ESTUDO COMPUTACIONAL DO EXPERIMENTO protoMIRAX

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17 de Novembro de 2010

1. O EXPERIMENTO PROTOMIRAX
2. SIMULAÇÕES
3. GEANT 4
4. RESULTADOS

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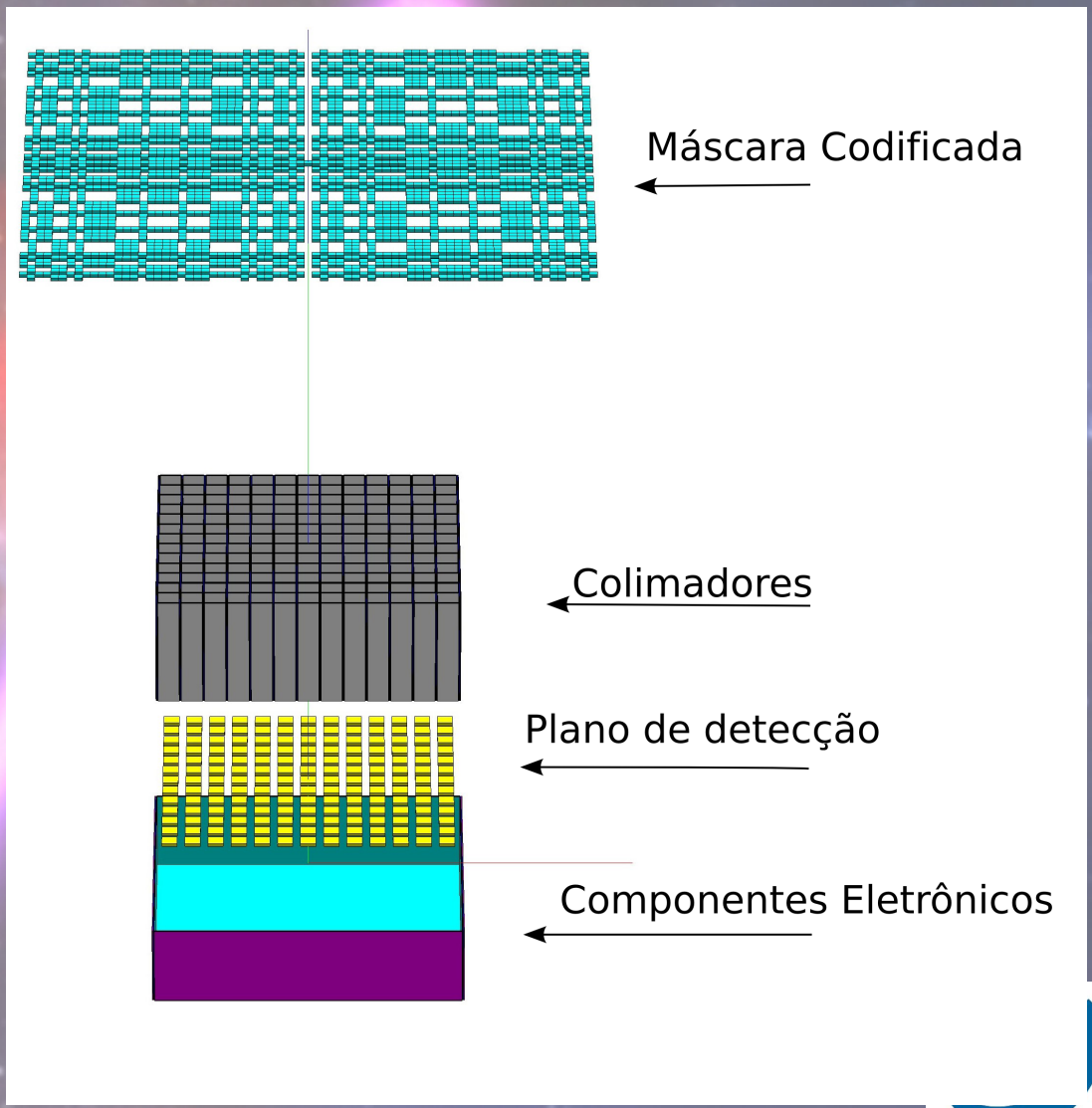
O experimento protoMIRAX

- 169 detectores.
- Colimadores:
  - Chumbo: $15\,mm \times 70\,mm \times 0.5\,mm$.
  - Estanho: $0.3\,mm$.
  - Cobre: $0.2\,mm$.
- Padrão de máscara:
  - MURA 13×13.
  - MURA 37×37.



