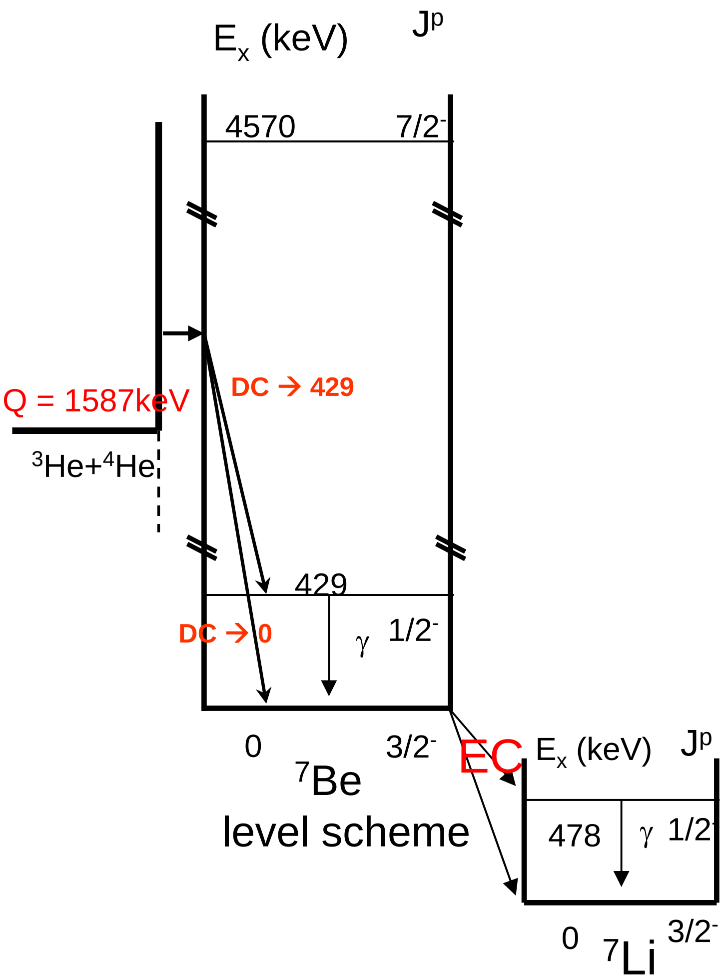
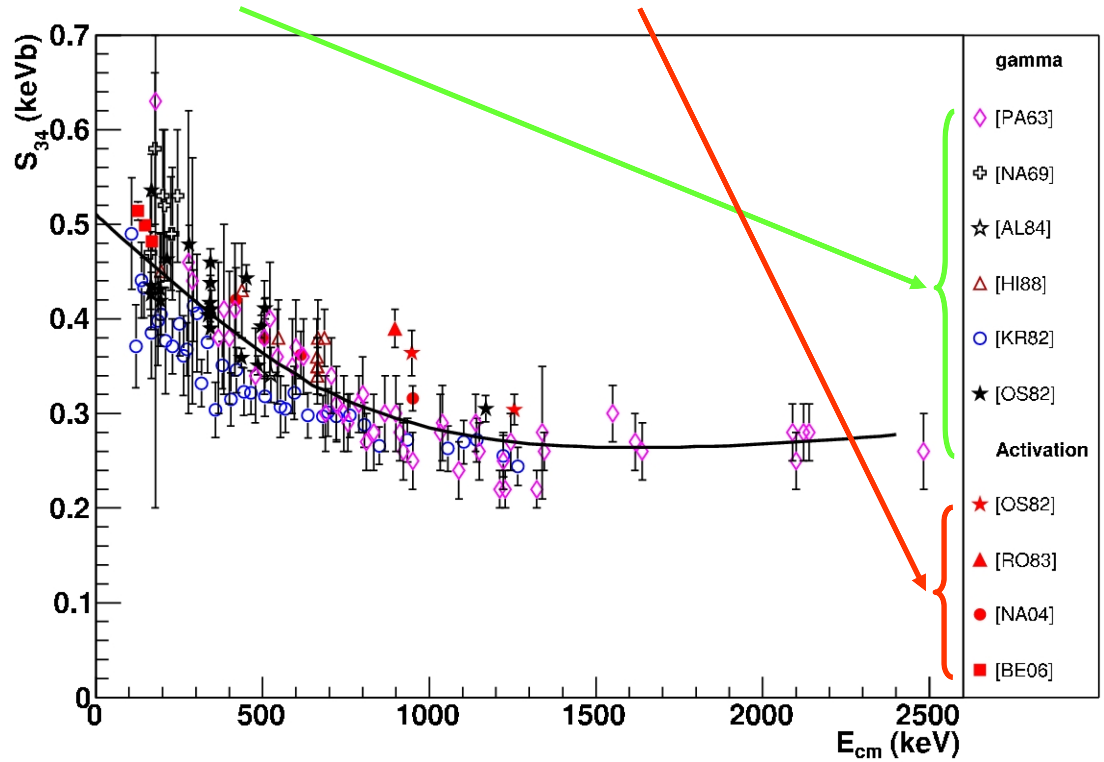
# Considerations on some cases for an underground laboratory

L. Gialanella INFN Naples, Italy

$^{3}He(\alpha,\gamma)^{7}Be(e,\nu)^{7}Li^{*}(\gamma)^{7}Li$




Gamma: $S_{34}(0) = 0.507 \pm 0.016$ keVb

Activation: $S_{34}(0) = 0.563 \pm 0.018$ keVb

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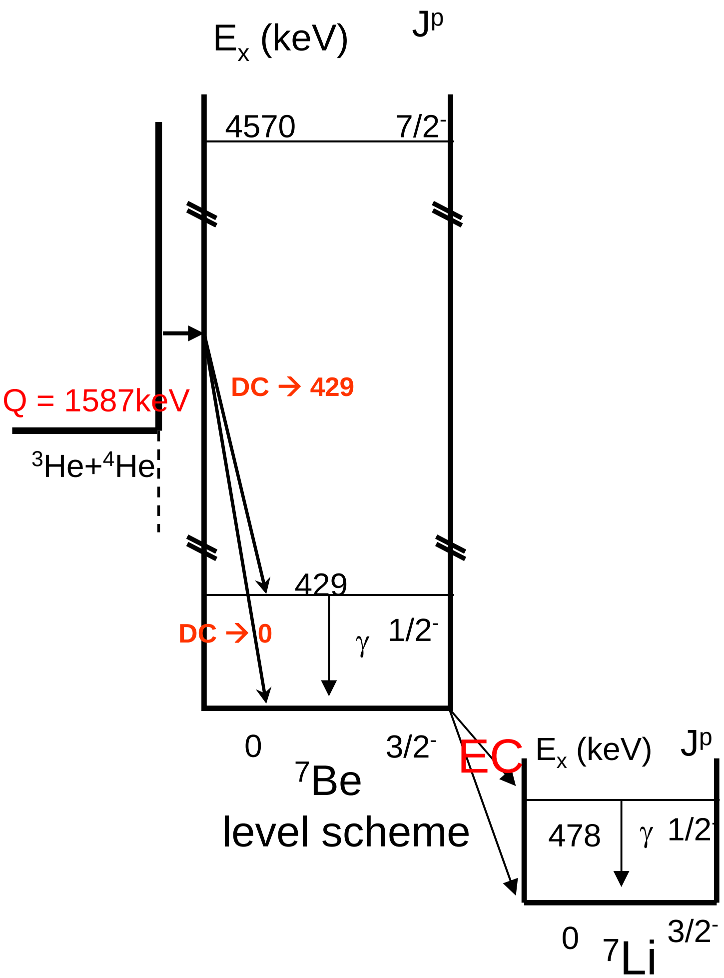
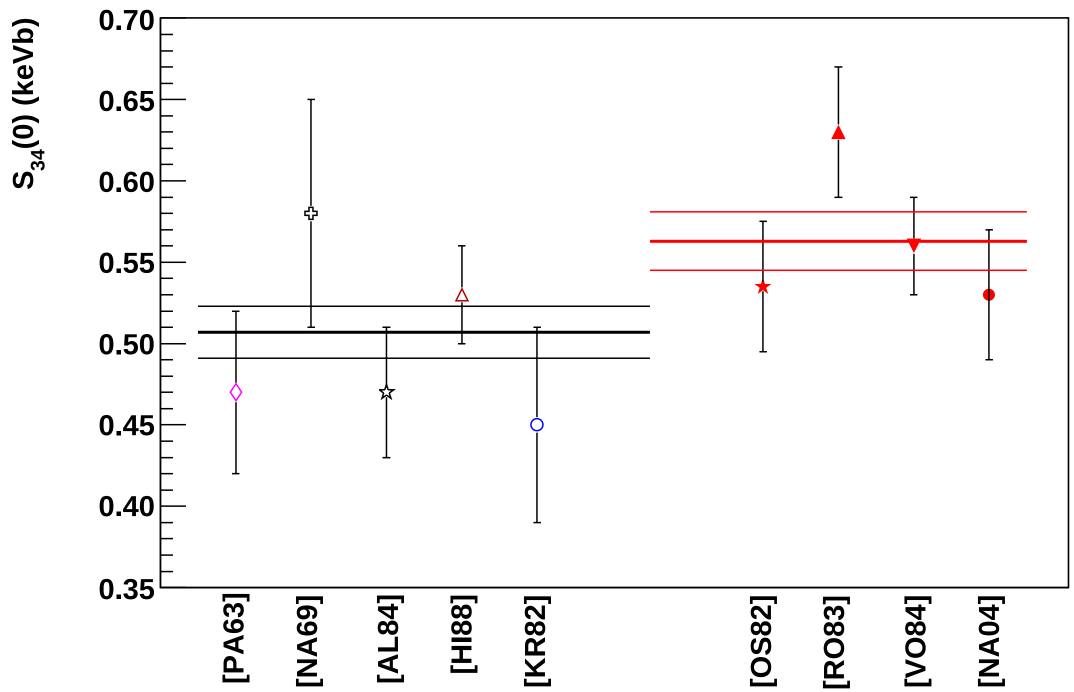
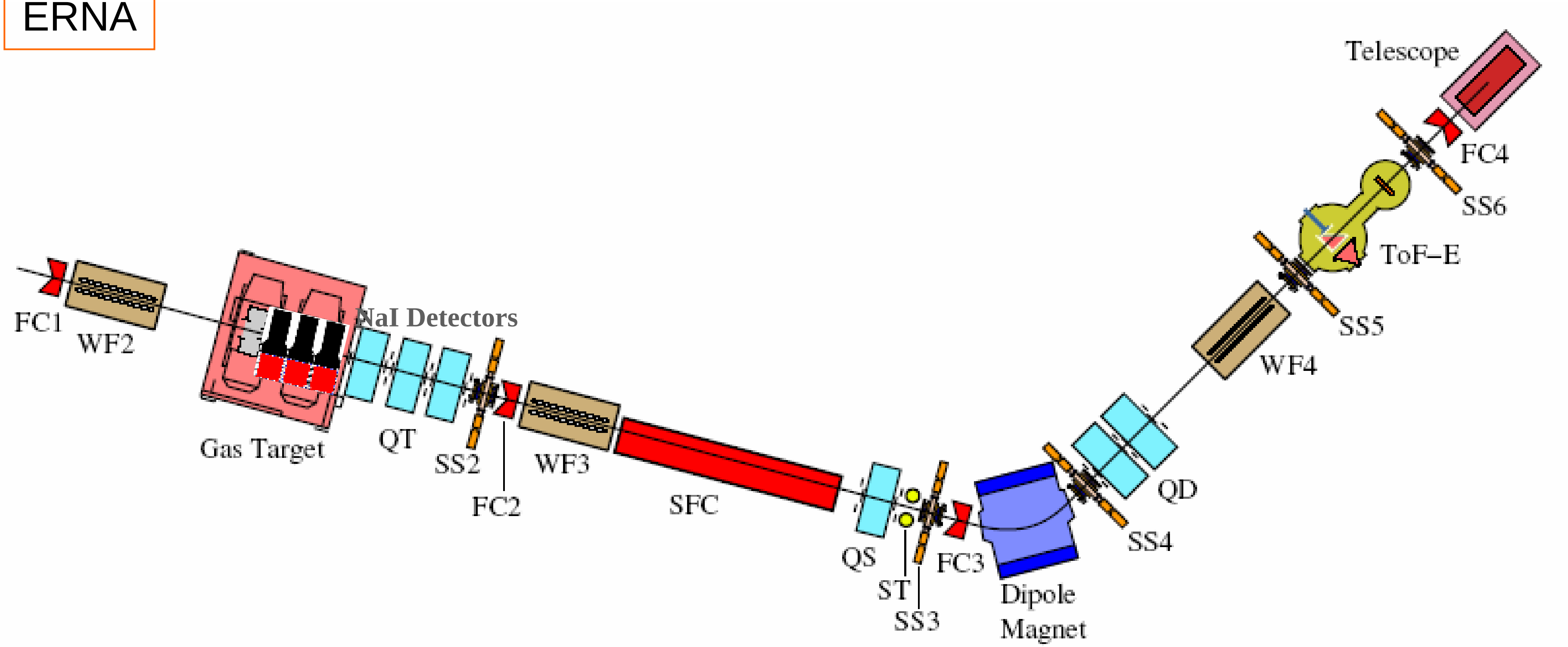


