



General Program Fr target list status

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on behalf of the SVOM GP French Working Groups**



GP Working Groups

- **Nov 22:** General call for participation to GPWG to SVOM science
- **Goal:** define a list of sources (**scientifically driven**) for the 1st year SVOM observation plan related to the main science cases (**GP + nominal ToO**):

Extragalactic	Blazars	A. Coleiro (APC)
	AGN QSO / Sey	F. Marin (ObsAS)
	AGN CLQ / Time variability	M. Dennefeld (IAP)
	ULX	O. Godet (IRAP)
	TDE	R. Starling (Leicester)
	ccSNe	M. Renaud (LUPM)
	FRB	
Galactic	XRB - BH	F. Cangemi (APC)
	XRB - NS - HM	G. Vasilopoulos (ObsAS)
	XRB - NS -LM	S. Guillot (IRAP)
	SNR / PWN / Pulsars	P. Maggi (ObsAS)
	CV / Novae	M. Clavel (IPAG)
	Magnetars / AXP / SGR	D. Götz (AIM)
	Peculiar / Flaring Stars	
Misc.	Sun / Solar System / Exoplanets	
	TGF	
	CXB	L. Bouchet (IRAP)
	Gal. Ridge X-ray Emission	

- **Working groups were asked to provide:**

- list of sources
- scientific justification
- immediate objectives to fulfill
- requested exposure time
- observing strategy
- trigger criteria (for ToO)
- synergies with other facilities

- **Main inputs:**

- Swift/XRT & BAT, RXTE, MAXI/GSC source catalogues
- Tuebingen X-ray binary catalog (<http://astro.uni-tuebingen.de/~xrbcat/>)
- ASI SED Builder tool (<https://tools.ssd.csi.it/SED/>)
- ASI Open Universe (Swift DeepSky) <https://openuniverse.asi.it>
- Literature
- Multi-messenger correlations

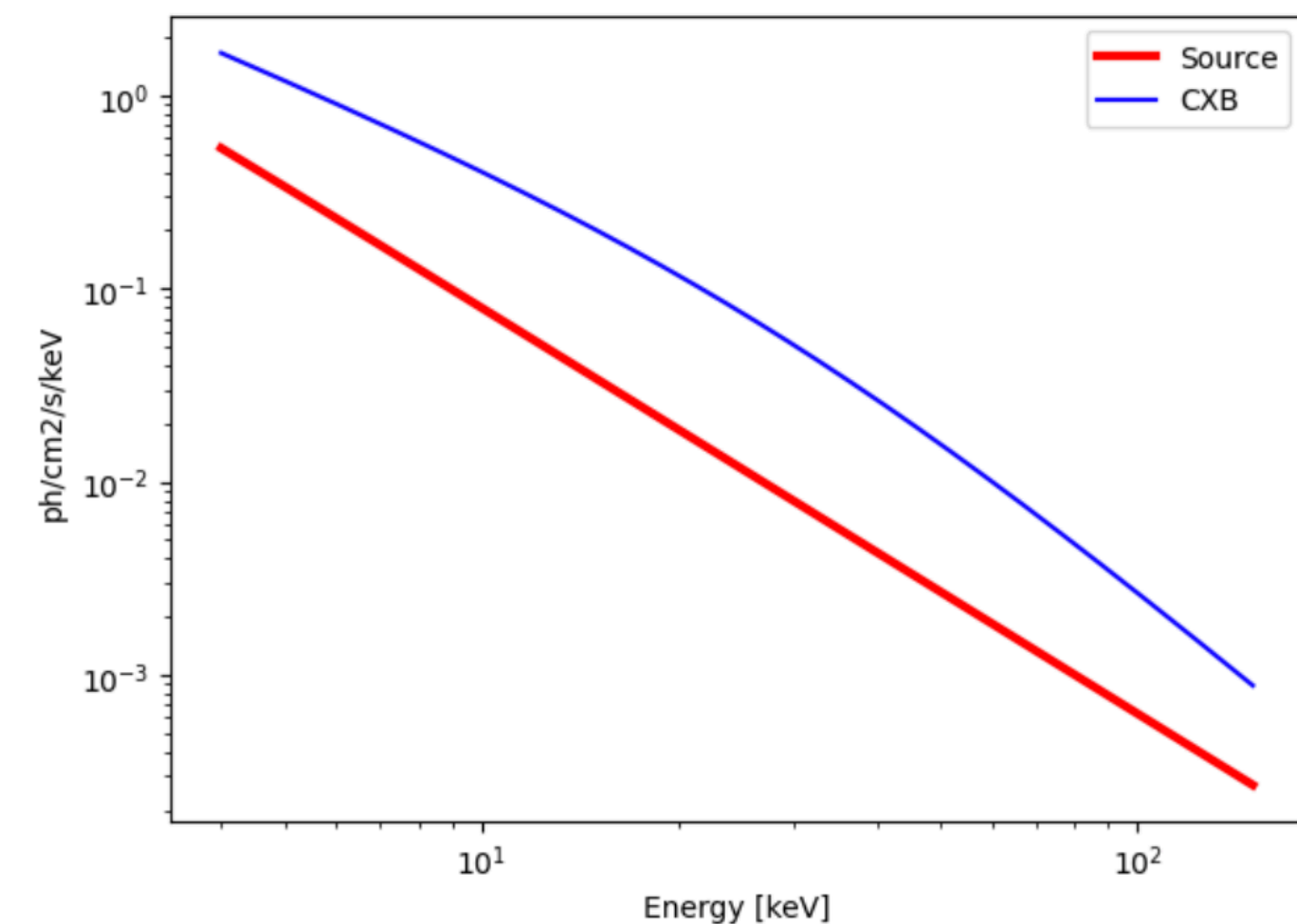
- Available at: <https://fcangemi.github.io/gp-tools-svom/intro.html>
- Preliminary exposure time calculators for MXT & ECLAIRs (based on current response matrices)
- Handle different spectral models: power law, broken power law, cutoff power law, blackbody
- Rough spectral simulation (works for PL, cutoff PL and bbody)