Objetivos Científicos

- Protótipo para testar sistemas a serem usados a bordo do MIRAX.
- Observações de fontes astrofísicas em raios X entre 30 - 200 keV.

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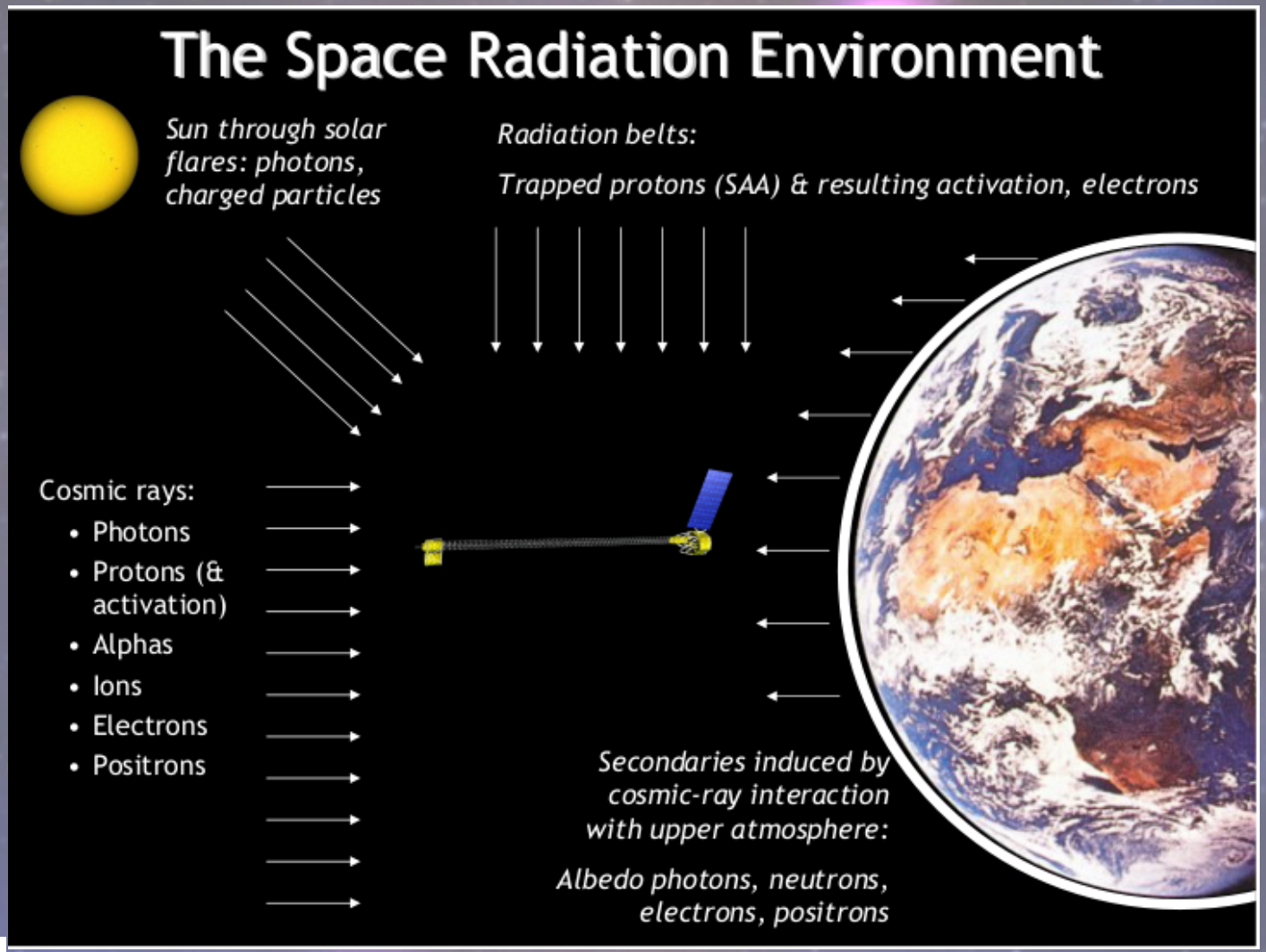
Fontes de ruído



Trabalho em desenvolvimento

Fontes de ruído a altitudes de balão

Partícula	Tipo de componente
Prótons	Primários e secundários
Elétrons	Secundários
Nêutrons	Secundários
Fótons γ	Primários e secundários

Algoritmos de reconstrução

Algoritmos de reconstrução usando máscara codificada.