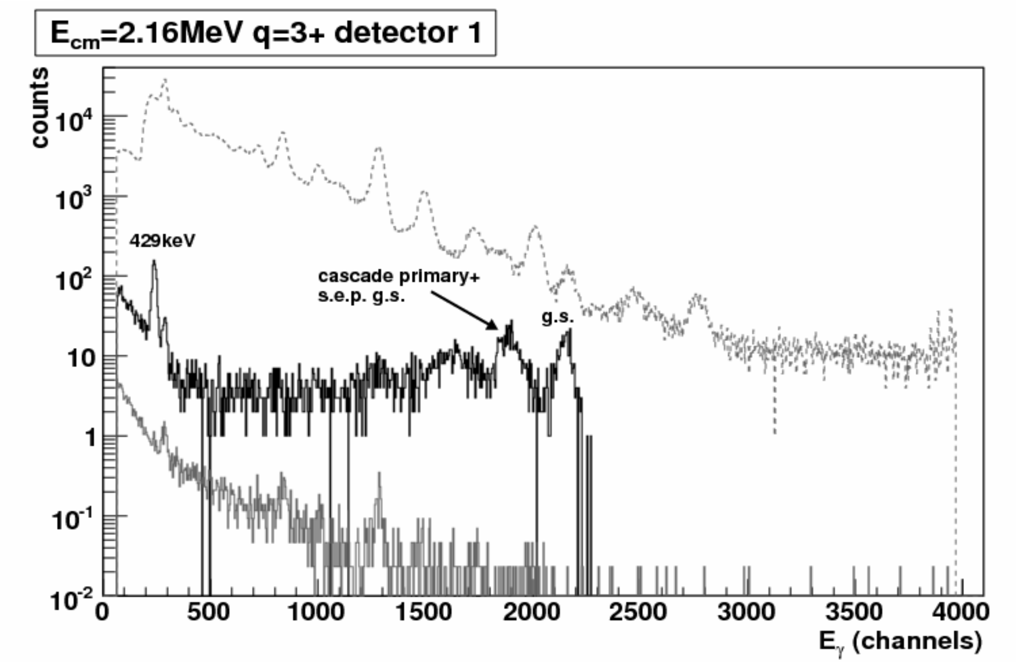



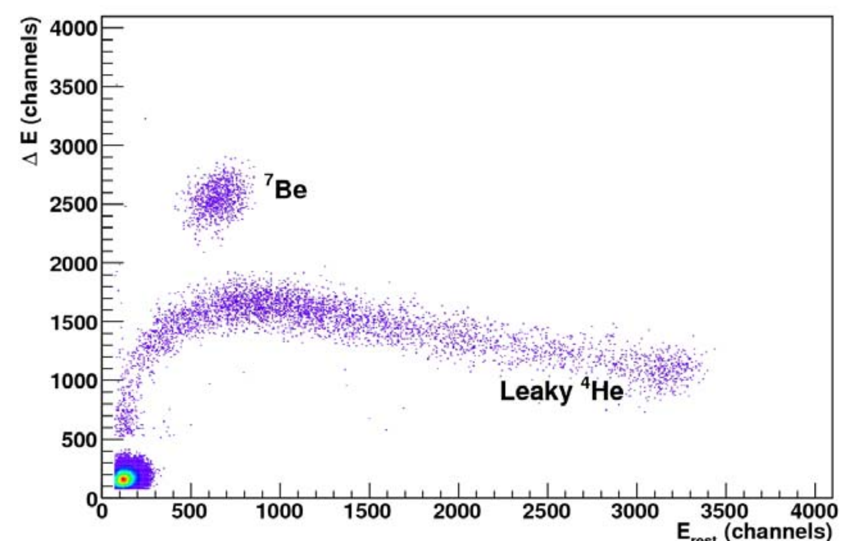

Gamma: $S_{34}(0) = 0.507 \pm 0.016$ keVb

Activation: $S_{34}(0) = 0.563 \pm 0.018$ keVb

# ERNA

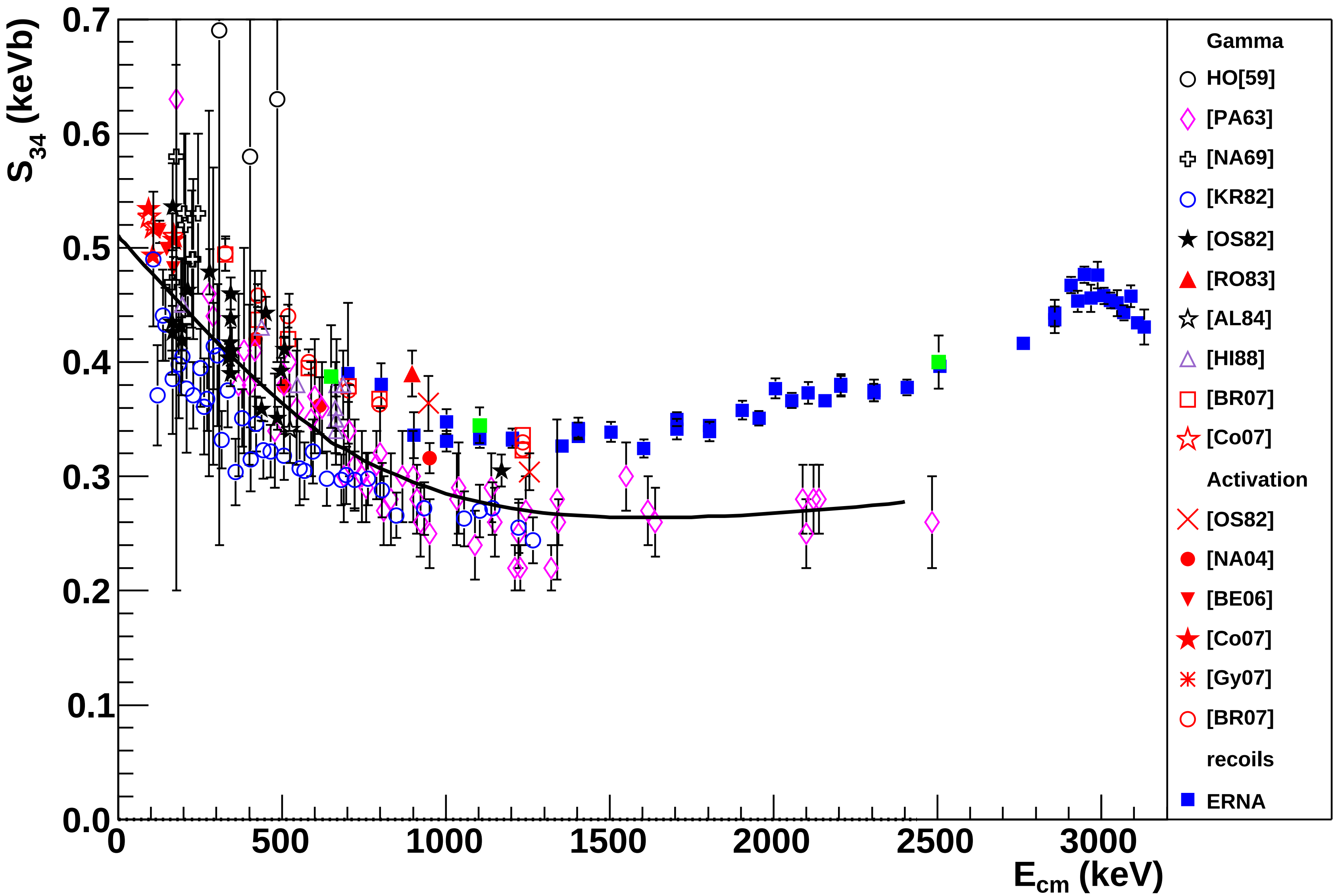


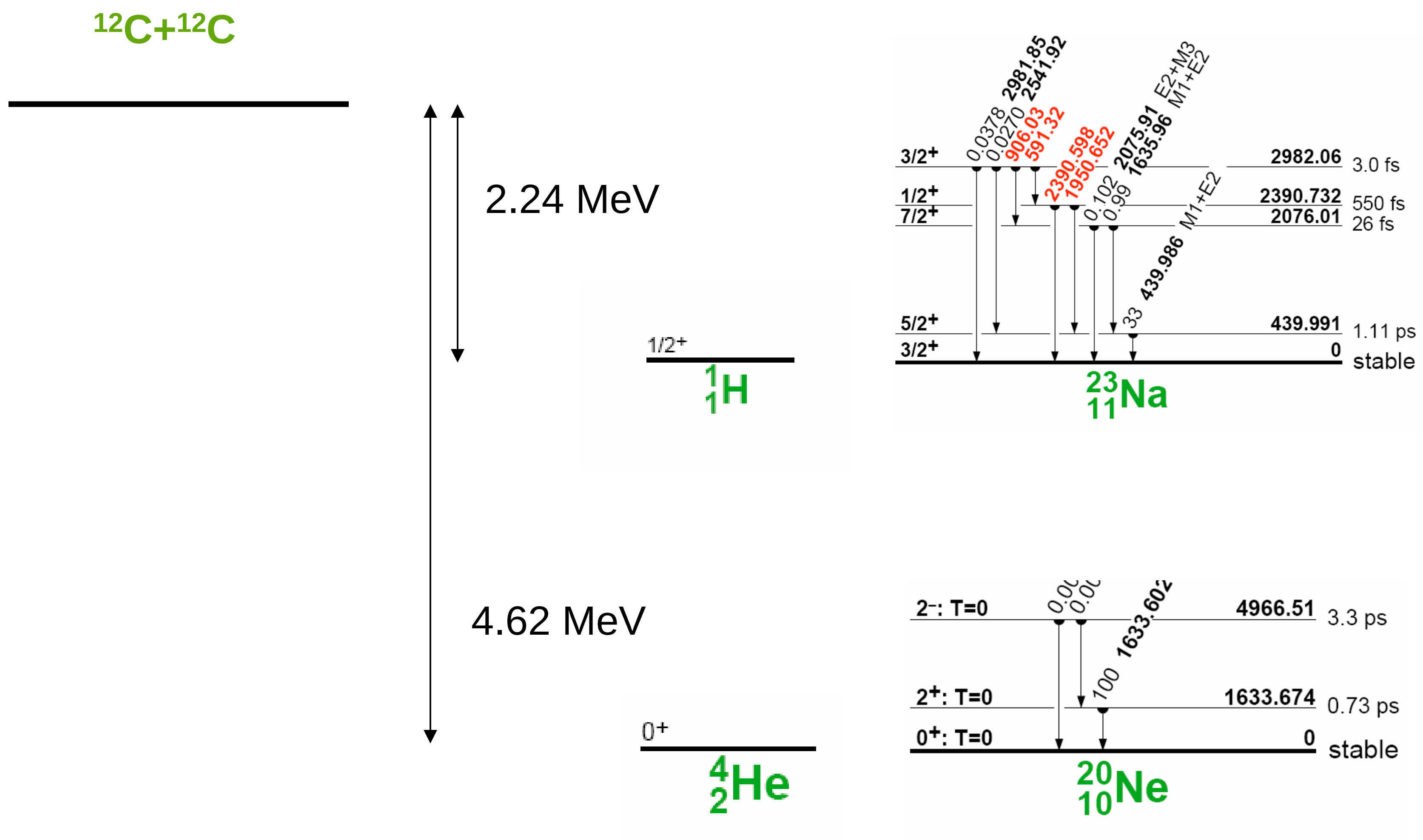




Di Leva 2008 to be published

# results



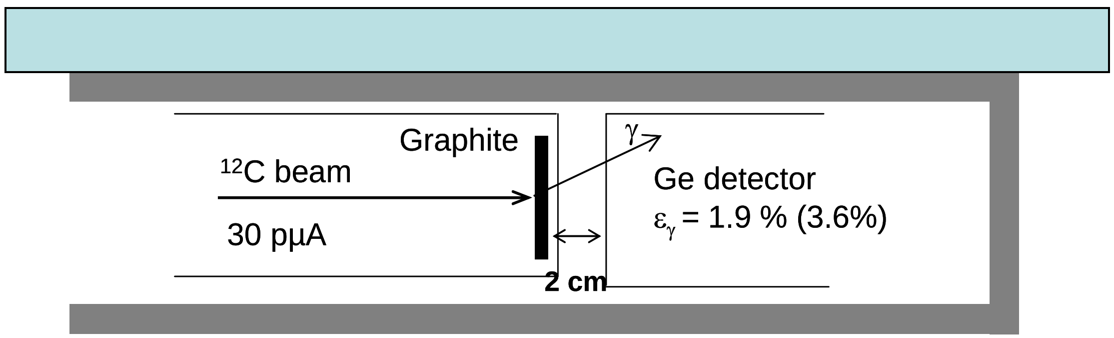
$S_{34}$ (keVb)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0
500
1000
1500
2000
2500
3000
$E_{cm}$ (keV)
Gamma
HO[59]
[PA63]
[NA69]
[KR82]
[OS82]
[RO83]
[AL84]
[HI88]
[BR07]
[Co07]
Activation
[OS82]
[NA04]
[BE06]
[Co07]
[Gy07]
[BR07]
recoils
ERNA



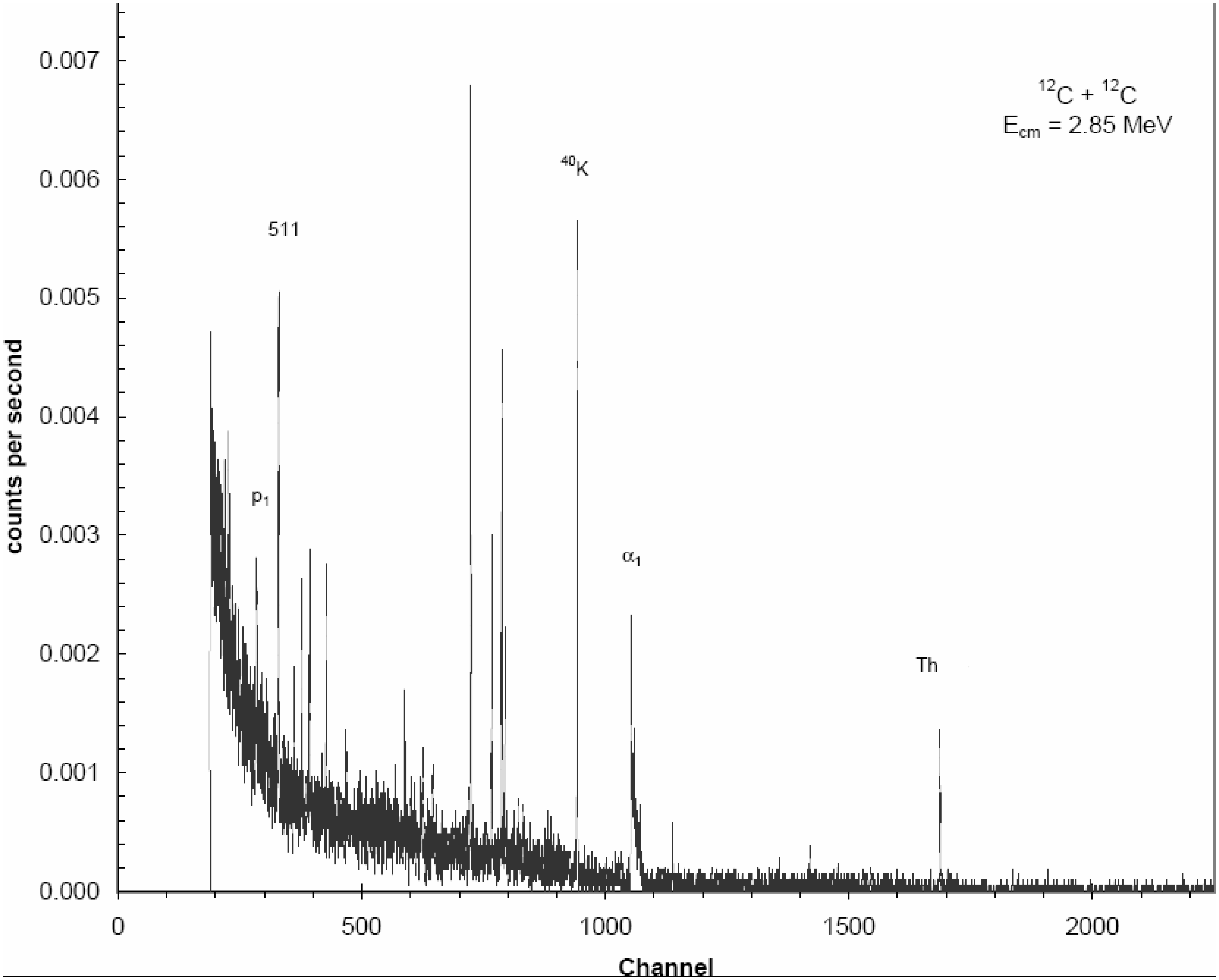
12C+12C
2.24 MeV
4.62 MeV
1/2+
