

CALIBRAÇÃO DO MAPA DE EMISSÃO
SÍNCROTRON DO RADIOTELESCÓPIO GEM
UTILIZANDO OS DADOS DE TEMPERATURA
ABSOLUTA DO EXPERIMENTO ARCADE 2

Mariana Chinaglia
Prof. Carlos Alexandre Wuensche

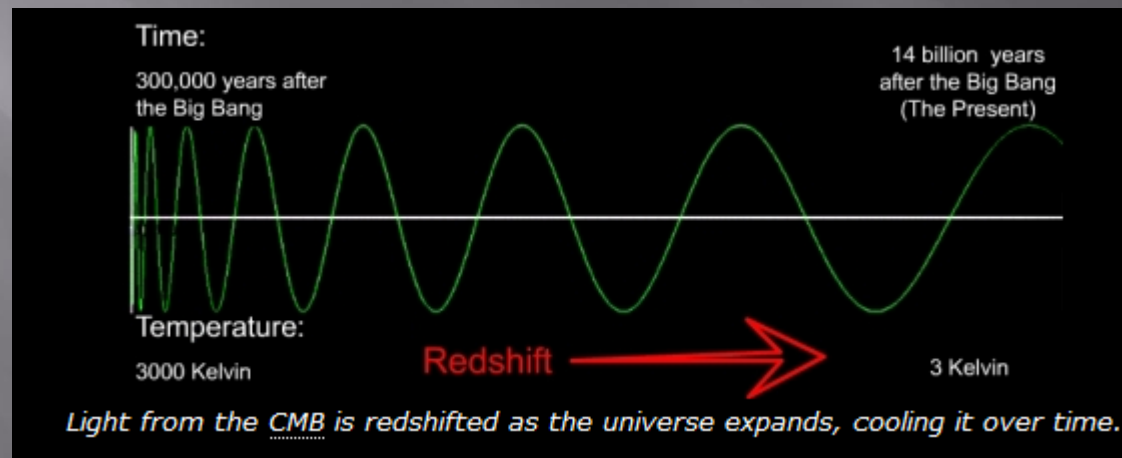
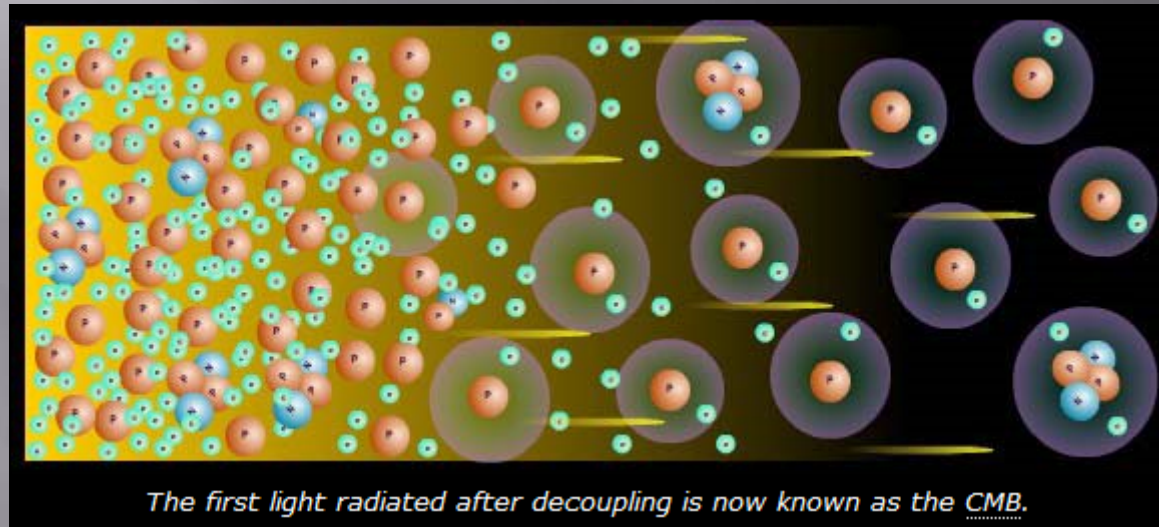
Motivação

- A motivação deste trabalho é produzir um mapa de emissão síncrotron em 2,3 GHz com relação sinal/ruído otimizada, utilizando os dados do experimento GEM (Galactic Emission Mapping), de modo a auxiliar o processo de separação de foregrounds (contaminantes astrofísicos) na análise de dados da Radiação Cósmica de Fundo (RCF).

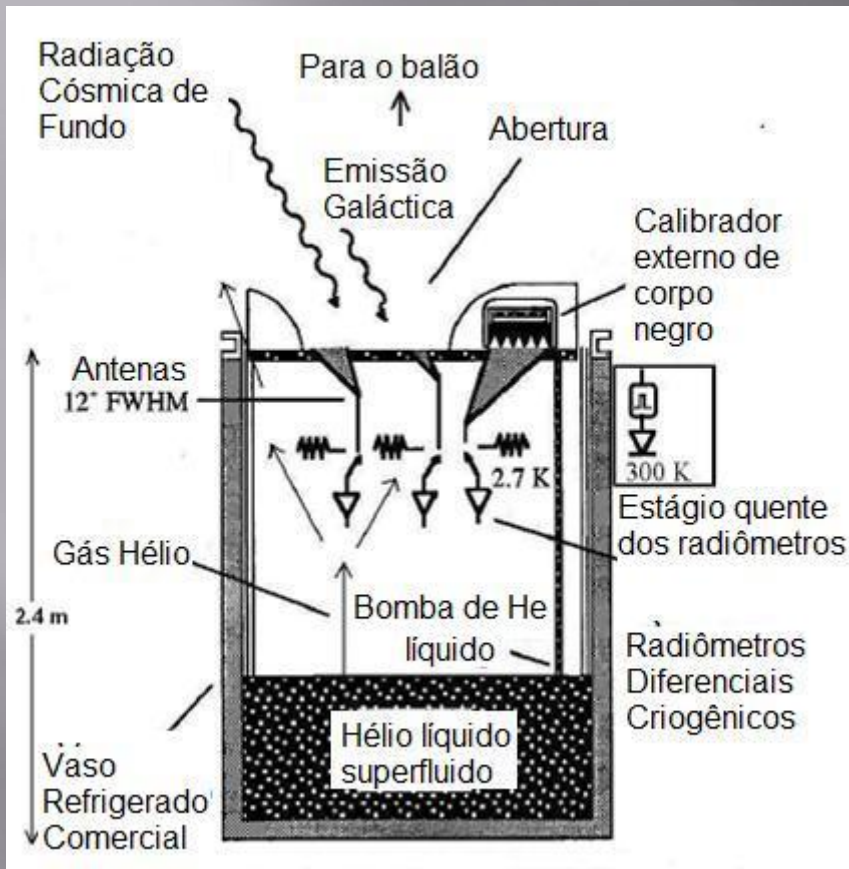
Objetivo

- Calibrar os mapas de emissão Galáctica, cujo processo de emissão dominante nas frequências medidas é o síncrotron, produzidos com o radiotelescópio GEM com medidas de temperatura do ARCADE 2 (Absolute Radiometer for Cosmology, Astrophysics and Diffuse Emission).

Radiação Cósmica de Fundo em Microondas (RCFM)



ARCADE 2

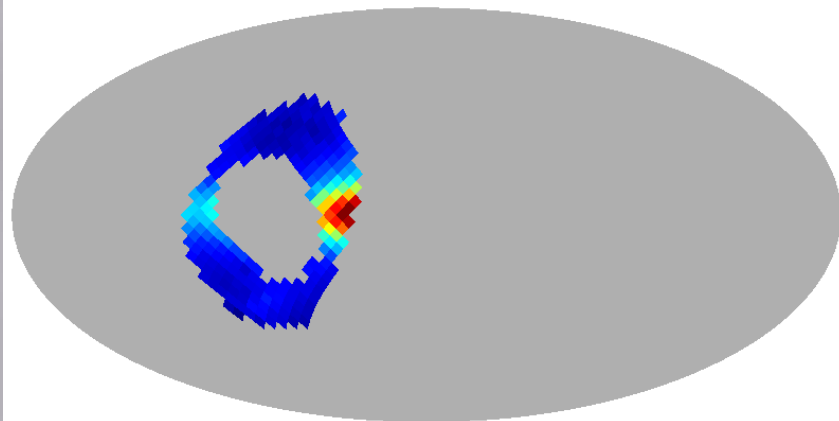


Resolução	11,6 minutos de arco
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Sensibilidade	1 mK
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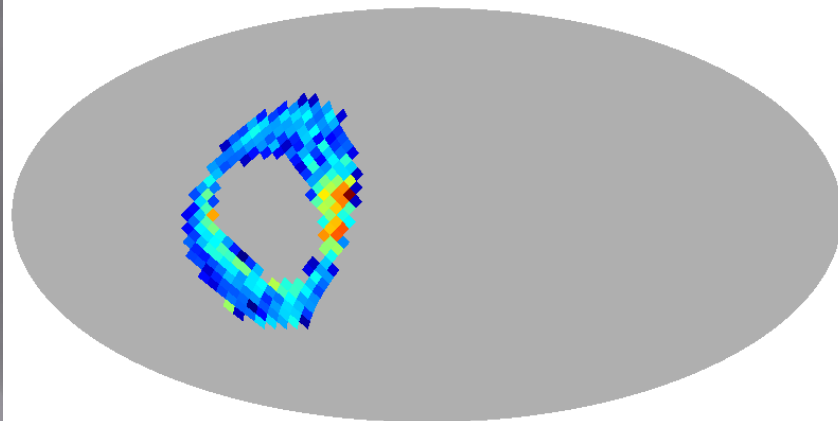
Frequências	3, 5, 8, 10, 30, 90
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ARCADE 3.15 GHz



