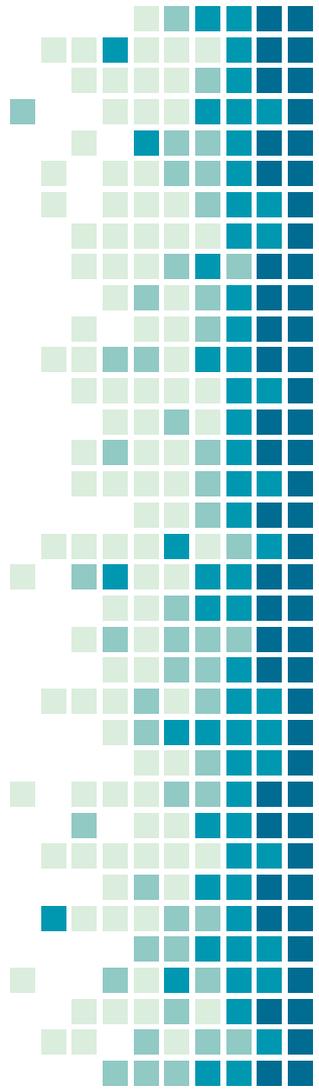


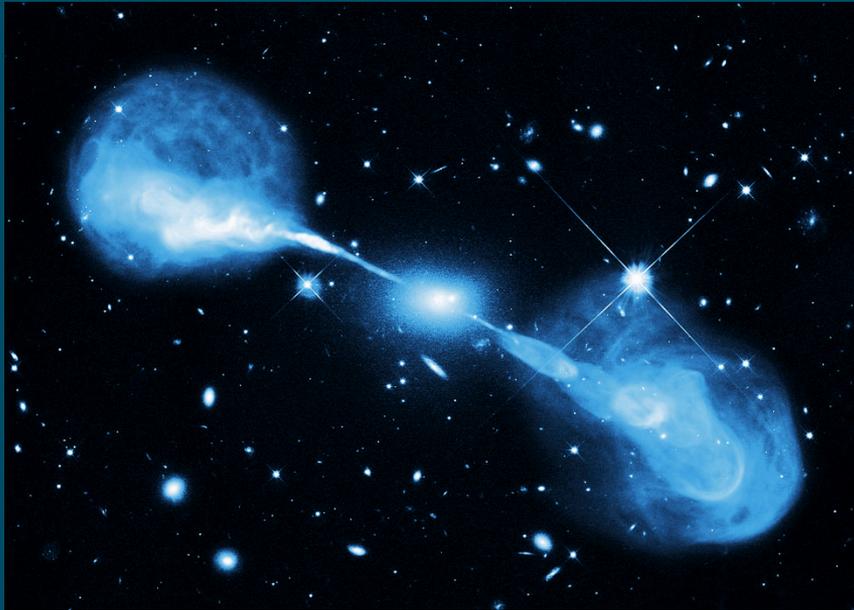
**PROGETTO Scuola-Lavoro**

**sperimEstate**

**26/06/2017 - 07/07/2017**



# Misura della luminosità radio di una galassia attiva



## **Stagisti:**

Alice Ticca

Enrico Vaccari

## **Tutor:**

Marcello Giroletti

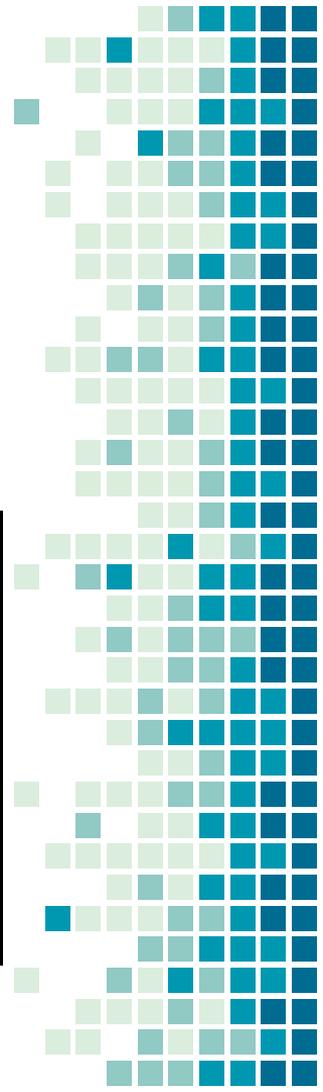
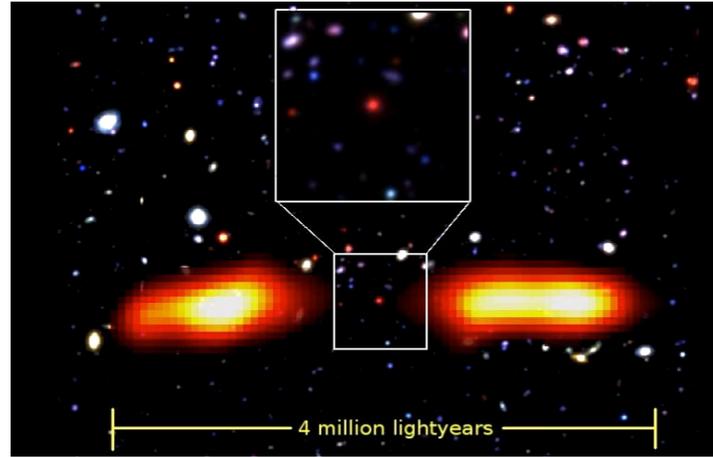
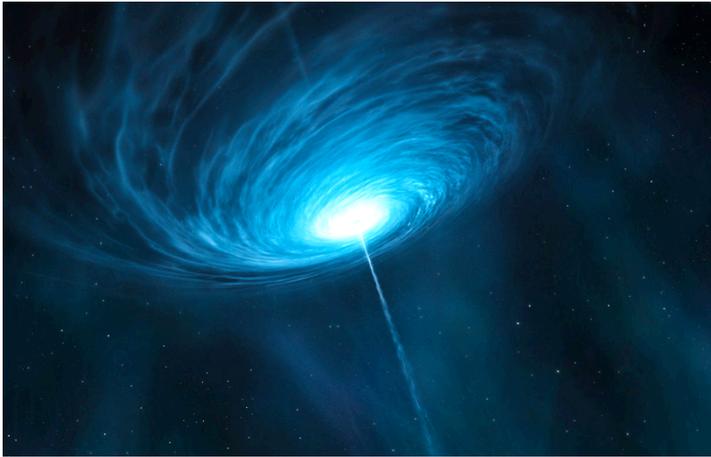
Simona Righini

# RADIO SORGENTI

(Quasar, Galassie, Nebulose Planetarie)

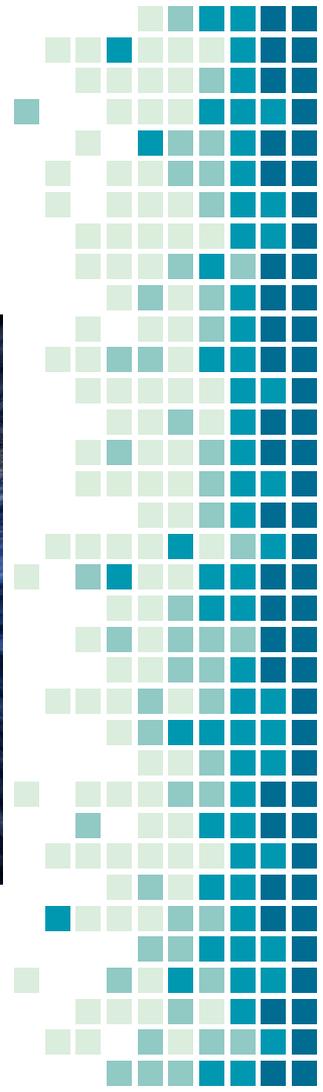
**NUCLEO ATTIVO**

**GETTI E LOBI**



# OBIETTIVO DEL PROGETTO

-  Misura delle **densità di flusso** (S)
-  Calcolo degli **indici spettrali** ( $\alpha$ )
-  Calcolo delle **luminosità assolute** (L)



