Parte 3: Acesso à base de dados: Acesso via formulário SQL

O usuário faz consultas utilizando linguagem SQL cruzando informações da síntese, medidas de linhas de emissão e do SDSS.

O usuário pode escolher entre quatro tipos de output.



The screenshot shows a Mozilla Firefox browser window titled "Starlight Database Query Access - Mozilla Firefox". The address bar contains the URL "http://www.starlight.ufsc.br/vo/sql.php". The browser's menu bar includes "File", "Edit", "View", "Go", "Bookmarks", "Tools", and "Help". The address bar also shows a search engine icon and the text "workshlogo ufscop". The browser's toolbar includes icons for "Getting Started", "Latest Headlines", "Universidade Aberta", "Google Dictionary", "WordReference", "Conversão", and "Chile, hoteles en Chi...". The browser's tab bar shows three tabs: "Cluster Minerva @ Fisica - UFSC", "Starlight Synthesis Project :...", and "Starlight Database Query A...".

The main content area of the browser displays the "Starlight Database Query Access" web interface. The title "Starlight Database Query Access" is centered in a large, bold, black serif font. Below the title, the word "EXPERIMENTAL" is displayed in a smaller, bold, red sans-serif font. The interface includes a section labeled "SQL Query Form:" with a text input field containing the SQL query: "SELECT \* from `synthesis` WHERE: `at\_flux` >= 7 AND `at\_flux` <= 8 LIMIT 10". To the right of the input field is a vertical list of database fields: "IAU\_ref", "ra", "dec", "arq\_syn", "arq\_base", "arq\_masks", "red\_law\_option", and "SN\_w". Below the "SQL Query Form:" section, there is a section labeled "Output Format:" with several radio button options: "HTML table", "Starlight SynID references", "ASCII Tabular Data", "VOTABLE", "Comma Separated Values", and "Comma Separated Values (MS EXCEL Format)". A checkbox labeled "Return the link for output only" is also present. At the bottom of the interface, there is a "Send SQL Query" button and a note: "Note: For instance, you can only do a "SELECT \* ..." type SQL queries."

### Parte 3: Acesso à base de dados: Um exemplo utilizando SQL

Seleção de galáxias com parâmetros:

Mass "currently" in stars > 7.52

SN\_w > 25

Halpna SN > 6

Concentration index, R90/R50 < 2.6

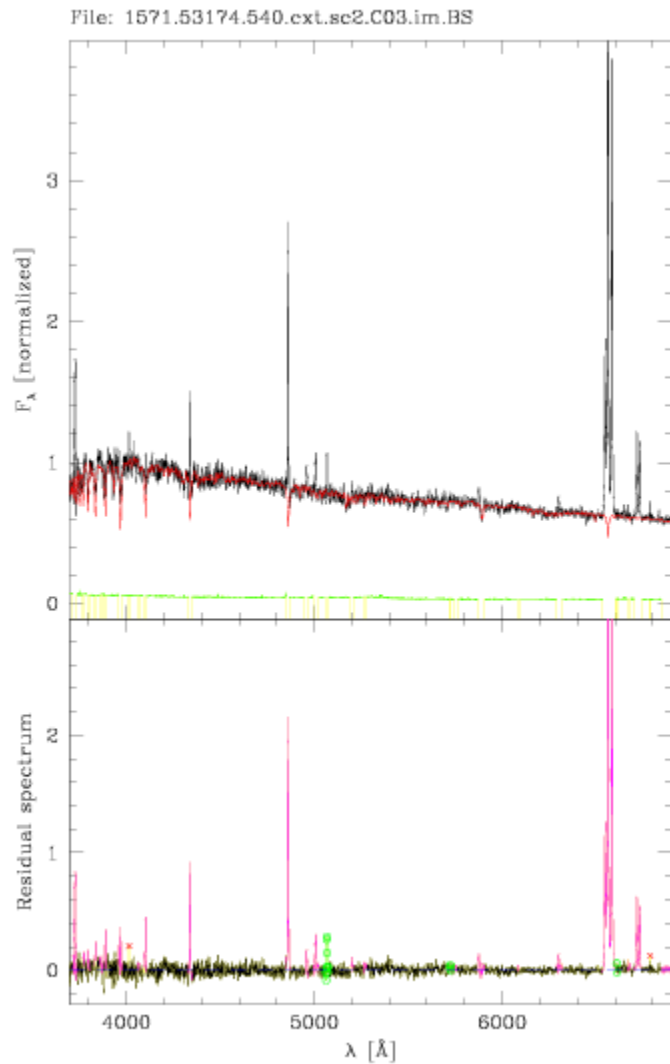
.099 > redshift > 0.101

ORDENADAS por <t>

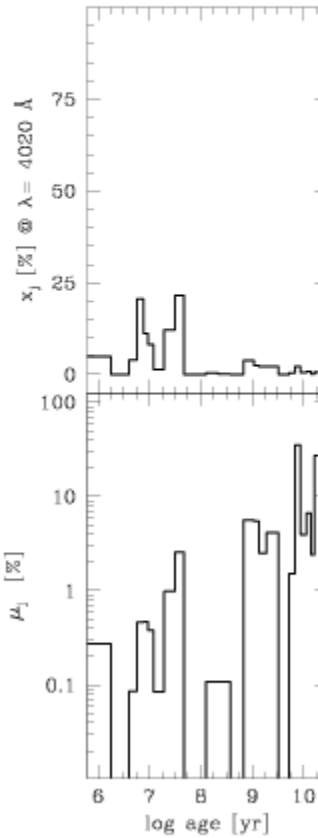
Foram baixados os fits, imagens e parâmetros das 92 galáxias desta sub amostra.

Dessas, foram escolhidos 10 para a apresentação...

# Parte 3: Acesso à base de dados: Exemplos utilizando SQL

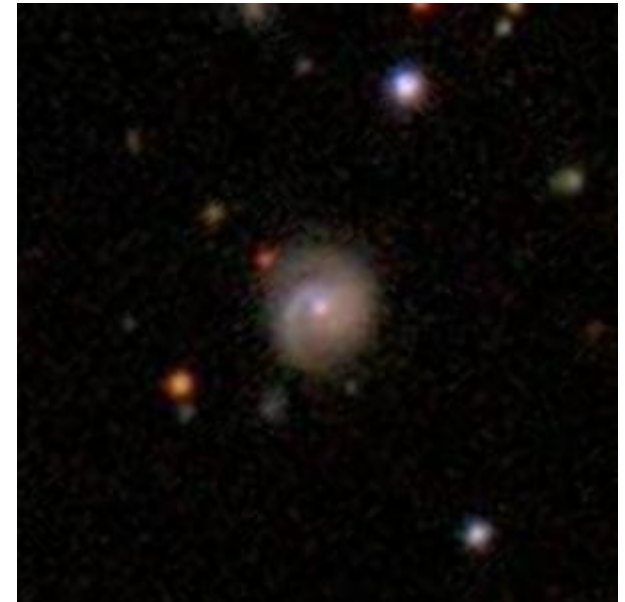


$\chi^2_\nu = 0.65172$  (2621)  
 $\text{adev} = 3.9952\%$   $- 1/25.03$   
 $\text{S/N} = 32.666$   
 $A_V = 0.5718$   
 $\sigma_* = 63.78$  km/s &  $v_* = -10.36$