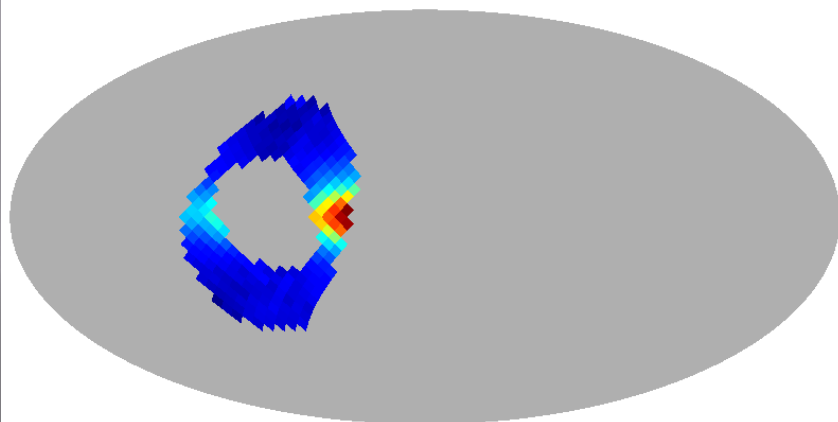
2.8  3.2

ERRO_ARCADE 3.15 GHz



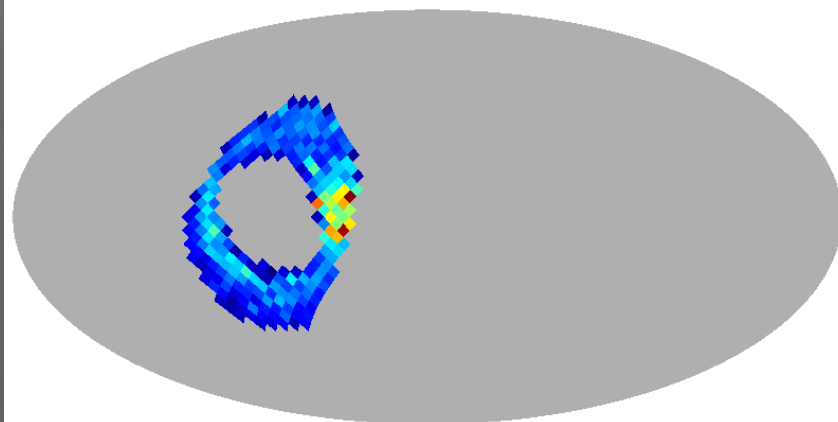
0.0028  0.040

ARCADE 3.41 GHz



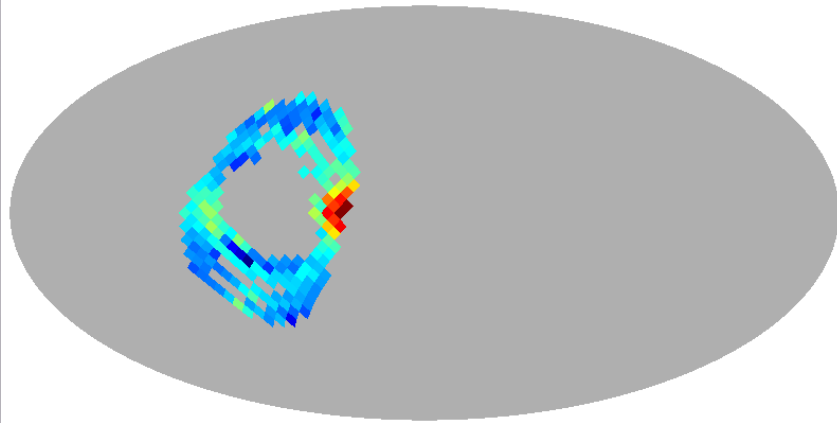
2.8  3.2

ERRO_ARCADE 3.41 GHz



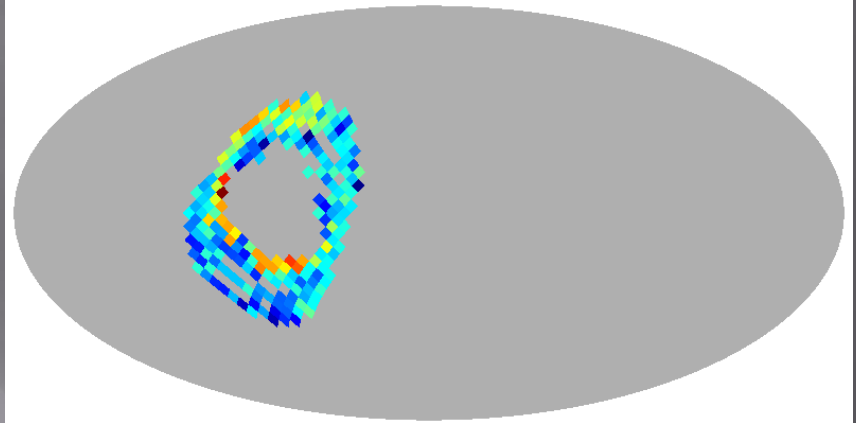
0.0027  0.043

ARCADE 7.98 GHz



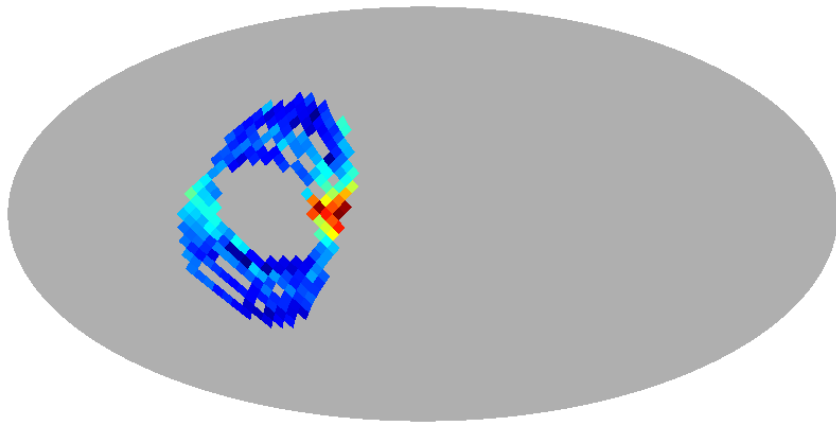
2.7  2.8

ERRO_ARCADE 7.98 GHz



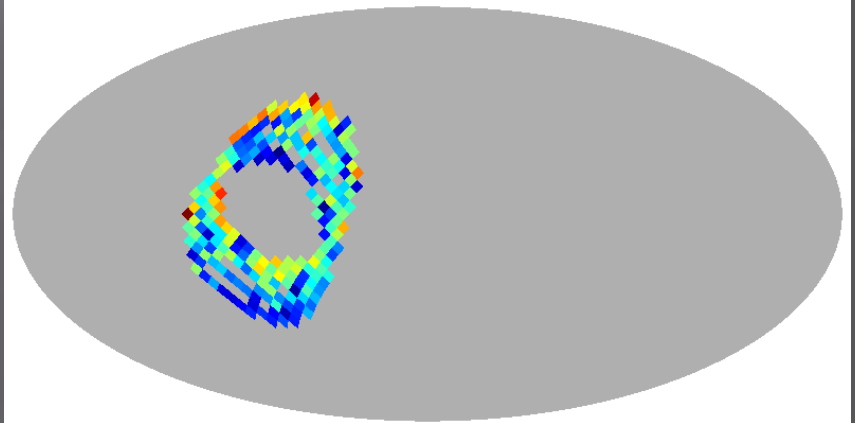
$4.5e-005$  0.018

ARCADE 8.33 GHz



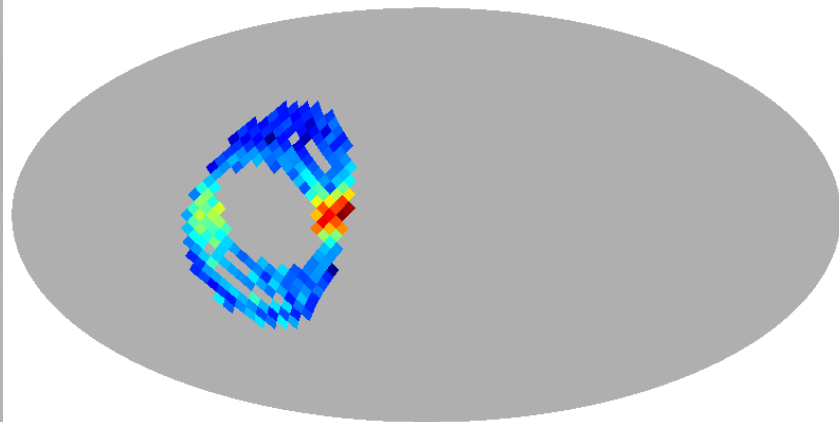
2.7  2.8

ERRO_ARCADE 8.33 GHz



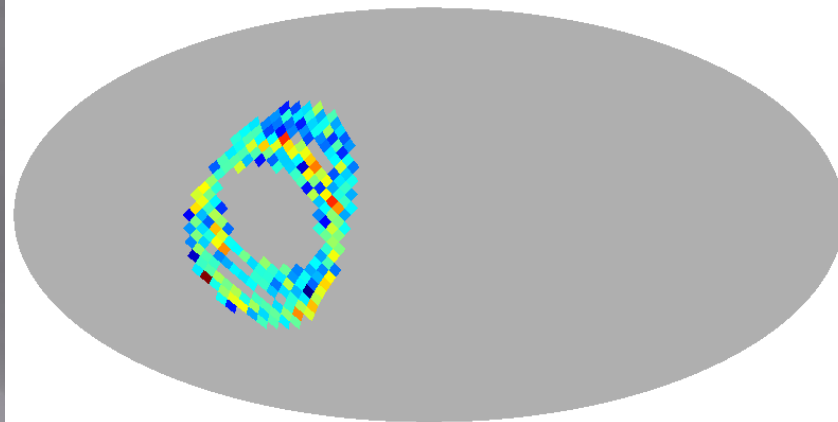
0.00022  0.016

ARCADE 9.72 GHz



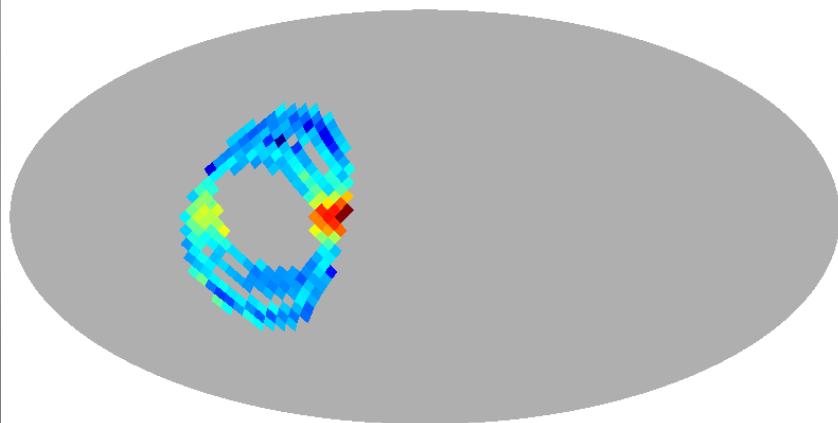
2.7  2.8

ERRO_ARCADE 9.72 GHz



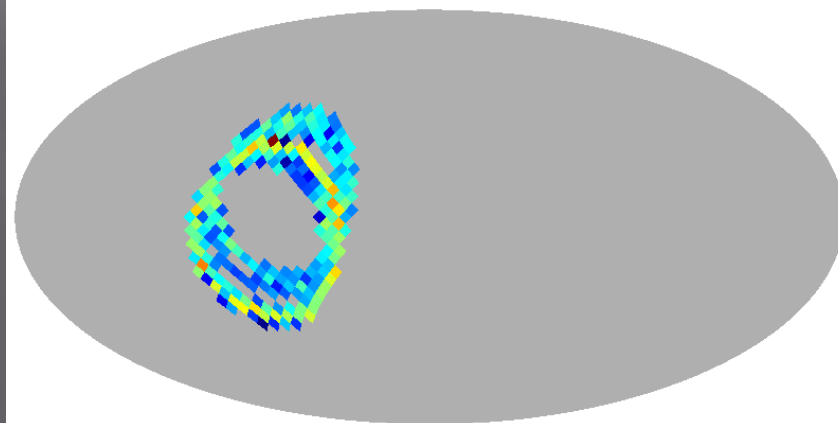
0.00029  0.0089

ARCADE 10.49 GHz



2.7  2.8

ERRO_ARCADE 10.49 GHz

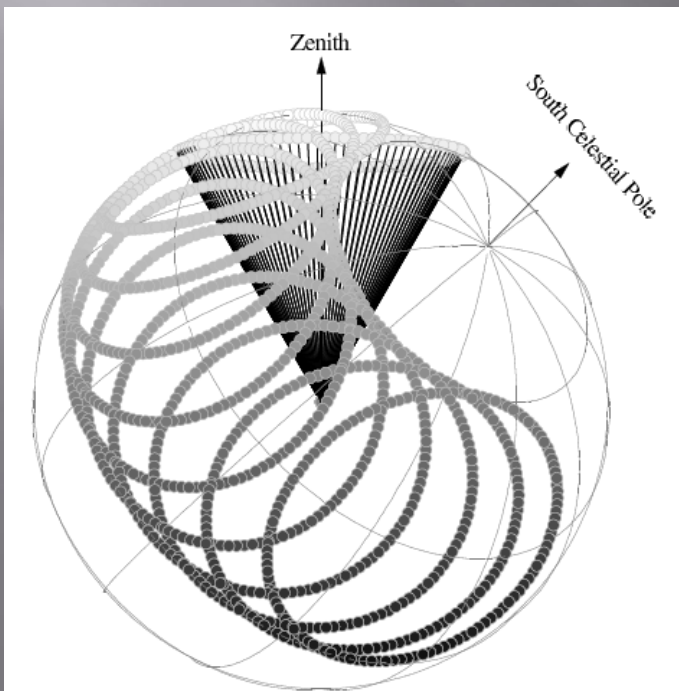


3.9e-005  0.0097

As medidas da RCF são feitas através de experimentos que observam o céu na faixa de GHz. No entanto, existem contaminantes (foregrounds), como a emissão Galáctica, que atrapalham a análise dos dados, pois possuem um sinal significativo nas frequências em que a RCF é observada.