# RADIOTELESCOPI NEL MONDO

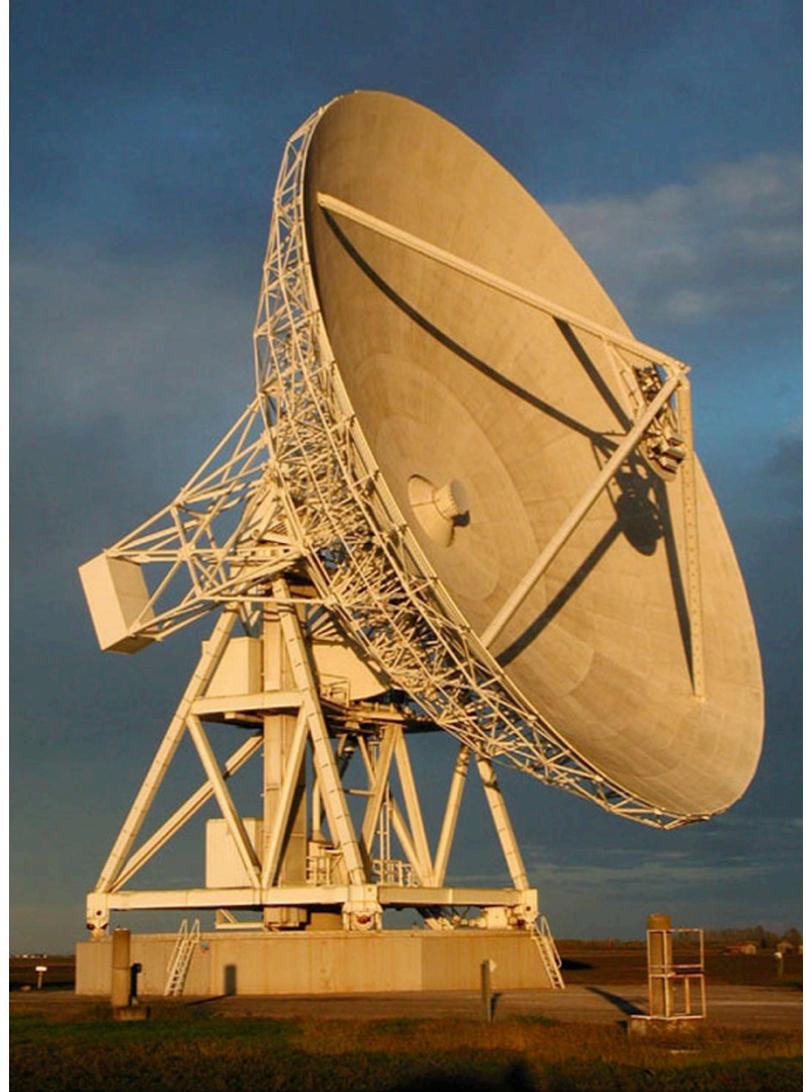


# IL RADIOTELESCOPIO DI MEDICINA

 Fuoco primario

 Fuoco secondario-cassegrain

 Subriflettore

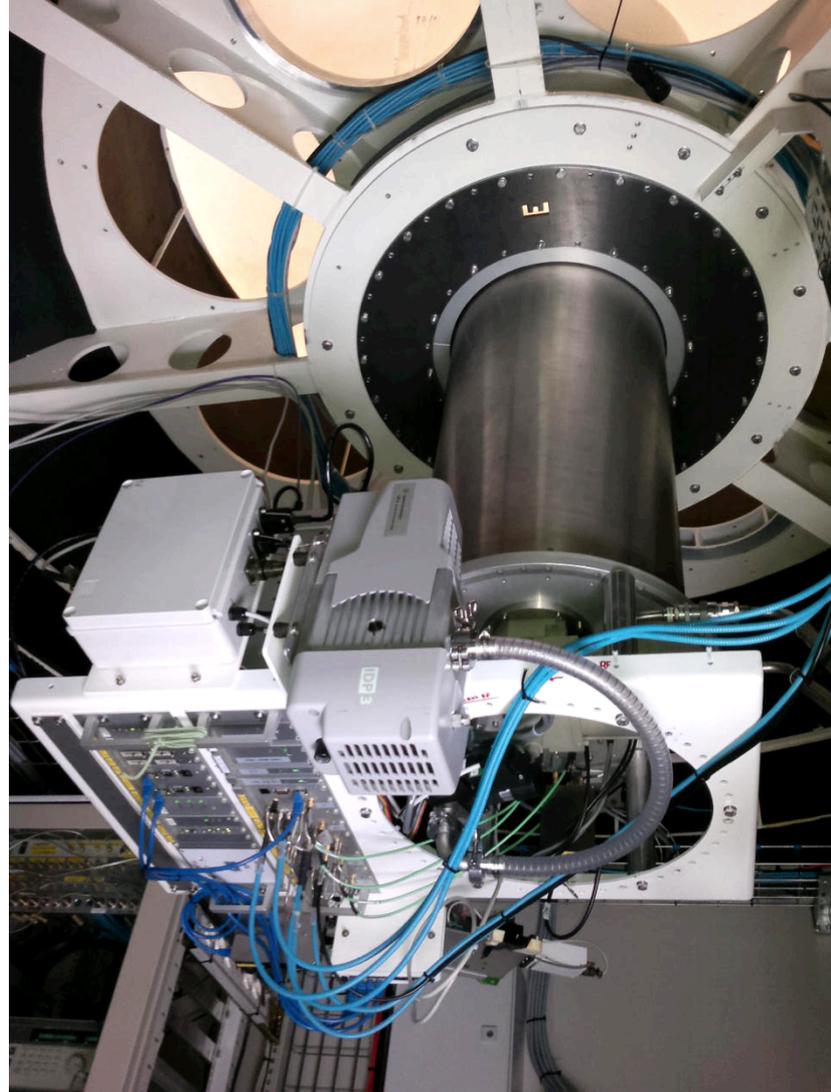


# IL RADIOTELESCOPIO DI MEDICINA (2)

 Ricevitori (C, X, K)

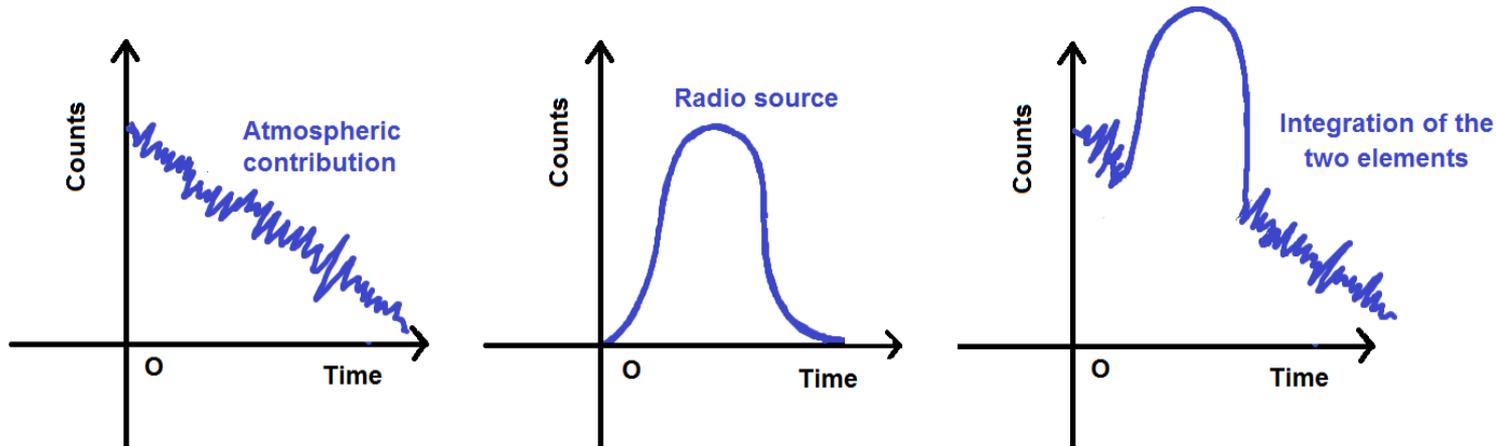
 Canali dx (0) e sx (1)