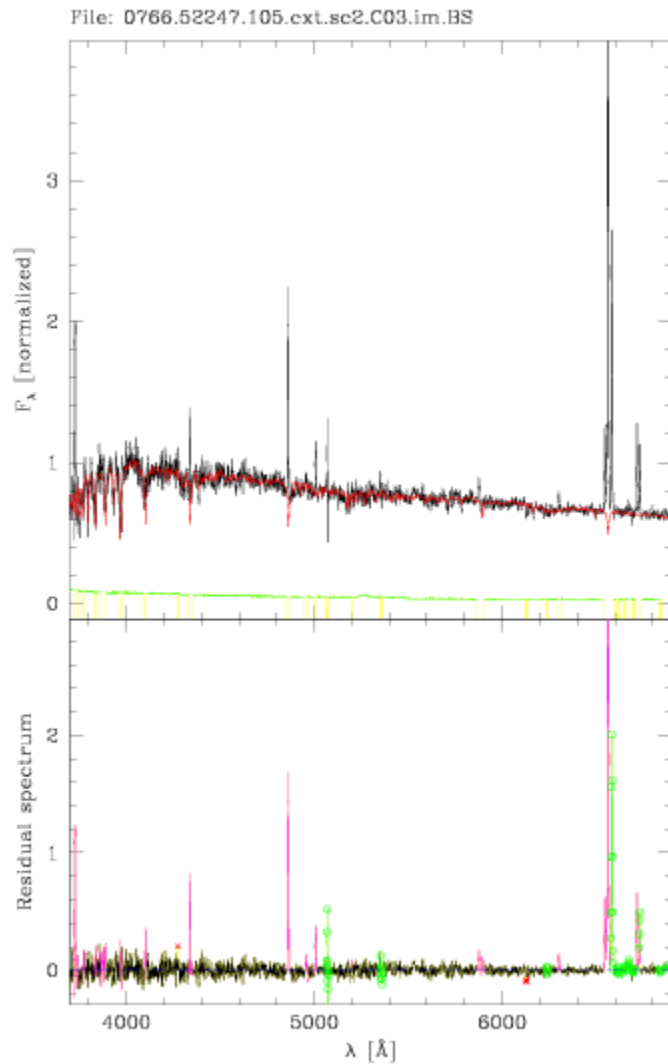


Parameters for 1571.53174.540.ext.sc2.C03.im.BS

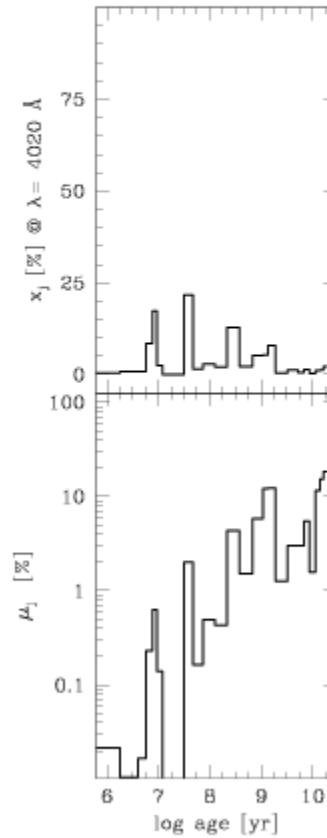
IAU Name	SDSS J163835.21+235330.4	Base	Base.bc03.S
RA	249.647	DEC	23.8918
SN_w	27.493	SN_n	32.666
chi2	0.651725	adev	3.99522
v0	-10.36	vd	63.78
RedLaw	<a href="#">CCM</a>	AV	0.5718
at_flux	7.4602	at_mass	9.7327
am_flux	0.3921	am_mass	1.2337



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.69713$  (2661)  
 $adev = 4.4915\%$  -  $1/22.264$   
 $S/N = 31.583$   
 $A_V = 0.372$   
 $\sigma_* = 65.73$  km/s &  $v_* = 12.79$

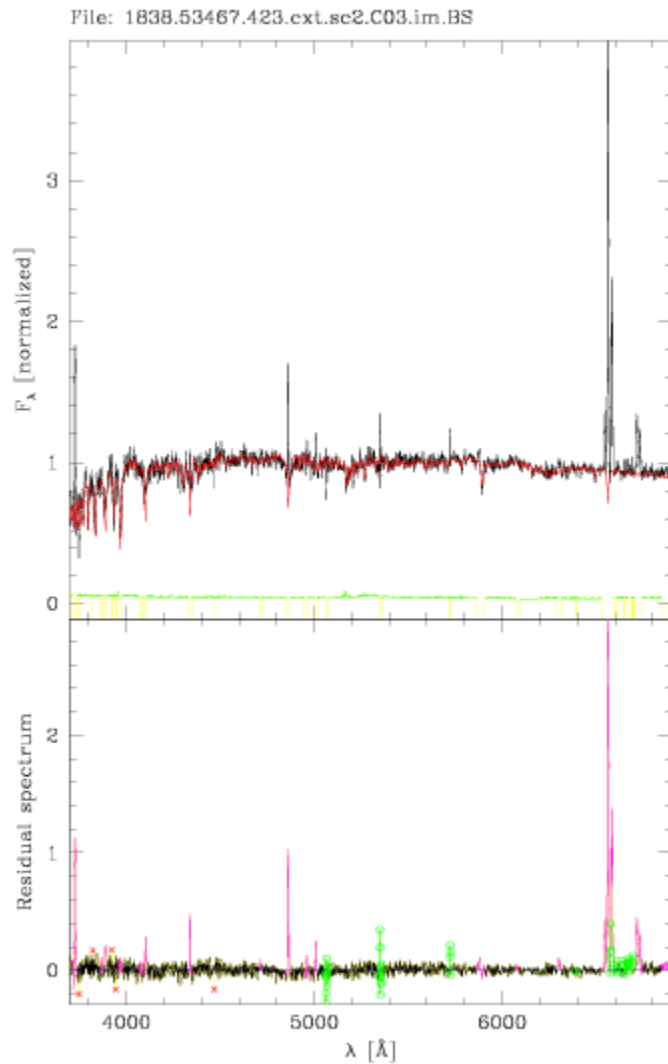


Parameters for 0766.52247.105.ext.sc2.C03.im.BS

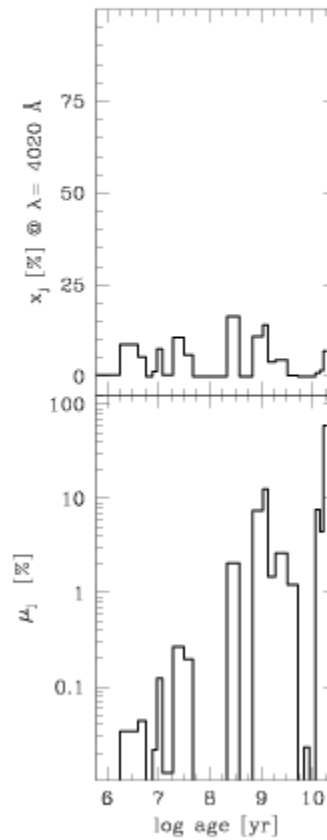
IAU Name	SDSS J092005.17+495007.3	Base	Base.bc03.S
RA	140.022	DEC	49.8354
SN_w	27.016	SN_n	31.583
chi2	0.697128	adev	4.49151
v0	12.79	vd	65.73
RedLaw	<a href="#">CCM</a>	AV	0.372
at_flux	8.0136	at_mass	9.5938
am_flux	0.7975	am_mass	0.7241