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Geant 4

Geant 4

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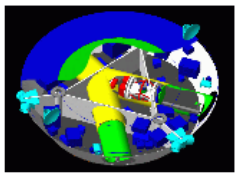
Search Geant4

Geant4 is a toolkit for the simulation of the passage of particles through matter. Its areas of application include high energy, nuclear and accelerator physics, as well as studies in medical and space science. The two main reference papers for Geant4 are published in *Nuclear Instruments and Methods in Physics Research* A 506 (2003) 250-303, and *IEEE Transactions on Nuclear Science* 53 No. 1 (2006) 270-278.

Applications

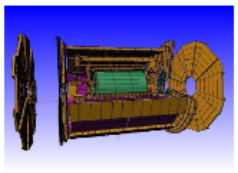
A sampling of applications, technology transfer and other uses of Geant4

User Support



Getting started, guides and information for users and developers

Results & Publications



Validation of Geant4, results from experiments and publications

Collaboration

Who we are: collaborating institutions, members, organization and legal information

News

- *24 September 2010* - **Patch-02** to **release 9.3** is available from the download area.
- *24 September 2010* - **Patch-04** to **release 9.2** is available from the archive download area.
- *25 June 2010* - **Release 9.4 BETA** is available from the Beta download area.
- *16 March 2010* - 2010 planned developments.

Events

- Geant4 Tutorial at LNGS (in Italian, restricted to INFN employees), Laboratori Nazionali del Gran Sasso, L'Aquila (Italy), **8-12 November 2010**.
- 29th Geant4 Technical Forum (dedicated to LHC experiments), CERN, Geneva (Switzerland), **16 November 2010**.
- Geant4 Tutorial and Workshop (in Japanese), Toyama National College of Technology, Toyama (Japan), **7-10 December 2010**.
- Geant4 Winter Course Tutorial, Texas A&M University, College Station, Texas (USA), **10-14 January 2011**.

- **Past events**

Applications | User Support | Results & Publications | Collaboration | Site Map

Contact Webmaster

Last updated: 12 Nov 2010

Figura: http://geant4.cern.ch/

O quê é possível fazer....

- Definir materiais.
- Montar geometrias.
- Definir processos físicos de interação.
- Gerar espectros de partículas.
- Definir regiões sensíveis...

Construindo uma geometria

Definindo o detector

```
G4double dim_x = 5.0*mm;
G4double dim_y = 5.0*mm;
G4double dim_z = 1.0*mm;
G4Box* detec_box = new G4Box("detector",dim_x,dim_y,dim_z);
G4G4LogicalVolume*  detec_log = new G4LogicalVolume(detec_box,CdZnTe,"Detector",0,0,0);
G4PVPlacement* detec_phys = new G4PVPlacement(0,G4ThreeVector(pos_x,pos_y,pos_z),detec_log,
                            "posi_detector",logicWorld,false,0);
```

Definindo o material

```
G4Element* Cd= new G4Element("Cadmio",symbol="Cd",z= 48., a= 112.40*g/mole);
G4Element* Zn = new G4Element("Zinco",symbol="Zn",z= 30., a= 65.40*g/mole);
G4Element* Te = new G4Element("Telurio",symbol="Te",z= 52.,a= 127.60*g/mole);
Definir CdTe
G4Material* CdTe =  new G4Material("CdTe",density=5.85*g/cm3,nel=2);
CdTe->AddElement(Cd,natoms=1);
CdTe->AddElement(Te,natoms=1);
Definir ZnTe
G4Material* ZnTe = new G4Material("ZnTe",density=6.34*g/cm3,nel=2)
ZnTe->AddElement(Zn,natoms=1);
ZnTe->AddElement(Te,natoms=1);
Definir CdZnTe
G4Material* CdZnTe = new G4Material("CdZnTe",density= 5.78*g/cm3,nel=2);
CdZnTe->AddMaterial(CdTe,90.*perCent);
CdZnTe->AddMaterial(ZnTe,10.*perCent);
```

RESULTADO: temos criado o primeiro elemento de detecção.