 Backend

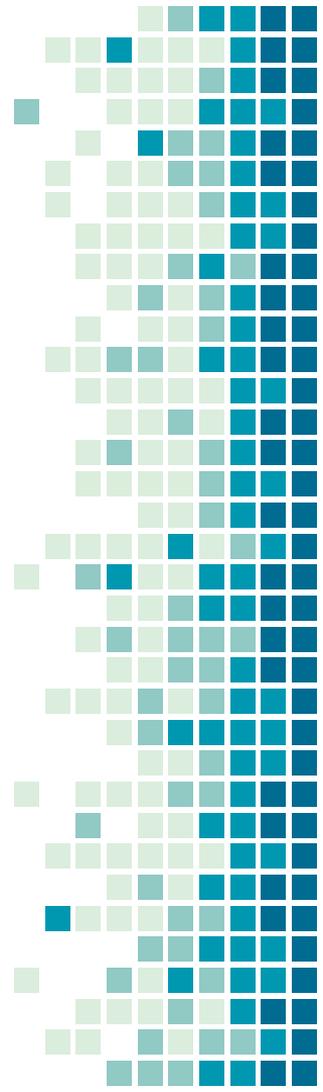


# LA MISURA DEL SEGNALE

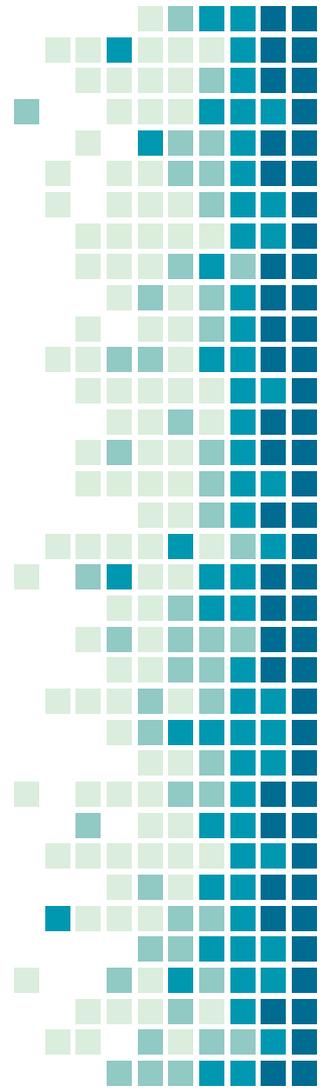
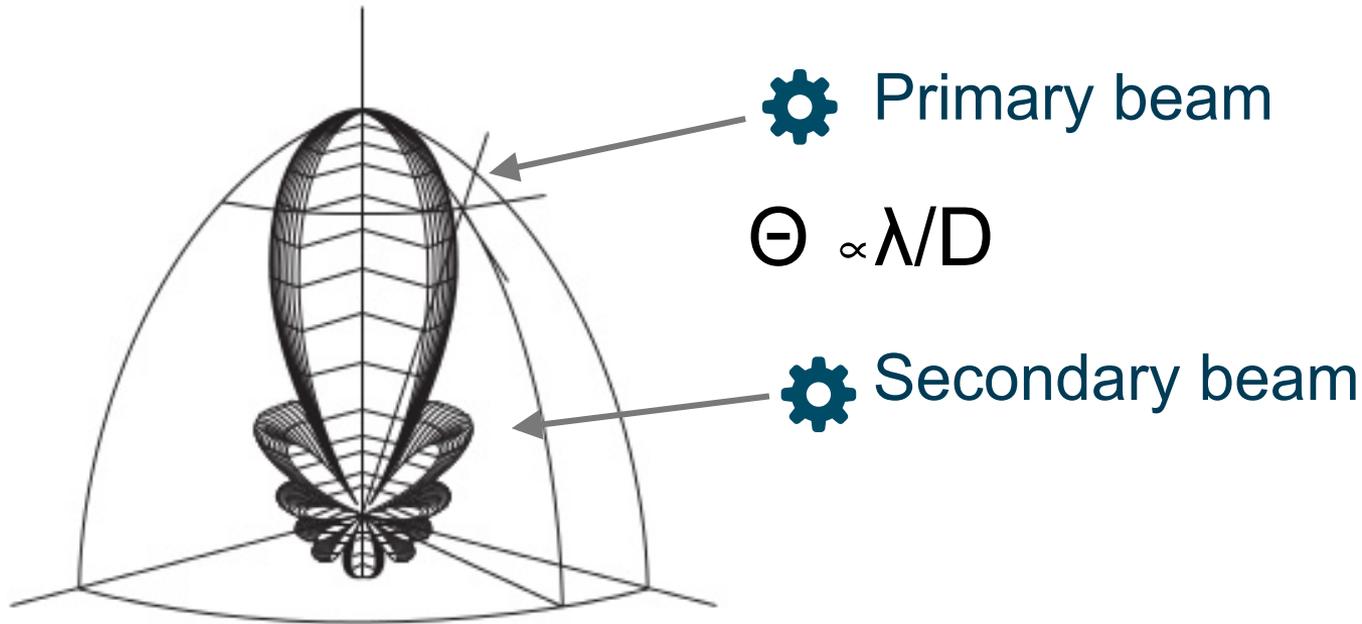
Baseline + Gaussiana



Backend analogico total power



# IL BEAM DELL'ANTENNA



# LE COORDINATE CELESTI



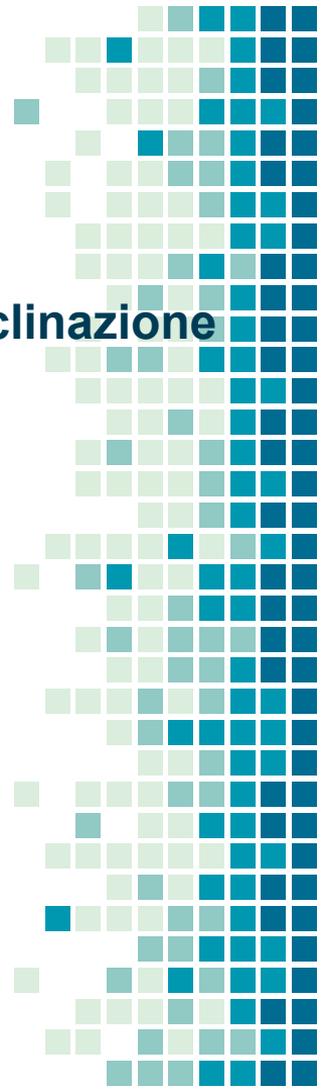
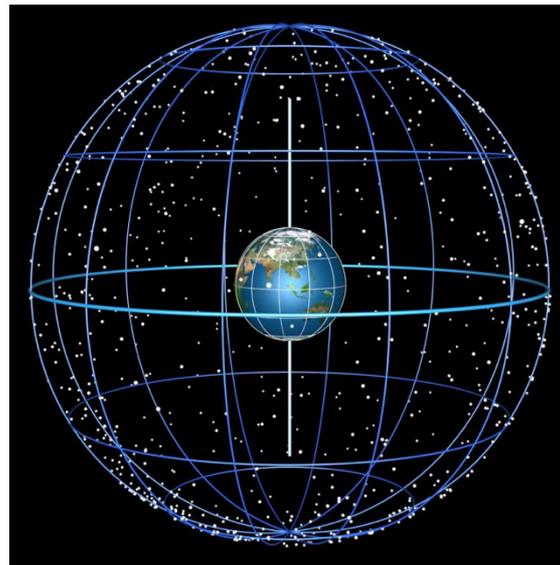
## Azimuth ed Elevazione

(riferite all'osservatore)



## Ascensione Retta e Declinazione

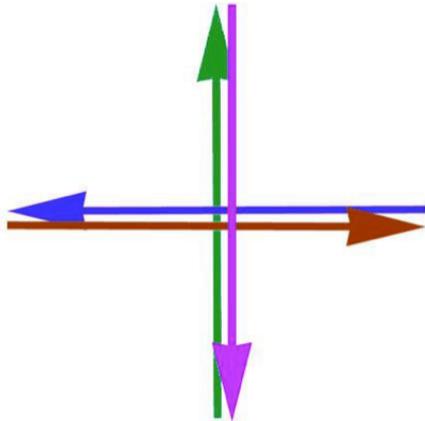
(solidali alla sfera celeste)



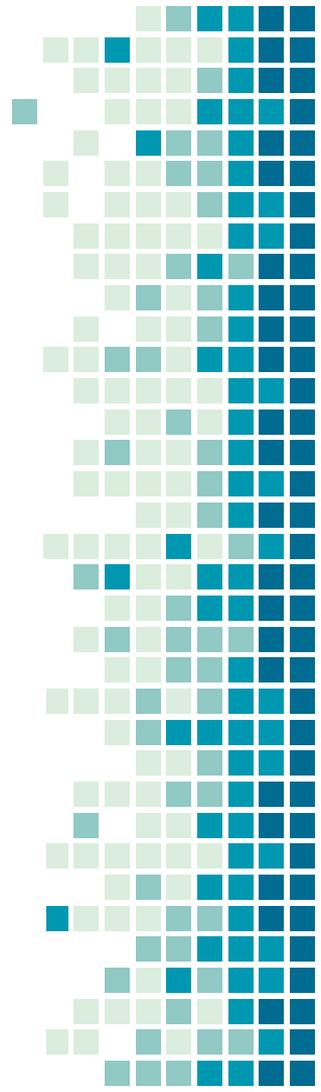
# IL CROSS SCAN

=

**4 SUBSCAN** a velocità costante verso la  
SORGENTE PUNTIFORME

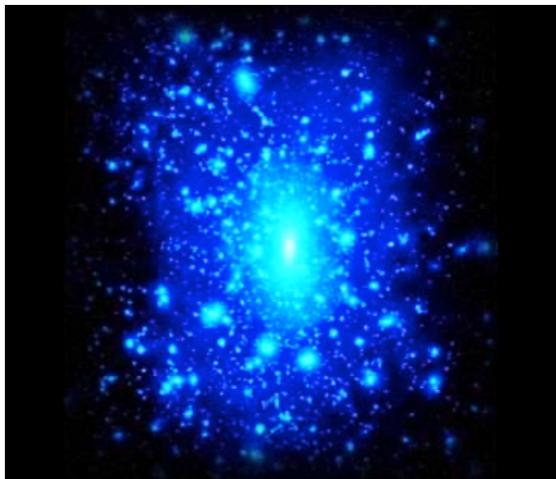


Full cross-scan



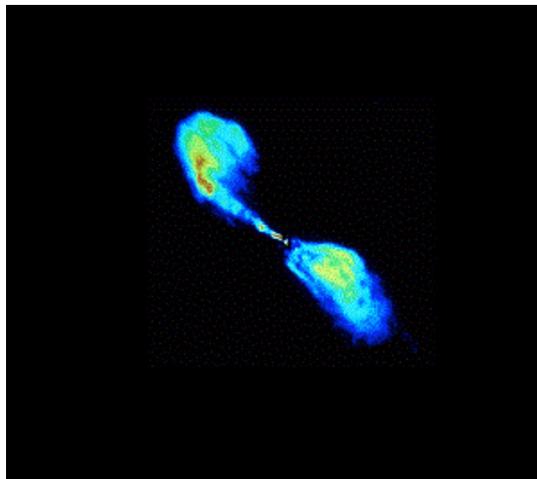
# RADIOSORGENTI

★ Target (flusso variabile)