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.55135$  (2182)  
 $adev = 3.3992\%$   $\sim 1/29.418$   
 $S/N = 30.895$   
 $A_V = 0.6281$   
 $\sigma_* = 89.07$  km/s &  $v_* = -17.4$

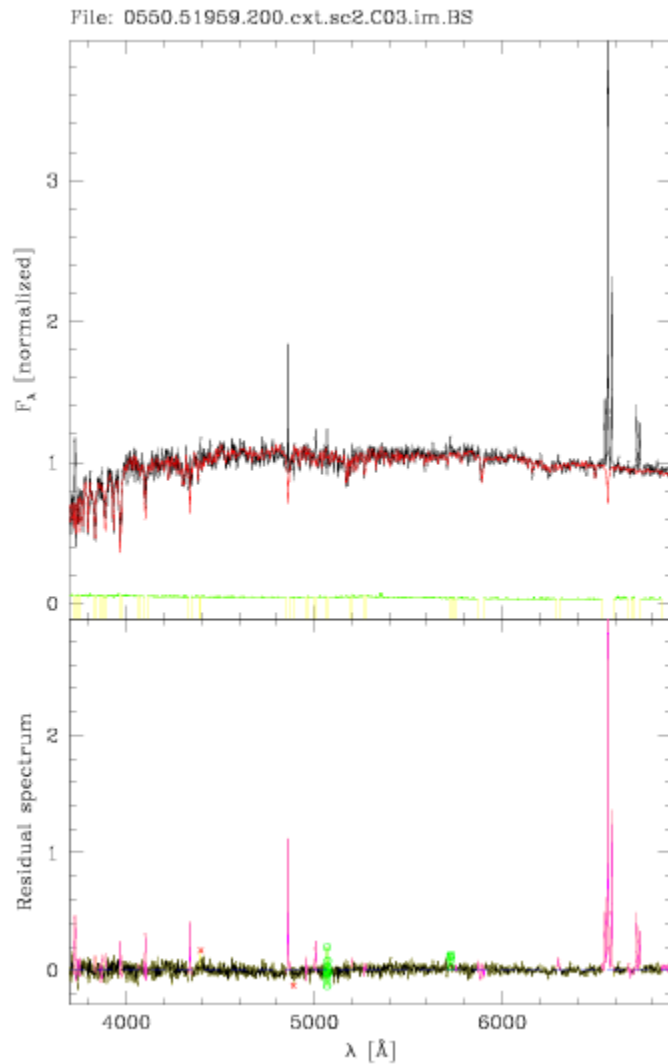


Parameters for 1838.53467.423.ext.sc2.C03.im.BS

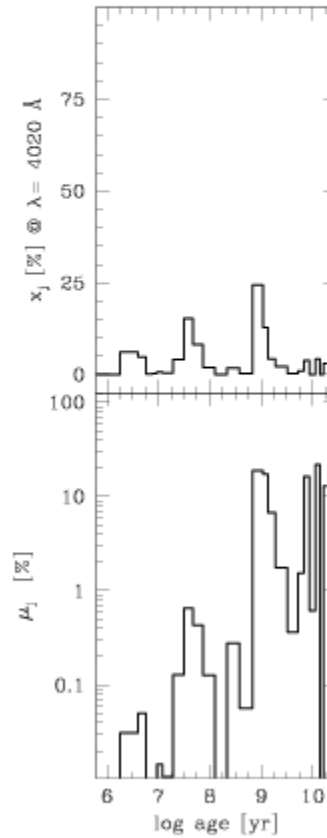
IAU Name	SDSS J135739.32+351235.2	Base	Base.bc03.S
RA	209.414	DEC	35.2098
SN_w	31.479	SN_n	30.895
chi2	0.551346	adev	3.39923
v0	-17.48	vd	89.07
RedLaw	<a href="#">CCM</a>	AV	0.6281
at_flux	8.2697	at_mass	9.8944
am_flux	0.8584	am_mass	1.6958



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL

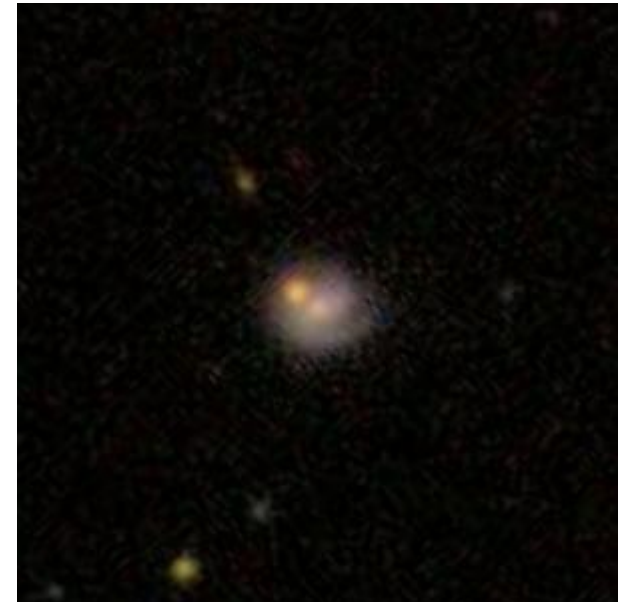


$\chi^2_\nu = 0.56803$  (2328)  
 $\text{adev} = 3.1623\%$   $\sim 1/31.622$   
 $S/N = 24.412$   
 $A_V = 0.4399$   
 $\sigma_* = 70.72$  km/s &  $v_* = -58.2$