Powerlaw (example for the Crab)

```
# Model and parameters
model = "powerlaw"
norm = 10      # Flux normalisation in ph/cm2/s/keV
Gamma = 2.1    # Photon index
n_H = 4.5      # Density column in 1e21 cm-2

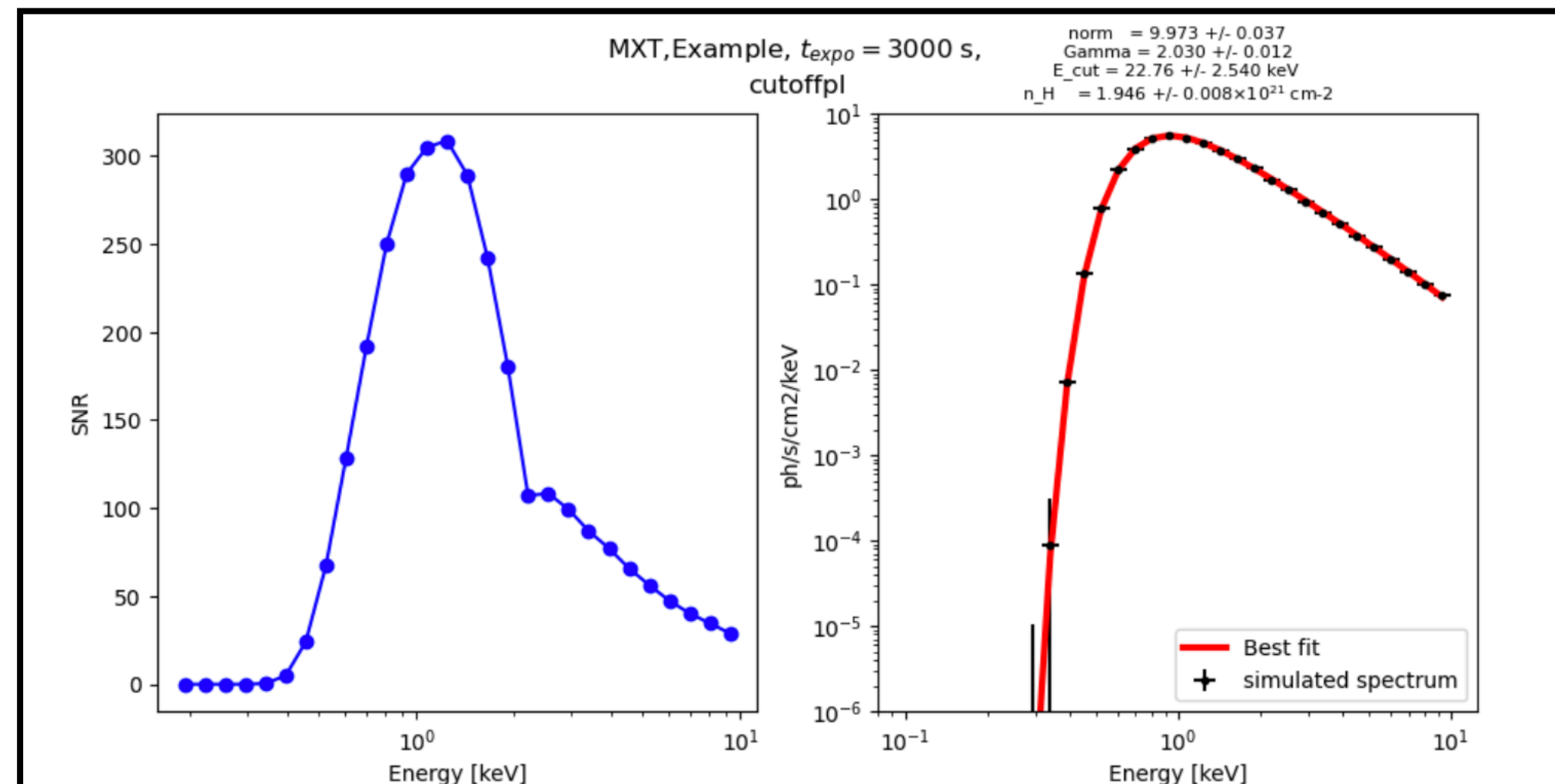
# Exposure time
calculate_exposure(SNR = 10, instrument = "ECLAIRs", Eband = [4, 150])
```

```
Emin = 4 keV
Emax = 150 keV
norm = 10.0000 ph/s/cm2/keV
Gamma = 2.1
n_H = 4.5 e21 cm-2
```



```
Background = 3587.2578 c/s in the energy band [4, 150] keV.
Source = 523.9236 c/s in the energy band [4, 150] keV.
ECLAIRs : need an exposure time of 1.78 seconds for a SNR = 10 over the energy band
```


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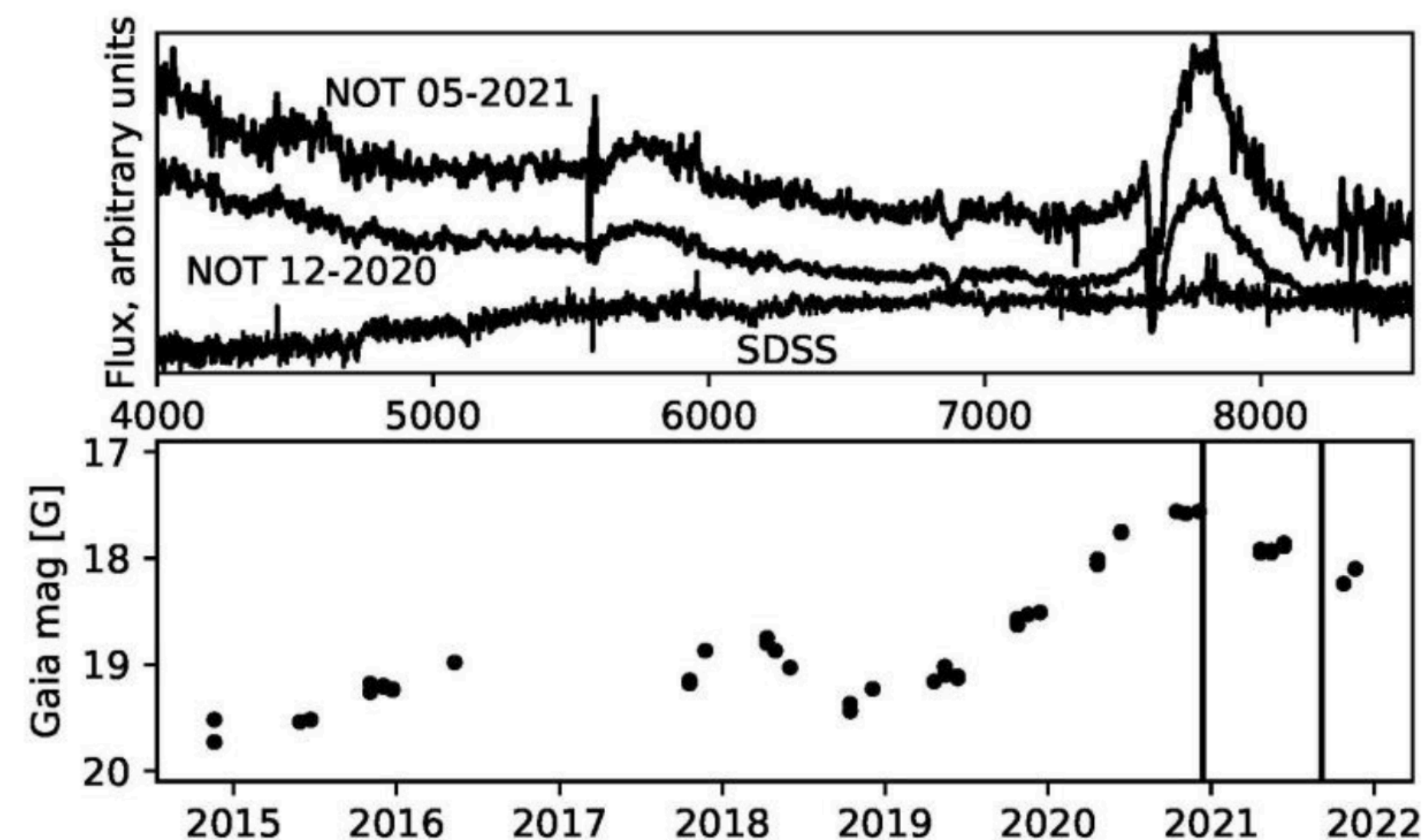
```
instrument = "MXT"
nbins = 32
tps_expo = 3000

# Optional parameters
title = "Example"
path_to_fig = " "
ylim1 = " "
ylim2 = [1e-6, 10]
color = "blue"

# Run make_spectra
make_spectra(instrument, nbins, tps_expo, title, path_to_fig, ylim1
```

```
norm = 10.0000 ph/s/cm2/keV
Gamma = 2.1
E_cut = 40
n_H = 2 e21 cm-2
[[Model]]
Model(_eval)
[[Fit Statistics]]
# fitting method = leastsq
# function evals = 70
# data points = 28
# variables = 4
chi-square = 32.8502047
reduced chi-square = 1.36875853
Akaike info crit = 12.4730970
Bayesian info crit = 17.8019151
R-squared = 0.65331278
[[Variables]]
norm: 9.97363429 +/- 0.03783086 (0.38%) (init = 1)
Gamma: 2.03044528 +/- 0.01281399 (0.63%) (init = 1.7)
E_cut: 22.7653706 +/- 2.54070426 (11.16%) (init = 70)
n_H: 1.94643304 +/- 0.00811948 (0.42%) (init = 20)
[[Correlations]] (unreported correlations are < 0.100)
C(Gamma, E_cut) = 0.944
C(Gamma, n_H) = 0.829
C(norm, E_cut) = -0.699
C(E_cut, n_H) = 0.692
C(norm, Gamma) = -0.475
```

