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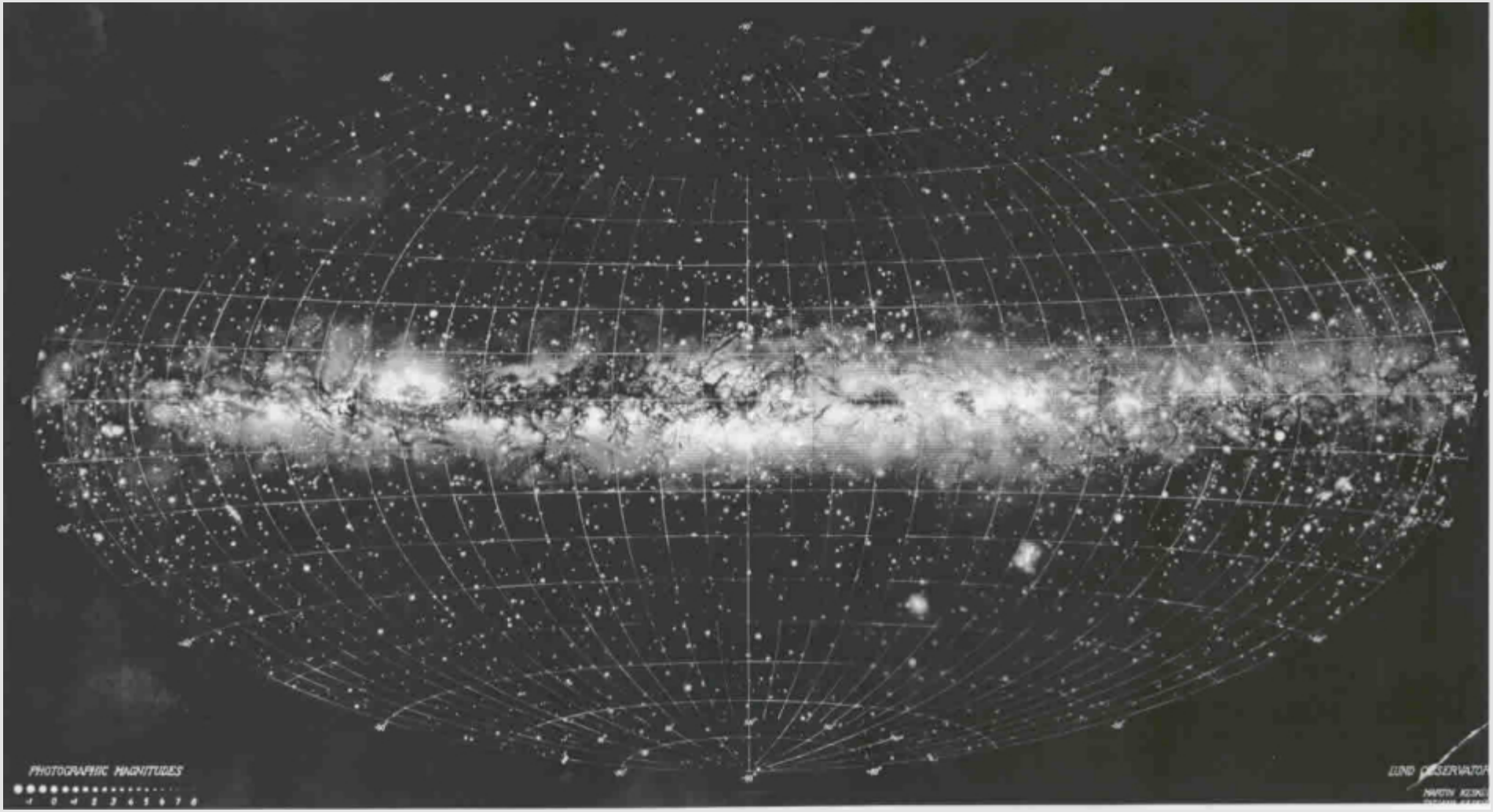