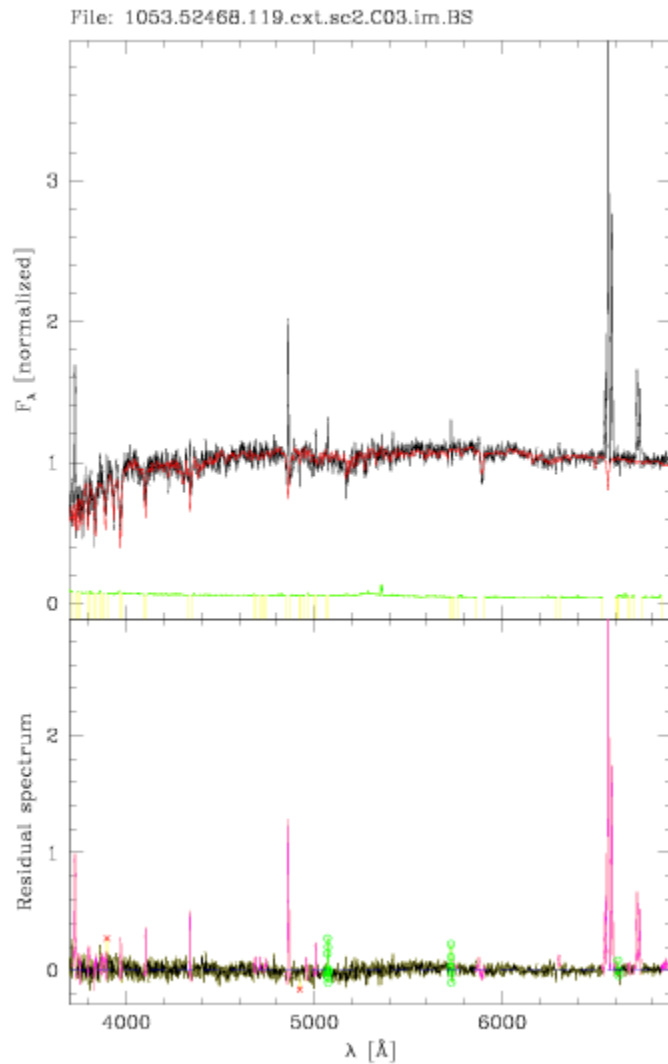


Parameters for 0550.51959.200.ext.sc2.C03.im.BS

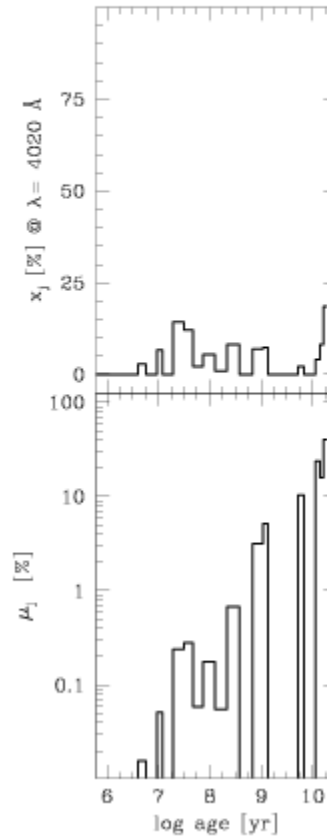
IAU Name	SDSS J083815.85+480101.3	Base	Base.bc03.S
RA	129.566	DEC	48.0171
SN_w	25.871	SN_n	24.412
chi2	0.568032	adev	3.16232
v0	-58.21	vd	70.72
RedLaw	<a href="#">CCM</a>	AV	0.4399
at_flux	8.4412	at_mass	9.5733
am_flux	1.071	am_mass	1.2982



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2 = 0.57368$  (2320)  
 $\text{adev} = 4.189\% = 1/23.872$   
 $S/N = 24.373$   
 $A_v = 0.6088$   
 $\sigma_* = 99.94 \text{ km/s}$  &  $v_* = -16.7$

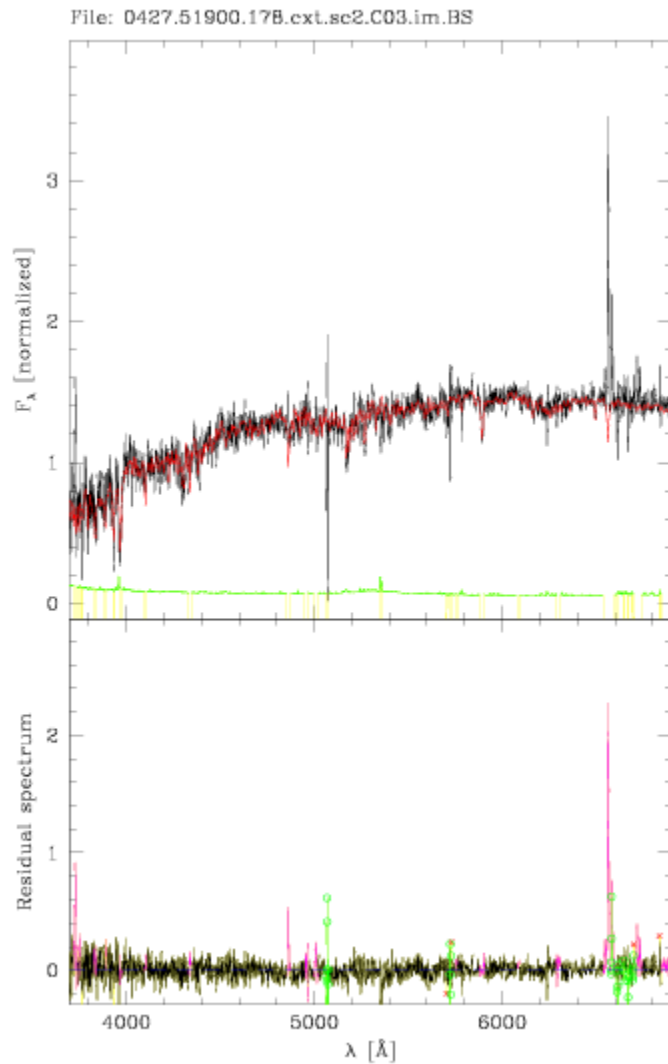


Parameters for 1053.52468.119.ext.sc2.C03.im.BS

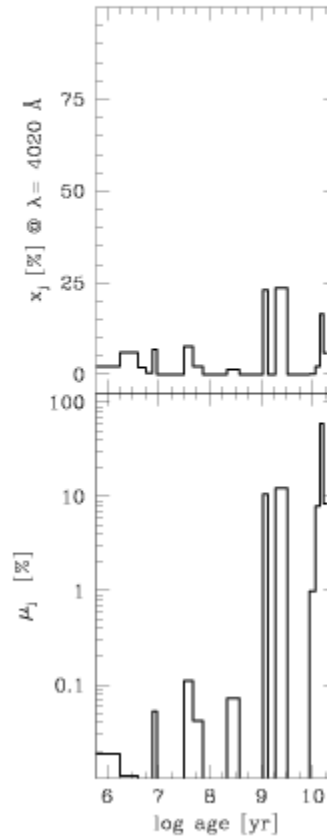
IAU Name	SDSS J154922.25+413219.7	Base	Base.bc03.S
RA	237.343	DEC	41.5388
SN_w	25.474	SN_n	24.373
chi2	0.573676	adev	4.18901
v0	-16.72	vd	99.94
RedLaw	<a href="#">CCM</a>	AV	0.6088
at_flux	8.6659	at_mass	10.0258
am_flux	0.658	am_mass	0.7348



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.83865$  (3317)  
 $\text{adev} = 6.036\% = 1/16.567$   
 $S/N = 20.642$   
 $A_V = 0.5878$   
 $\sigma_* = 109.25 \text{ km/s}$  &  $v_* = -10$



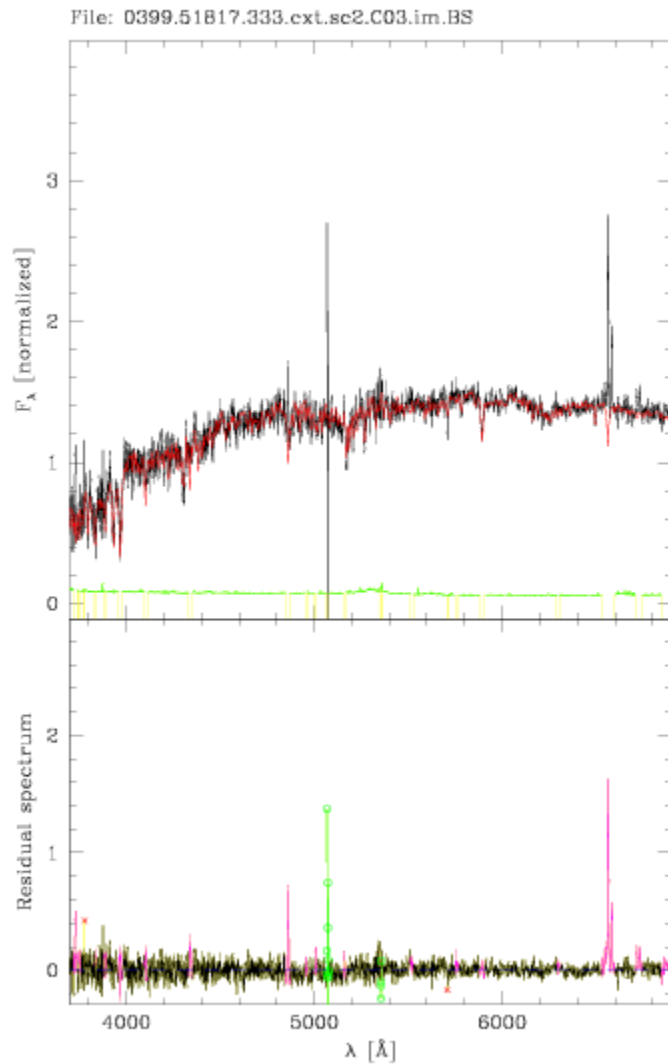
Parameters for 0427.51900.178.ext.sc2.C03.im.BS