- Subclass of AGNs showing large flux variations as well as changes in spectral features (broad Balmer lines / Sey 2 \leftrightarrow Sey 1) over \sim months.
- **Possible explanations:**
 - Variation of the accretion rate
 - Obscuration change (due to moving clumps)
 - Other structural changes ?
- **Multi- λ observations needed to constrain models:**
 - If central engine is involved: expect a delay between luminosity variation and BLR changes
 - If obscuration variations: X-ray obs. should reveal a change in the N_H .



- **Proposal:** SVOM (X-ray and optical) monitoring of a sample of confirmed Changing Look Quasars to constrain the physical processes at play.
- **Obs. strategy:**
 - Trigger **ToO** (\sim 30 ksec) when a significant optical magnitude change is detected (e.g. GAIA).
 - For targets with no previous X-ray observation, **GP observation** (205 ksec) for reference.
 - Weekly monitoring of G22css

- **Open questions:**

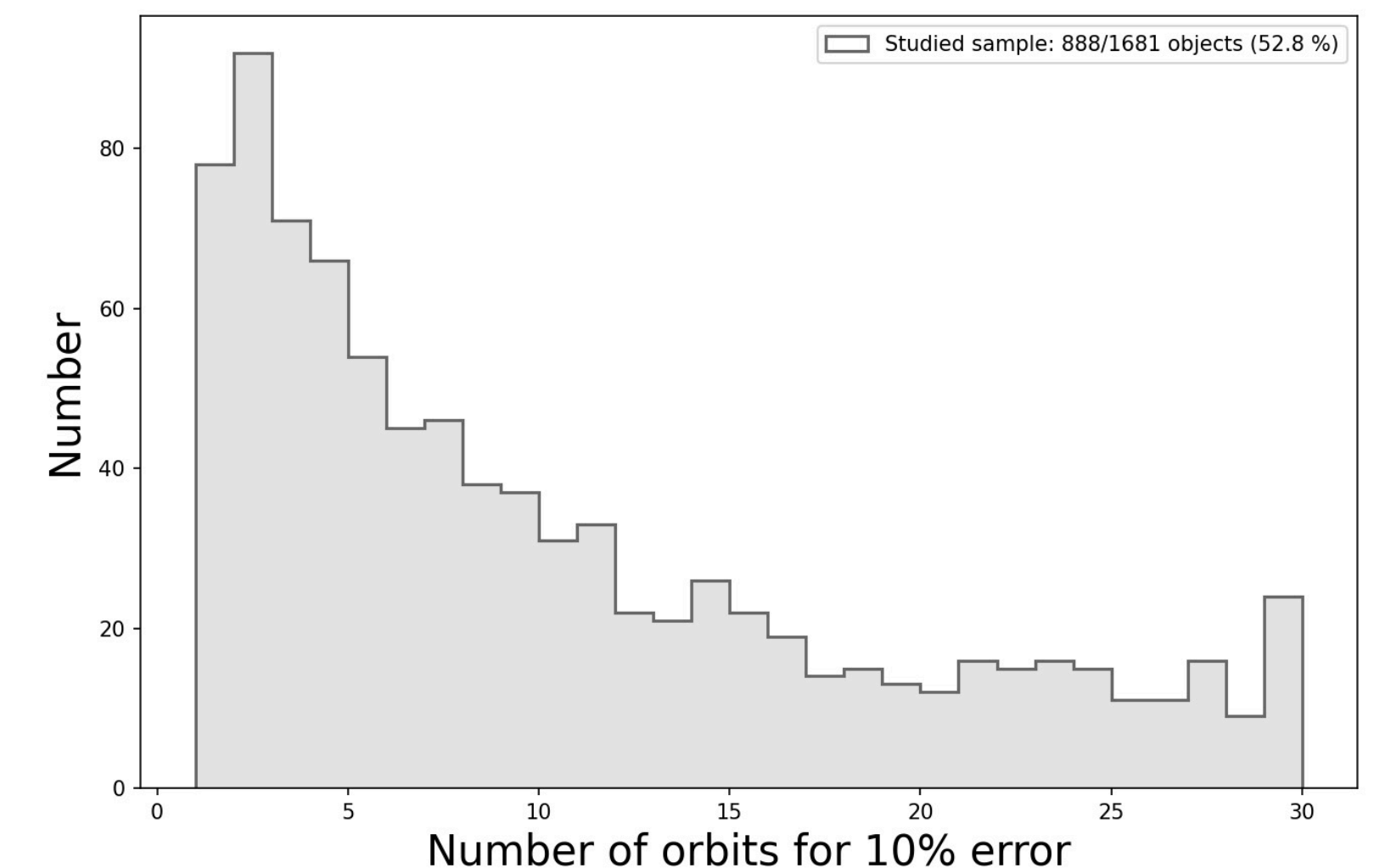
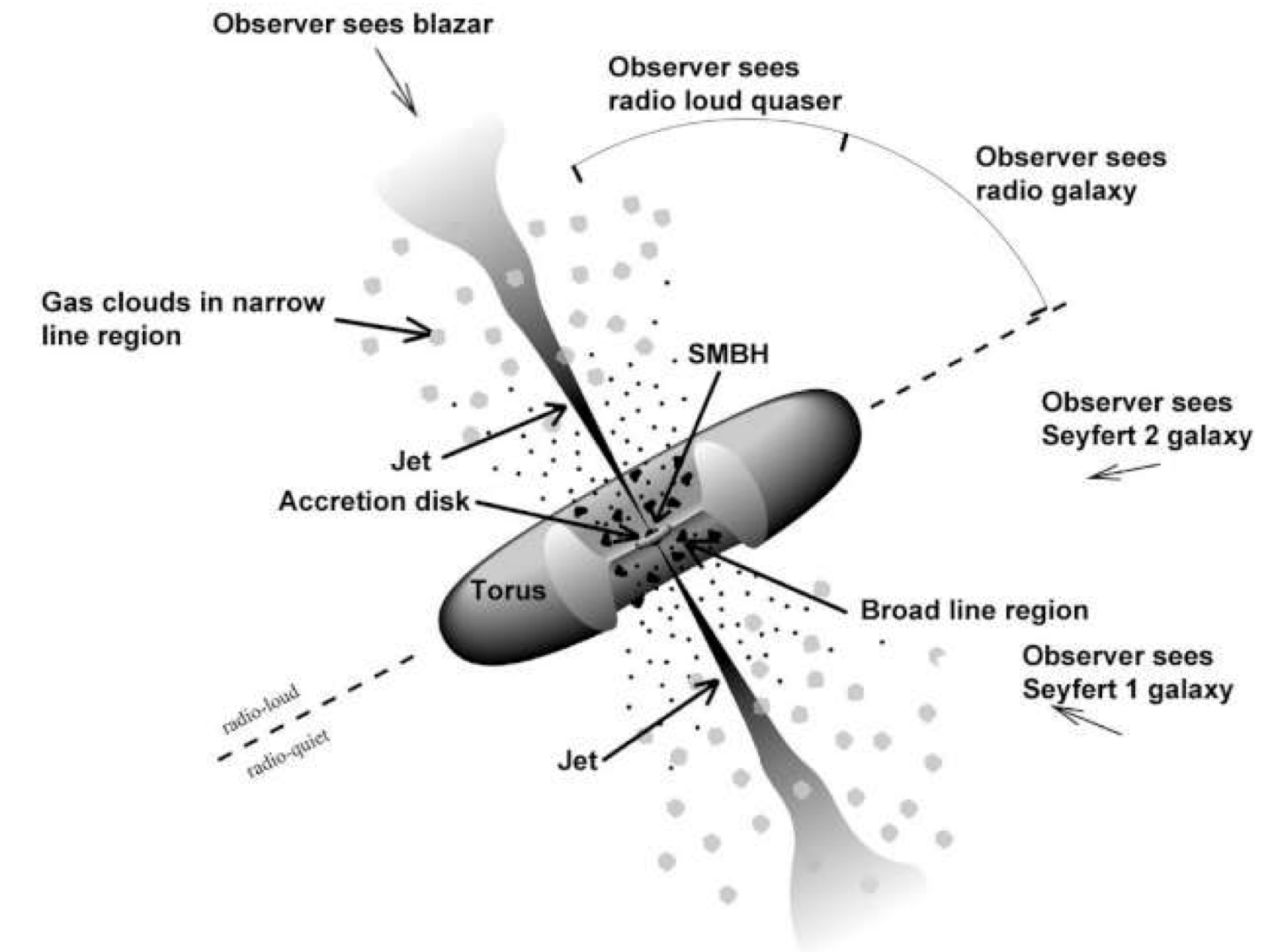
- Particle acceleration mechanism, origin of the high-energy component (leptonic vs hadronic)
- Emission of high-energy neutrinos ?