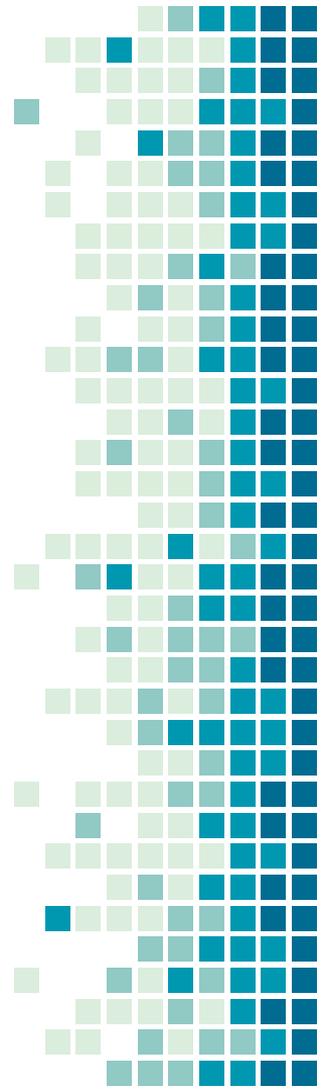


Sorgente OJ287

★ Calibratori (flusso costante)



Sorgente 3C123



# ELENCO SORGENTI

Sorgente	RA	DEC	Tipo	Calibratore (C) o Target (T) ?	Densità di flusso in letteratura (NED)		
					@5 GHz (Jy)	@8 GHz (Jy)	@22 GHz (Jy)
<b>3C 20</b>	00h43m08,80s	+52d03m35,00s	Galaxy	T	4,15	8,00	0,90
<b>3C 48</b>	01h37m41,30s	+33d09m35,00s	Quasar	C	5,50	3,33	1,23
<b>3C 123</b>	04h37m04,38s	+29d40m13,82s	Galaxy	C	16,21	10,60	3,52
<b>0716+714</b>	07h21m53,45s	+71d20m36,40s	Quasar	T	0,97	0,60	1,30
<b>0735+178</b>	07h38m07,39s	+17d42m19,00s	Quasar	T	2,20	3,60	3,20
<b>OJ 287</b>	08h54m48,87s	+20d06m30,60s	Quasar	T	2,61	3,86	5,40
<b>3C 286</b>	13h31m08,29s	+30d30m32,96s	Quasar	C	7,43	5,36	2,30
<b>NGC 7027</b>	21h07m01,50s	+42d14m12,00s	Pl. Neb.	C	5,51	0,75	5,50
<b>2230+114</b>	22h32m36,41s	+11d43m50,90s	Quasar	T	3,65	3,40	2,15

# VISIBILITÀ DELLE SORGENTI

Giornate di osservazione a Medicina:



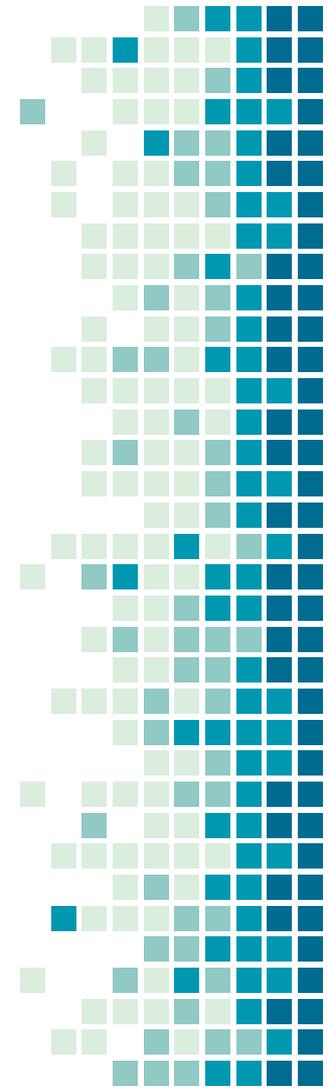
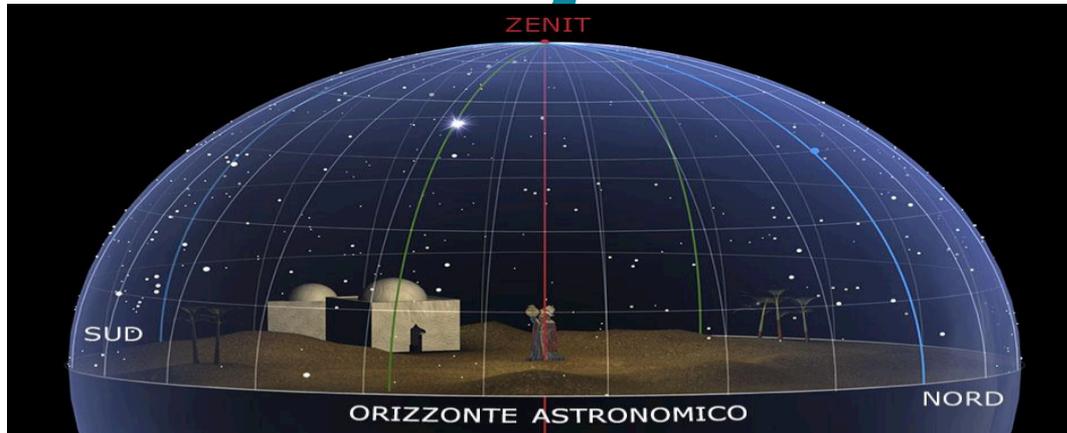
28/06/2017

29/06/2017

03/07/2017



Dalle 11:00 alle 14:00



# CASTIA-Source Visibility

**CASTIA - Source Visibility**

CASTIA is a software package able to check radio source visibility at a given date from a collection of international facilities. The tool outputs plots containing the visibility and the elevation of radio sources versus time. A special mark is used for the transit time and visual warnings are present when the azimuth rate is beyond the recommended limit or superposition with the sun/moon occurs. The query can be done by source name, sent to the SIMBAD name resolver for finding the corresponding right ascension and declination, or by giving coordinates for a single source or for a group of targets.

**Parameters:**

Source(s):    
Source name (SIMBAD search):

Date:

Site Name:

Lower elevation:

Upper elevation:

[Quick help](#) [Manual](#) [Reset](#) [Default](#) [Run CASTIA](#)