IAU Name	SDSS J020139.48+132105.6	Base	Base.bc03.S
RA	30.4145	DEC	13.3516
SN_w	26.48	SN_n	20.642
chi2	0.838654	adev	6.03598
v0	-10.52	vd	109.25
RedLaw	<a href="#">CCM</a>	AV	0.5878
at_flux	8.8595	at_mass	9.9588
am_flux	0.9481	am_mass	0.967

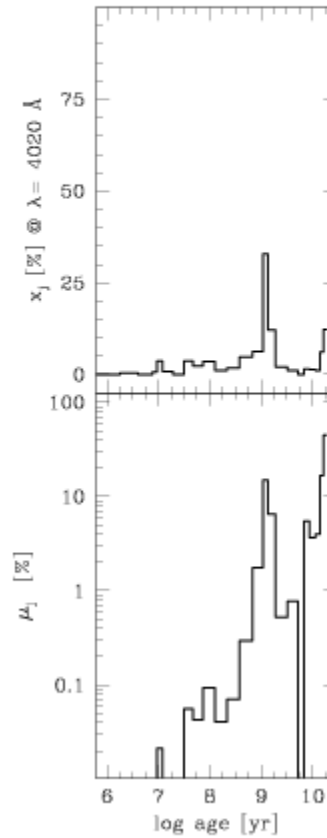




# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.67486$  (2815)  
 $\text{adev} = 5.2542\% = 1/19.033$   
 $S/N = 21.062$   
 $A_V = 0.3376$   
 $\sigma_* = 110.58 \text{ km/s}$  &  $v_* = -20$

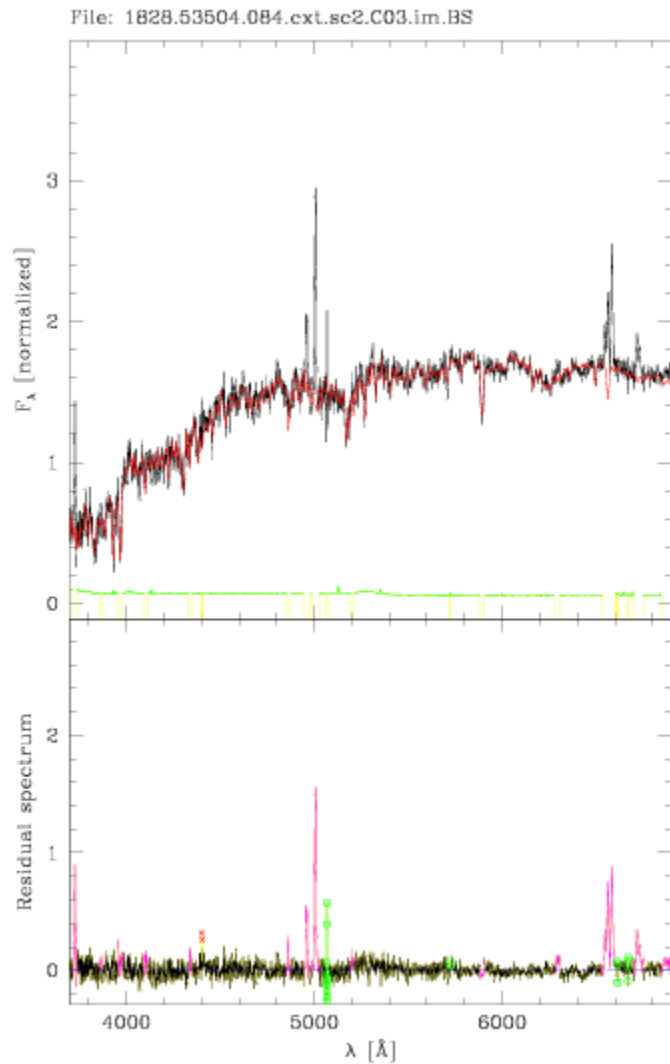


Parameters for 0399.51817.333.ext.sc2.C03.im.BS

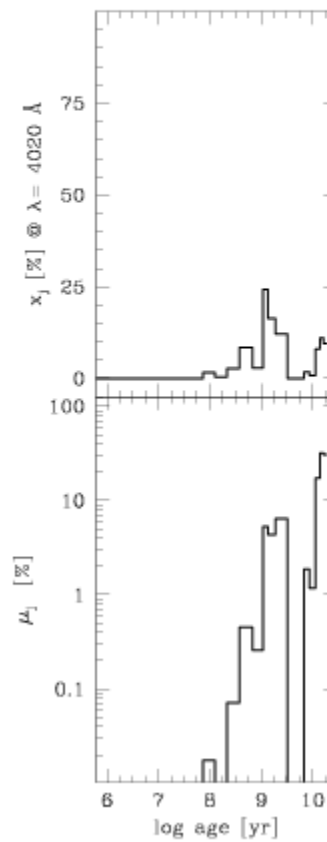
IAU Name	SDSS J012245.54+005322.6	Base	Base.bc03.S
RA	20.6898	DEC	0.889619
SN_w	28.114	SN_n	21.062
chi2	0.674864	adev	5.25416
v0	-20.85	vd	110.58
RedLaw	<a href="#">CCM</a>	AV	0.3376
at_flux	9.0672	at_mass	9.9191
am_flux	1.5108	am_mass	1.2959



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL

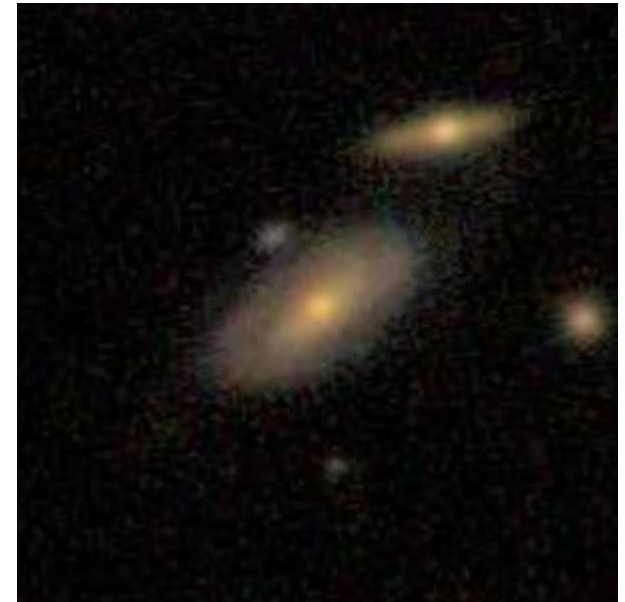


$\chi^2_\nu = 0.55892$  (2263)  
 $\text{adev} = 4.1146\%$   $\sim 1/24.304$   
 $S/N = 19.855$   
 $A_V = 0.1746$   
 $\sigma_* = 181.53 \text{ km/s}$  &  $v_* = -30$