- SED modeling \Rightarrow multi-wavelength monitoring. Collaboration with other facilities (e.g. HESS & MAGIC)

- Estimate observing time with MXT to get $<10\%$ uncertainties on spectral parameters (needed to accurate SED fitting)

- **List of sources:**

- Blazars (AGNs) in neutrino alert error boxes (~ 40 targets)
- Extreme blazars (<https://arxiv.org/abs/2001.09222>)
- Blazars detected at VHE (synergies with HESS and MAGIC)



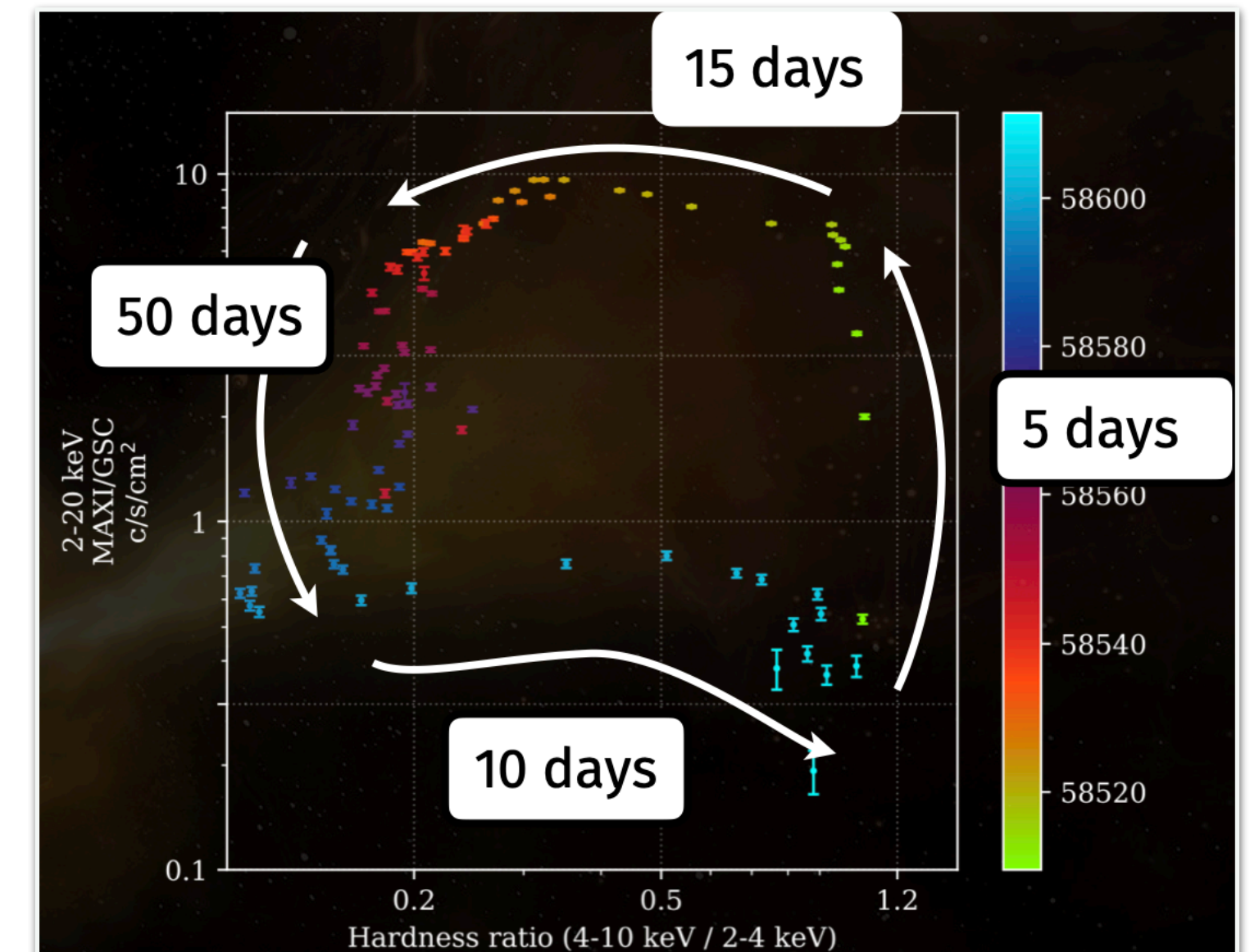
- **Persistent vs transient sources**

- **GP list (persistent sources):**

- Cyg X-3
 - Cyg X-1
 - GRS 1915+105
- } Regular monitoring to improve our understanding of accretion-ejection processes.
 ⇒ **100 ks each** (~30 orbits) evenly distributed over the period of visibility of the source:
 1 orbit/week = good compromise based on the source variability.