GEM

O GEM (Galactic Emission Mapping) é um instrumento de solo que foi desenvolvido para medir a intensidade e polarização da radiação síncrotron Galáctica nas frequências de 0,408; 1,465; 2,3; 5 e 10 GHz.



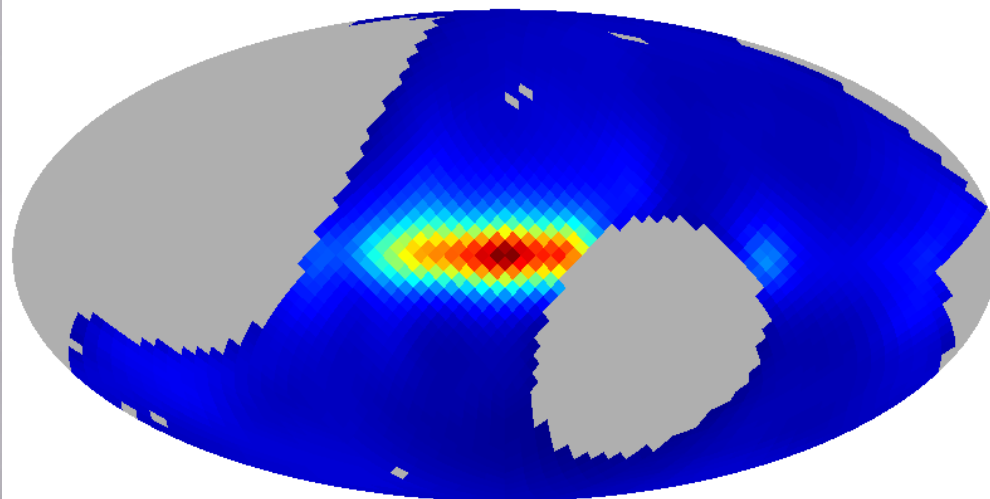
A estratégia observacional do GEM e seu design experimental buscam a produção de templates síncrotron com o objetivo de minimizar esse foreground nos mapas da RCF.

GEM

Sítio	Cachoeira Paulista, Brasil	Villa de Leyva, Colômbia
resolução (HPBW)	$2,31^{\circ} \times 1,82^{\circ}$	$2,30^{\circ} \times 1,92^{\circ}$
Cobertura do Céu	$-52^{\circ} < \delta < +8^{\circ}$	$-24^{\circ} < \delta < +36^{\circ}$
Cobertura do Céu %	46,8	46,3
Frequência	2300	2300
Altitude (m.a.s.l.)	572	2173
Ano	1999	1995
Duração (h)	532	231

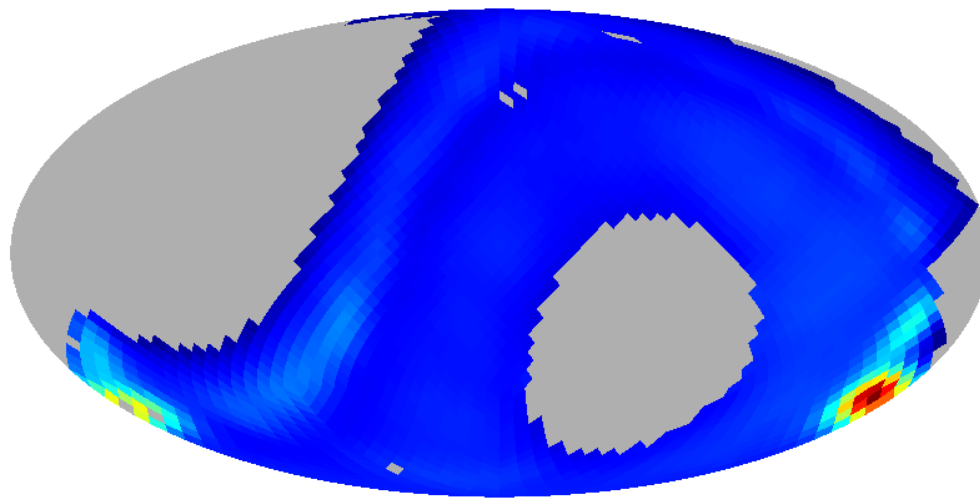
GEM

GEM 2.3 GHz



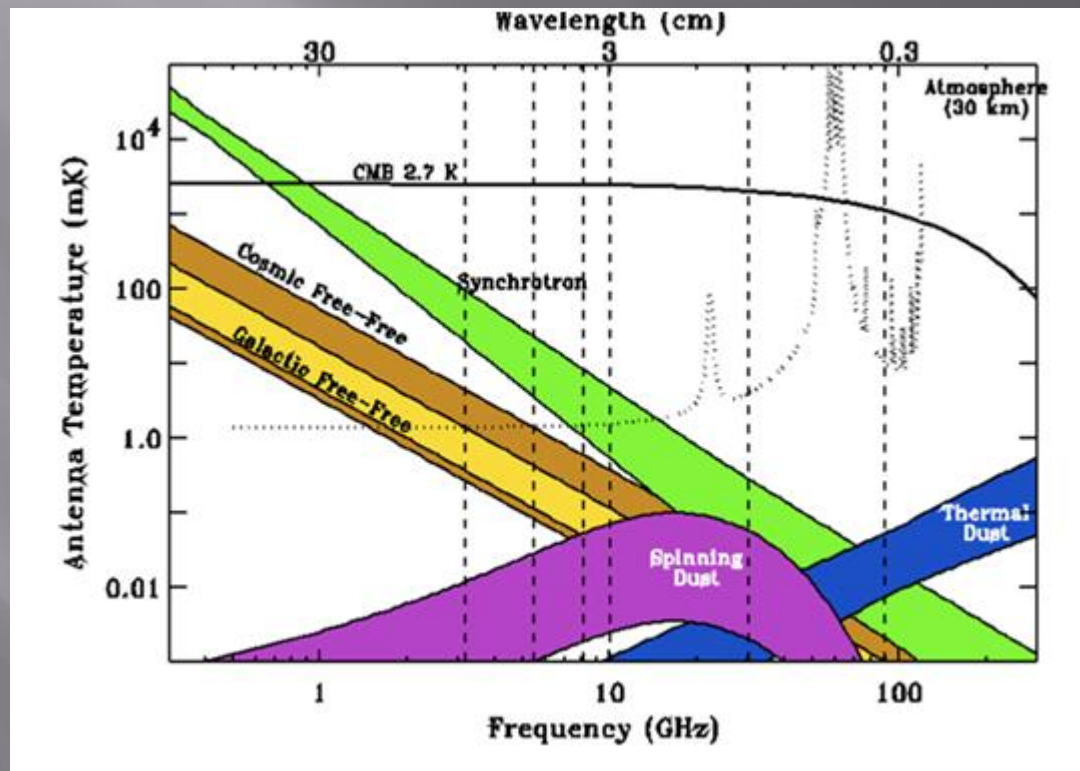
0.053  2.5

ERRO GEM 2.3 GHz



0.34  4.2

Emissões Galácticas



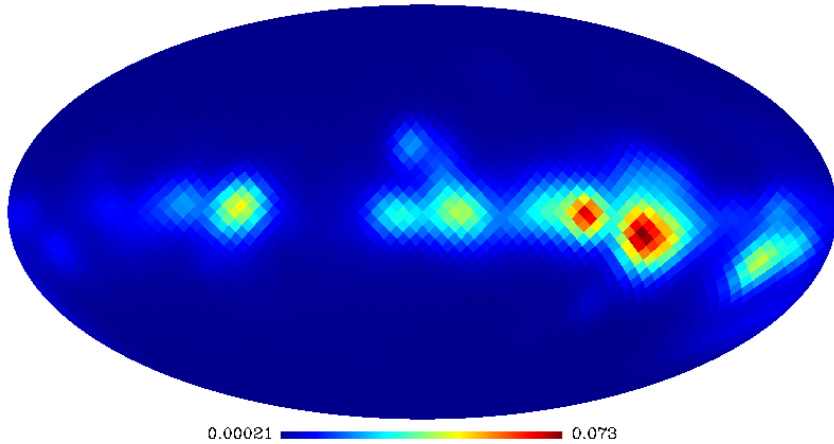
Como comparar GEM e ARCADE?

