



M1 INTERSHIP:

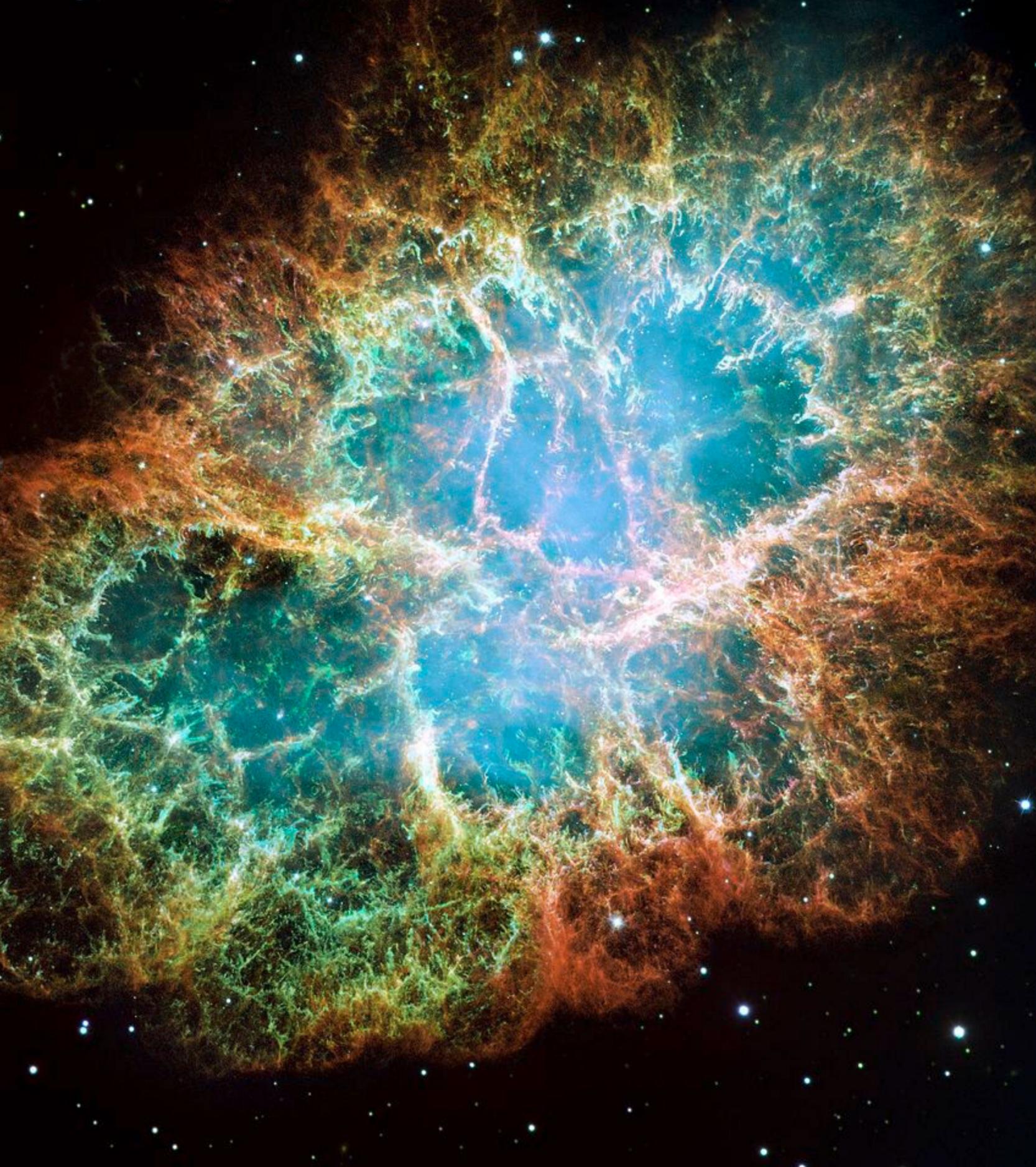
# PREPARATION OF A BACKGROUND MODEL FOR SIMULATIONS OF SPACE-BASED X-RAY OBSERVATORIES

Presented by Latafi Damien



Faculté de **physique et ingénierie**

Université de Strasbourg



# **TABLES OF CONTENTS:**

## **INTRODUCTION**

Context of the internship and Problematics  
Goals and objectives of the internship  
X ray background Components

## **THEORETICAL DESCRIPTION AND**

## **IMPLEMENTATION OF X RAY BACKGROUND**

Theoretical aspect  
Point sources implementation  
Diffuse sources implementation  
CXB & GXB implementation