- **ToO list (transient sources):**

- List of 73 microquasars (19 BH and 54 BH candidates)
- } 25 ToO requested (total of **75 ks**)
 Trigger criteria: flux higher than **50 mCrabs**
 in the MXT and/or ECLAIRs band



- **Low Mass X-ray binaries with a neutron star compact companion**

Search and monitoring of X-ray outbursts of LMXBs.

⇒ Regular monitoring to improve the understanding of accretion/ejection processes.



Observing strategy:

- 1) Twice-per-month observation of NS-LMXB requiring < 0.5 ksec to reach $S/N=10$
- 2) Monthly observation of NS-LMXB requiring between 0.5 and 1.5 ksec to reach $S/N=10$

Requested exposure time driven by ECLAIRs:

- Interest of the full 4-150 keV band
- ECLAIRs wide field of view will observe “for free” other sources in the FOV
- Small exposure times with MXT could allow pointing at more sources, but would require a lot of overheads (slew)

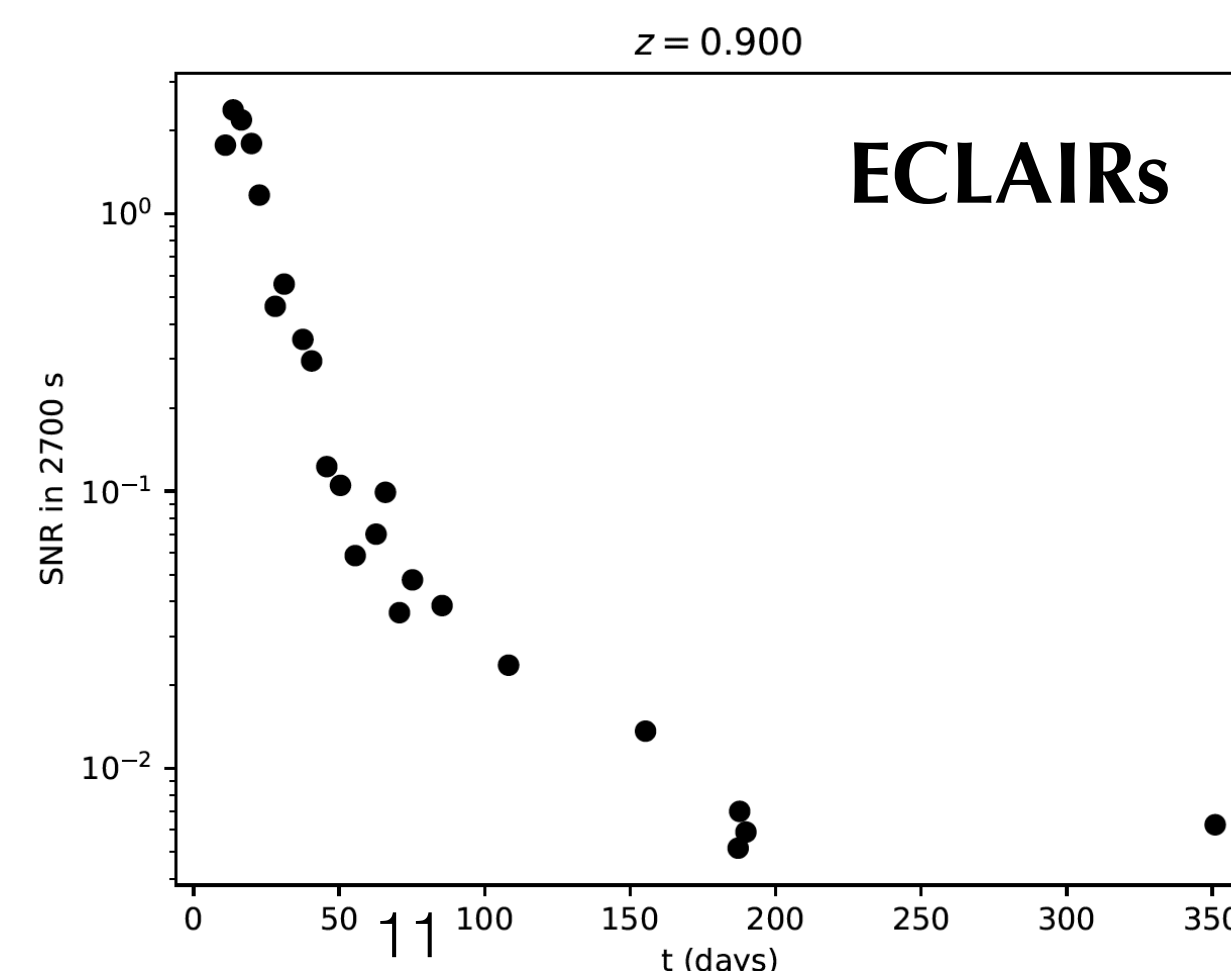
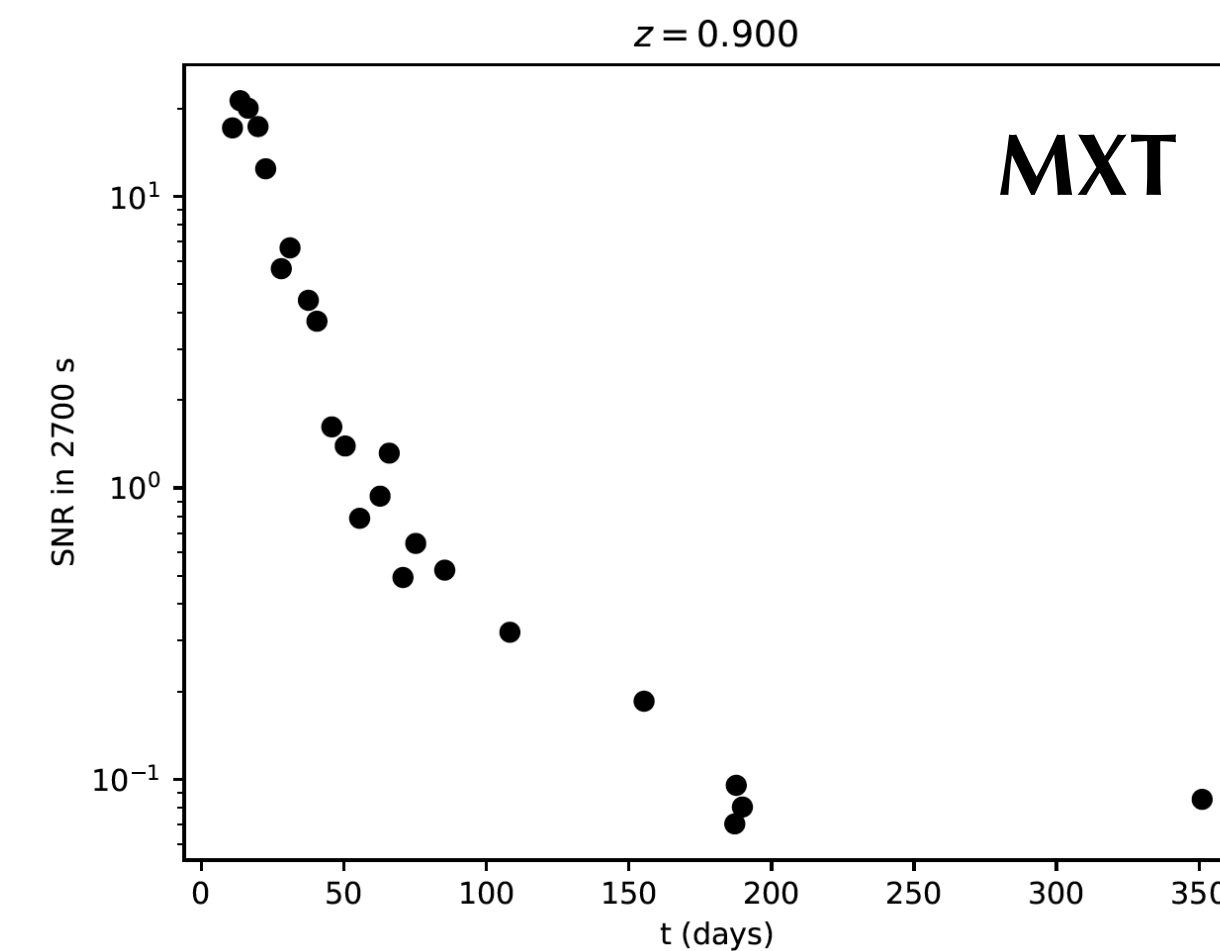
- **Mostly Seyfert galaxies from Swift/BAT catalogue (+ INTEGRAL)**
 - **AGNs observations above 10 keV essential:**
 - study non-thermal processes
 - observes sources strongly affected by absorption in the soft X-ray band
 - information on spectral features (high energy cut-off and reflection fraction)
- ⇒ provide insight into physical properties of the region around the central BH
- **Multi-wavelength (MXT + VT) monitoring:**
 - ⇒ put stronger constraints on spectral parameters.
 - **Proposal:** monitoring of 66 targets every week in B1 (~4 pointings on average)