1H
0+
4He
23Na
3/2+
1/2+
7/2+
5/2+
3/2+
2982.06
2390.732
2076.01
439.991
0
3.0 fs
550 fs
26 fs
1.11 ps
stable
2981.85
2541.92
906.03
591.32
2390.598
1950.652
2075.91
1635.96
439.986
E2+M3
M1+E2
M1+E2
0.0378
0.0270
0.102
0.99
33
20Ne
2−: T=0
2+: T=0
0+: T=0
4966.51
1633.674
0
3.3 ps
0.73 ps
stable
1633.602
100

# $^{12}C+^{12}C$

cosmic background: factor 2 reduction of at $E\gamma=1.6$ MeV




Beam induced background from $^{1}H(^{12}C,\gamma)^{13}N$ and $^{2}H(^{12}C,p\gamma)^{13}C$

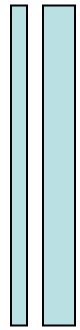



T. Spillane et al PRL 2007

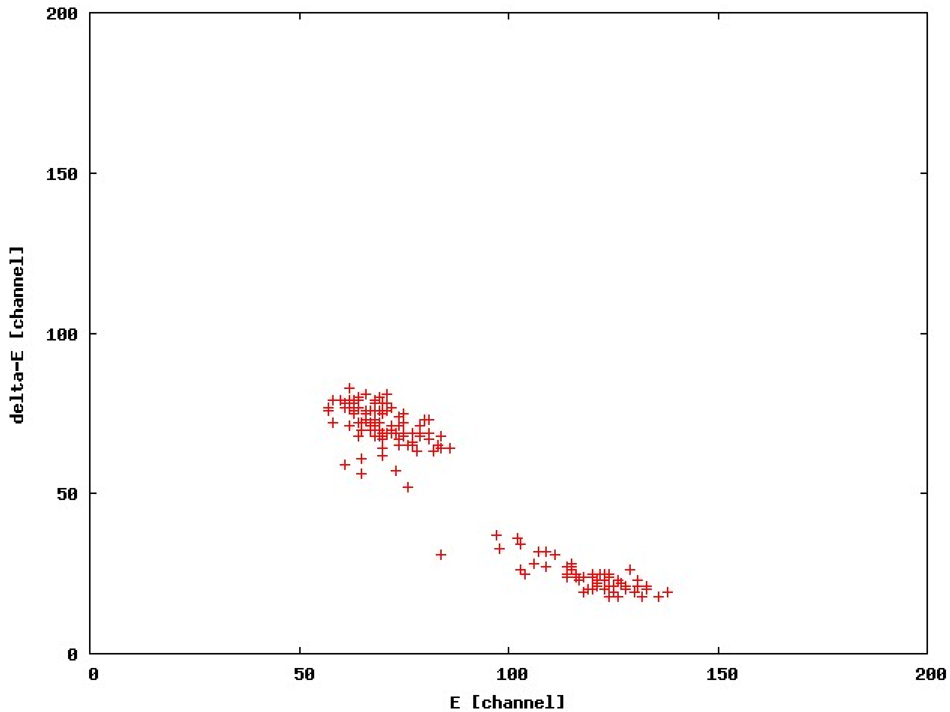
Centre for Isotopic Research for Cultural and Environmental heritage
Caserta, Italy