## **CONCLUSION**

## **THANKS**

# INTRODUCTION

CONTEXT AND PROBLEMATICS OF THE INTERSHIP

## SVOM MISSION

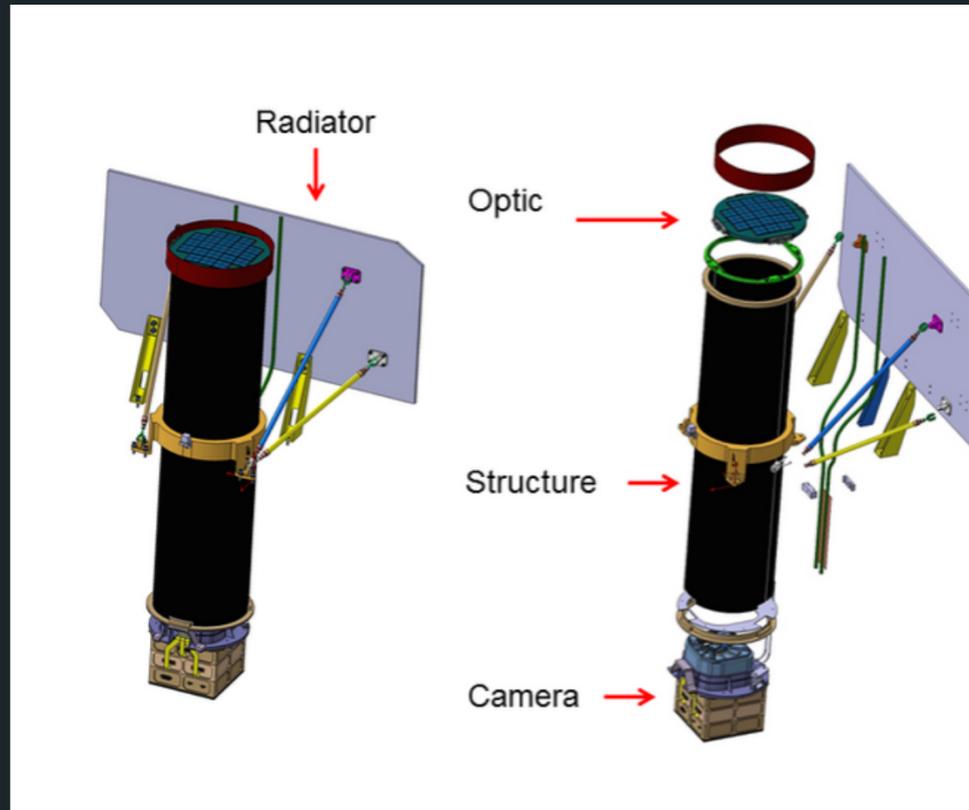
MXT (MICROCHANNEL X-RAY  
TELESCOPE)

## X RAY BACKGROUND

WHAT ARE THE INFLUENCES  
OF THE X RAY  
BACKGROUND ON  
MEASUREMENTS

HOW CAN WE SIMULATE THE  
BEHAVIOR OF X RAY  
BACKGROUND WITH THE  
TOOLS AVAILABLE

WHAT ARE THE MAJOR  
COMPONENTS ?



SEARCH OF GAMMA RAYS BURST

# OBJECTIFS AND GOALS OF THE INTERSHIP

Objectifs :

1

CARACTERISATION OF  
THE X RAY  
BACKGROUND

SCIENTIFICS ARTICLES AND  
BIBLIOGRAPHIC RESSOURCES

2

IMPLEMENTATION OF  
THE X RAY  
BACKGROUND

BASH SCRIPT AND USE OF X  
RAY TOOLS

3

TEST AND  
VERIFICATION OF  
THE MODEL

TEST AND VERIFICATION OF  
THE ENTER FILE

Goals:

1

Build X ray background file as an  
environment for measurements  
made by a given virtual telescope