$\text{ARCADE} = \text{síncrotron} + \text{CMB} + \text{brems}$

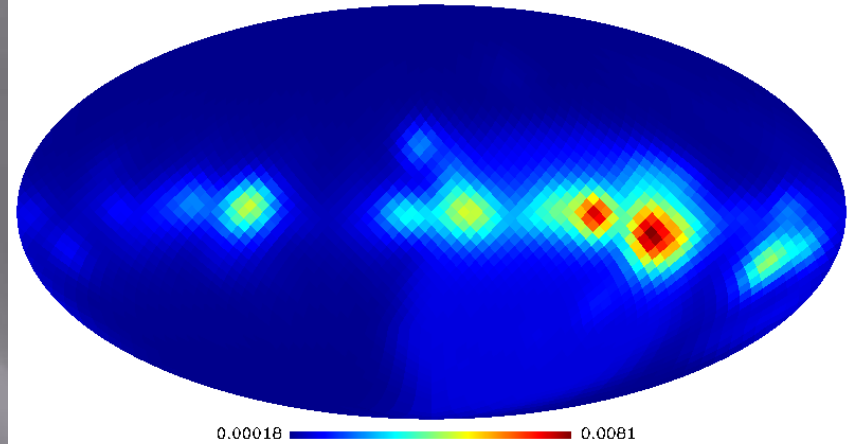
$\text{síncrotron} = \text{ARCADE} - \text{CMB} - \text{brems}$

Mapa Finkbeiner

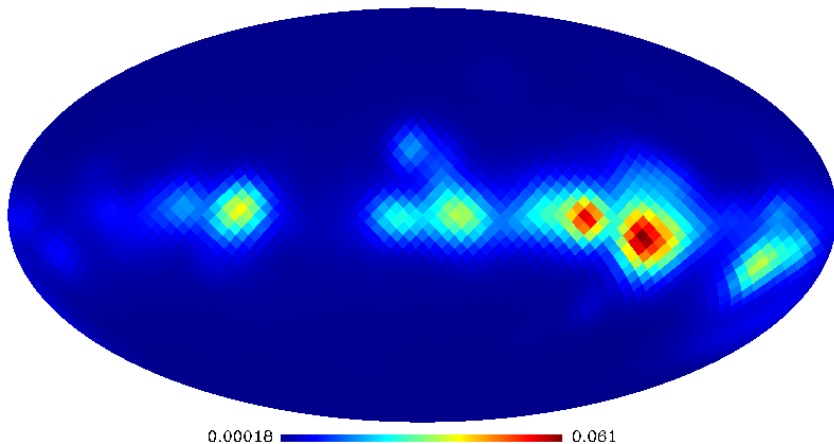
Template_ff_3.15T=7000.



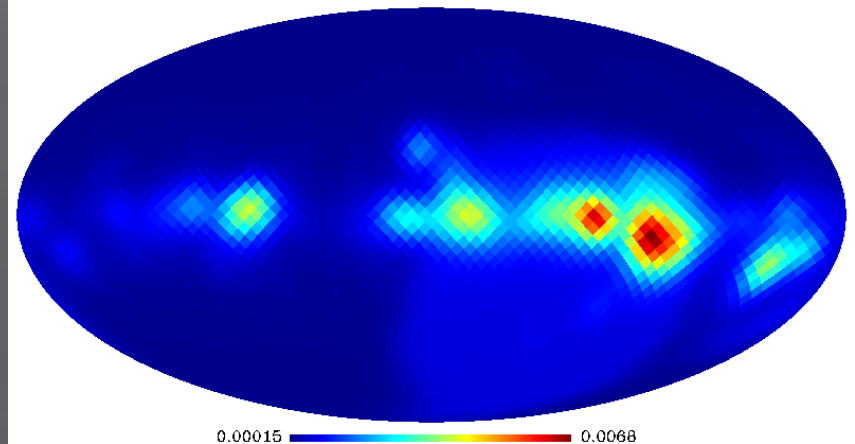
Erro_Template_ff_3.15T=7000.



Template_ff_3.41T=7000.

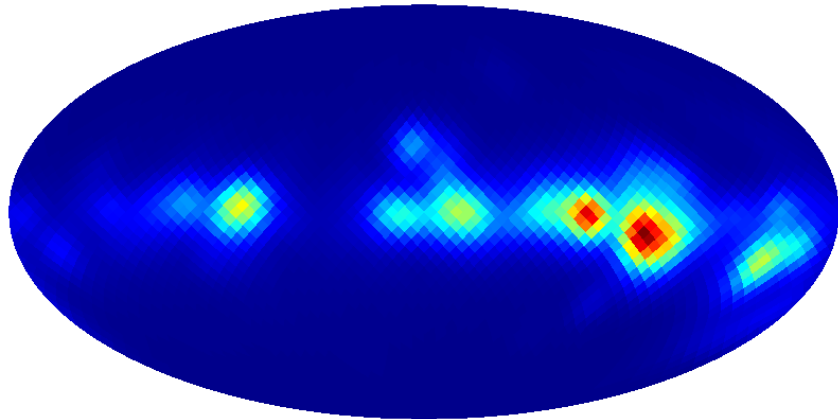


Erro_Template_ff_3.41T=7000.



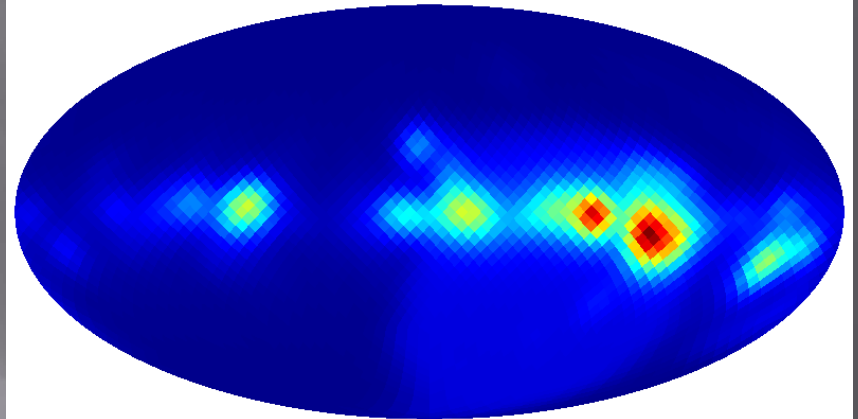
Mapa Finkbeiner

Template_ff_7.98T=7000.



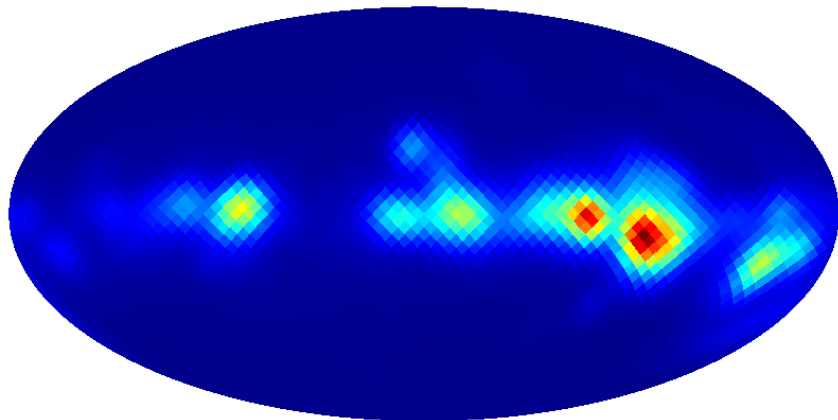
2.8e-005 0.0097

Erro_Template_ff_7.98T=7000.



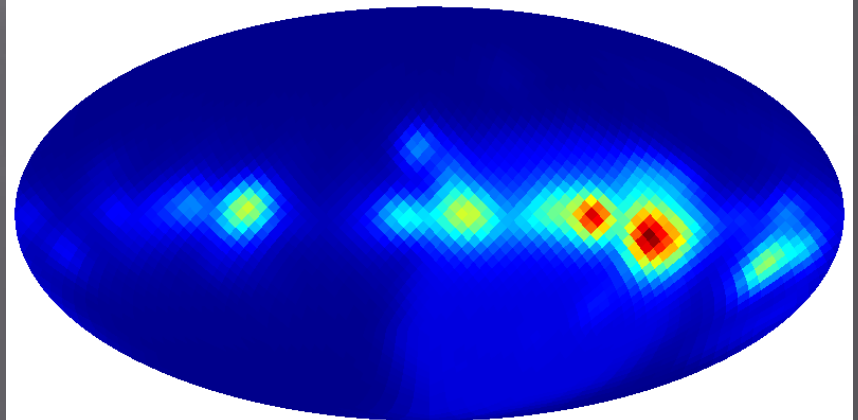
2.4e-005 0.0011

Template_ff_8.33T=7000.