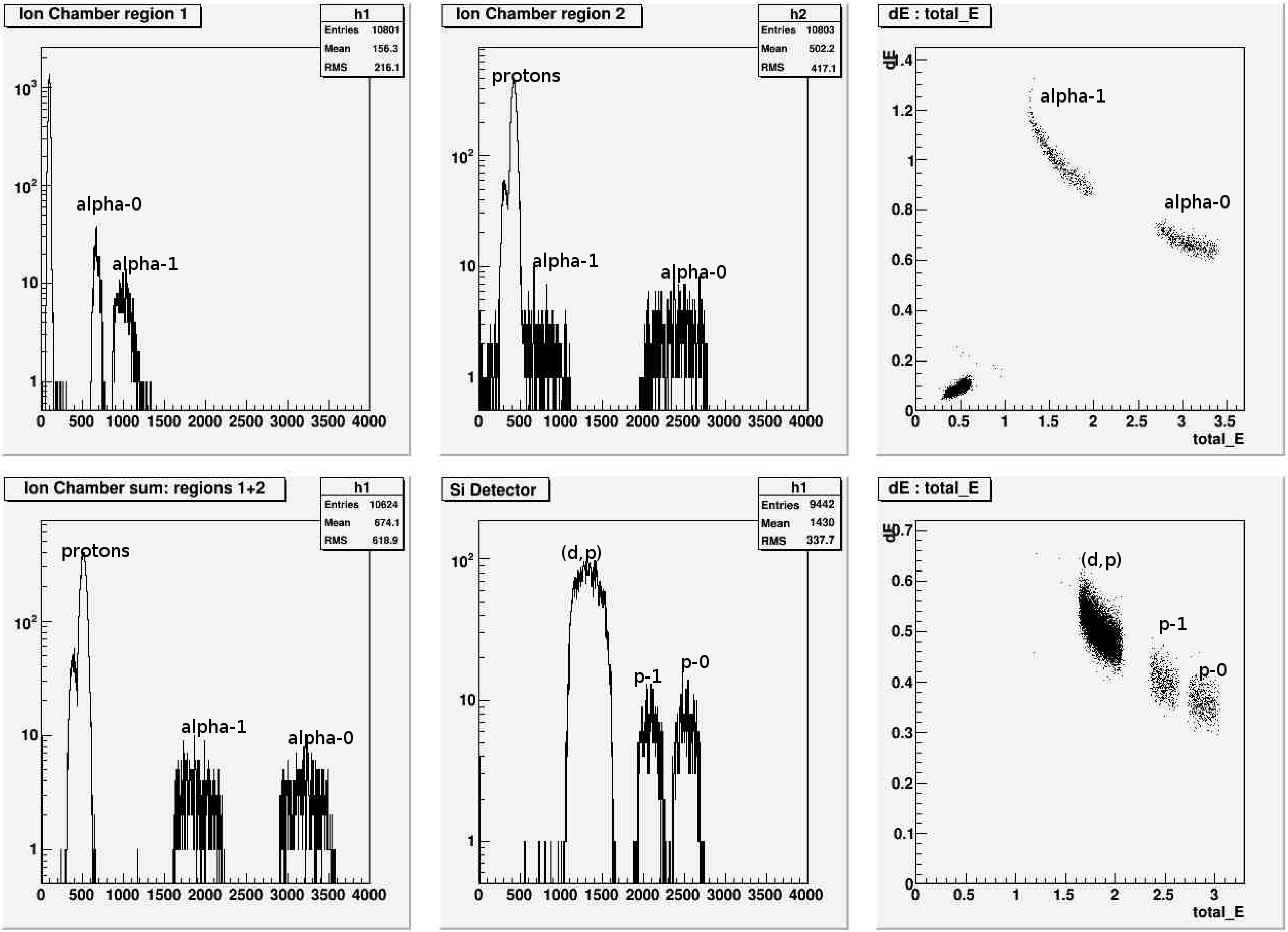
$I_{12C} \sim 20\ \mu A$ p-channel ok

Beam induced background $^{2}H(^{12}C,p\gamma)^{13}C$ may be a problem for the $\alpha$-channel

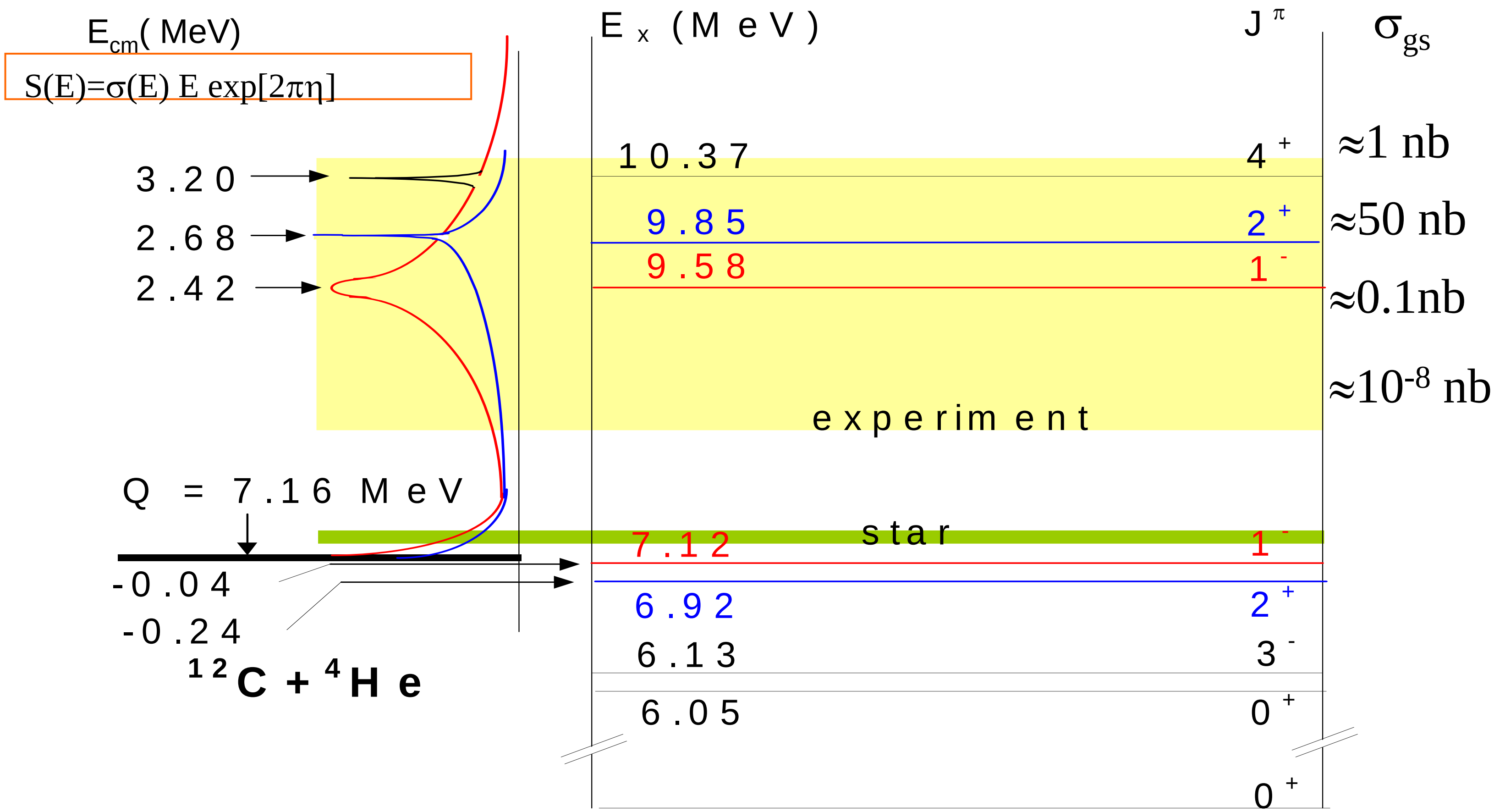


Si



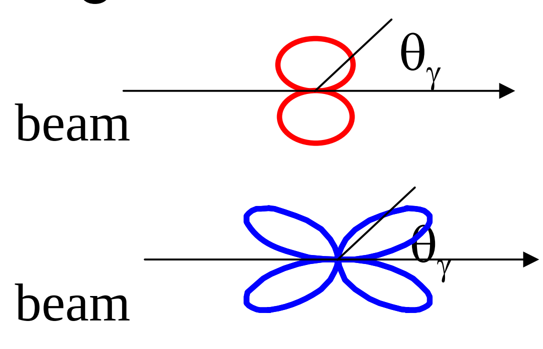



T. Spillane UConnecticut




**$^{16}$O**

$$\sigma_{gs} = \sigma_{E1} + \sigma_{E2}$$




$$W_{E1}(\theta_\gamma) \propto \sin^2(\theta_\gamma)$$

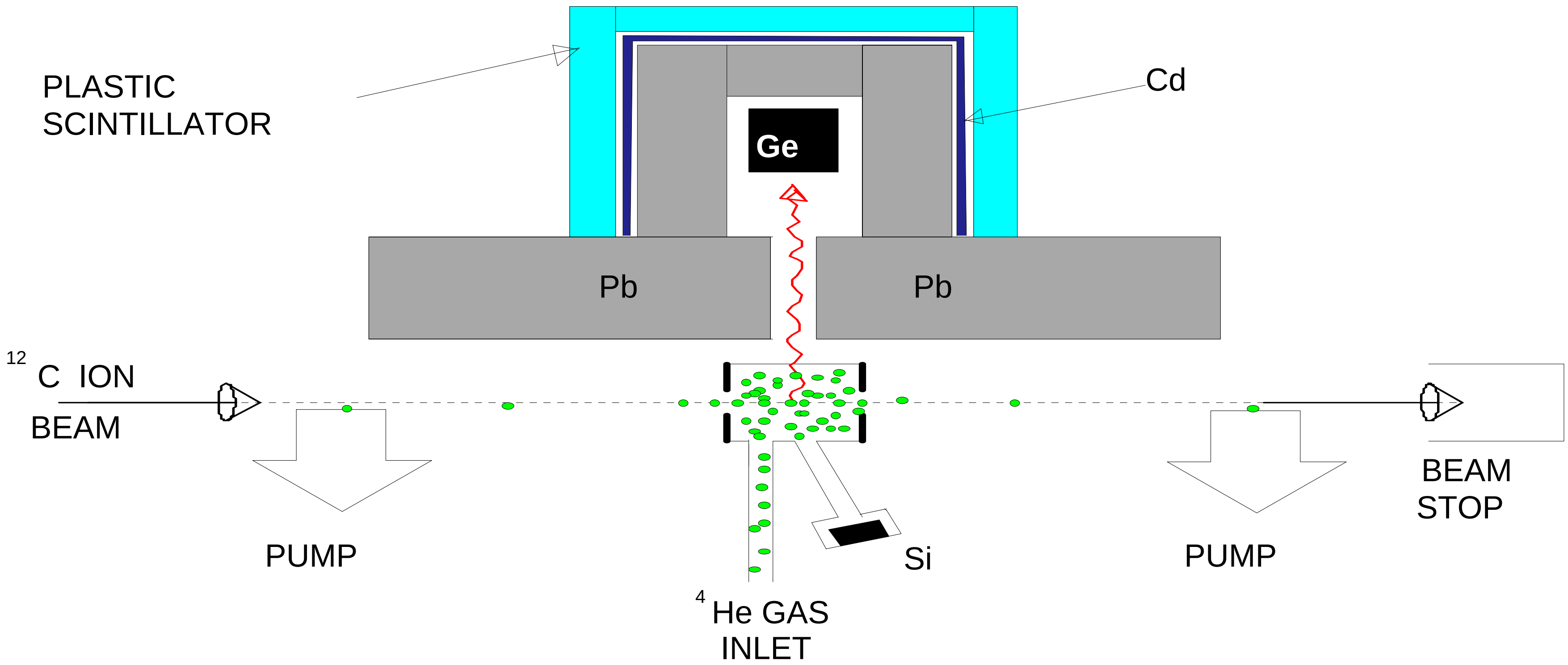
$$W_{E2}(\theta_\gamma) \propto \sin^2(\theta_\gamma)\cos^2(\theta_\gamma)$$