2

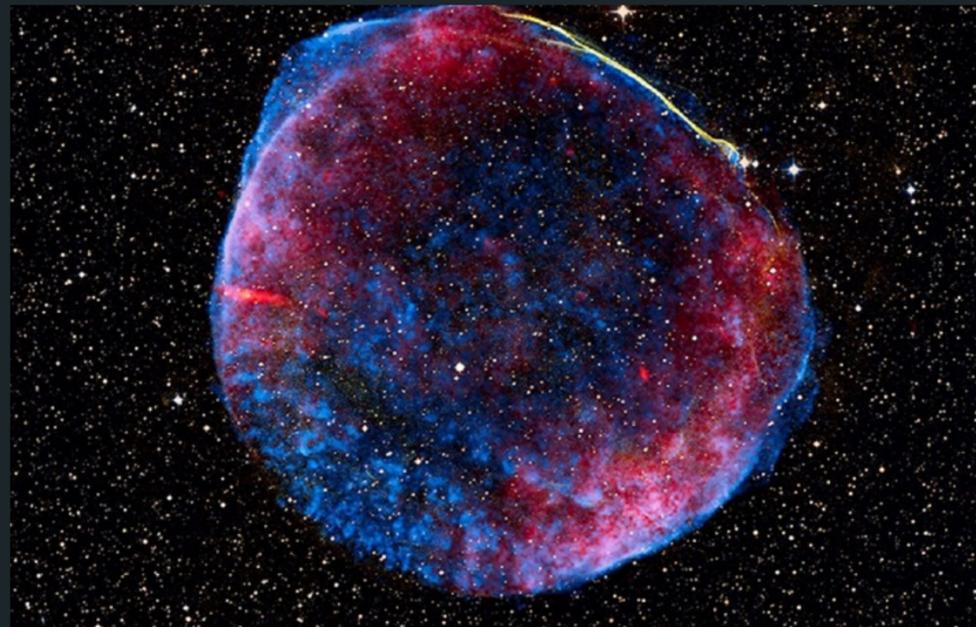
Allow to compare multiple  
telescope

# X ray background Components



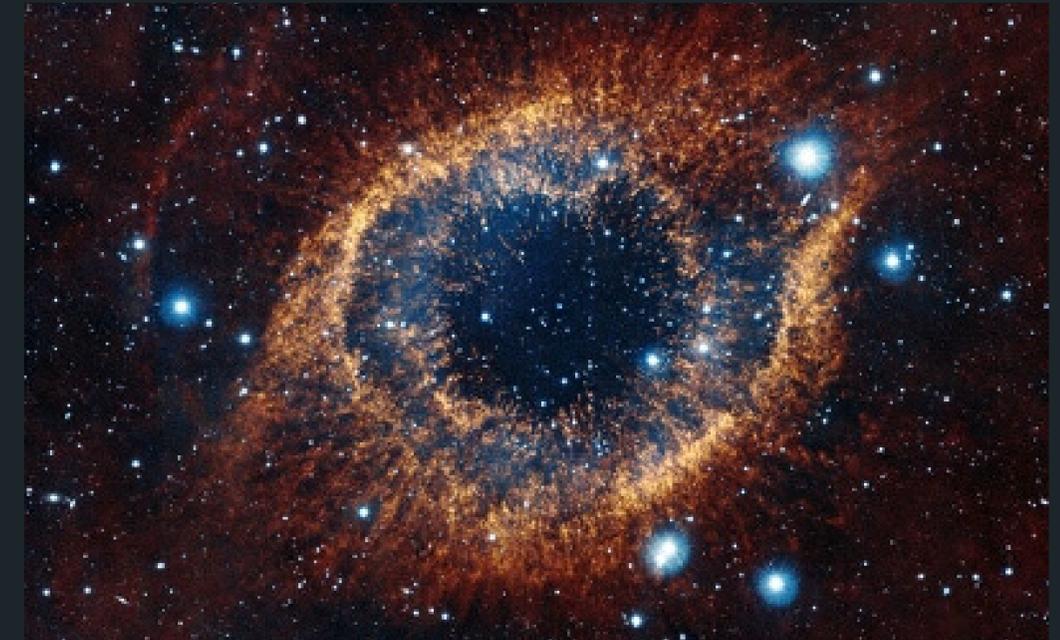
## POINTS SOURCES

Taken from the "Second ROSAT all-sky survey (2RXS) source catalog"



## DIFFUSE SOURCES

Galaxies clusters & supernova remnants



## GXB AND CXB

Galactic & Cosmic X rays background

# THEORETICAL DESCRIPTION AND IMPLEMENTATION OF X RAY BACKGROUND

WHAT IS A SOURCE IN ASTRONOMY ?

SOURCE FLUX

SOURCE SPECTRUM

LOCATION IN THE SKY

# SPECTRUMS

## Thermal Spectrum

### THERMAL BREMSSTRAHLUNG

acceleration of electrons in collisions  
with other electrons  
-hot gas

### BLACK BODY

Plancks law

### EMISSION AND ABSORPTION LINES

-Atoms, atoms nuclei.