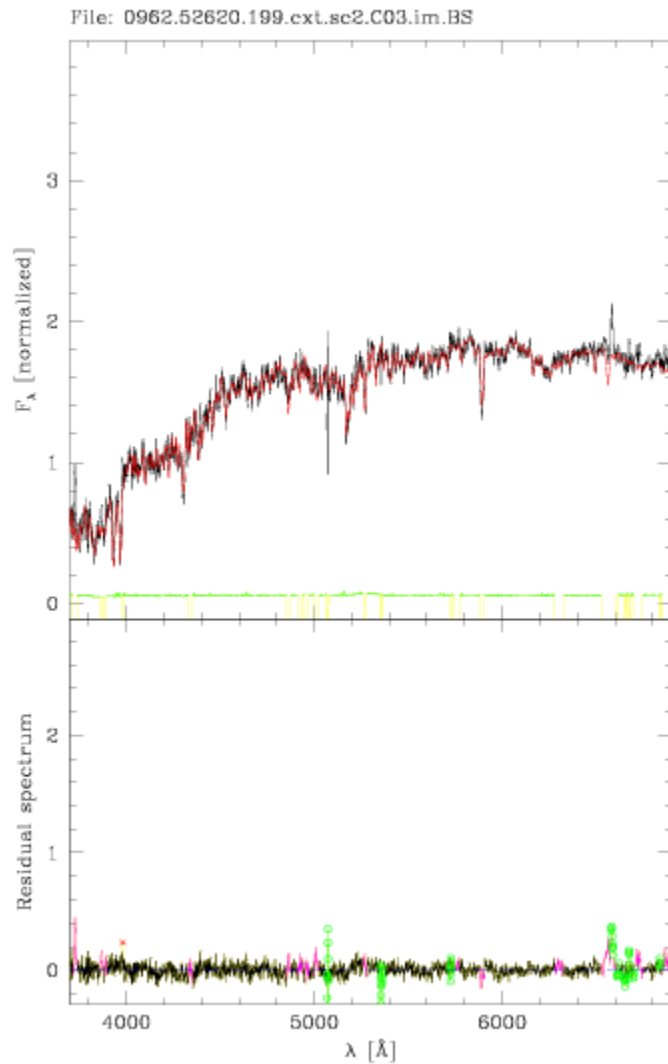


Parameters for 1828.53504.084.ext.sc2.C03.im.BS

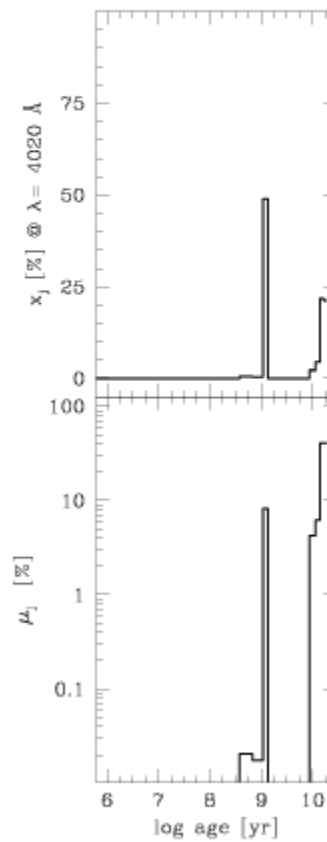
IAU Name	SDSS J143652.46+050454.8	Base	Base.bc03.S
RA	219.219	DEC	5.08191
SN_w	29.479	SN_n	19.855
chi2	0.558919	adev	4.1146
v0	-30.28	vd	181.53
RedLaw	<a href="#">CCM</a>	AV	0.1746
at_flux	9.4034	at_mass	10.0189
am_flux	1.9475	am_mass	1.8101



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.60953$  (2349)  
 $\text{adev} = 3.4483\% = 1/29$   
 $S/N = 17.971$   
 $A_V = 0.0381$   
 $\sigma_* = 193.13 \text{ km/s}$  &  $v_* = -3.0$

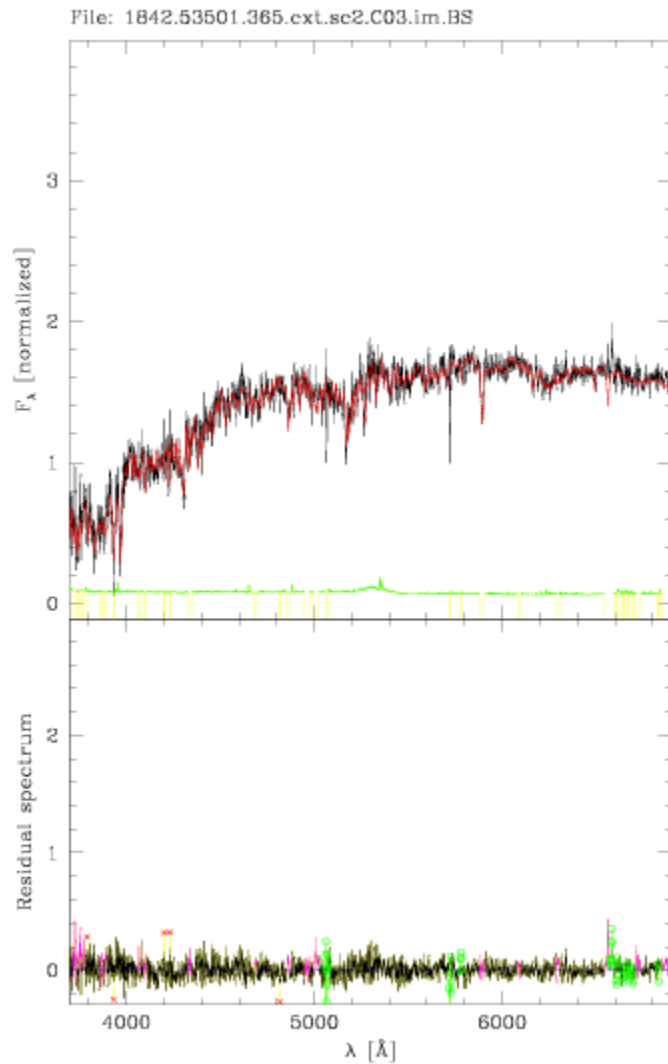


Parameters for 0962.52620.199.ext.sc2.C03.im.BS

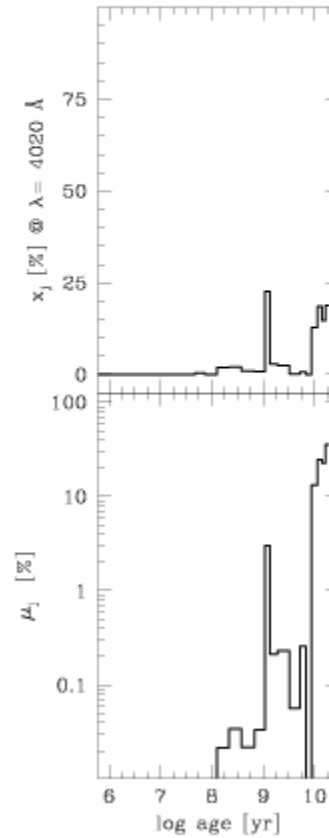
IAU Name	SDSS J103904.47+470559.9	Base	Base.bc03.S
RA	159.769	DEC	47.1
SN_w	28.61	SN_n	17.971
chi2	0.609532	adev	3.44827
v0	-3.01	vd	193.13
RedLaw	<a href="#">CCM</a>	AV	0.0381
at_flux	9.6482	at_mass	10.1089
am_flux	1.8278	am_mass	1.3772