Far geometry

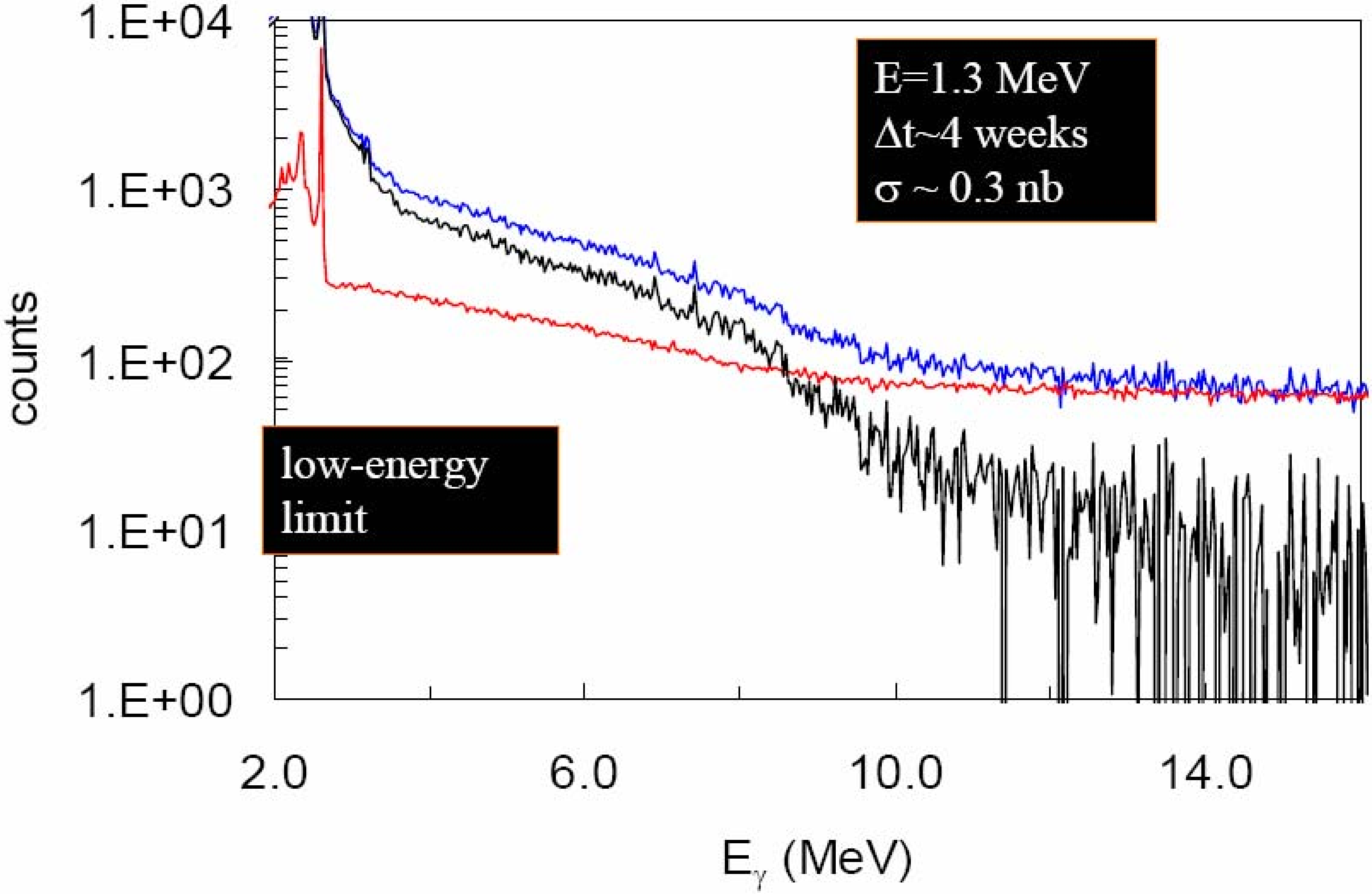
Detector array

High resolution detectors (HPGe)

Inverse kinematics (gas target)




E2 suppression : 94 %

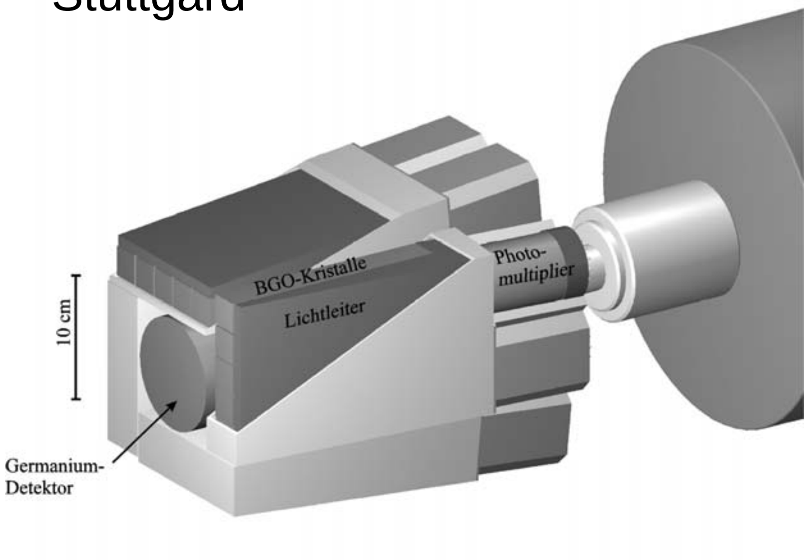


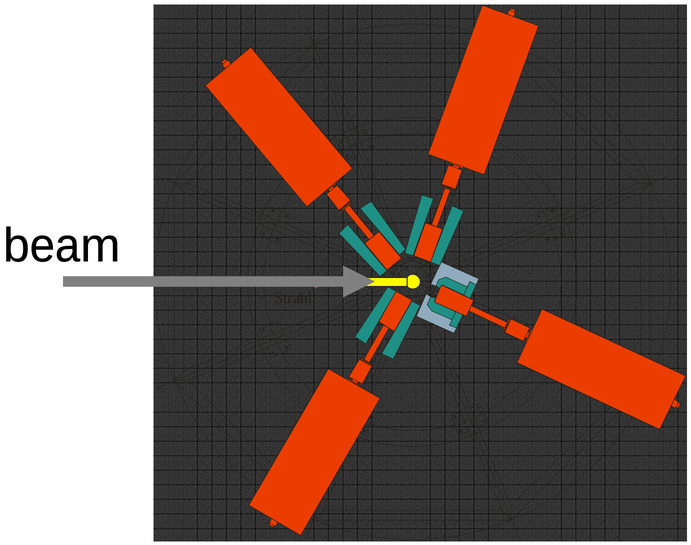

L.Gialanella et al. EPJ A 2001

# $^{12}C(^{4}He,\gamma)\ ^{16}O$

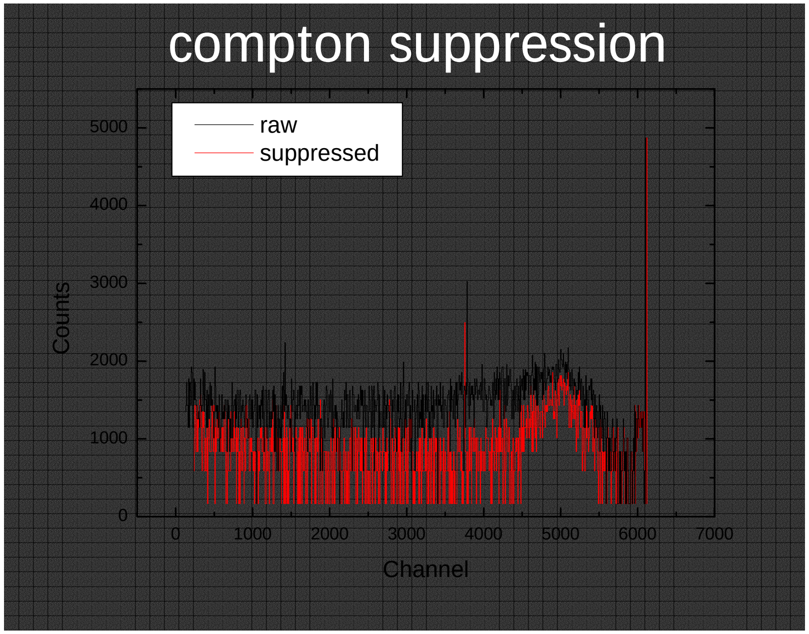
- $^{4}$He beam on $^{12}$C solid target
- Targets: (low-energy) ion beam implantation
  - $^{12}$C/$^{13}$C separation of accelerated ions
- Array of Ge detectors
  - 4 home made / 16 Eurogam
  - Ge surrounded by BGO crystals (active shielding)
    - Compton suppression
    - Cosmic ray suppression