## Non Thermal Spectrum

### SYNCHROTRON

radiation associated with  
acceleration of electron in a  
magnetic field  
-powerlaw shape

### INVERSE COMPTON

scatters photons from  
lower to higher energies in  
interactions with electrons  
-power law shape  
-galaxy

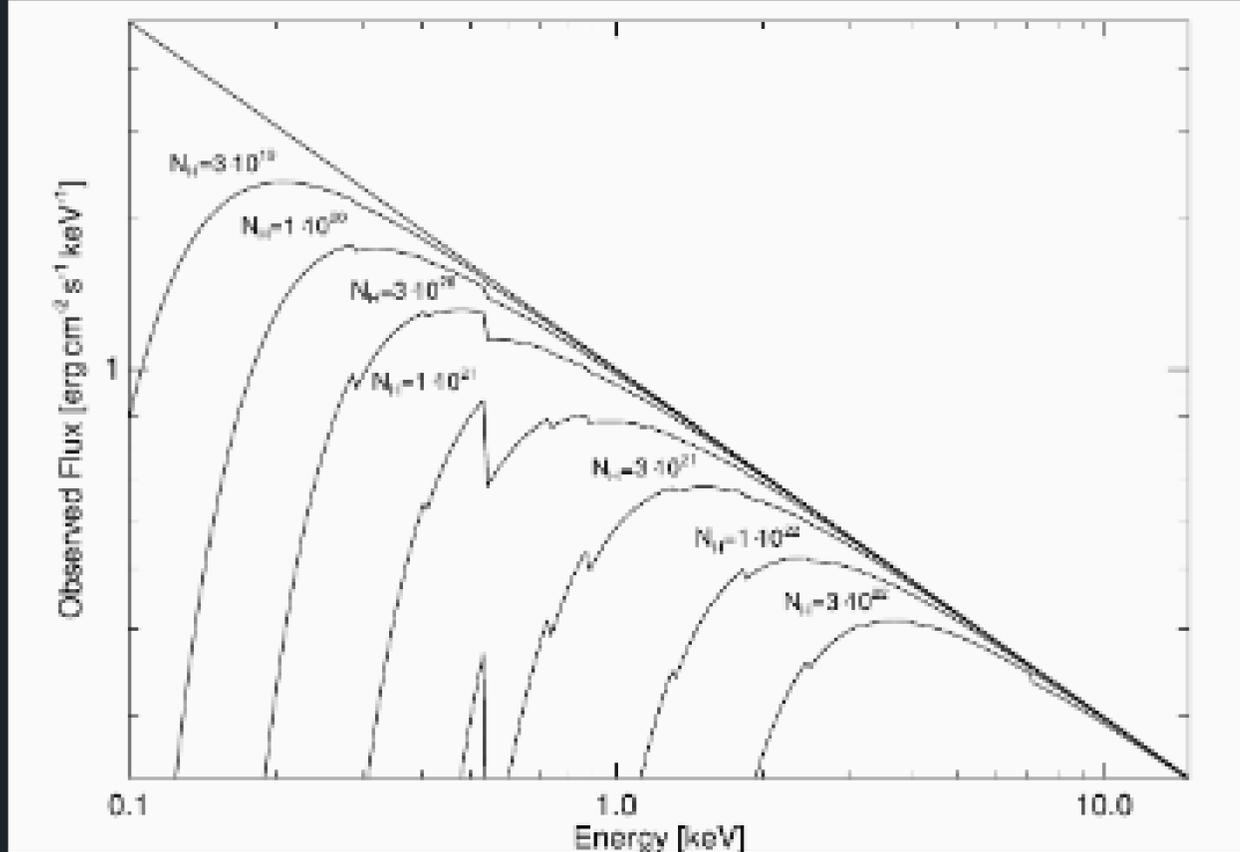