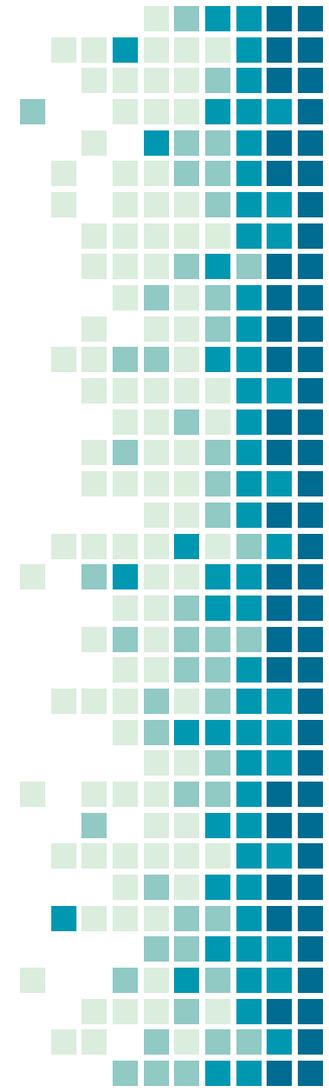
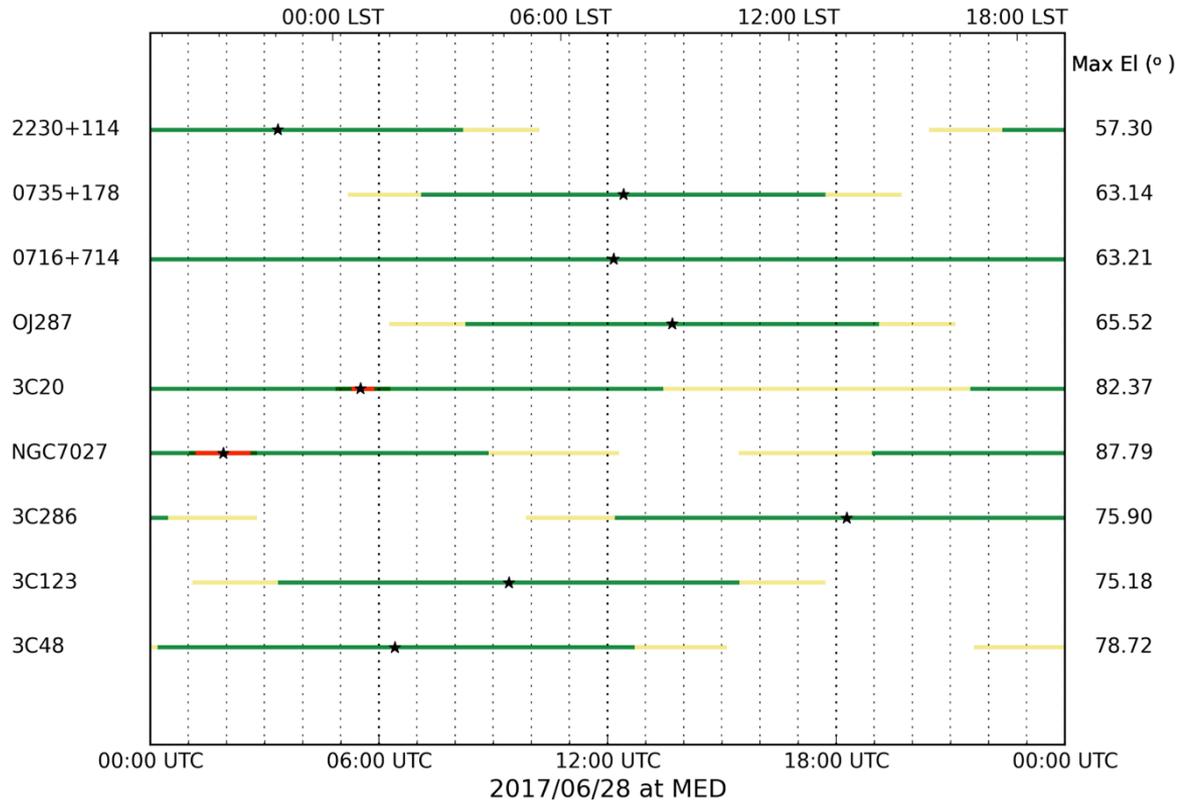
Show/Hide

INAF IIRA

SRT  
SARDINIA  
RADIO  
TELESCOPE

OAC

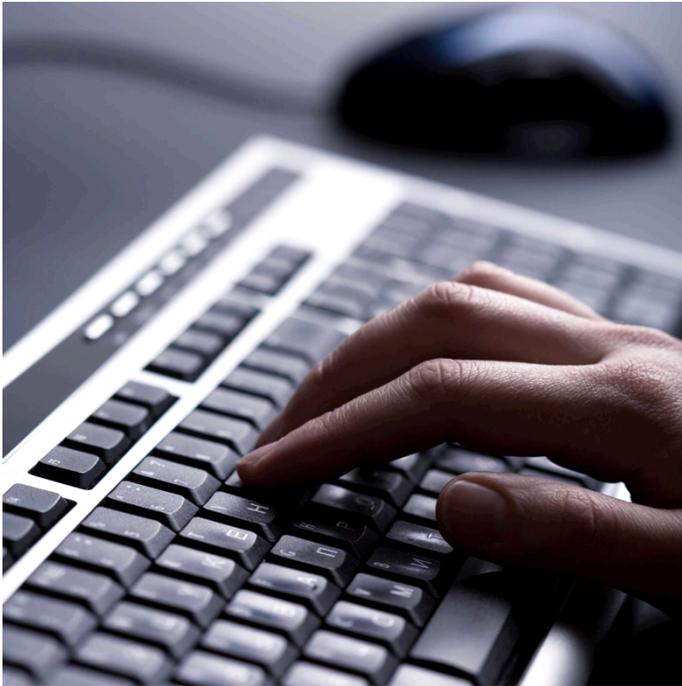
# INTERVALLI DI VISIBILITÀ



# ELENCO SORGENTI

Sorgente	RA	DEC	Tipo	Calibratore (C) o Target (T) ?	Densità di flusso in letteratura (NED)			Osservabile in sessione?
					@5 GHz (Jy)	@8 GHz (Jy)	@22 GHz (Jy)	
<b>3C 20</b>	00h43m08,80s	+52d03m35,00s	Galaxy	T	4,15	8,00	0,90	<b>Y</b>
<b>3C 48</b>	01h37m41,30s	+33d09m35,00s	Quasar	C	5,50	3,33	1,23	<b>Y</b>
<b>3C 123</b>	04h37m04,38s	+29d40m13,82s	Galaxy	C	16,21	10,60	3,52	<b>Y</b>
<b>0716+714</b>	07h21m53,45s	+71d20m36,40s	Quasar	T	0,97	0,60	1,30	<b>Y</b>
<b>0735+178</b>	07h38m07,39s	+17d42m19,00s	Quasar	T	2,20	3,60	3,20	<b>Y</b>
<b>OJ 287</b>	08h54m48,87s	+20d06m30,60s	Quasar	T	2,61	3,86	5,40	<b>Y</b>
<b>3C 286</b>	13h31m08,29s	+30d30m32,96s	Quasar	C	7,43	5,36	2,30	<b>N</b>
<b>NGC 7027</b>	21h07m01,50s	+42d14m12,00s	Pl. Neb.	C	5,51	0,75	5,50	<b>N</b>
<b>2230+114</b>	22h32m36,41s	+11d43m50,90s	Quasar	T	3,65	3,40	2,15	<b>N</b>

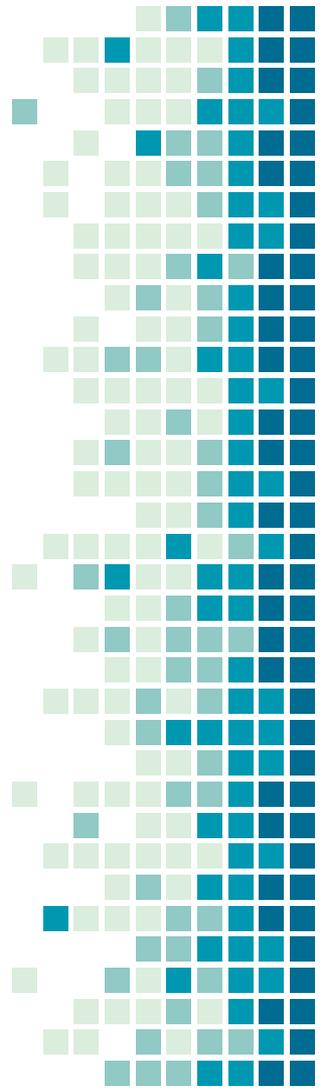
# PREPARAZIONE DELLE “SCHEDULE”



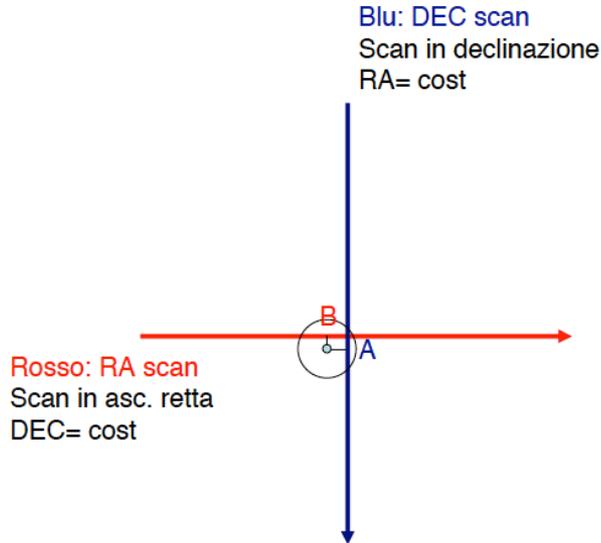
File “**configuration**”



File “**targets**”