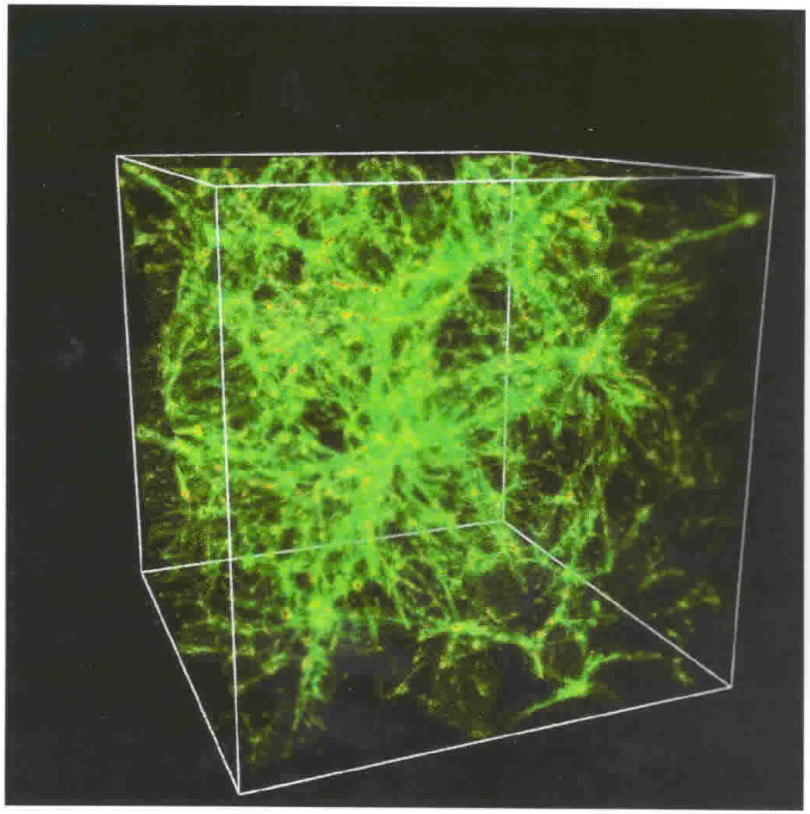
Interstellar Medium