Stuttgard

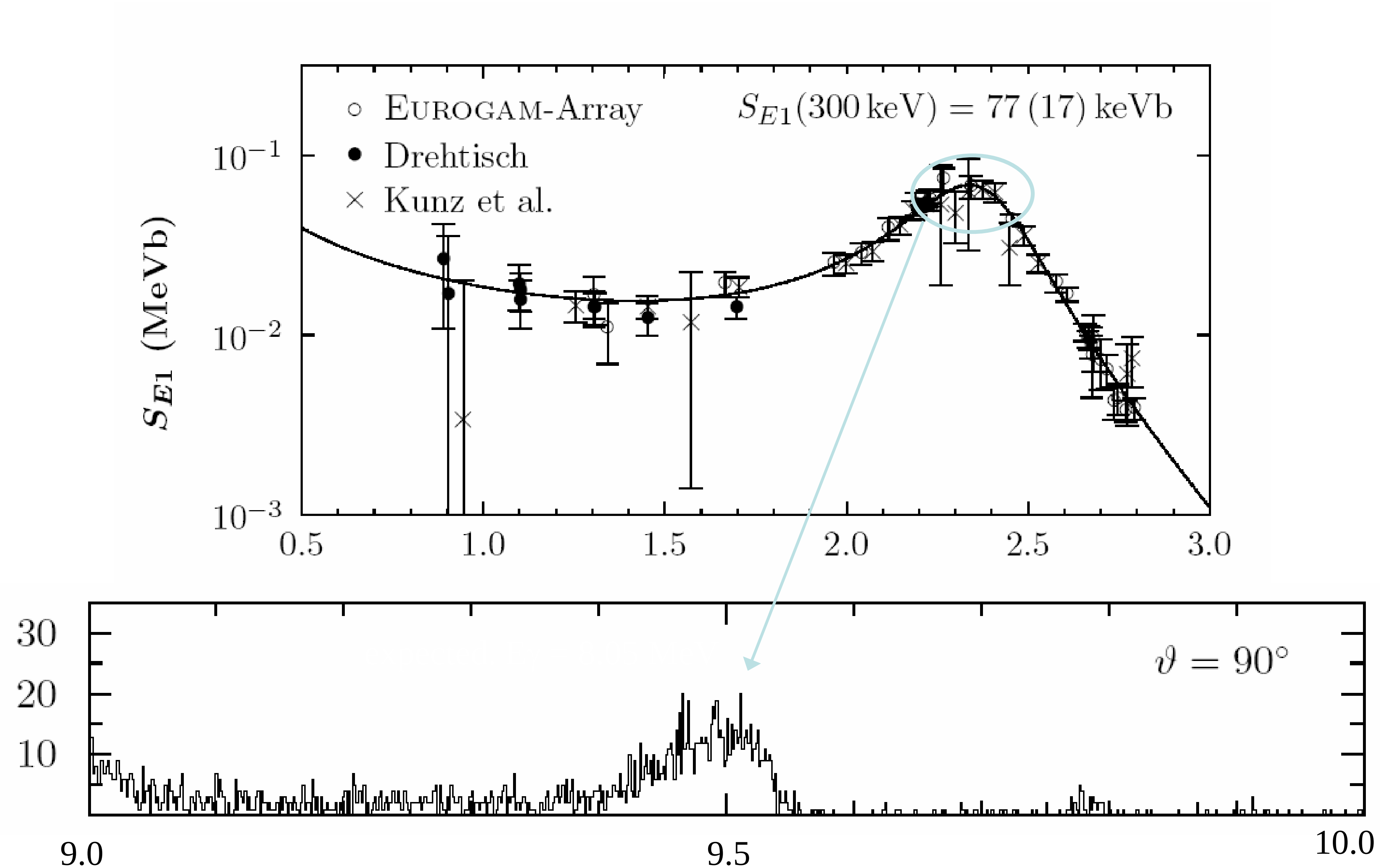



R. Kunz et al PRL 2001



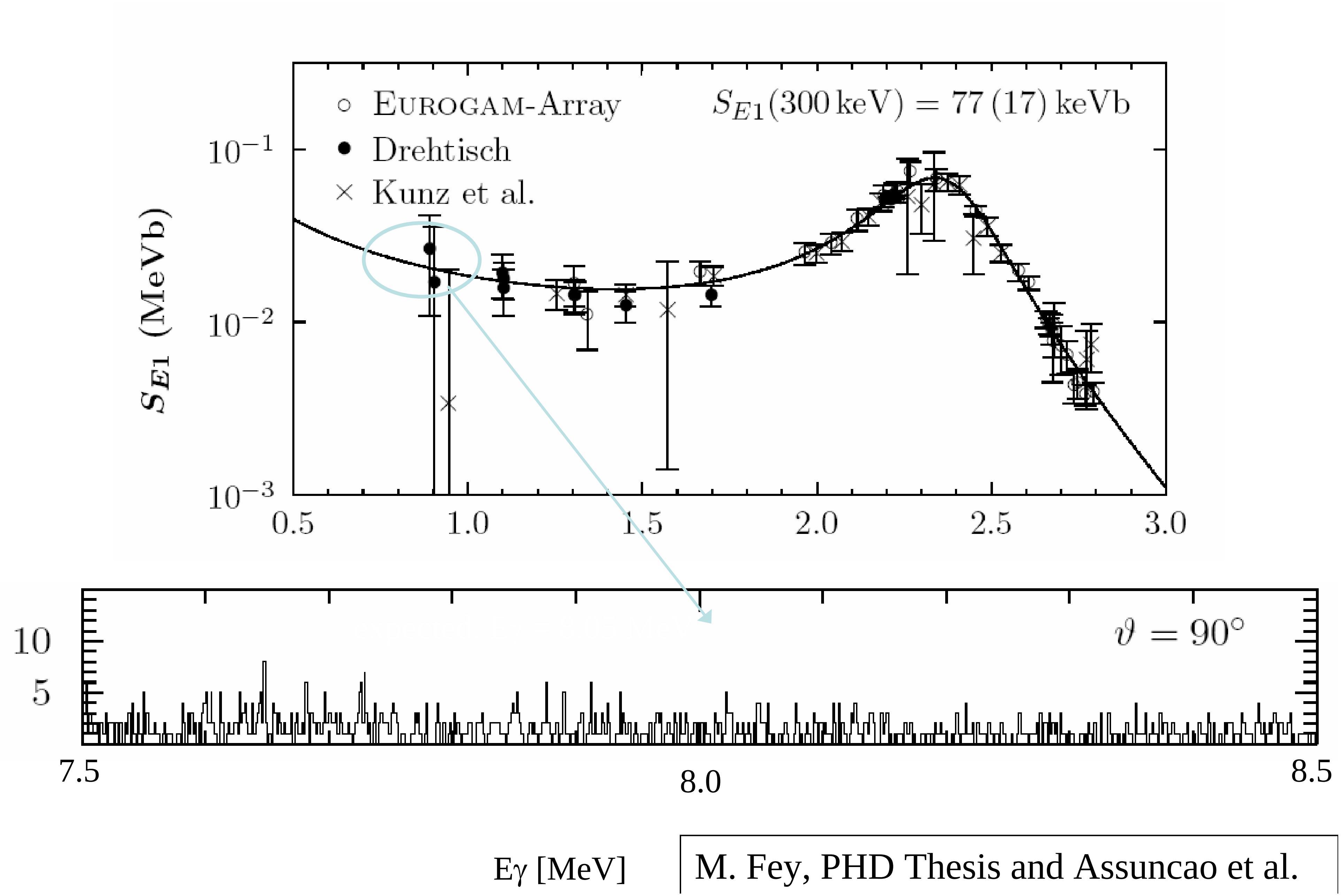
# Stuttgart-Eurogam




Eγ [MeV]

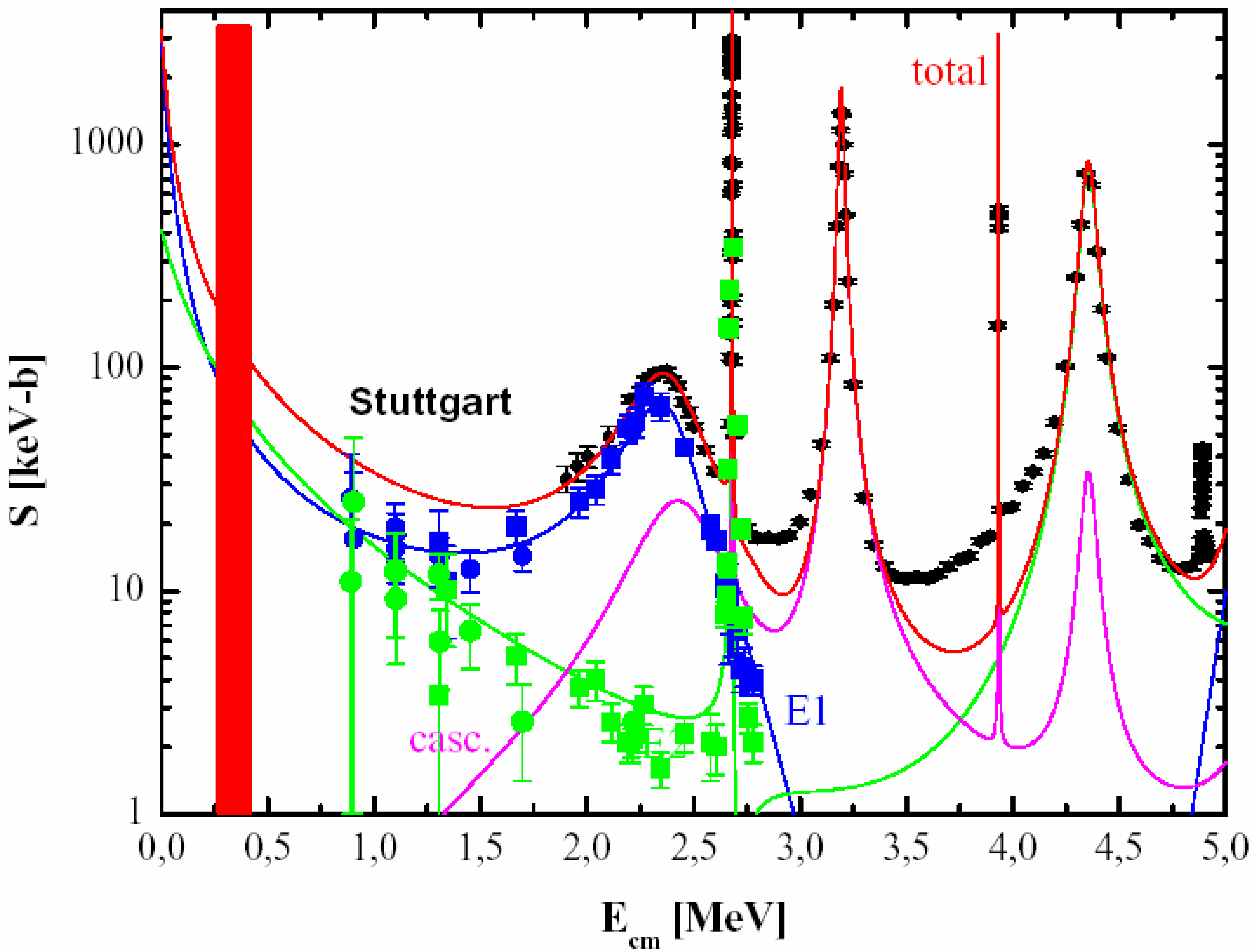
M. Fey, PHD Thesis and Assuncao et al.