# Parte 3: Acesso à base de dados: Exemplos utilizando SQL



$\chi^2_\nu = 0.64263$  (2594)  
 $\text{adev} = 5.1976\%$  &  $1/19.24$   
 $S/N = 17.553$   
 $A_v = 0.0731$   
 $\sigma_* = 144.44$  km/s &  $v_* = -5.3$



Parameters for 1842.53501.365.ext.sc2.C03.im.BS

IAU Name	SDSS J144059.46+320721.9	Base	Base.bc03.S
RA	220.248	DEC	32.1228
SN_w	26.348	SN_n	17.553
chi2	0.642631	adev	5.19764
v0	-5.38	vd	144.44
RedLaw	<a href="#">CCM</a>	AV	0.0731
at_flux	9.7554	at_mass	10.1256
am_flux	1.0129	am_mass	0.9949



## Parte 3: Acesso à base de dados: Seleção por posição

O usuário faz consultas, selecionando as galáxias de nosso banco de dados de duas formas:

### Seleção retangular:

#### Starlight Database Query Access

**EXPERIMENTAL**

Rectangular Search Query Form:

<input type="text"/>	=> RA >=	<input type="text"/>	Right-ascension in the J2000 coordinate system. This must be in decimal degrees.
<input type="text"/>	=> DEC >=	<input type="text"/>	Declination in the J2000 coordinate system. This must be in decimal degrees.
<input type="button" value="Send Query"/>			

**Note:** You can directly get data from TOPCAT, Aladin or your favorite VOTABLE program using the format:  
[http://www.starlight.ufsc.br/vo/conesearch.php?ra\\_min=ra\\_min&ra\\_max=ra\\_max&dec\\_min=dec\\_min&dec\\_max=dec\\_max](http://www.starlight.ufsc.br/vo/conesearch.php?ra_min=ra_min&ra_max=ra_max&dec_min=dec_min&dec_max=dec_max)

<http://www.starlight.ufsc.br/vo/rectangluar.php>

### Seleção cônica ou circular:

#### Starlight Database Query Access

**EXPERIMENTAL**

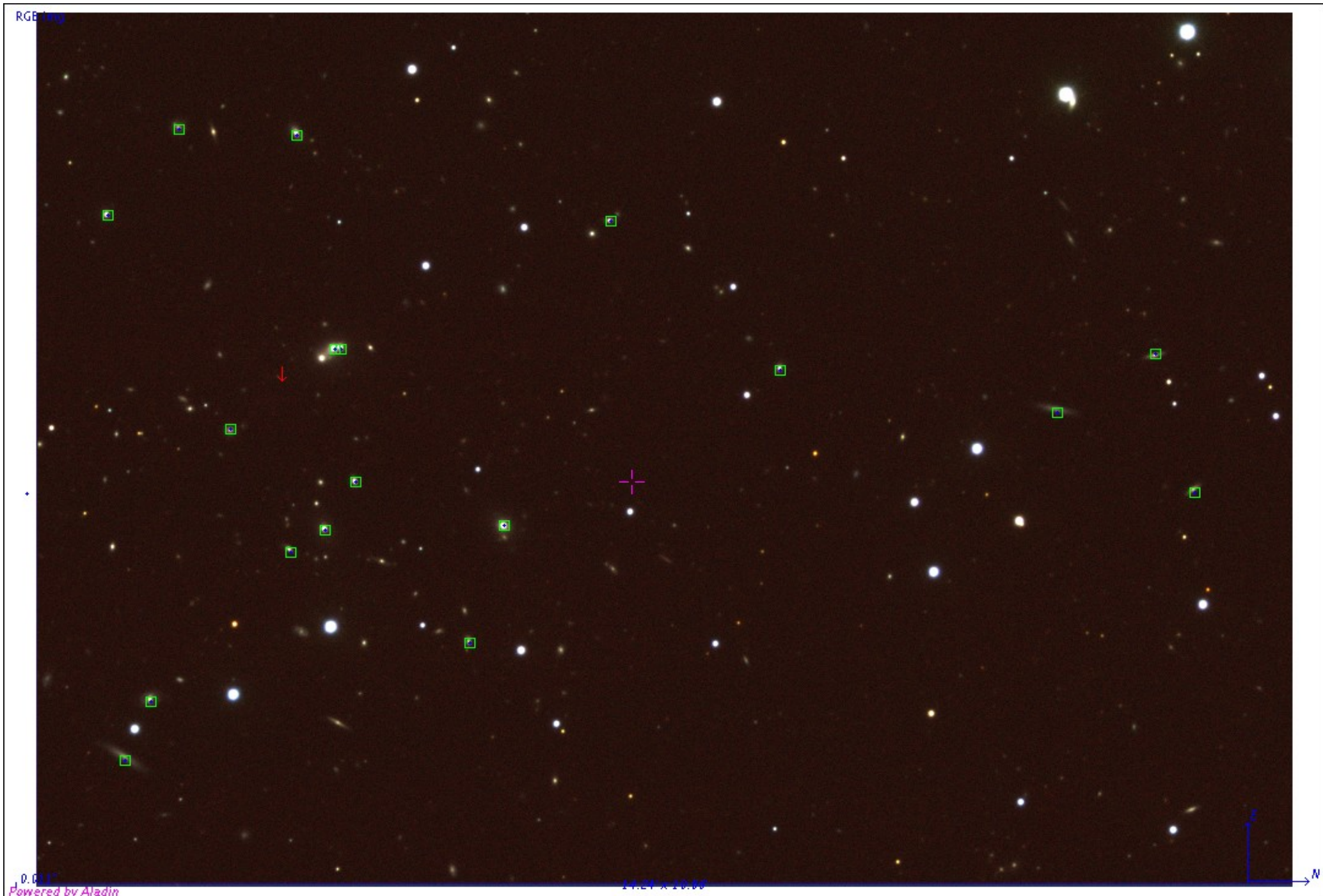
Cone-Search Query Form:

RA:	<input type="text"/>	Right-ascension in the J2000 coordinate system. This must be in decimal degrees.
DEC:	<input type="text"/>	Declination in the J2000 coordinate system. This must be in decimal degrees.
Search Radius:	<input type="text"/>	Search radius in decimal degrees.
<input type="button" value="Send Query"/>		

**Note:** You can directly get data from TOPCAT, Aladin or your favorite VOTABLE program using the format:  
<http://www.starlight.ufsc.br/vo/conesearch.php?RA=ra&DEC=dec&SR=sr>

<http://www.starlight.ufsc.br/vo/cone.php>

### Parte 3: Acesso à base de dados: Um exemplo utilizando Aladin



## Parte 4: Status atual do projeto

### **Consultas**

- SQL: Não totalmente implementada.  
O usuário pode somente fazer seleções na tabela de síntese e o output é limitado.
- Por posição: Implementada somente para os dados da síntese com as mesmas limitações do SQL.

### **Scripts auxiliares**

- Série de scripts PHP para realizar tarefas auxiliares, como baixar gráficos de fit do STARLIGHT, imagens do SDSS e informações sobre as linhas de emissão.
- Em fase de testes!!!