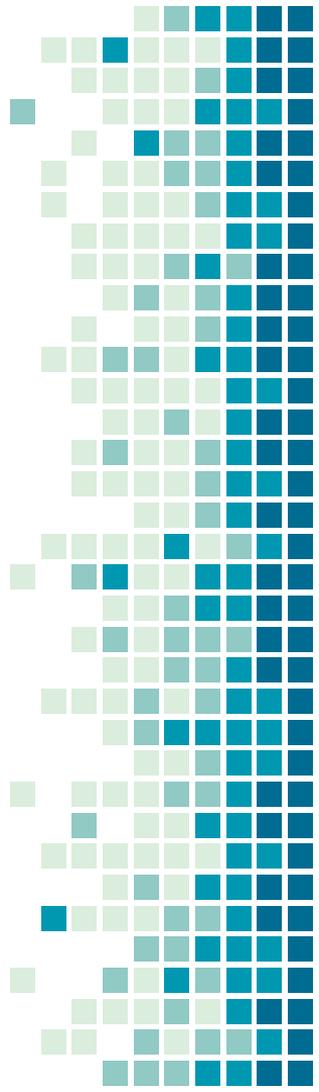
# ERRORI DI PUNTAMENTO



Per **alte** frequenze (beam ridotto)



Cross-scan di tipo “point”



# ESECUZIONE CON ESCS

(sistema di controllo dell'antenna)

Spiegazione comandi	Banda C	Banda X	Banda K
Impostazione banda e fuoco di riferimento	setupCCCL	setupXXP	setupKKC
Regolazione oscillatore locale	setLO=4900	N.D. /	setLO=23400
Regolazione larghezza di banda	Default/	Default/	setSection=[n] , * , 1200 , * , * , * , *
SceltaImpostazione del canale di riferimento	device=0	device=0	device=1
Verifica dell'intensità del segnale	getTpi	getTpi	getTpi
Regolazione dell'intensità (900-1000 valori ottimali)	setAttenuation=[n] , [dB]	setAttenuation=[n] , [dB]	setAttenuation=[n] , [dB]
Avvio della schedula	startSchedule=bandaC . scd , 1	startSchedule=bandaX . scd , 1	startSchedule=bandaK . scd , 1
Sospensione della schedula	stopSchedule	stopSchedule	stopSchedule
Posizione di parcheggio dell'antenna	antennaPark	antennaPark	antennaPark

# VISUALIZZAZIONE GRAFICA CON IDL

<b>Nome utente</b>	ssh -X students@192.167.189.54
<b>Password</b>	*****
<b>Lanciare il software</b>	idl
<b>Compilare codice (compilatore)</b>	.r fitslook
<b>Avviare programma di visualizzazione</b>	fitslook



Diagramma dei dati rilevati in tempo reale

# LE BANDE

**C**

(5 GHz)



Sensibile alle  
interferenze

**X**

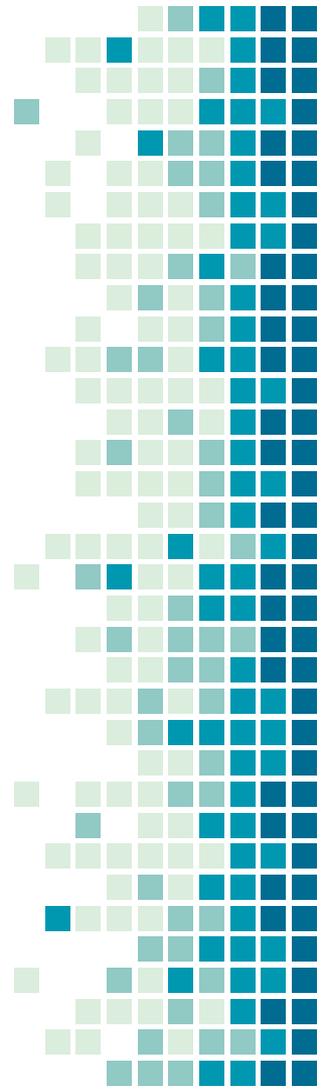
(8 GHz)



Disturbata dalle  
condizioni  
atmosferiche

**K**

(18-26 GHz)