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Montar a geometria

Reconstrução de imagens

Método de deconvolução.

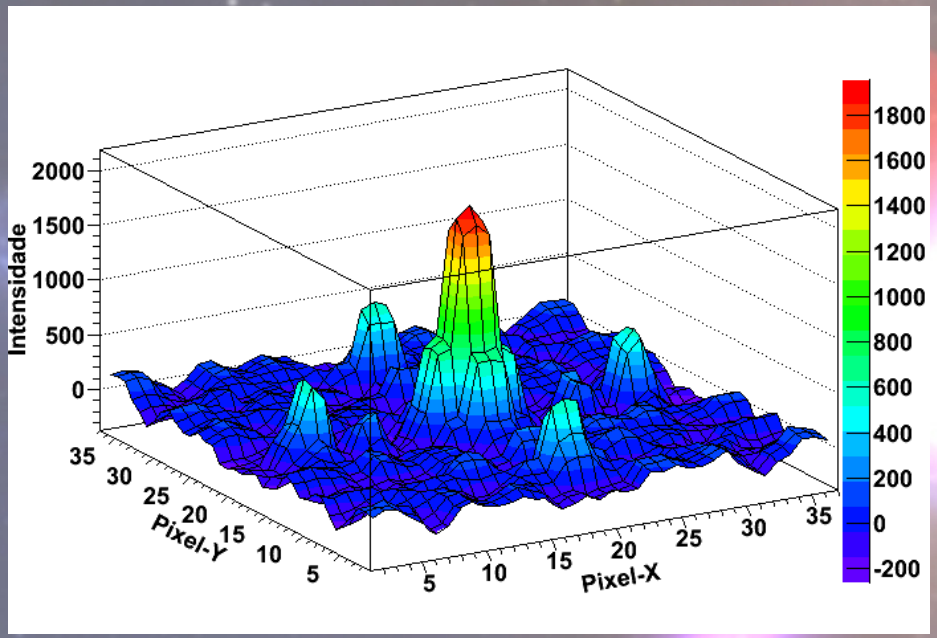
Reconstrução iterativa

Algoritmo de Richardson-Lucy

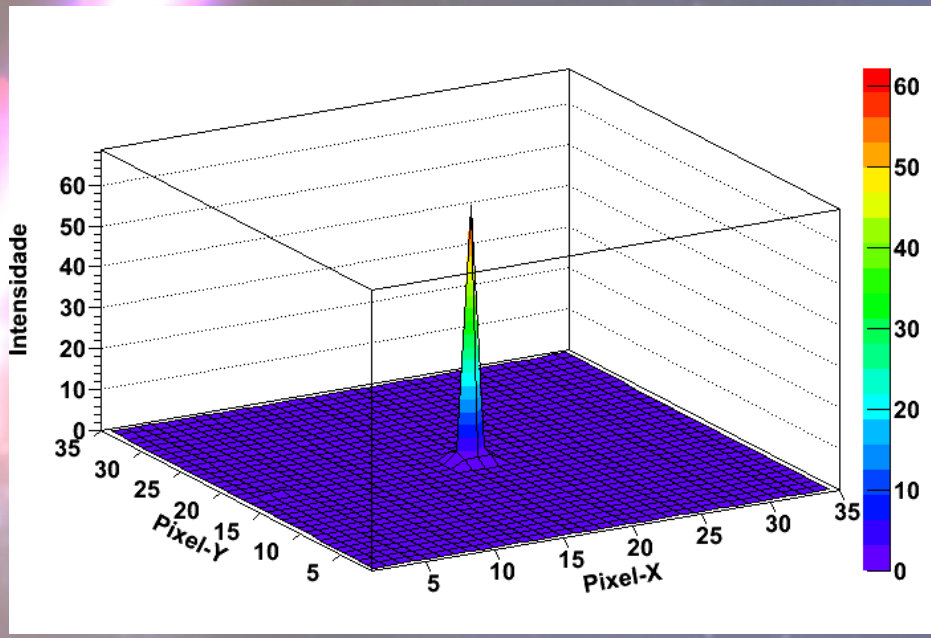
$$O_{i,j}^{(r+1)} = \frac{O_{i,j}^{(r)}}{\sum_{s,t} P_{s+i,t+j}} \sum_{l,m} \left[P_{l+i,m+j} \frac{D_{l,m}}{\sum_{e,f} P_{e+l,f+m} O_{l,m}^{(r)}} \right]$$