• Search for Tidal Disruption Events (TDEs):

- Tidal disruption of matter on close approach to a black hole resulting in a range of transient behaviour to be understood.
- **Goal:** probe short and long-term spectral and temporal variability, obtaining a SNR > 10 and good parameter constraints.
- **MXT exposure time:** ~ 3 ksec to detect the source up to ~ 3 weeks after peak.

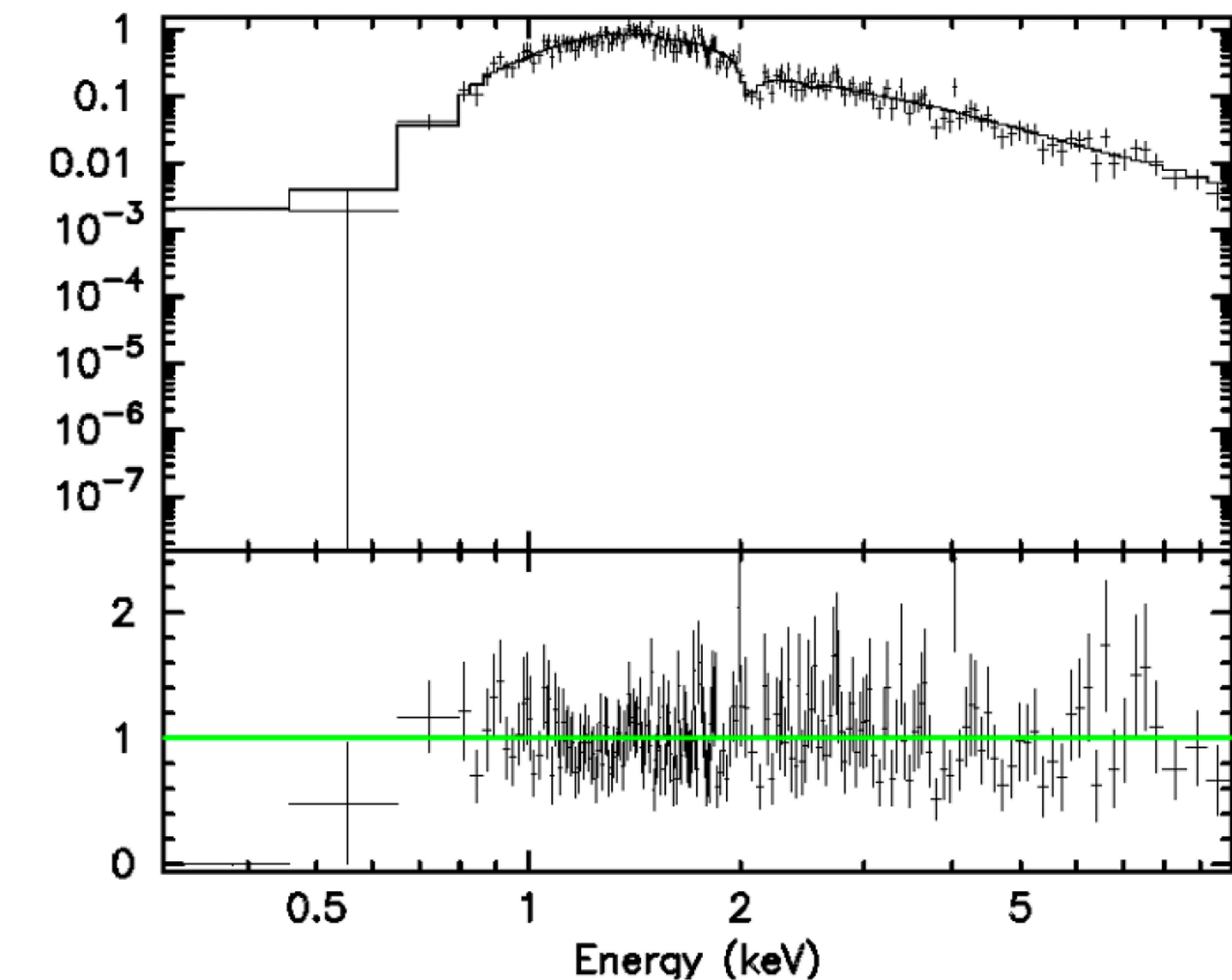
Example of Swift J2058 (jetted TDE):