# NH: hydrogen column density

TRANSLATES THE AMOUNT OF HYDROGEN SPRAYED ALONG THE LINE OF SIGHT

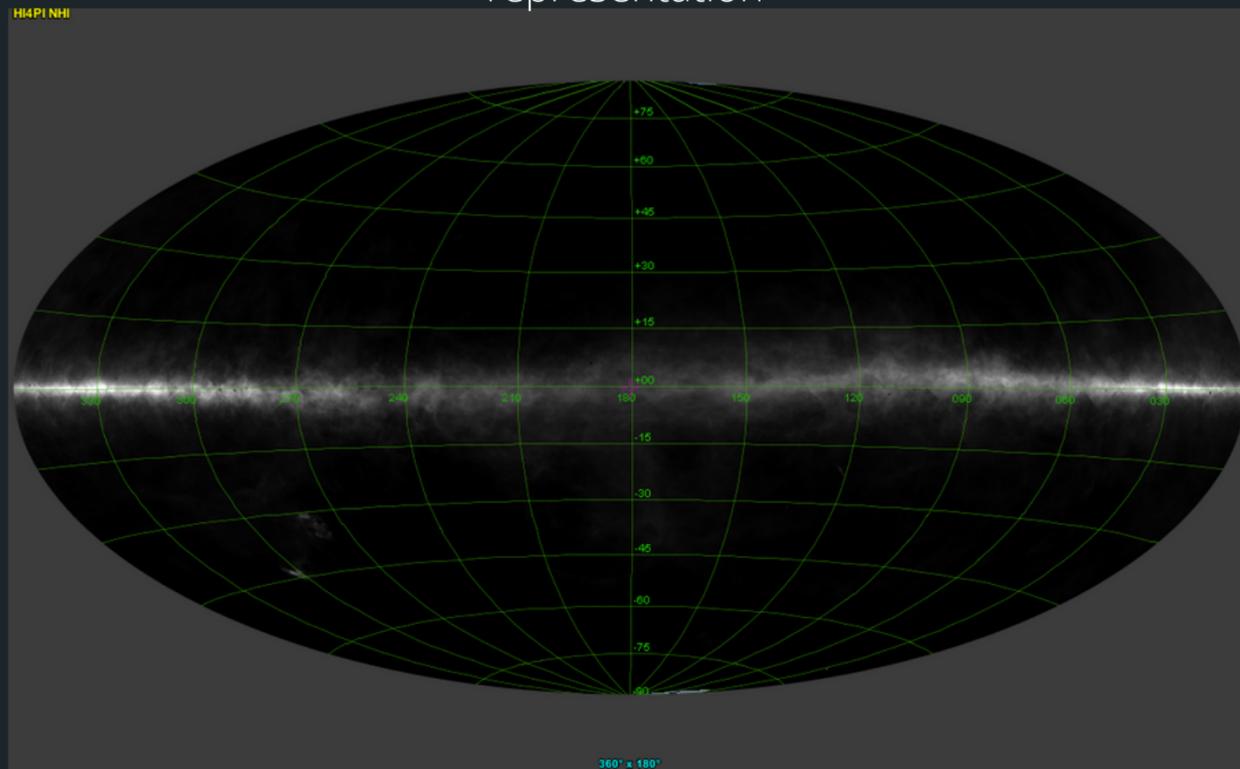
Expressed as a surface density of hydrogen in  $\text{cm}^{-2}$

INFLUENCES THE ENERGY OF PHOTONS

reducing the number of photons observed at low energy



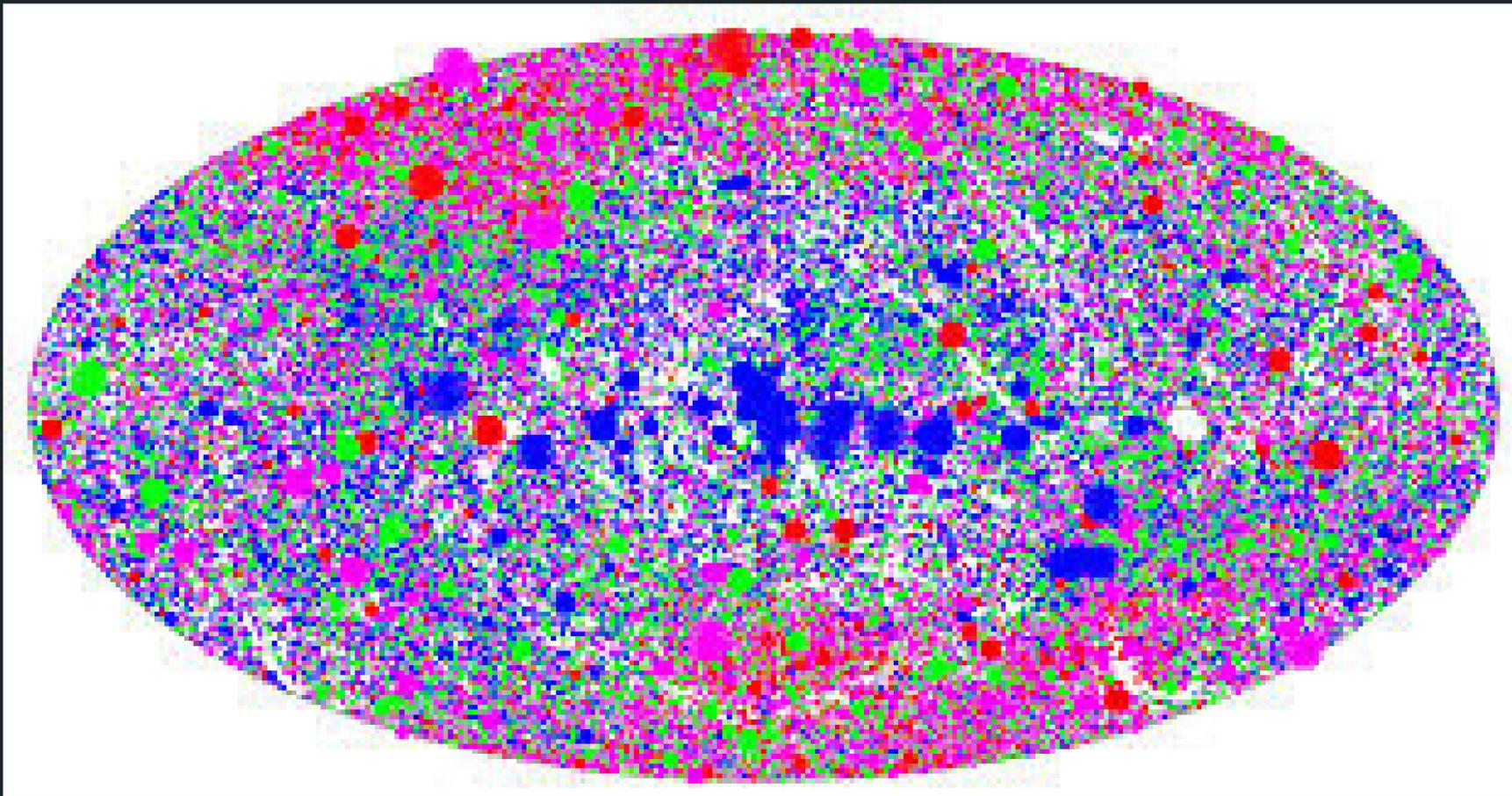
Effect of Hydrogen column density in flux energy representation