# IL NOISE

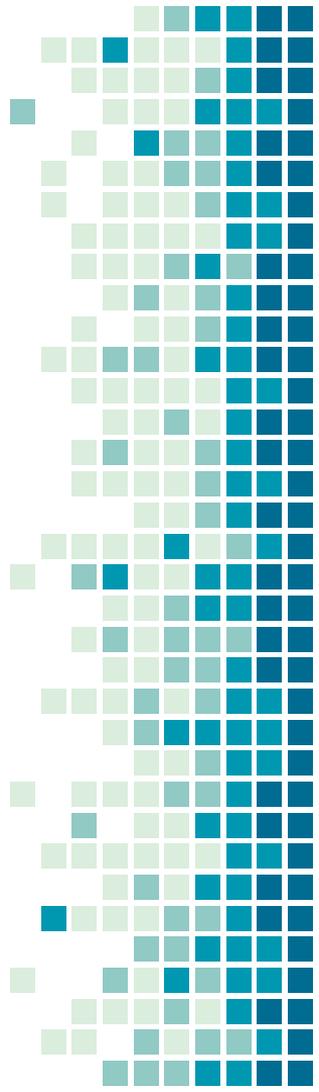


**Segnali** di origine aleatoria  
che vanno a sommarsi con il segnale utile

$$\sigma = \frac{T_{\text{sys}}}{\sqrt{t \Delta \nu}}$$

**Temperatura del sistema**

**Tempo e frequenza**

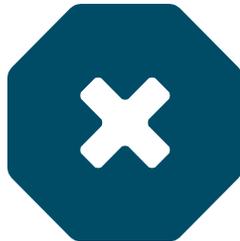


# LOGBOOK DELLE SESSIONI

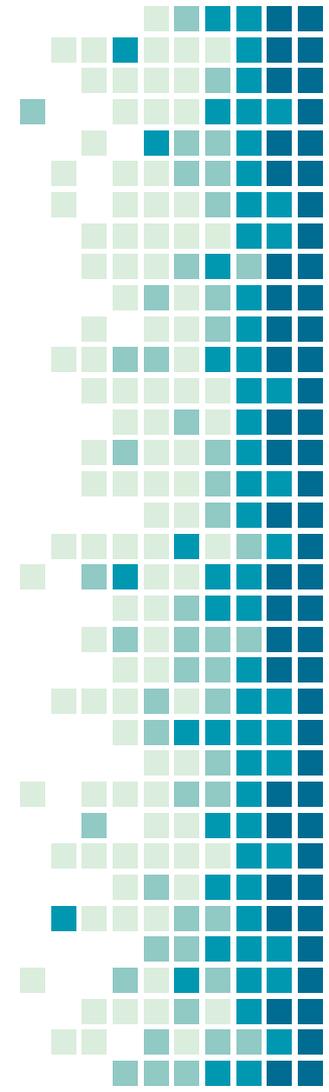
GIORNO 1:  
**28/06/2017**



GIORNO 2:  
**29/06/2017**

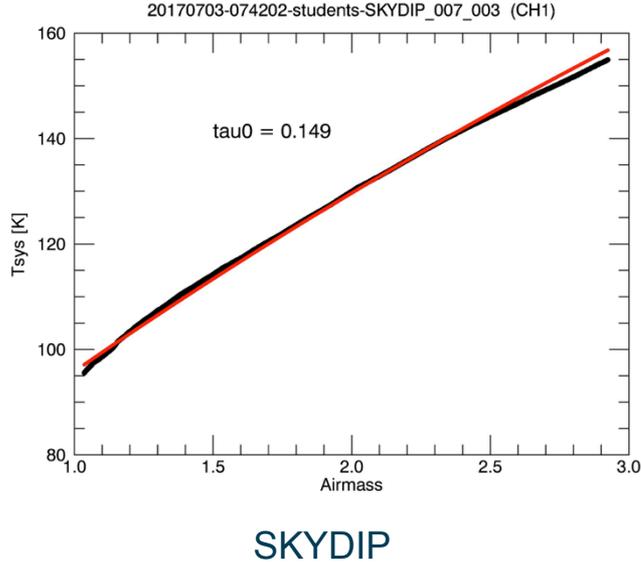


GIORNO 3:  
**03/07/2017**



# RIDUZIONE DATI

**Fattori** da tenere in considerazione durante le rilevazioni



Errori di puntamento



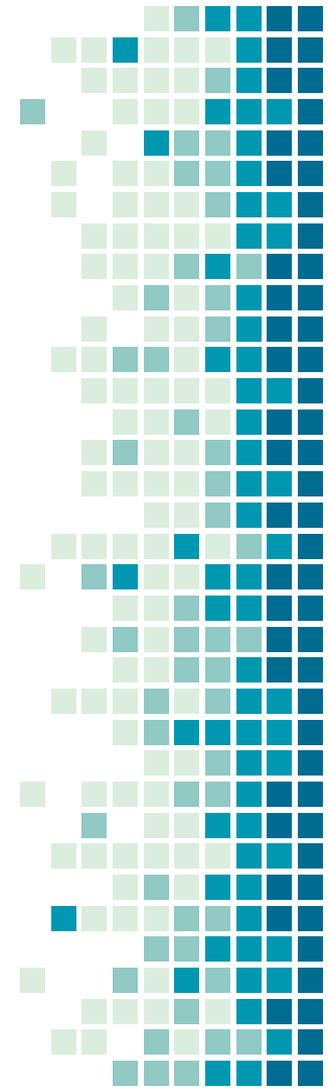
Deformazioni antenna



Posizione calibratori-target



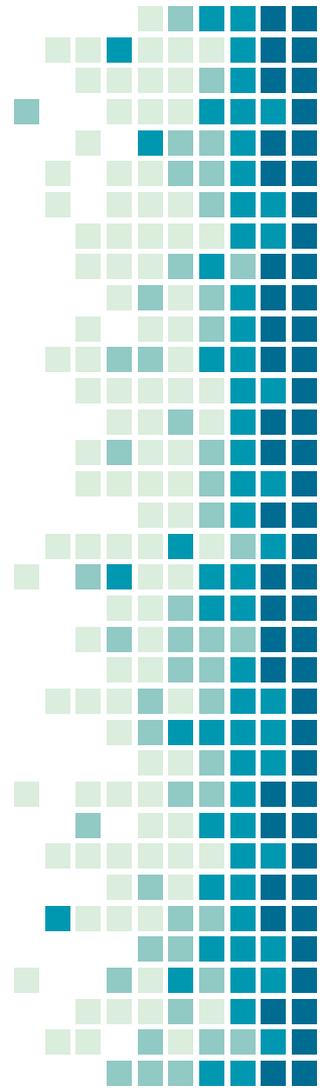
Opacità atmosferica



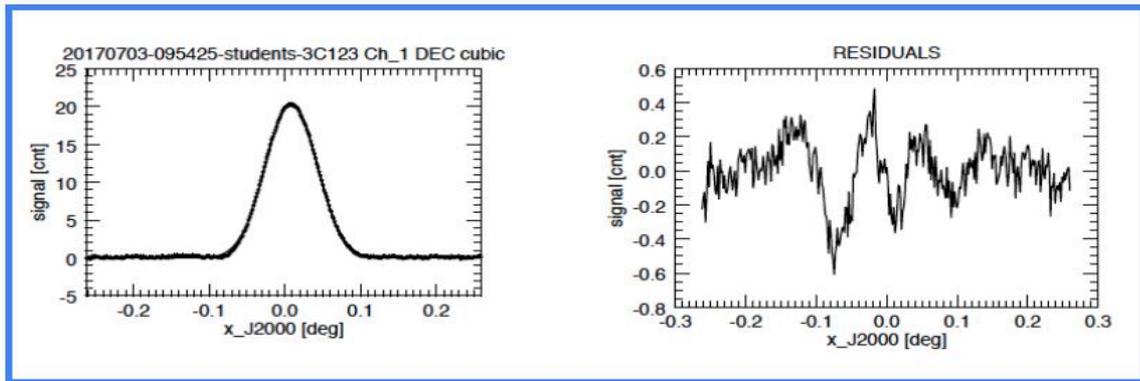
# CAP (Cross-scan Analysis Pipeline)

**Calcolo flusso:  
5 step per ciascuna banda di frequenza**

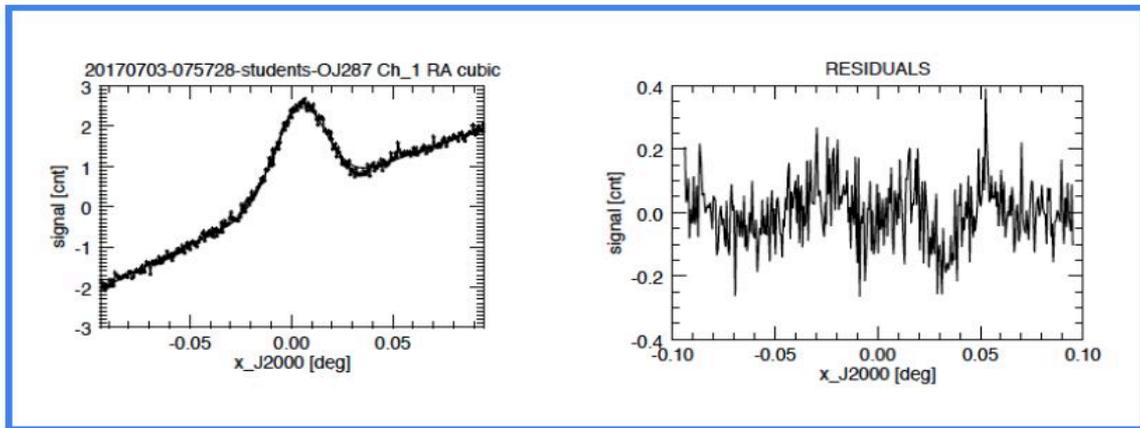
1. “Separa”
2. “Flagging”
3. “Runcalib”
4. “C2Jtimeline”
5. “Runtarget”



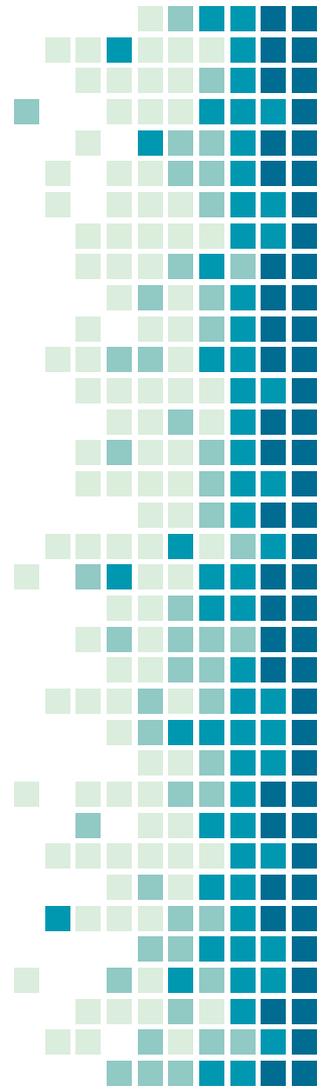
# ESEMPI PLOT



Sorgente  
3C123



Sorgente  
OJ287



# CALCOLO INDICI SPETTRALI ( $\alpha$ )

**Valore** che descrive l'andamento  
del flusso al variare della

$$S(\nu) = \nu^{-\alpha} \quad \alpha > 0$$



Se  $\alpha$  grande

Spettro ripido

Sorgente molto “rossa”

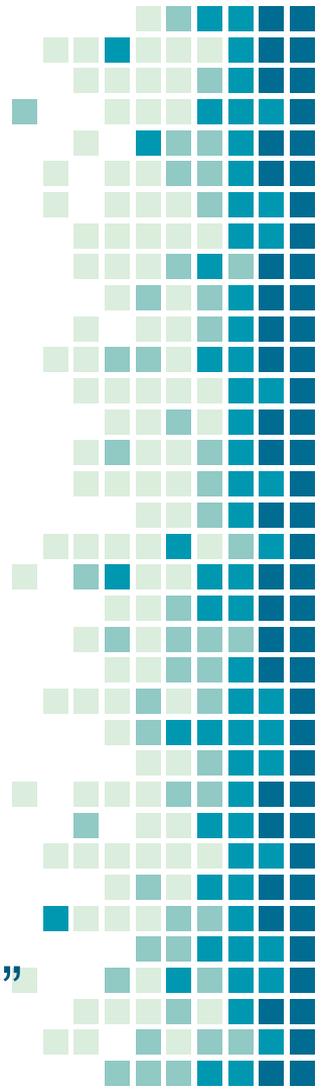


Se  $\alpha$  piccolo

Spettro piatto

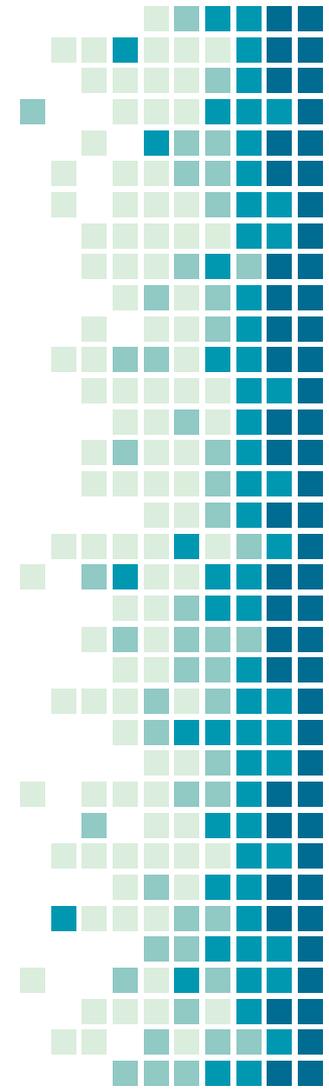
Sorgente meno “rossa”