June 20, 2002

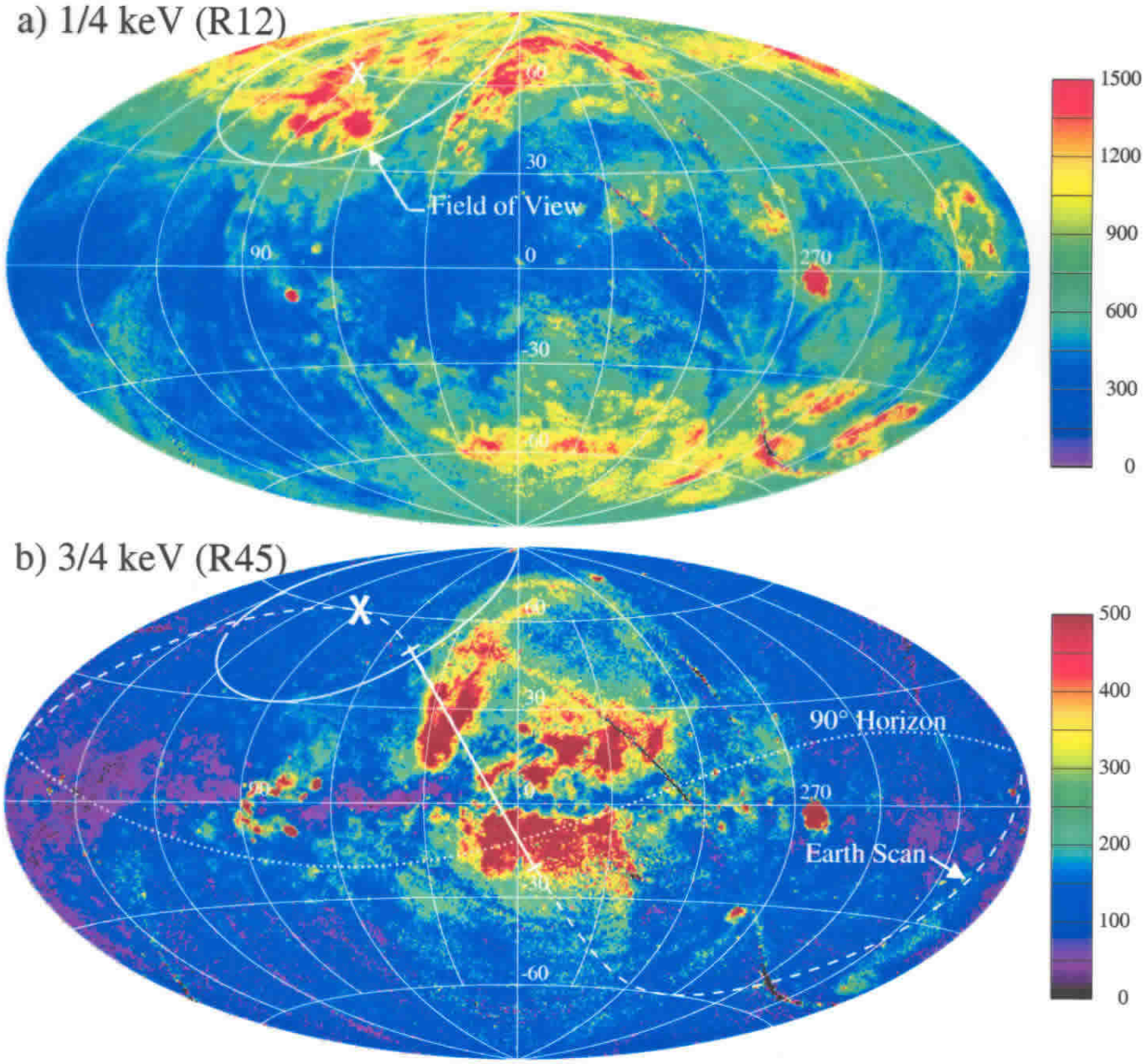
Galactic Coordinates



Picture of the sky at night, if we could see it all at once…



Most of the normal matter in the Universe may be in intergalactic structures like these. High-resolution X-ray spectroscopy could find out.


a) 1/4 keV (R12)
60
30
Field of View
90
0
270
-30
-60
1500
1200
900
600
300
0
b) 3/4 keV (R45)
60
30
90° Horizon
90
0
270
Earth Scan
-30
-60
500
400
300
200
100
0

Thermal Spectrum

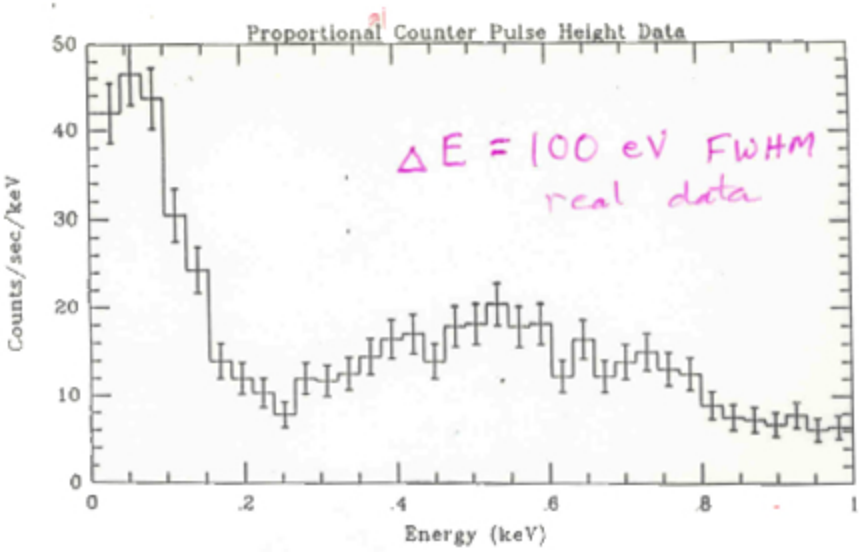


Figure 1 – A pulse hight distribution from a proportional counter on the sounding rocket flight 27.121.