Aitoff projection of the HI4PI map

# Point sources implementation

## Rosat catalog



Aitoff projection in Galactic coordinates of the sky distribution of 2RXS sources. The size of the symbols scales with source count rate and the colours represent different spectral characteristics (increasing hardness ratio from red to blue).

### Tables components :

RA, DEC, Nh, Number of photons, T, Photon index

### Point source sampling

- 1) 135 000 point sources
- 2) 73,969 most convincing sources

### Point source splitting according to their spectrum

2472 Power law spectrum

397 Mekal spectrum

1479 Black-body spectrum

69,621 non-fitted with powerlaw spectrum.

# Diffuse sources implementation

Galaxies clusters & Supernova remants

Extended sources  
spatial flux dependance



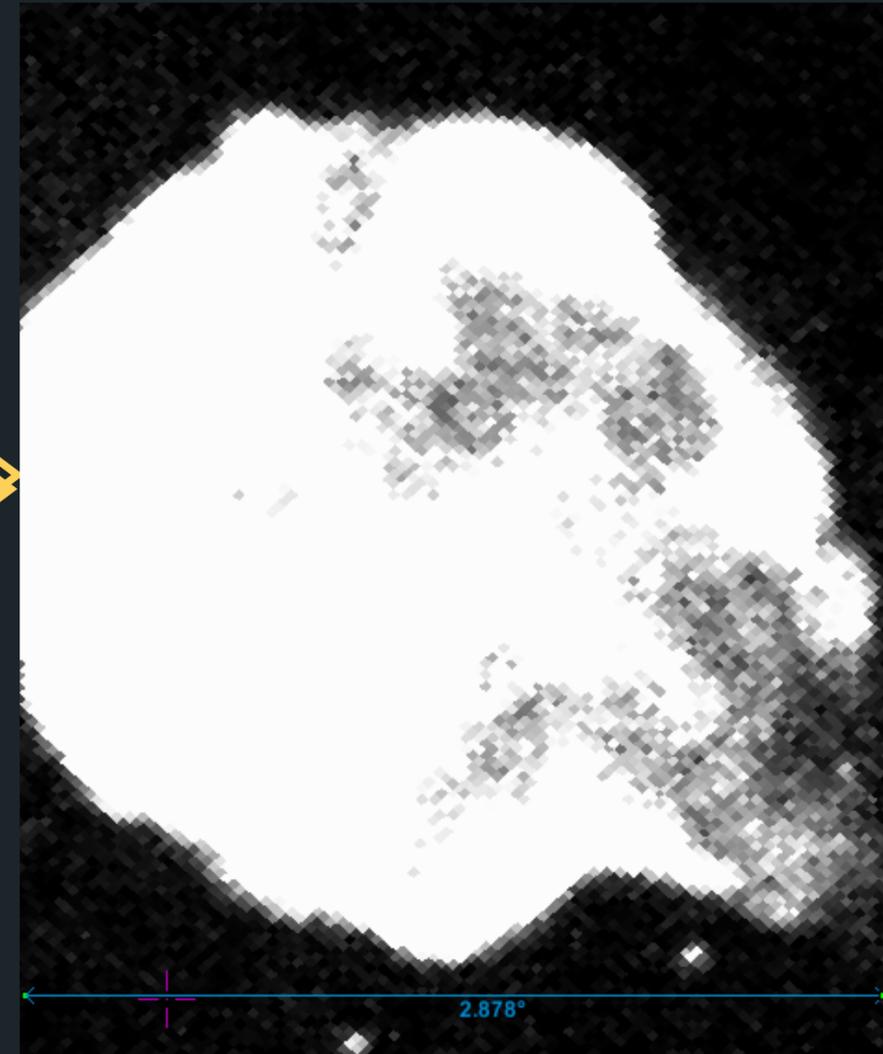
Spatial flux  
representation needed



Located object



fixed value of  $N_h$  column density