2.6e-005 0.0089

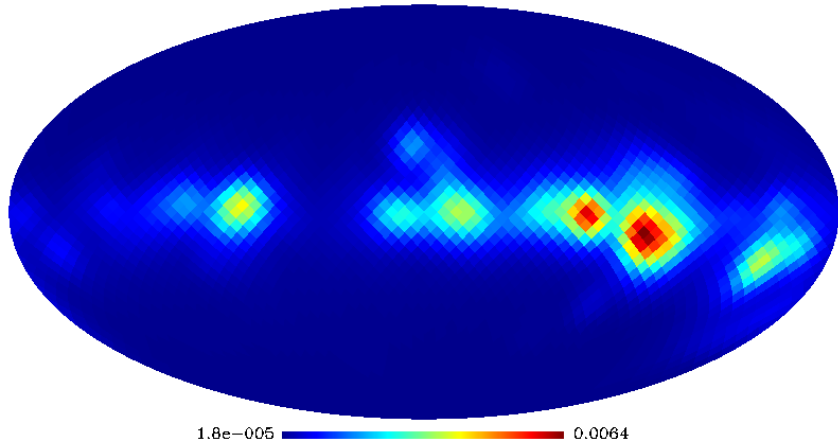
Erro_Template_ff_8.33T=7000.



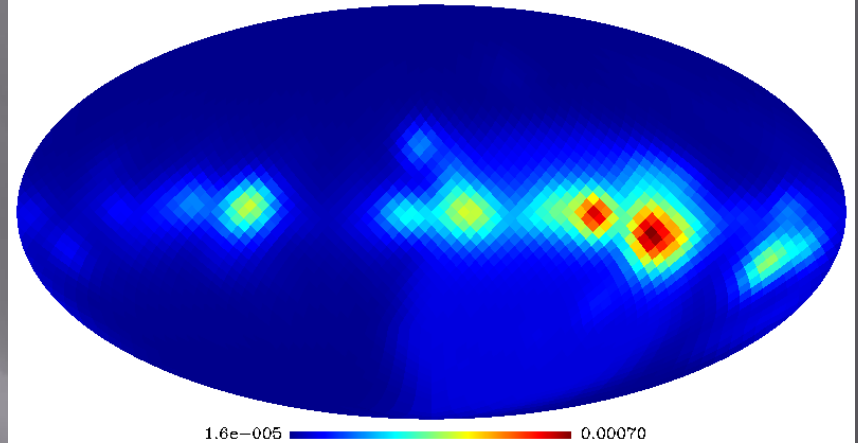
2.2e-005 0.00099

Mapa Finkbeiner

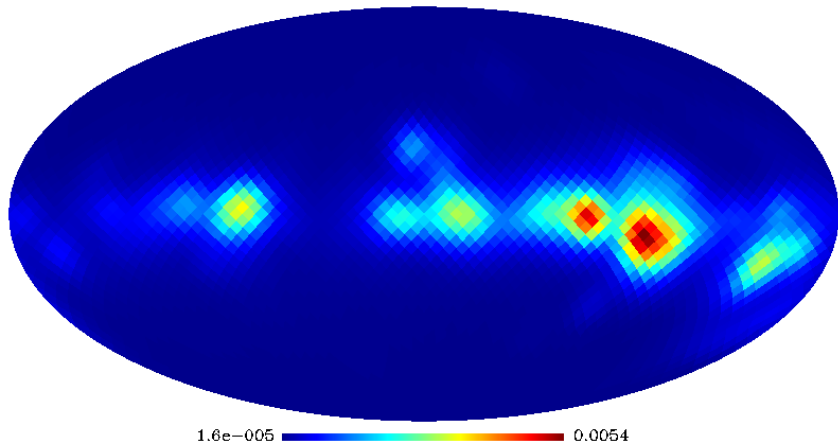
Template_ff_9.72T=7000.



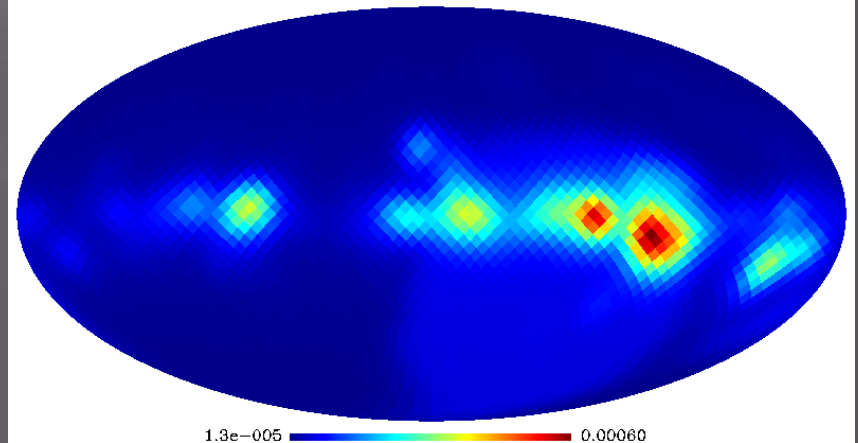
Erro_Template_ff_9.72T=7000.



Template_ff_10.49T=7000.



Erro_Template_ff_10.49T=7000.



Medida	Erro
ARCADE	ΔA
CMB	ΔCMB
Bremsstrahlung	Δb

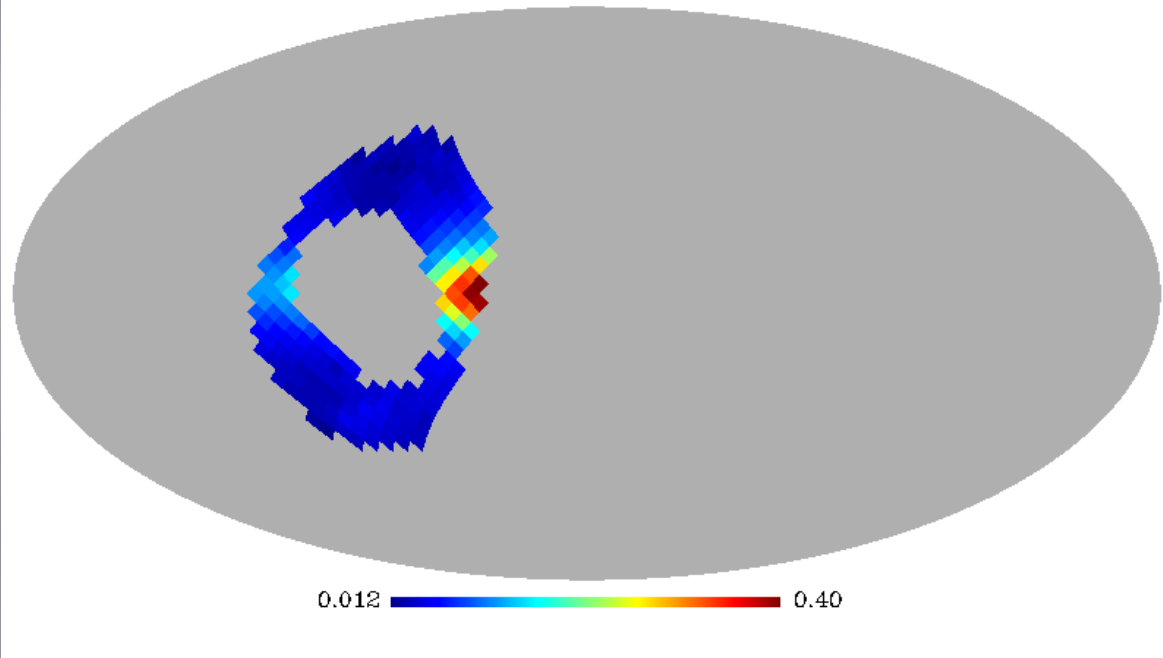
Mapa = ARCADE - CMB - bremsstrahlung

$$\Delta M^2 = (\Delta A)^2 + (\Delta \text{CMB})^2 + (\Delta b)^2$$

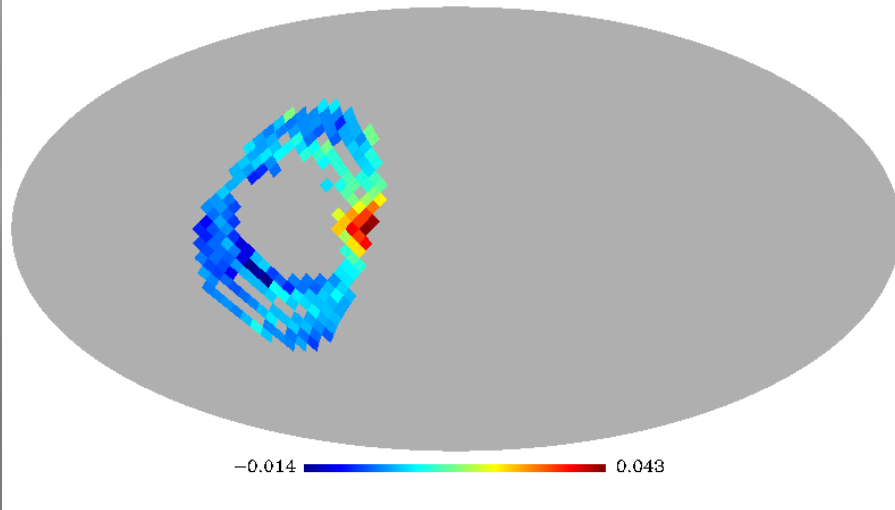
Lembrando que temos dois canais para cada frequência, faremos uma média ponderada entre os dois canais:

$$\overline{\text{Mapa}} = \frac{\sum_i \frac{M_i}{\Delta M_i^2}}{\sum_i \frac{1}{\Delta M_i^2}} \quad (\overline{\Delta M}) = \frac{1}{\sum_i \frac{1}{\Delta M_i^2}}$$