Thermal spectrum: Hot gas at 1×10^6 K and 3×10^6 K

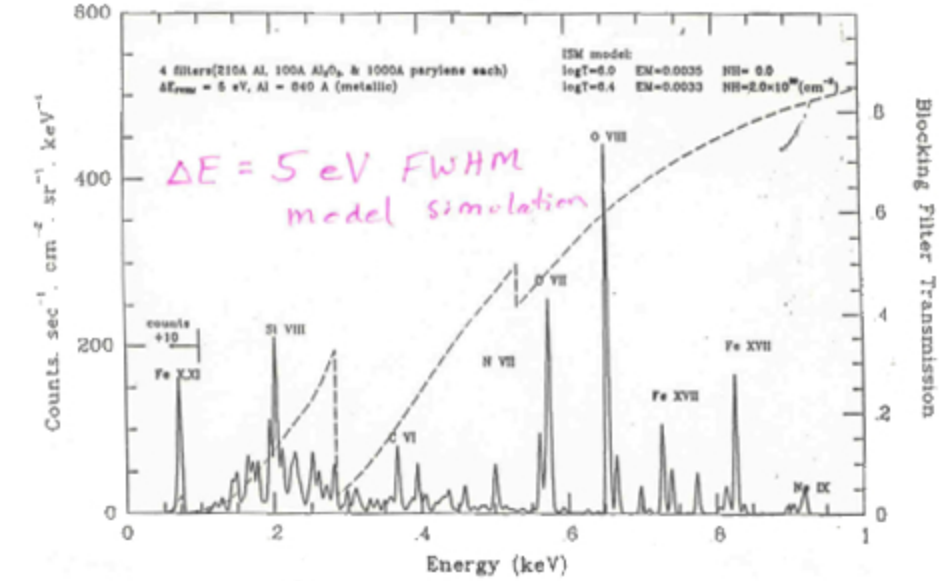
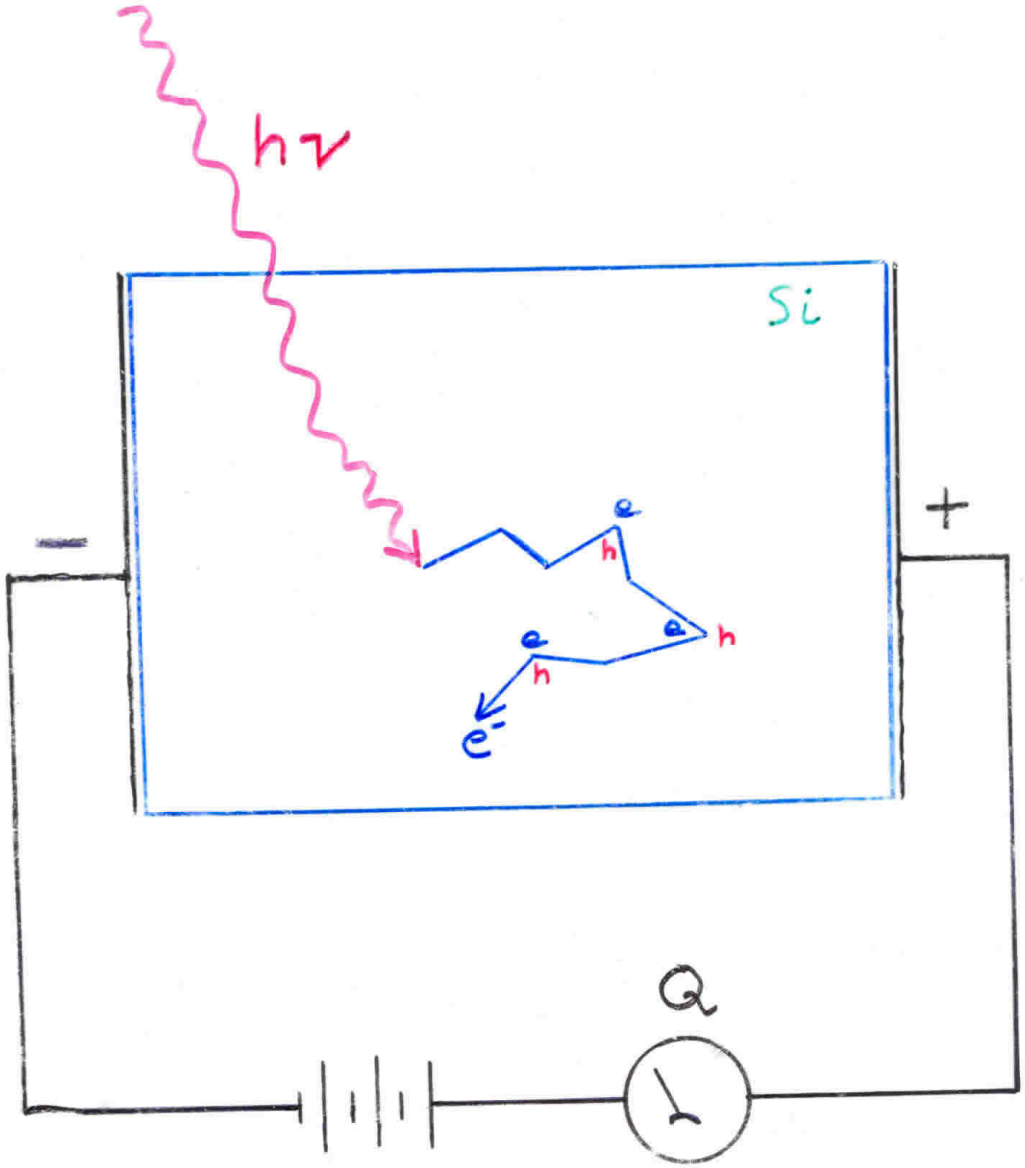