**CYGNUS LOOP**

Hips2fits image of an SNR

located at RA=73.9816

DEC=-8.5645

Size = 2.878°

# Cosmic X rays background

1

## BIBLIOGRAPHIC RESEARCH

"The 2-8 keV cosmic X-ray background spectrum as observed with XMM-Newton" by Andrea De Luca and Silvano Molendi

2

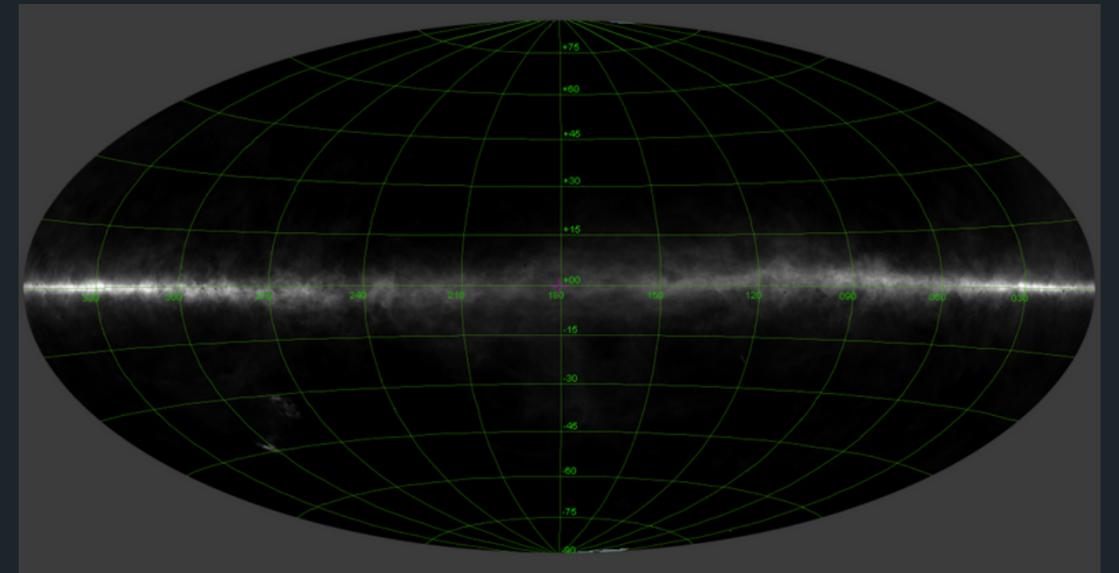
## PROPERTIES

isotropic background  
Power law spectrum  
(Gamma=1.41)  
fixed Flux =  $(2.24 \pm 0.16) \times 10^{-11} \text{ erg cm}^{-2} \text{ s}^{-1} \text{ deg}^{-2}$  in 2-10keV energy band

3

## IMPLEMENTATION

Full sky cut in 32  $(45 \times 45) \text{ deg}^2$  images with a flux per image of  $2.24 \times 10^{-11} \times (45 \times 45) = 4.536 \times 10^{-8} \text{ erg cm}^{-2} \text{ s}^{-1}$   
Nh column density images with "HI4PI" map



The HI4PI map

# GXB(Galactic X rays background)

LHB(Local hot bubble)



## BIBLIOGRAPHIC RESEARCH

"The Structure of the Local Hot Bubble"  
by Wenhao Liu ...