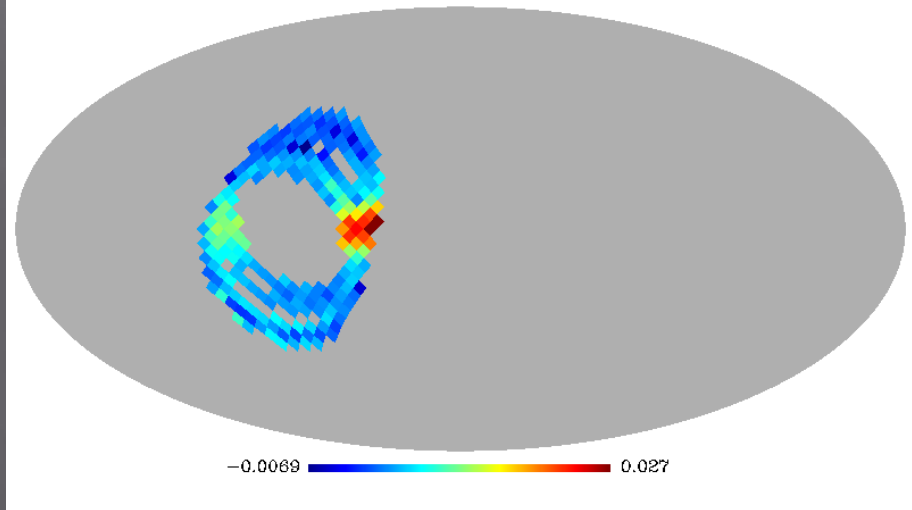
ARCADE 3 GHz

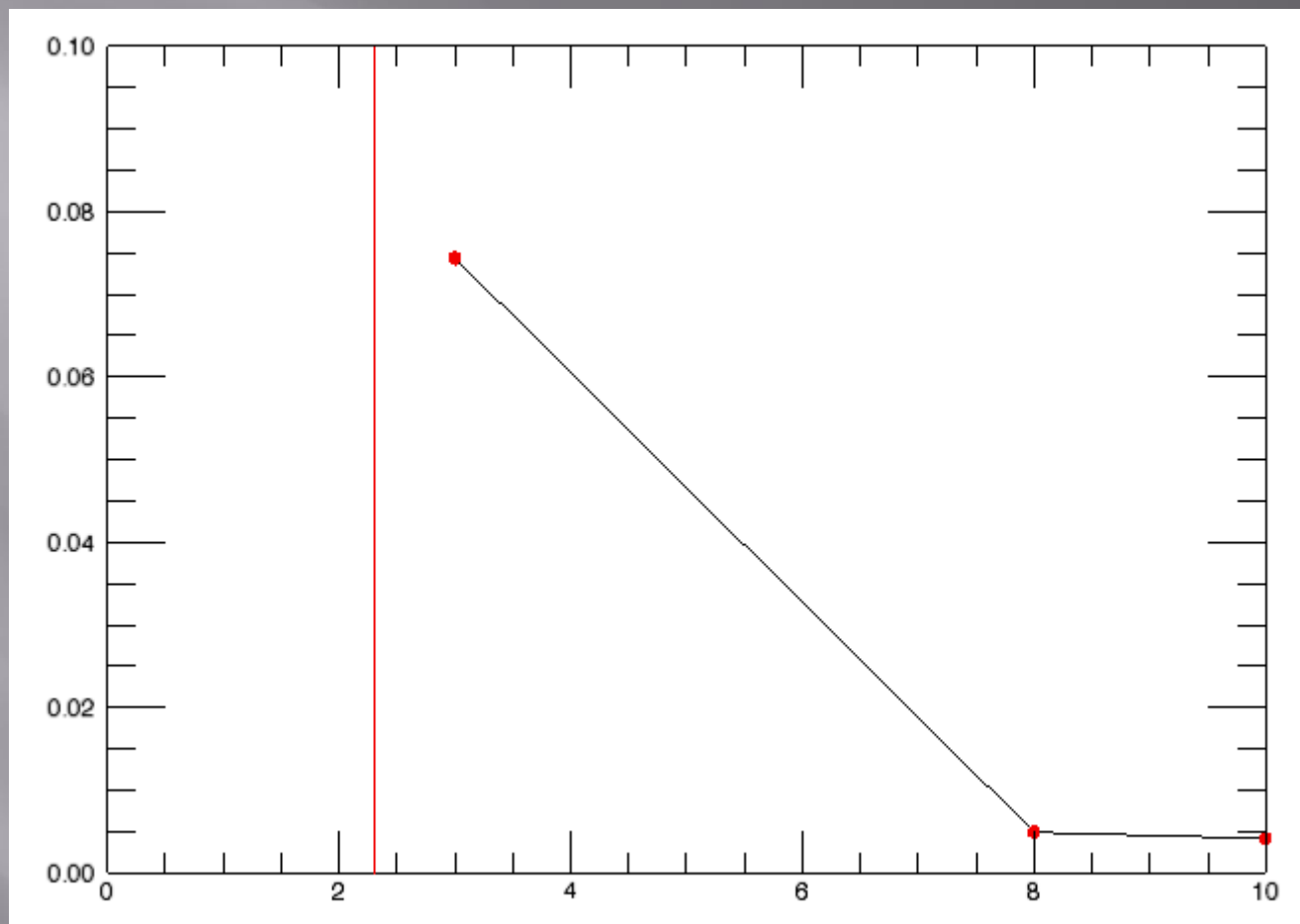


ARCADE 8 GHz



ARCADE 10 GHz





$$Mapa_{ii} = a_{ii} + b_{ii}(v) + c_{ii}(v^2)$$

$$ii = 0 - (npix - 1)$$

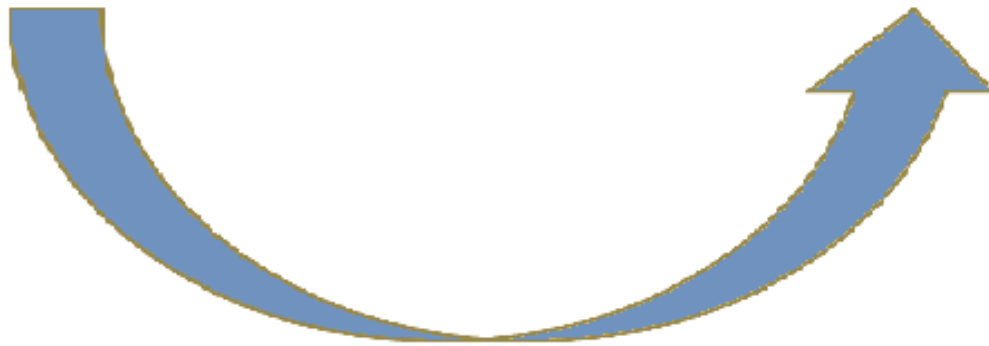
Mapas de temperatura média do ARCADE nas frequências de 3,8 e 10GHz



Extrapolação ARCADE 3,8,10 GHz para 2.3 GHz

ARCADE sintético: 2.3 GHz

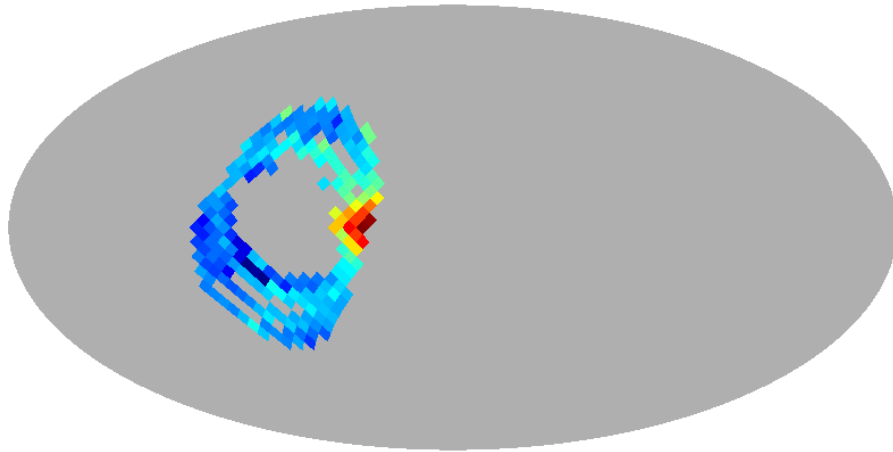
GEM 2.3GHz



GEM calibrado

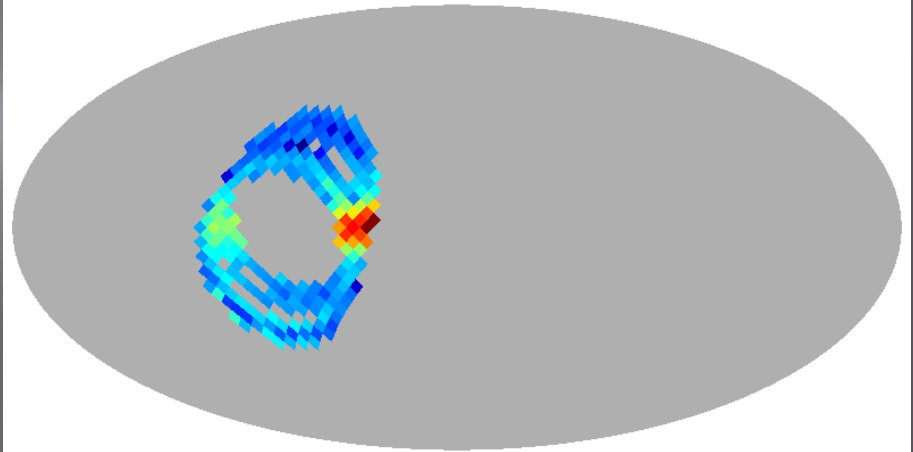
Problema: mapas médios em 8 e 10 GHz possuem pontos negativos