Obtenção de espectros

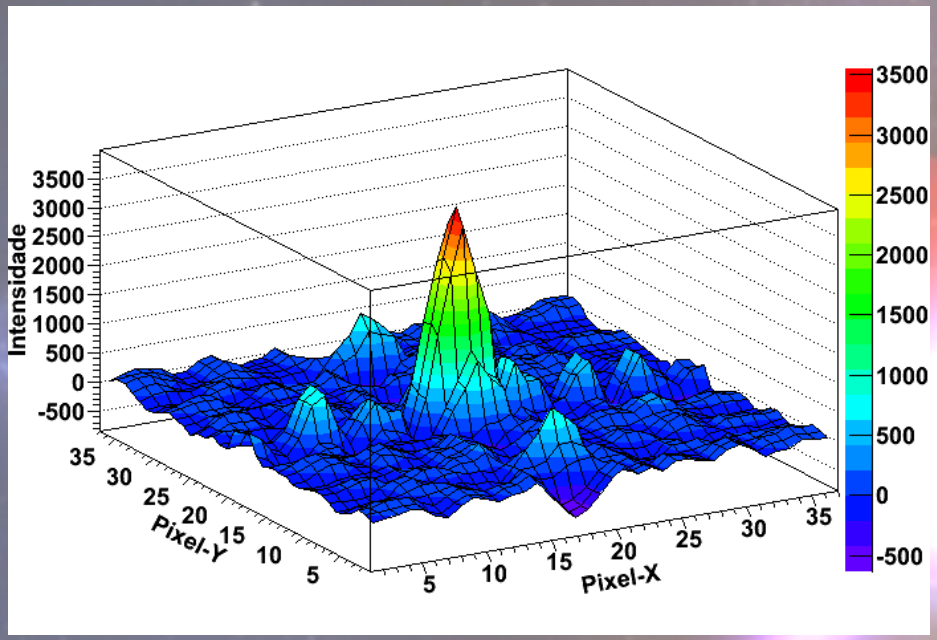
Alguns resultados

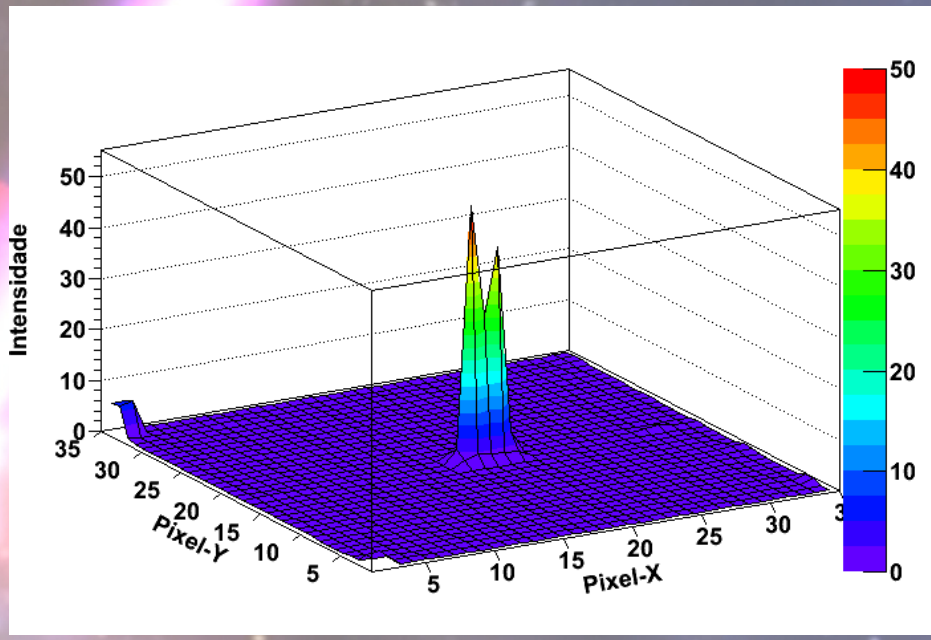


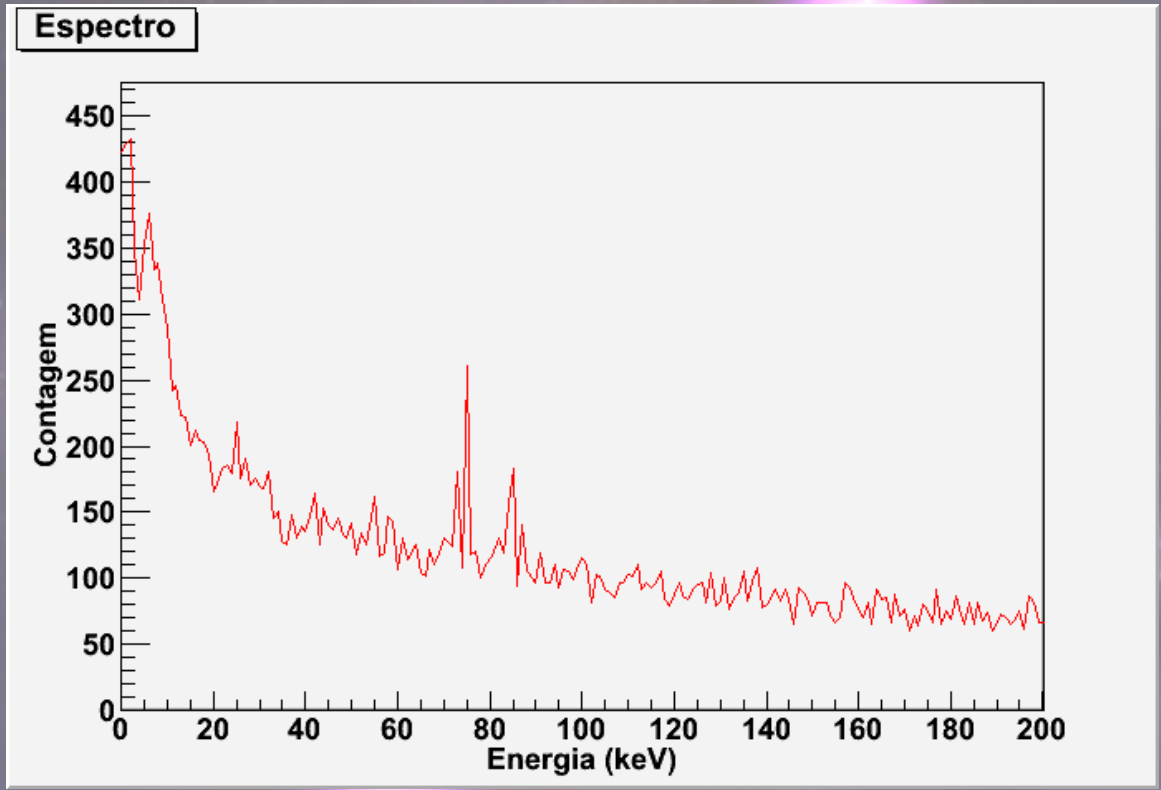
FWHM=2, 29 °



FWHM=0, 46 °


Intensidade
3500
3000
2500
2000
1500
1000
500
0
-500
35
30
25
20
15
10
5
Pixel-Y
5
10
15
20
25
30
35
Pixel-X
3500
3000
2500
2000
1500
1000
500
0
-500


Intensidade
50
40
30
20
10
0
35
30
25
20
15
10
5
Pixel-Y
5
10
15
20
25
30
Pixel-X
50
40
30
20
10
0


Espectro
Contagem
Energia (keV)
0
50
100
150
200
250
300
350
400
450
0
20
40
60
80
100
120
140
160
180
200

FIM