# Stuttgart-Eurogam



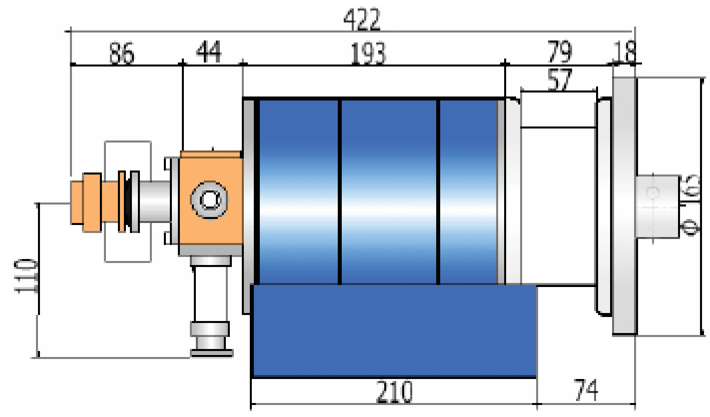

M. Fey, PHD Thesis and Assuncao et al.

$^{12}C(\alpha,\gamma)^{16}O$

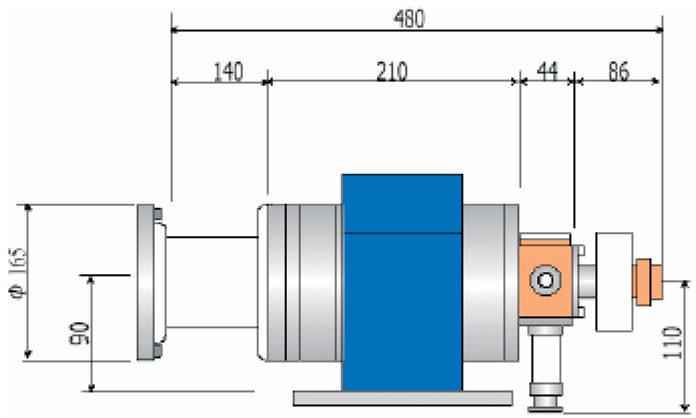


# ECR sources

## Microgan-industry




## Nanogan



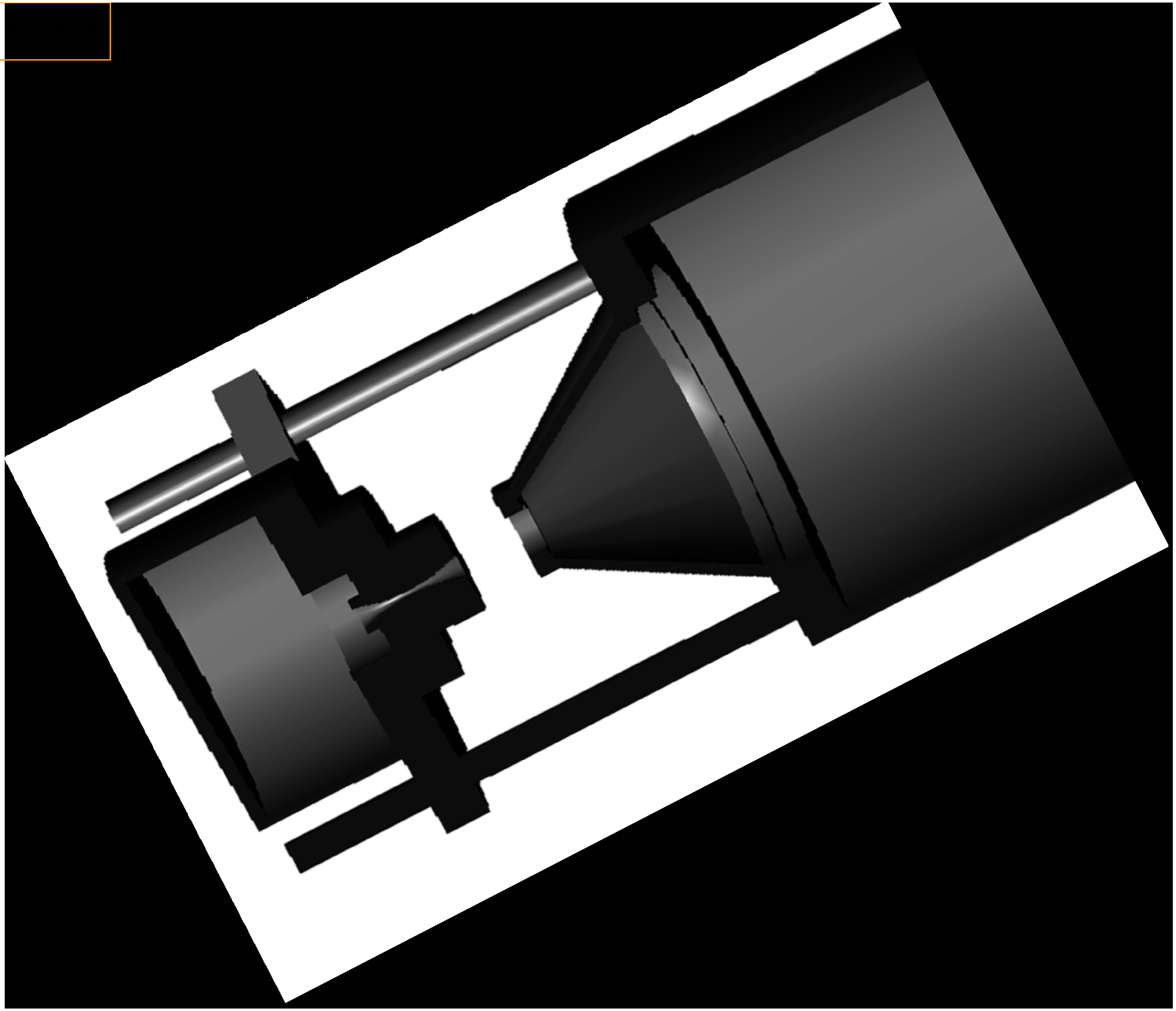

| Q+ | 1 | 2 | 3 | 4 | 5 | 8 |
|---|---|---|---|---|---|---|
| H | 7000 | | | | | |
| He | 5000 | | | | | |
| Ar | 2000 | 1290 | 600 | 220 | | 20 |
| P | 2000 | 1200 | 700 | 200 | 20 | |
| O | 4000 | 400 | 170 | | | |

Beam current intensity in eμA

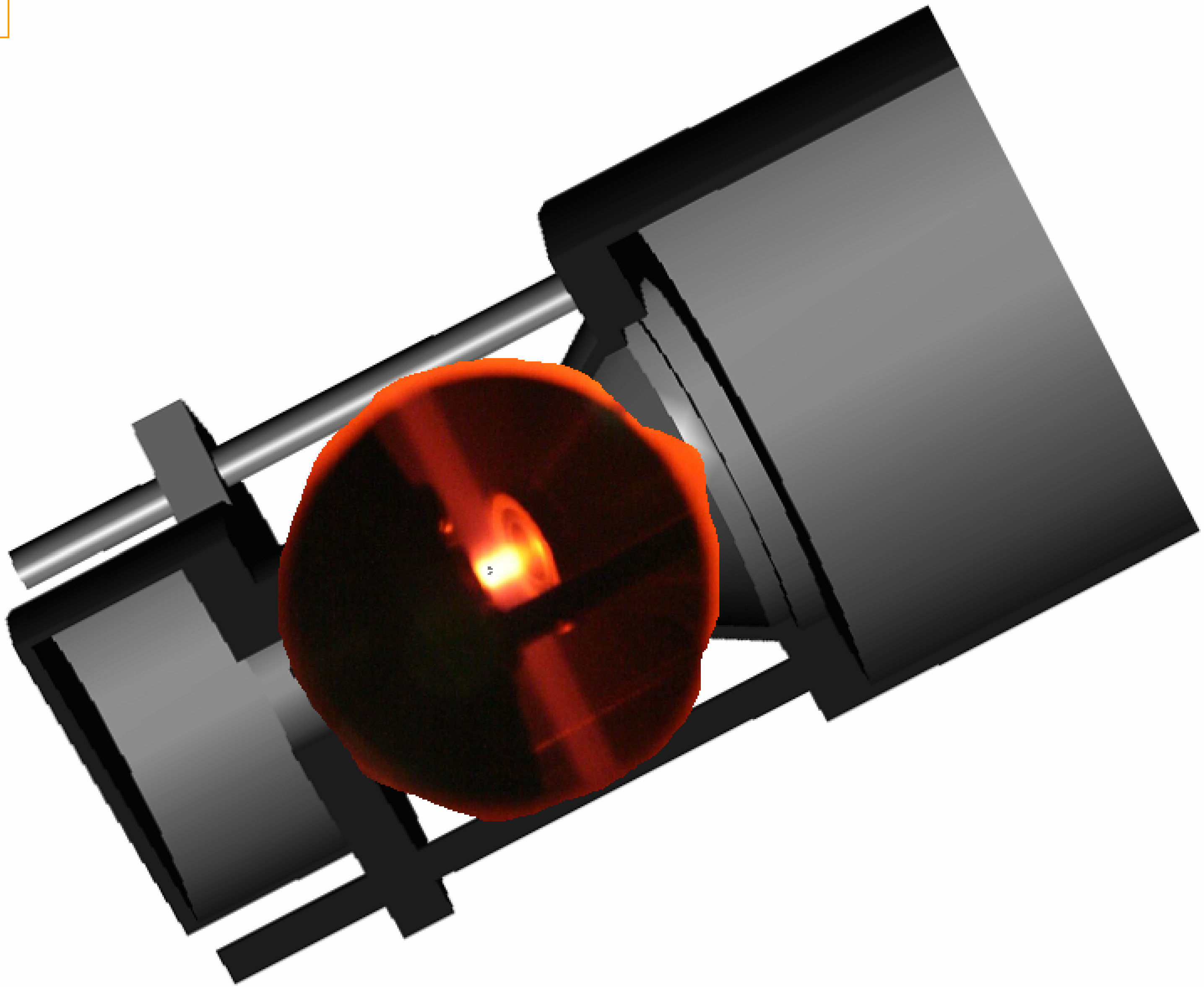
| Q+ | 1 | 2 | 4 | 6 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| H | 1000 | | | | | | | | | | | | |
| He | 1000 | 100 | | | | | | | | | | | |
| Ar | 500 | | 140 | 45 | 40 | 11 | | 1 | | | | | |
| Xe | | | | | | | | | | 8 | 7 | | 5 |
| Ta | | | | | 5 | 10 | | | 10 | | 5 | | |
| Au | | | 8 | 6 | 8.4 | 7.8 | 9 | | | 5 | 1.4 | 1 | |