ARCADE 8 GHz

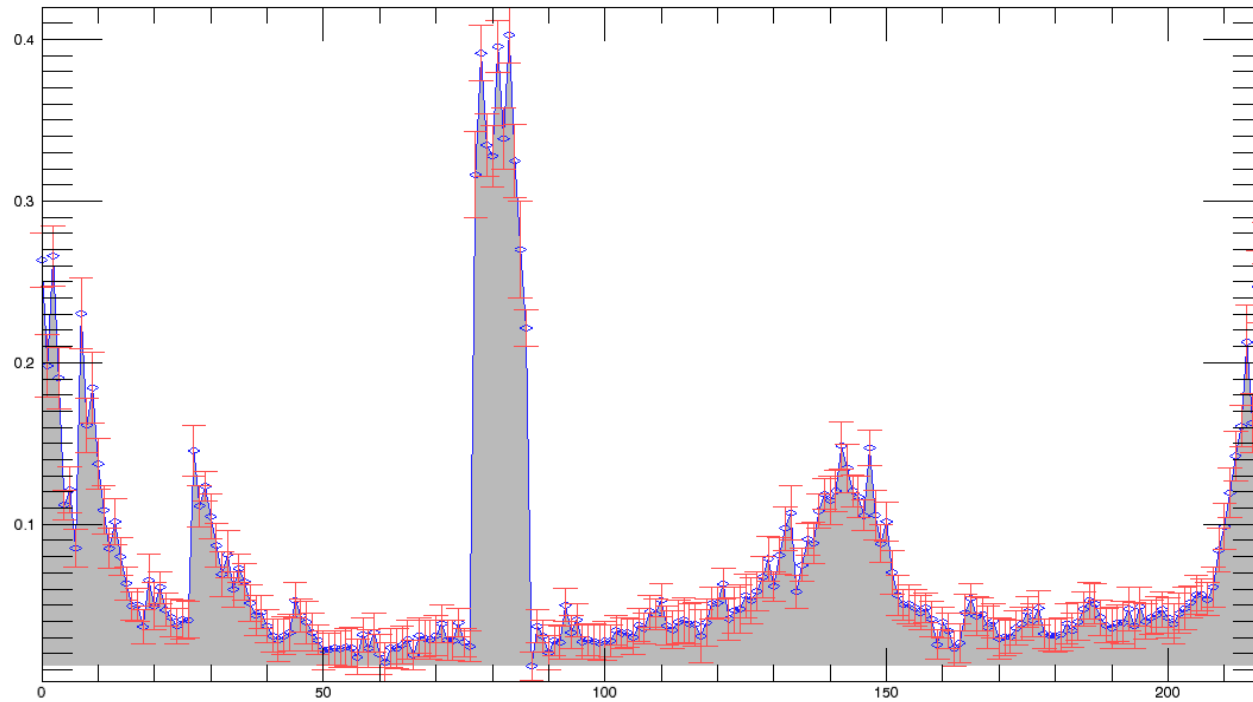


-0.014 0.043

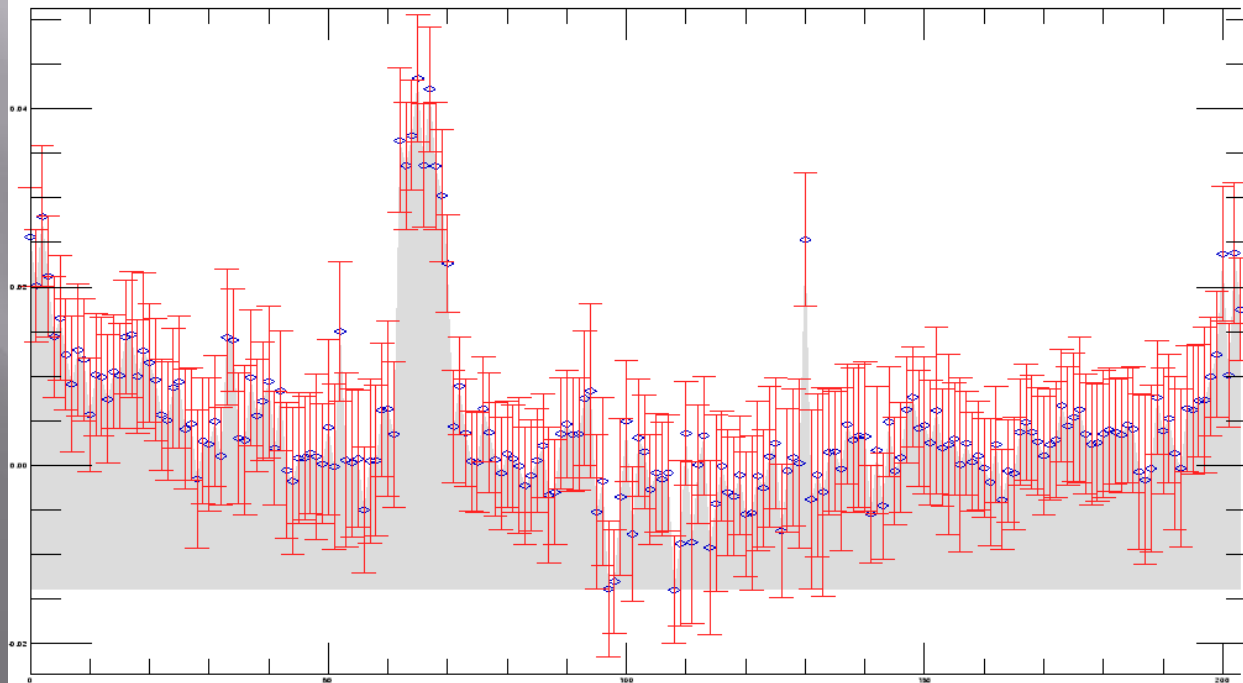
ARCADE 10 GHz



-0.0069 0.027

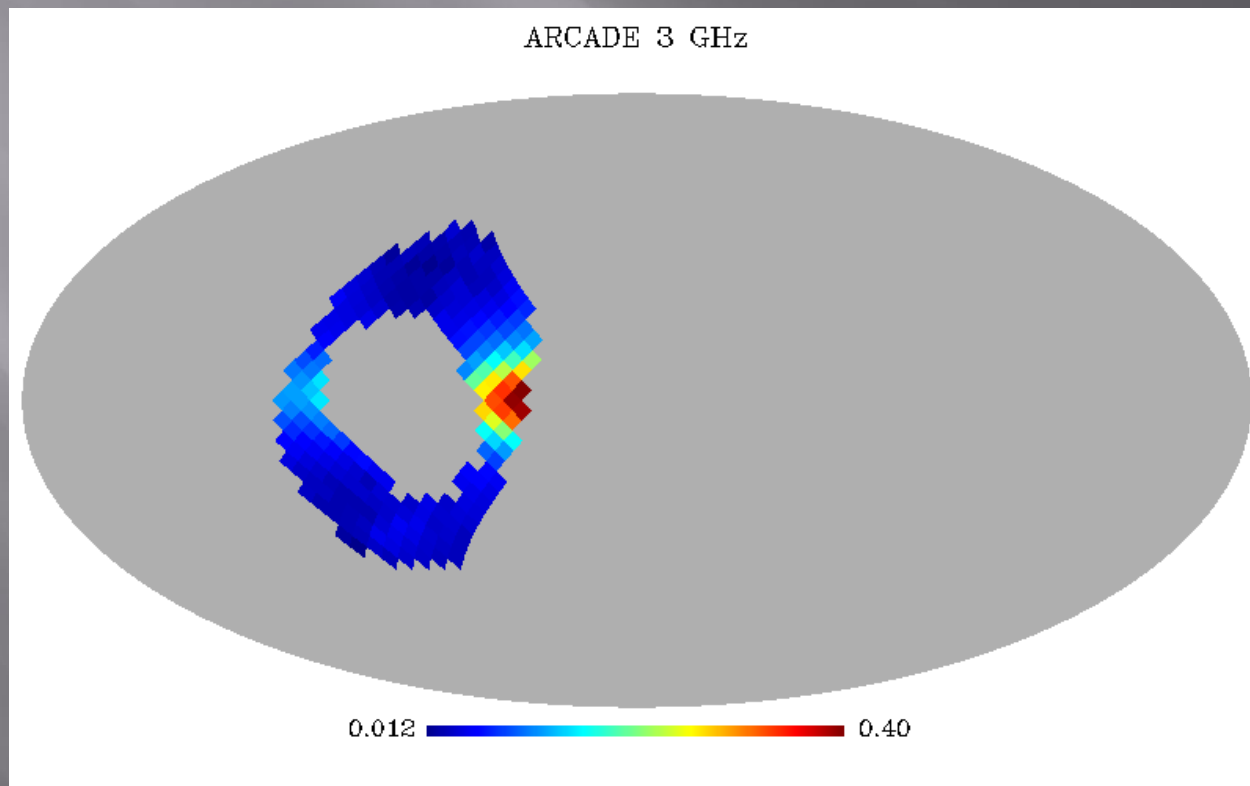


ARCADE 3 GHz



ARCADE 8 GHz

Proposição de outro método: Extrapolar o mapa em 3 GHz conhecendo o mapa de índice espectral



Mapa de entrada
(ARCADE 3
GHz)

Mapa de índice
espectral

2,3
GHz

$$I_{\nu_1} = I_{\nu_2} \left(\frac{\nu_1}{\nu_2} \right)^\beta$$

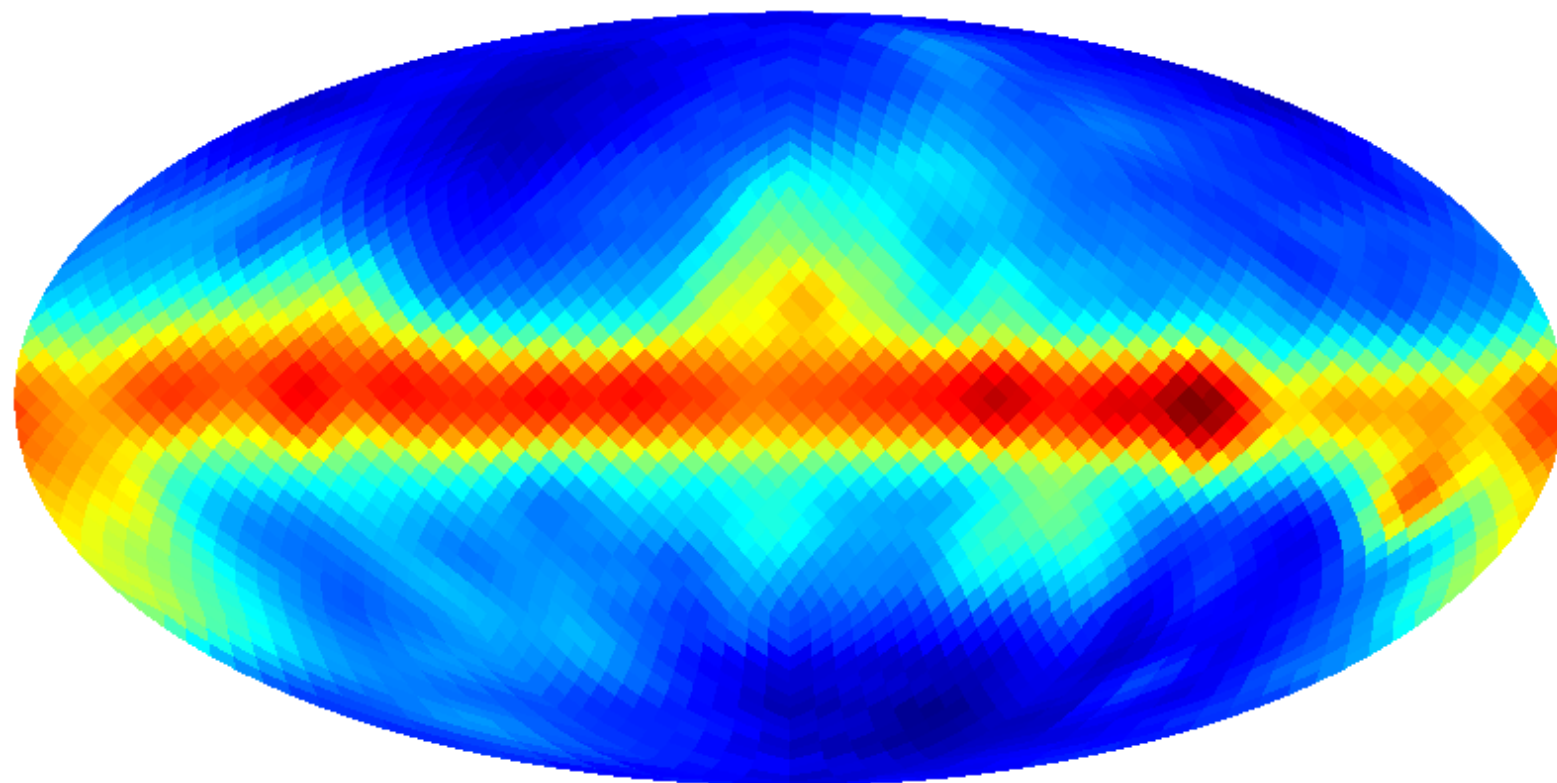
Mapas de entrada
(WMAP e HASLAM)