(sorgente “pseudo-blu”)



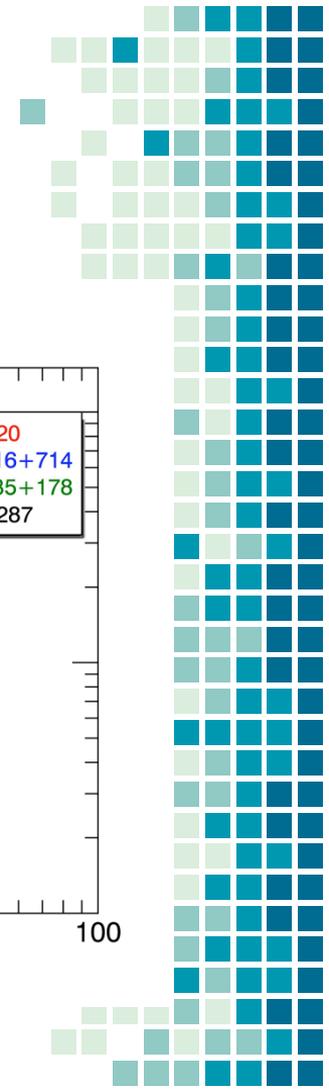
# TABELLA CON DENSITÀ DI FLUSSO E INDICI SPETTRALI

SORGENTE	D. flusso (NED)	Densità di flusso misurata			Indice spettrale	
		@1,4 GHz (Jy)	@5 GHz (Jy)	@8,4 GHz (Jy)	@24 GHz (Jy)	1,4-8,4 GHz
3C 20	11,28 $\pm$ 0,36	[6,2]	2,22 $\pm$ 0,06	0,74 $\pm$ 0,16	0,9 $\pm$ 0,0	1,0 $\pm$ 0,2
0716+714	0,73 $\pm$ 0,22	/	1,78 $\pm$ 0,04	3,44 $\pm$ 0,23	-0,5 $\pm$ 0,2	-0,6 $\pm$ 0,1
0735+178	2,10 $\pm$ 0,09	/	0,80 $\pm$ 0,04	0,66 $\pm$ 0,56	0,5 $\pm$ 0,0	0,2 $\pm$ 0,8
OJ 287	2,16 $\pm$ 0,01	[5,9]	6,79 $\pm$ 0,06	6,86 $\pm$ 0,48	-0,6 $\pm$ 0,0	0,0 $\pm$ 0,1

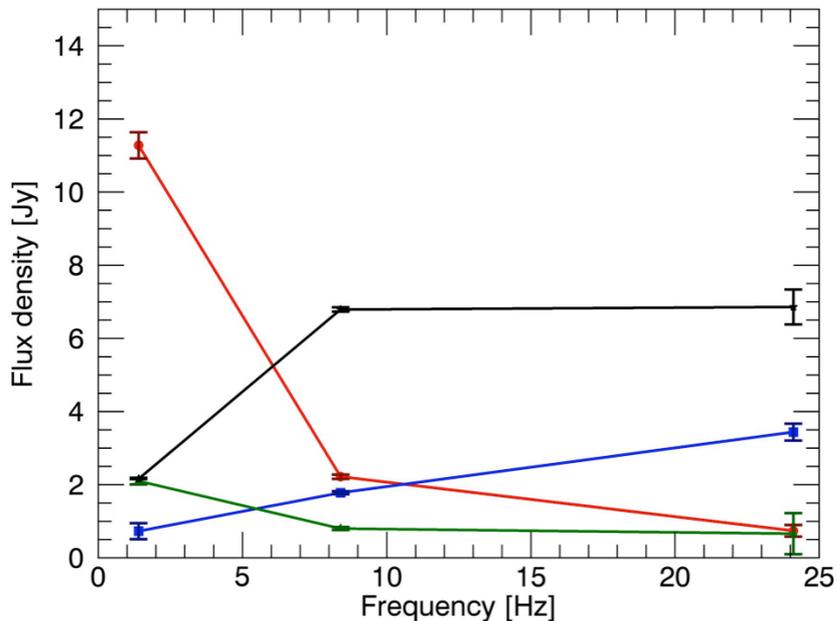




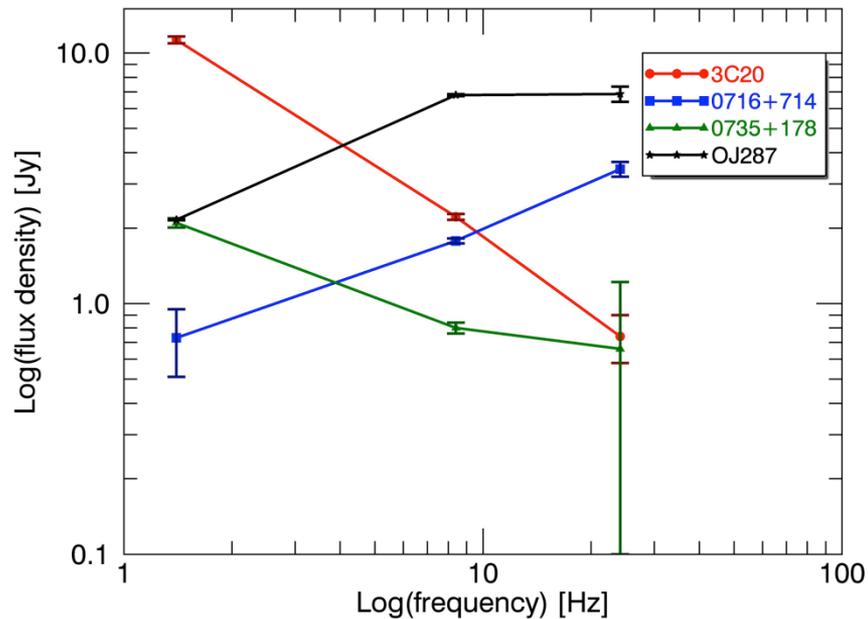
# RISULTATI OTTENUTI



Measured flux densities



Measured flux densities



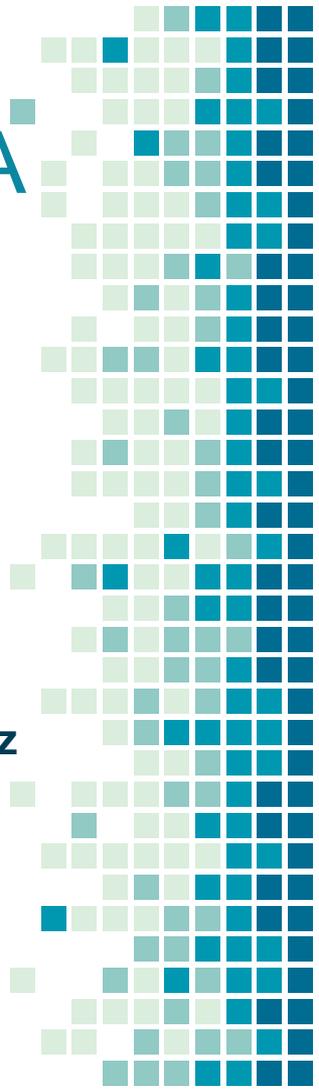
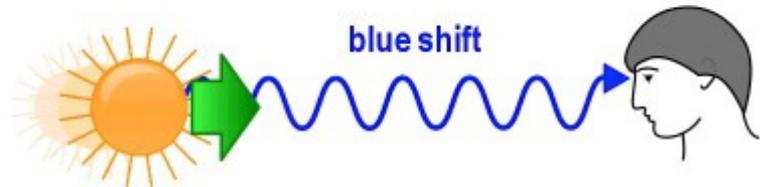
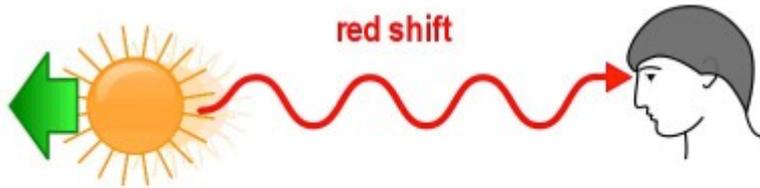
# REDSHIFT e LUMINOSITÀ ASSOLUTA

**Parametro** che dà informazioni circa la distanza di un oggetto cosmico

**Dato** ottenuto tramite la formula

$$L = 4\pi \cdot d^2 \cdot S$$

Valori nel range 1E+25 - 1E+28 W/Hz





# GRAZIE PER L'ATTENZIONE!

Un ringraziamento speciale ai nostri tutor:



**Marcello Giroletti** (Ricercatore presso INAF-IRA)



**Simona Righini** (Tecnologa presso INAF-IRA)