Weight approx. 11 kg

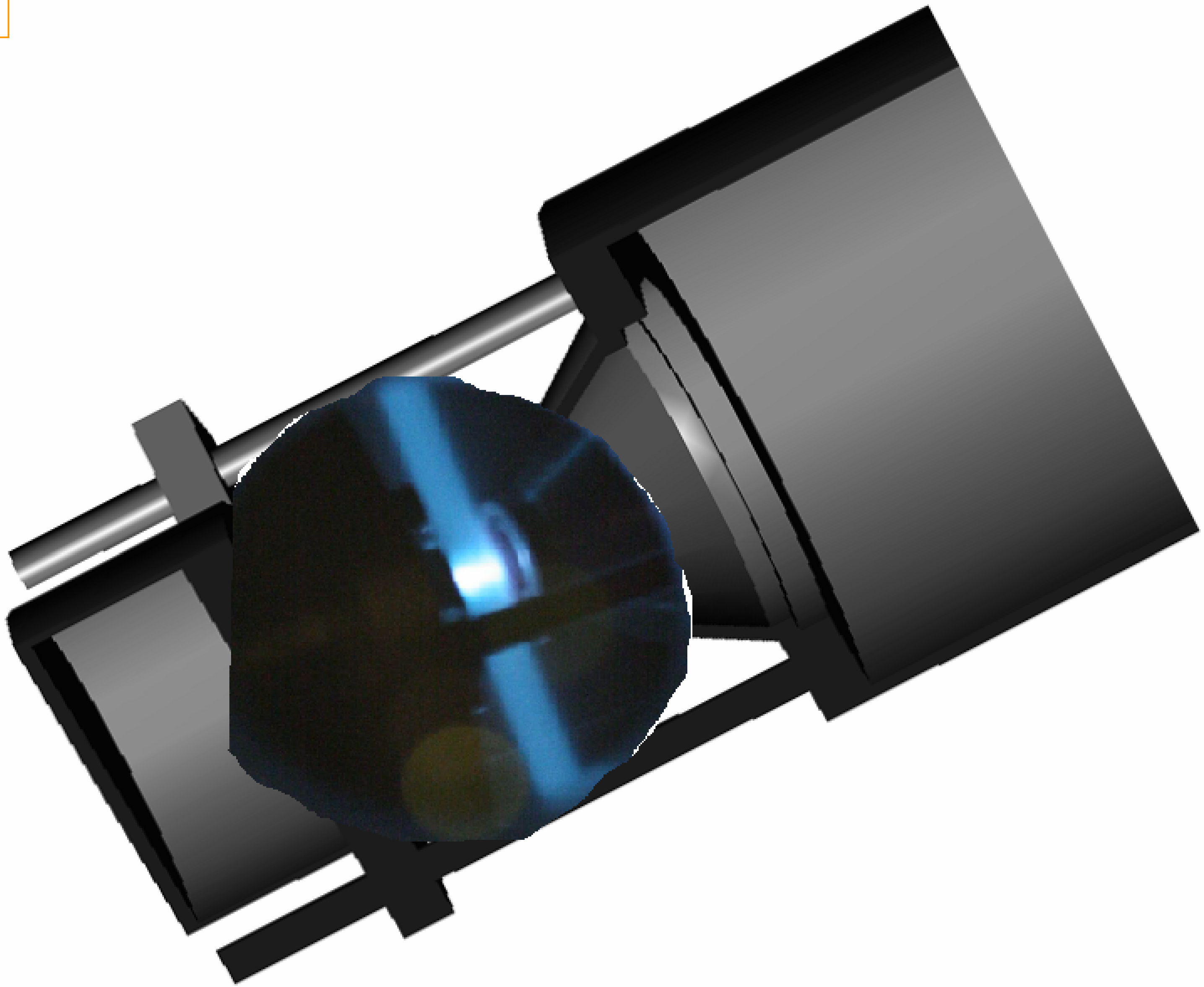
Jet



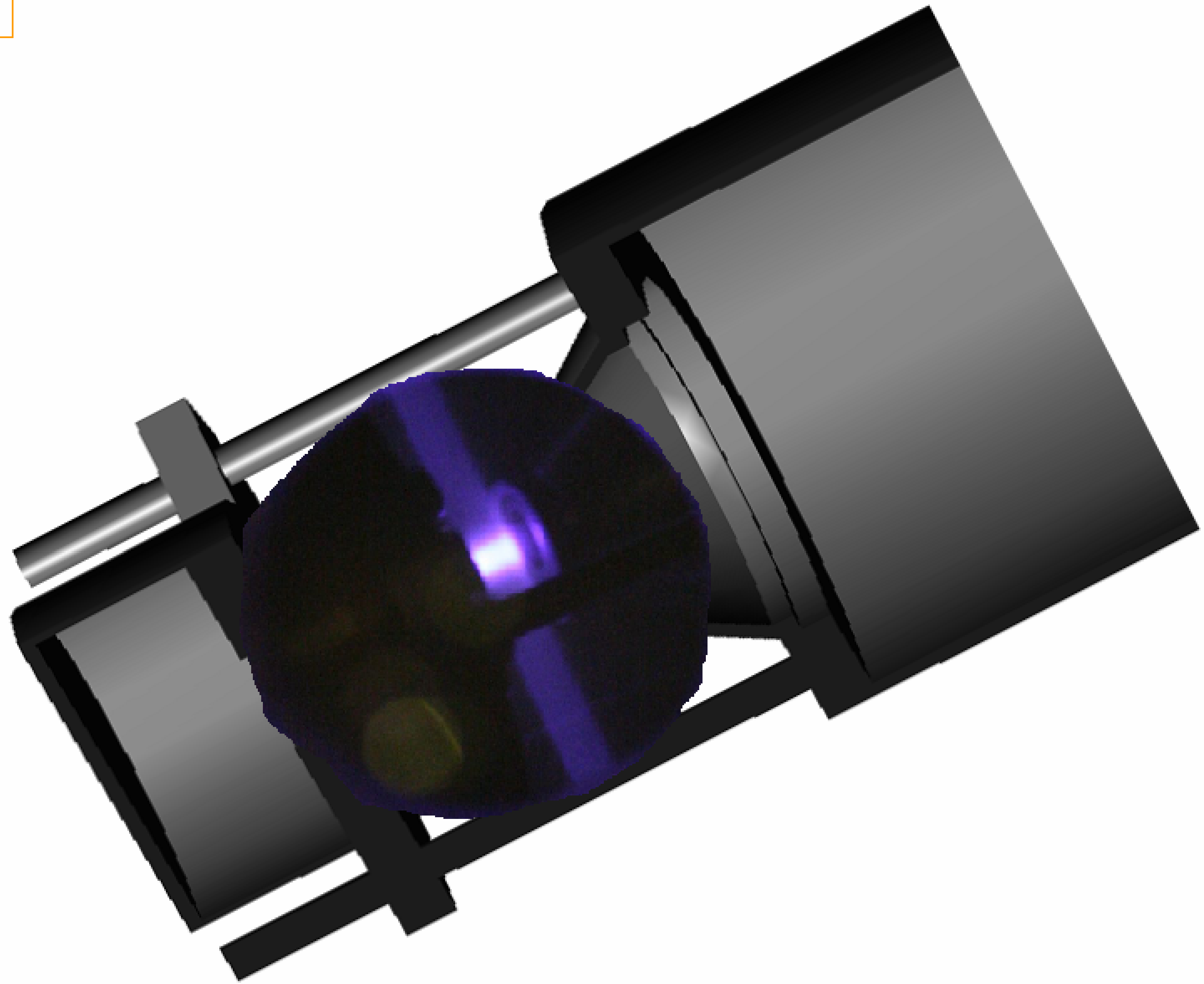
Jet target



Jet target



Jet target

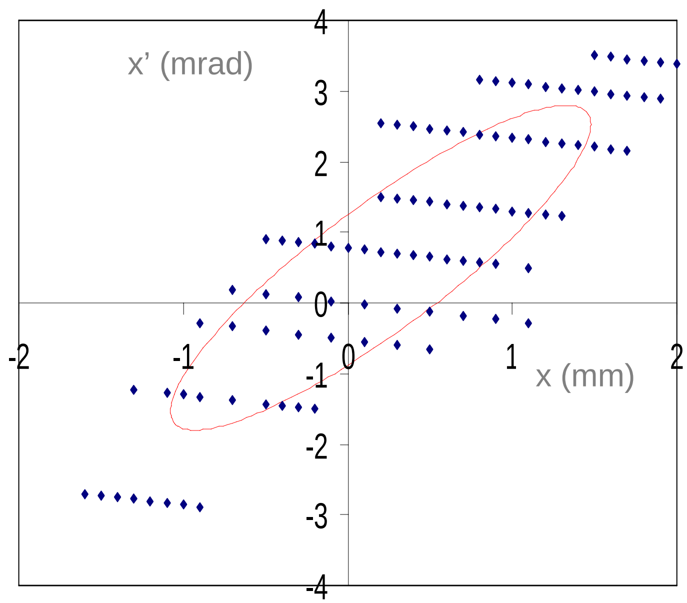


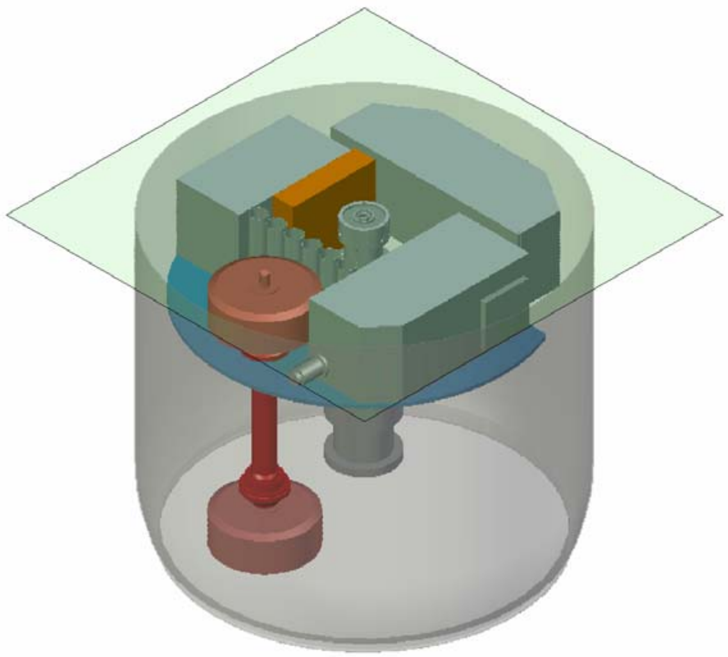
# ECR+Pelletron

Pelletron+ECR source

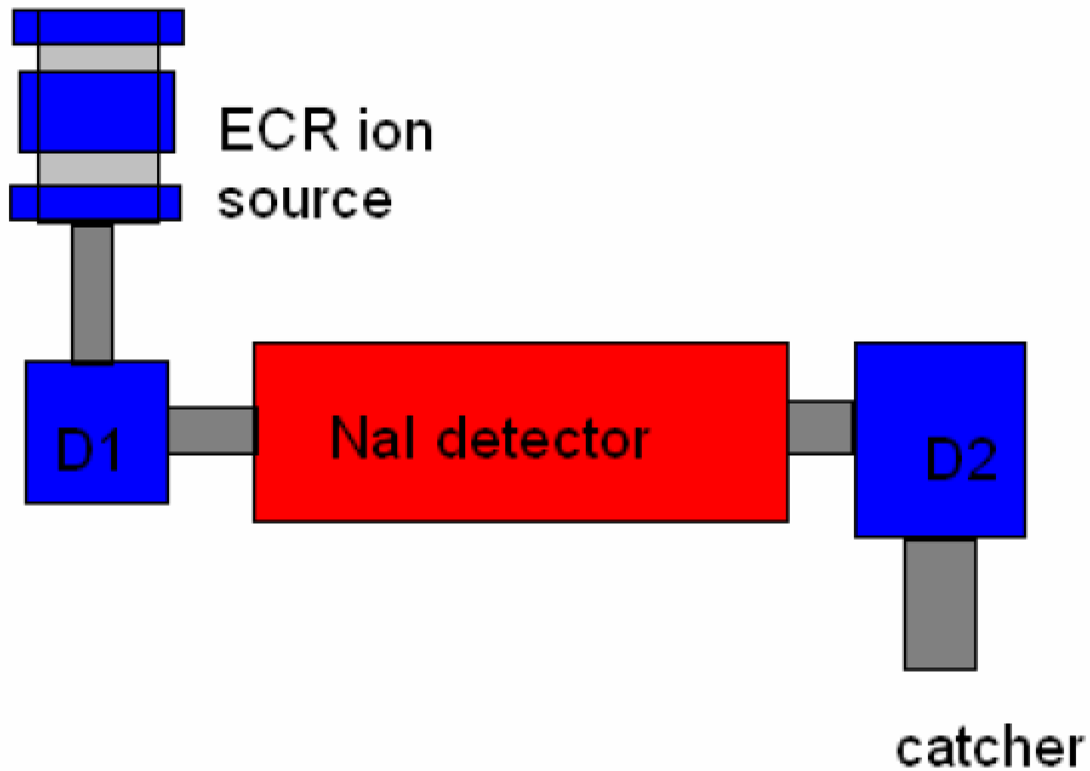
HV = 3 MV
Beam emittance:
at the source <200 $\pi$ ·mm·mrad
after acceleration<6 $\pi$ ·mm·mrad

For a RMS: ≈ 4 $\pi$ ·mm·mrad



7Be halflife



# Conclusions

- Only when the astrophysical relevant energy is reached one does not need high energy data
- When high energy data are needed, consistency is fundamental.
- Complementarity