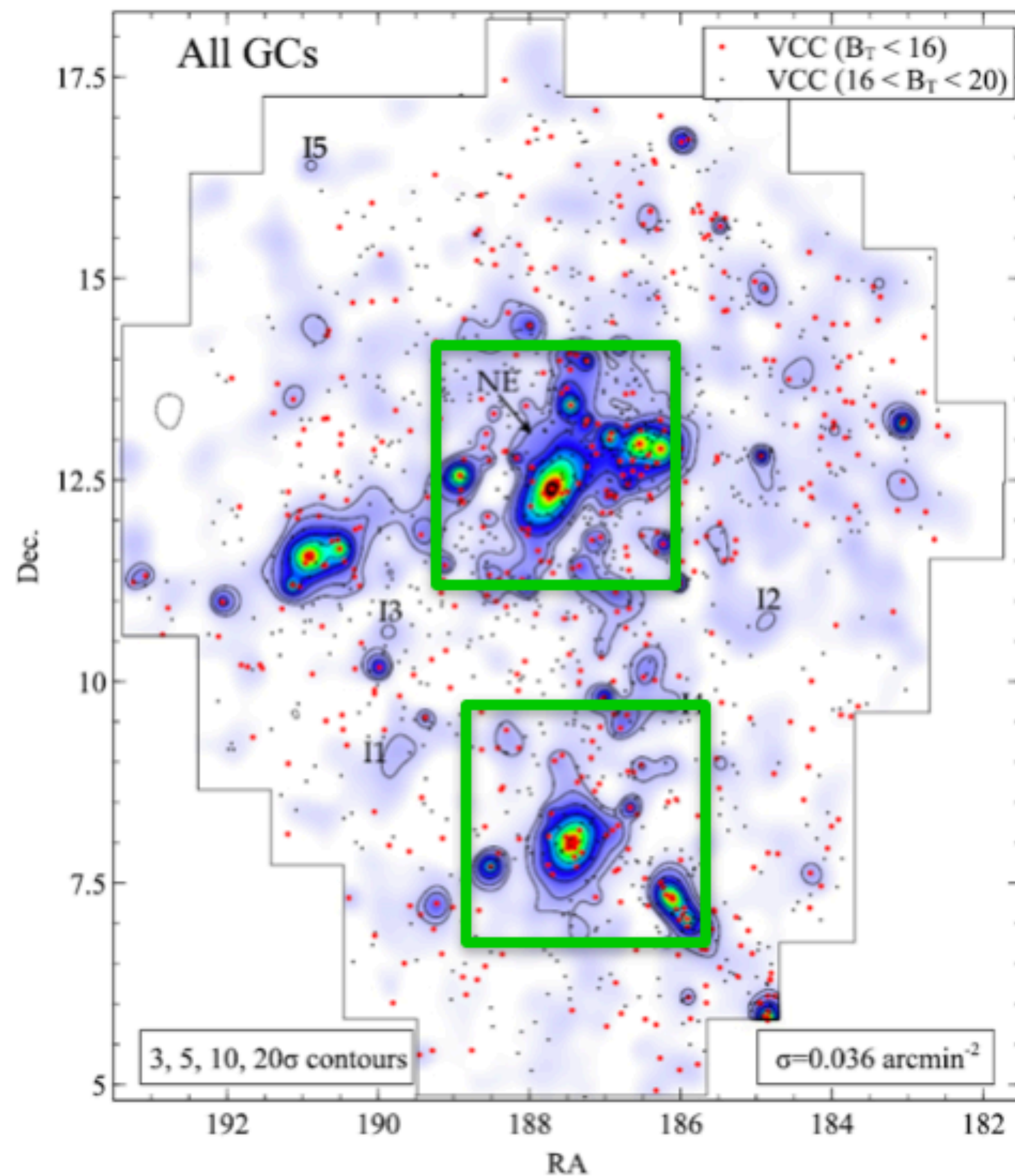
Simulation of the SNR vs time for MXT and ECLAIRs



Example of Swift J1644 (jetted TDE):

Simulation of MXT spectrum for 1 orbit at 2 days:





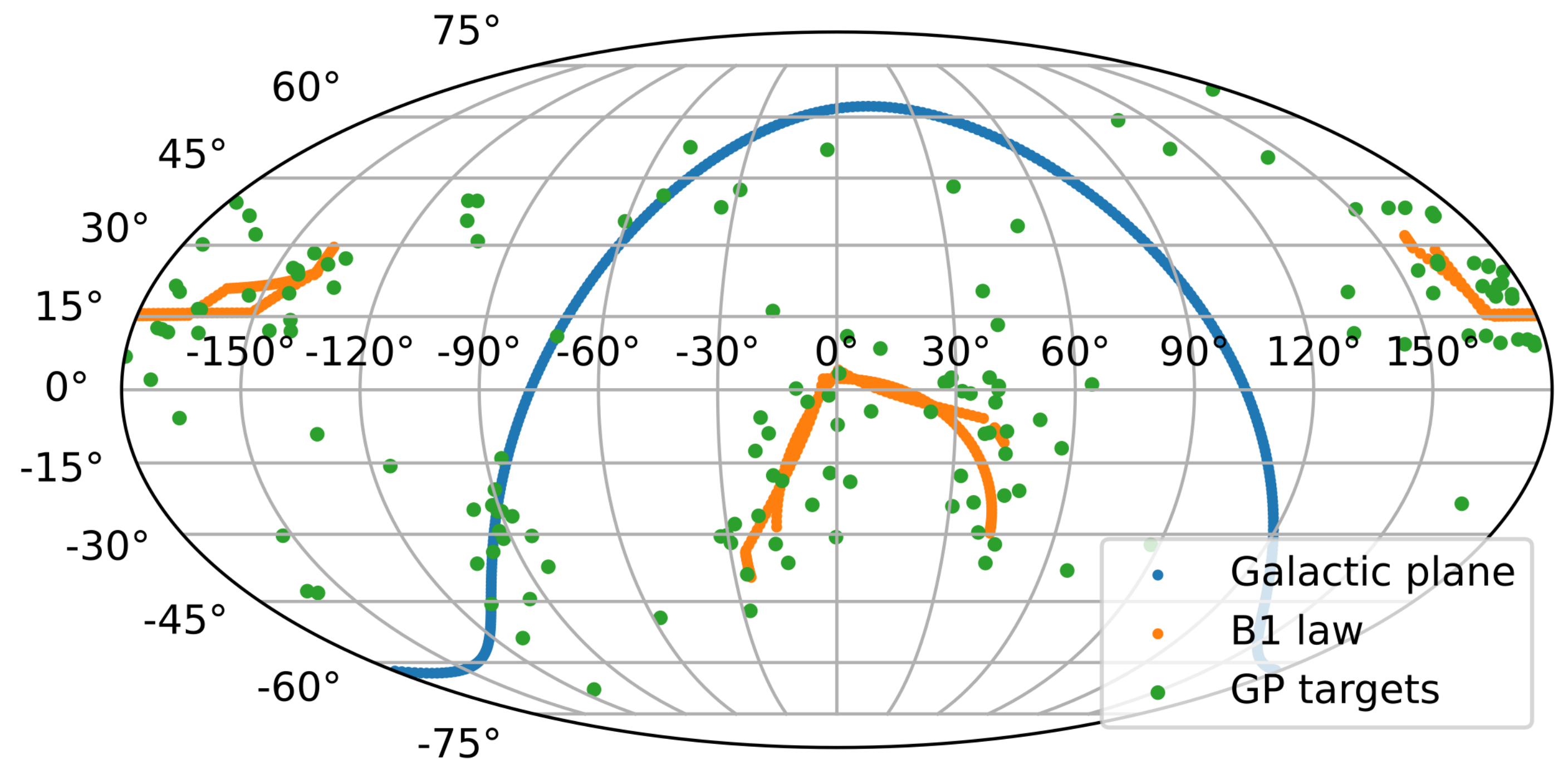
- (3deg x 3deg) tiling centered on M87 and M49 (high density of galaxies and globular clusters)
- Assuming 3ksec exposure time per tile \Rightarrow 2 regions x 9 tiles x 3 ksec = 54 ksec per observation.
- M87 and M49 compatible with B1 34 and 24 days / year respectively
- 1 observation every week in the B1 and every 3 weeks outside:
 - \Rightarrow In B1: 54 ksec x 5 repetitions = 270 ksec
 - Outside B1: 54 ksec x (52-5)/3 = 329 ksec

With such a strategy, 50% of the TDEs should be detected within \sim 5 days from the peak (90% within \sim 8 days).