## Parte 4: Status atual do projeto: lista de scripts auxiliares

### Detailed information about Starlight-VO scripts

are based in the [GET](#) method. Each one has at least one argument and can be accessed by this way, for example:  
[starlight.ufsc.br/vo/rect.php?ra\\_min=0&ra\\_max=2&dec\\_min=0&dec\\_max=4](http://starlight.ufsc.br/vo/rect.php?ra_min=0&ra_max=2&dec_min=0&dec_max=4)

	<b>Description and arguments</b>
<a href="http://starlight.ufsc.br/vo/aladin.php">starlight.ufsc.br/vo/aladin.php</a>	Open in ALADIN Java Applet the selected field and Simbad Database <b>Argument:</b> arq_syn.
<a href="http://starlight.ufsc.br/vo/conesearch.php">starlight.ufsc.br/vo/conesearch.php</a>	Return a list of galaxies parameters given a RA, DEC and a search radius. <b>Arguments:</b> RA, DEC and SR.
<a href="http://starlight.ufsc.br/vo/fit.php">starlight.ufsc.br/vo/fit.php</a>	Return a JPEG file with a plot Observed Spectra + Syntetic Spectra + Errors + Residual Spectra + Full Population Vector. <b>Arguments:</b> arq_syn.
<a href="http://starlight.ufsc.br/vo/image.php">starlight.ufsc.br/vo/image.php</a>	JPEG file with a SDSS color-image of the galaxy field <b>Arguments:</b> arq_syn, opt (optional).
<a href="http://starlight.ufsc.br/vo/lines.php">starlight.ufsc.br/vo/lines.php</a>	Return a table of emission line measurements <b>Arguments:</b> arq_syn, type (optional).
<a href="http://starlight.ufsc.br/vo/rect.php">starlight.ufsc.br/vo/rect.php</a>	Return a list of galaxies parameters given a RA and DEC ranges <b>Arguments:</b> ra_min, ra_max, dec_min and dec_max.
<a href="http://starlight.ufsc.br/vo/spec.php">starlight.ufsc.br/vo/spec.php</a>	Return a HTML page with information of the galaxy <b>Arguments:</b> arq_syn.
<a href="http://starlight.ufsc.br/vo/textspec.php">starlight.ufsc.br/vo/textspec.php</a>	Return ASCII txt file of Observed Spectra + Syntetic Spectra + Errors <b>Arguments:</b> arq_syn.
<a href="http://starlight.ufsc.br/vo/xmlspec.php">starlight.ufsc.br/vo/xmlspec.php</a>	Return VOTABLE of Observed Spectra + Syntetic Spectra + Errors <b>Arguments:</b> arq_syn.

cripts and their arguments.

<http://www.starlight.ufsc.br/vo/urls.php>

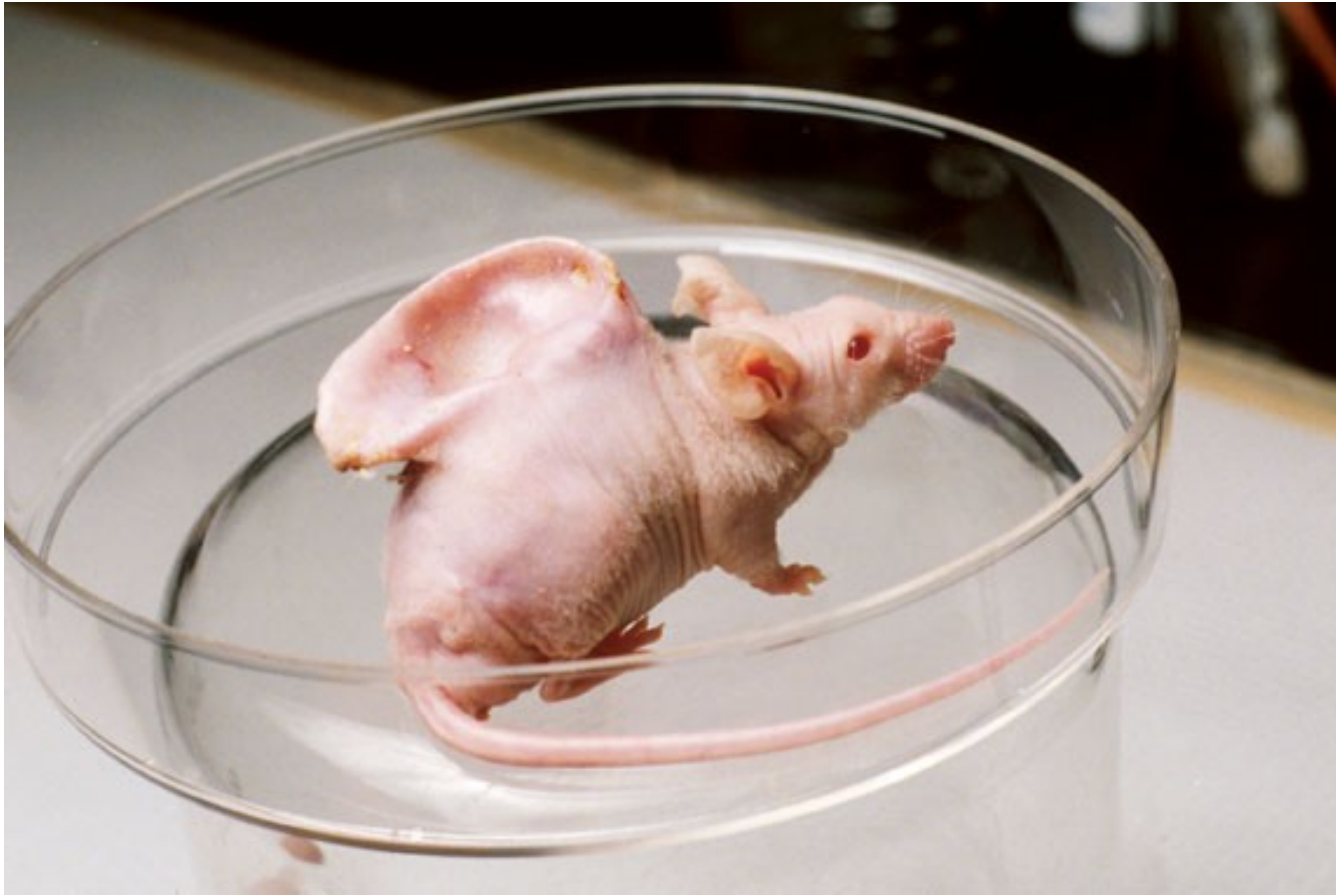


## Parte 5: Próximos passos

- Incluir a possibilidade de fazer consultas cruzando os dados das três tabelas. (2007.1)
- Criar mais uma tabela com os vetores de população. (2007.1)
- Fazer com que as consultas retornem somente os campos desejados e não uma lista fixa de campos como é atualmente. (2007.1)
- Documentação completa do acesso aos dados. (2007.2)
- Divulgação do STARLIGHT. (2007.32) ???

## Parte 5: Próximos passos

- Conseguir cobaias para testar e criticar a base de dados para que ela se torne acessível de forma simples e completa. (AGORA ?)



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FIM

arq\_syn example:

0283.51959.502.cxt.sc2.C03.im.BS

plate => 0283

MJD => 51959

fiber => 502

filetype => cxt

Starlight Version => sc2

Config => c03

Mask Type => im

Base => BS