Frequência
referente ao
mapa de
entrada

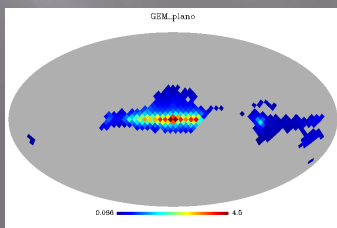
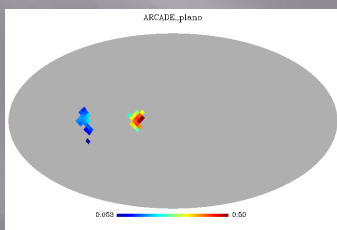
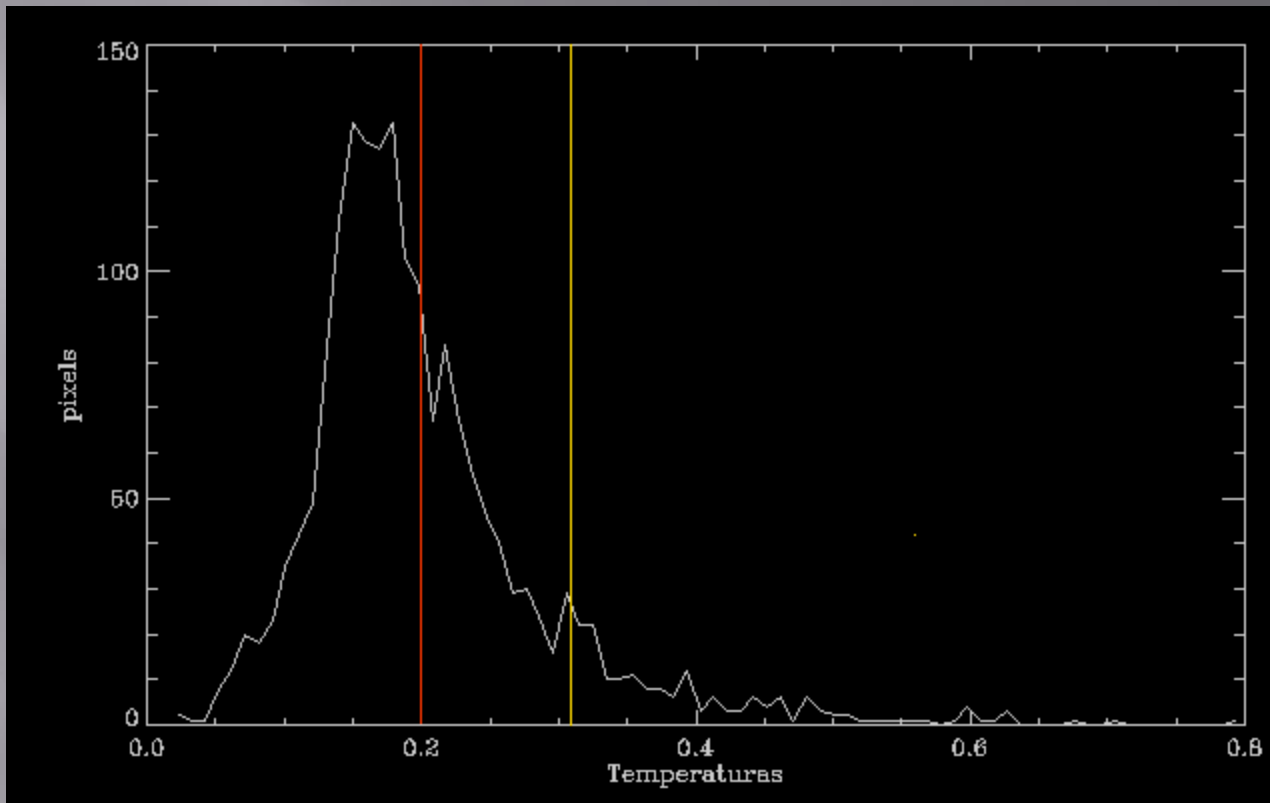
$$\beta = \frac{\log \left(\frac{I_1}{I_2} \right)}{\log \left(\frac{\nu_1}{\nu_2} \right)}$$

Frequências
referentes aos
mapas

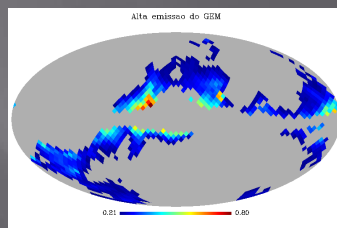
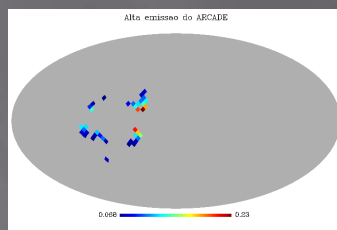
MAPA DE INDICE ESPECTRAL



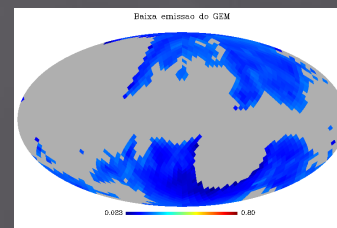
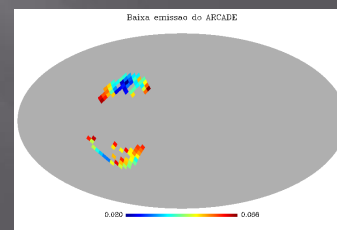
-3.2  -2.5



C
1



C
2



C
3

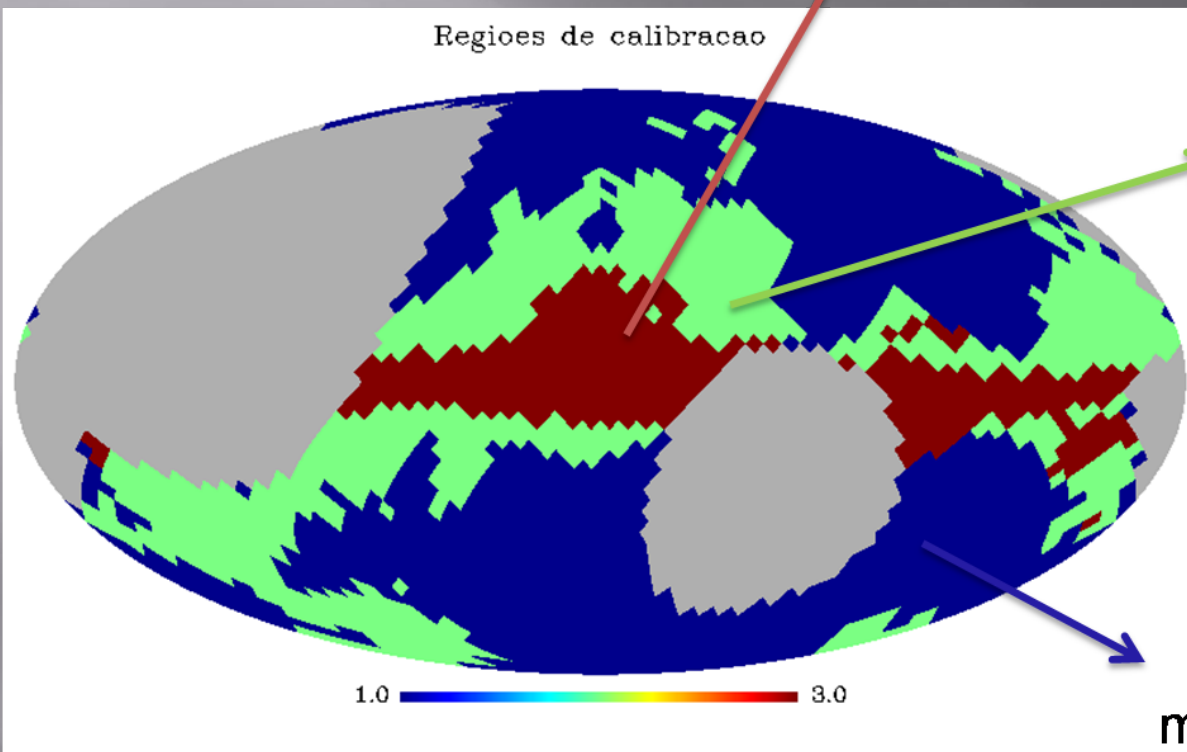
Regioes de calibracao

Região que será multiplicada por C1

Região que será multiplicada por C2

Região que será multiplicada por C3

1.0 3.0



Obrigada