Exact strategy TBC to minimize the requested observing time

- **Current number of sources = 159:**

- **3 microquasars** (outside B1 law)
- **7 CLQ** (4 compatible with B1 law)
- **20 LMXBs/NS** (outside B1)
- **129 AGNs and blazars** (including 66 AGNs from Swift/BAT catalogue and 58 sources either correlated with neutrinos or detected at VHE or of particular interest for accretion/ejection studies)





Synergies with MAGIC Cherenkov telescopes

- Joint monitoring with MAGIC for the following sources:

Source name	Monitoring Cadence with SVOM
Mrk 421	Weekly joint monitoring during common visibility period
M87	
PG 1553+113	
1ES 2344+514	
Mrk 501	
1ES 1959+650	
PKS 1510-089	
1ES 0229+200	
3C 279	SVOM monitoring → MAGIC ToO if X-ray flare
OJ 287	
BL Lac	
3C 66A	
PKS 1222+216	
3C 264	
TON 116	
OP 313	
Cyg X-1	Weekly monitoring with SVOM
Cyg X-3	

- **Observing strategy:**

- **Microquasars:** weekly monitoring during visibility period (not in B1)
- **AGN/CLQ:** Single pointing for 6 targets (no X-ray flux available). For G22css: daily monitoring in B1 and weekly monitoring outside (evaluate the amplitude of short-term fluctuations).
- **LMXBs:** twice per month or monthly monitoring (outside B1)
- **Blazars and VHE AGNs:** One pointing or regular (from day to month) monitoring (synergy with HESS, MAGIC, ...)
- **AGNs from Swift/BAT catalog:** weekly monitoring during B1

	Requested time (ksec)	Available Fr time (ksec)	Difference (ksec)
Total time within B1 (in ksec)	3663	4513.5	850.5
Total time outside B1 (in ksec)	1336	796.5	-539.5
Total time (in ksec)	4998	5310	312

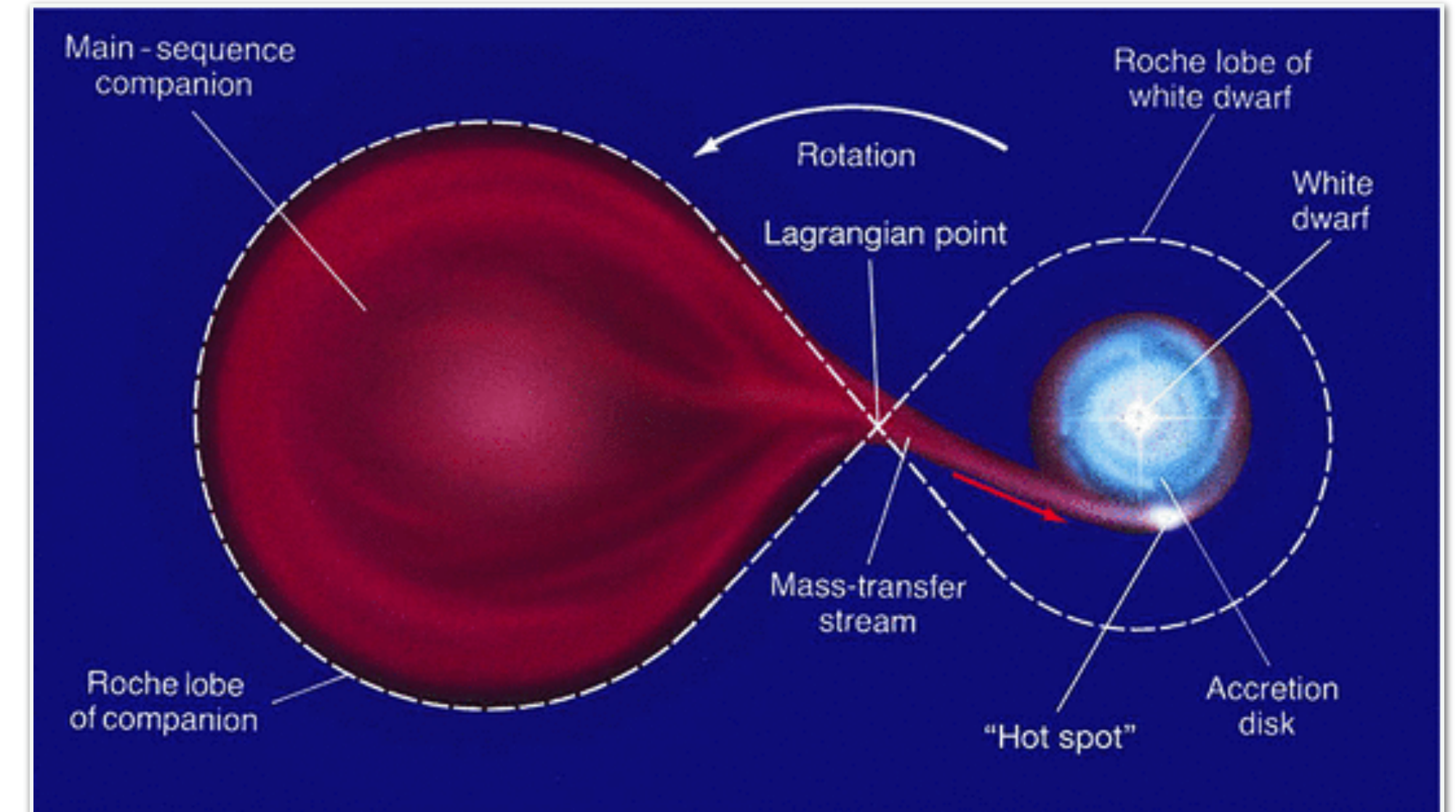
- Priority (A+ / A / B / FIT) attributed to each source
- Does not include yet survey of Virgo cluster nor CVs and unclassified sources \Rightarrow will increase the requested time.
- Available time = total available time (not effective time taking into account the fraction of time dedicated to GP)

- **Multi-wavelength observation of CVs:**

- Do the very high accretion rates measured in several sources correspond to a general property of CVs (could have strong implications on accretion process in these sources).

- **Observing strategy:** one observation of 20-30 ks / source

- **Focus on closeby (<500 pc) objects:** 31 sources.



- **Unclassified Fermi and INTEGRAL sources:**

- 79 Fermi sources (priority A) + 10 INTEGRAL sources (priority B)
- Assuming power law spectrum (E^{-2} and flux density = 10^{-12} erg/s/cm²)
- **MXT exposure time = 50 ksec (SNR = 5)**
- **1 pointing per source**

- **Ultra Luminous X-ray sources**

- $L > L_{\text{Edd}}$ for neutron star or stellar black hole
- Observing strategy TBC

Still to be done

- Include survey of Virgo cluster (pointing strategy TBC) + CVs + ULXs + unclassified Fermi sources.
- Planning implementation for survey mode sources to be checked
- Decision to be taken regarding overlapping sources between Fr and Ch catalogues
- List of sources for nominal ToOs to be finalized
- Final GP catalog will be provided during the commissioning (yearly planning to be updated before beginning of October).

THANK YOU