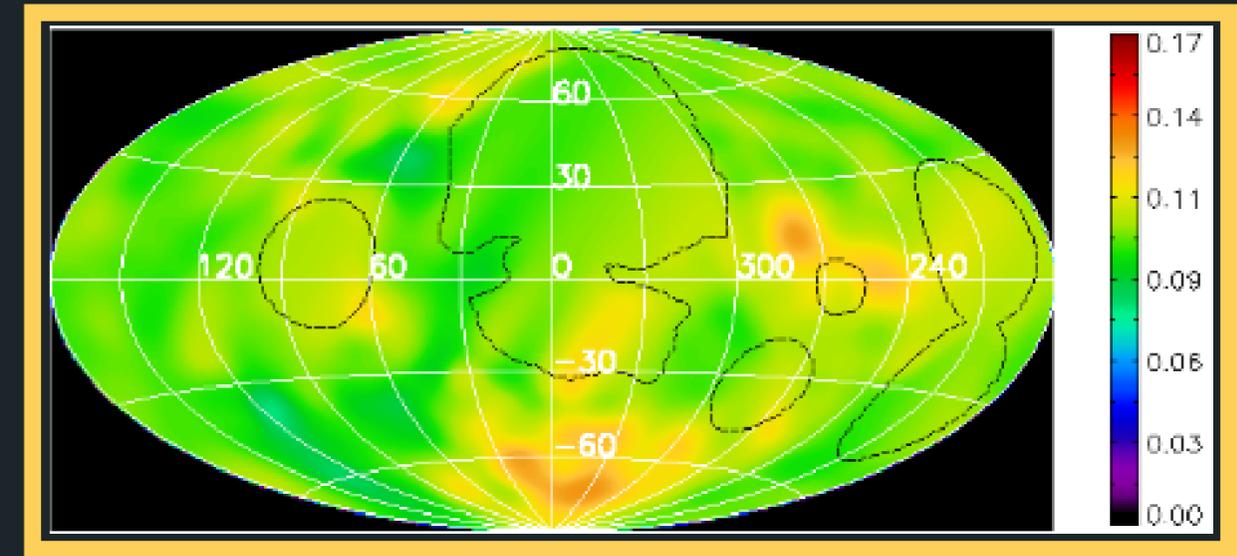


## PROPERTIES

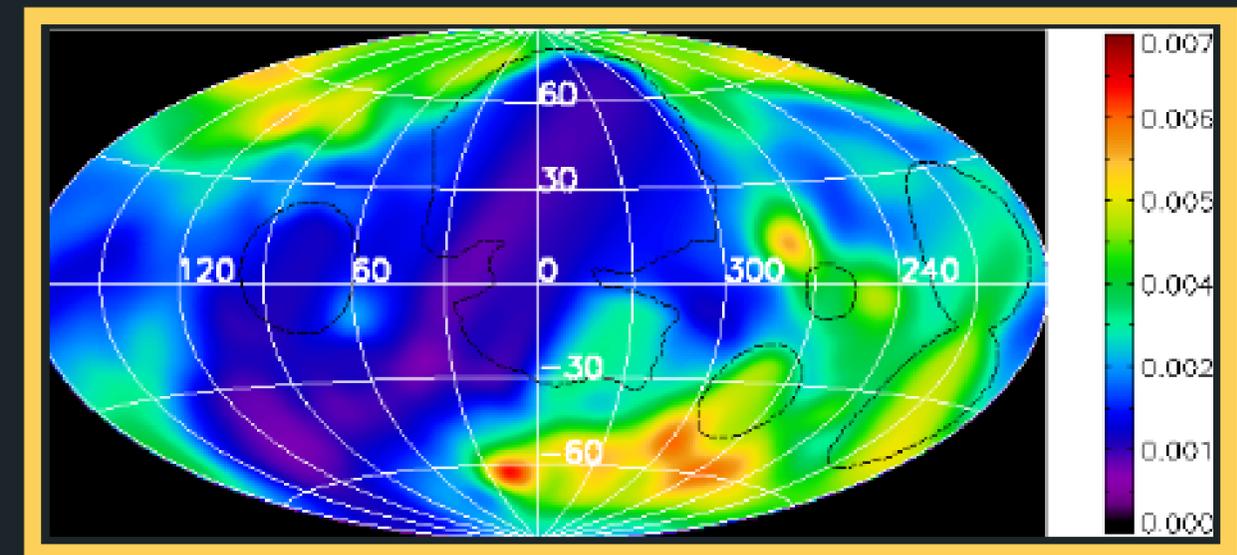
Fixed temperature = 0.097 keV  
Anisotropic emission and flux  
no  $N_h$  cause of his locality  
Hot gas  $\longrightarrow$  mekal spectrum

## IMPLEMENTATION

Full sky cut in 32 (45\*45)deg<sup>2</sup> images with  
a flux per image oof  $9.598 \cdot 10^{-8}$  erg s<sup>-1</sup>  
cm<sup>-2</sup>.  
-No  $N_h$  values cause of his locality



The Aitoff-Hammer projection of the LHB temperature in keV



The Aitoff-Hammer projection of the LHB tLHB emission measure in cm<sup>-6</sup>pc

# Conclusion

## Going further

- 1** All the codes and the files created are modular you can add or improve the final input file
- 2** Create a virtual telescope  
Use SIXTE and specify the input file, telescope and the position of the object you want to study

## internship review

# THANKS

I would first like to thank the entire teaching staff of the Faculty of Physics and Engineering and the professional contributors responsible for basic physical training, for having provided the administrative part of it.

I also thank Mr. Maggi Pierre for help and advice regarding assignments during the internship.