Figure 15 continuum. Same as Figure 13, except the source spectrum does not include an extrapolation of the extragalactic The thermal components have been increased to account for the observed broadband rates.



$$N = \frac{E}{W}$$

$$\Delta N \sim \sqrt{FN}$$

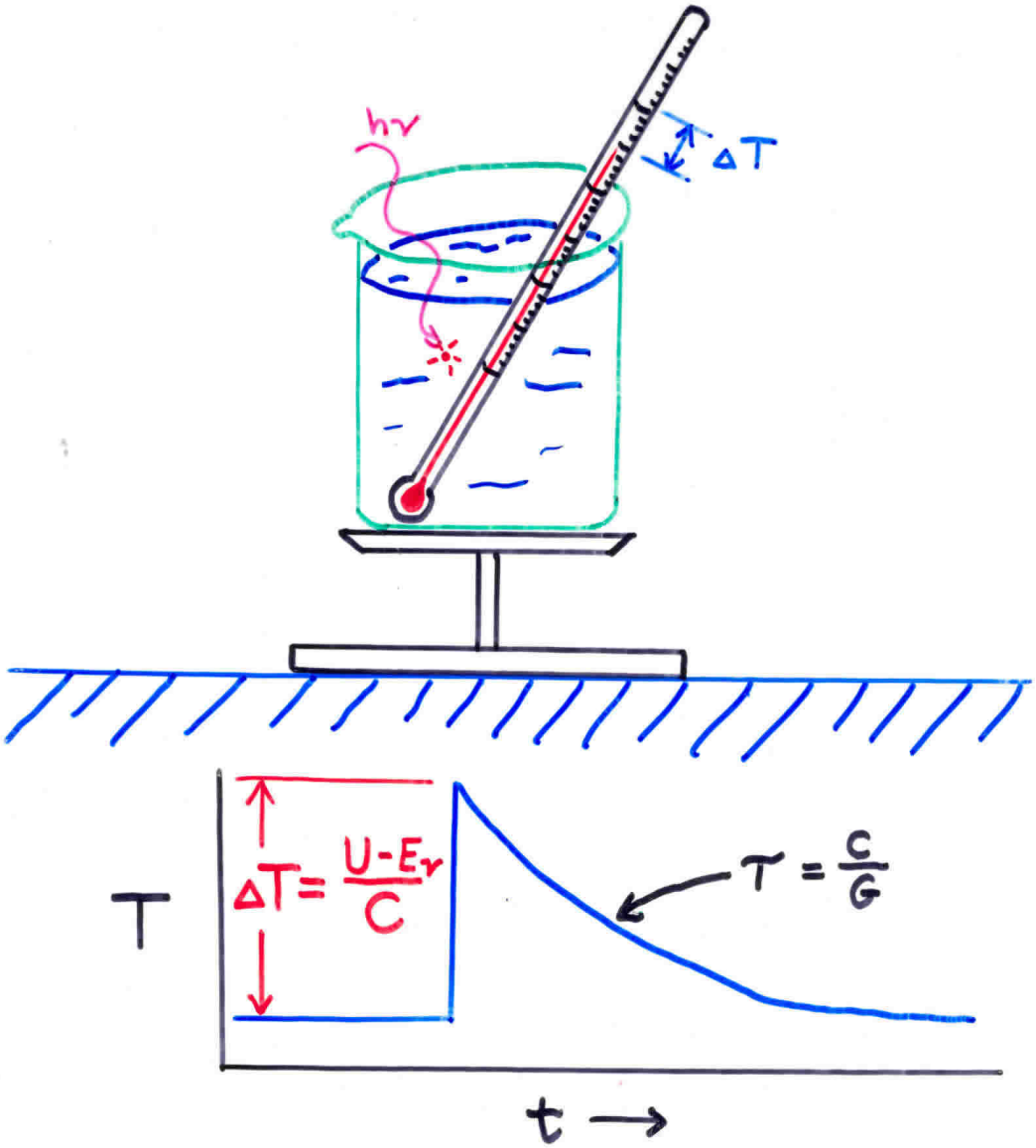
$$\Delta E = W \Delta N \sim 100\ \text{eV FWHM} \quad @\ 6\ \text{KeV}$$

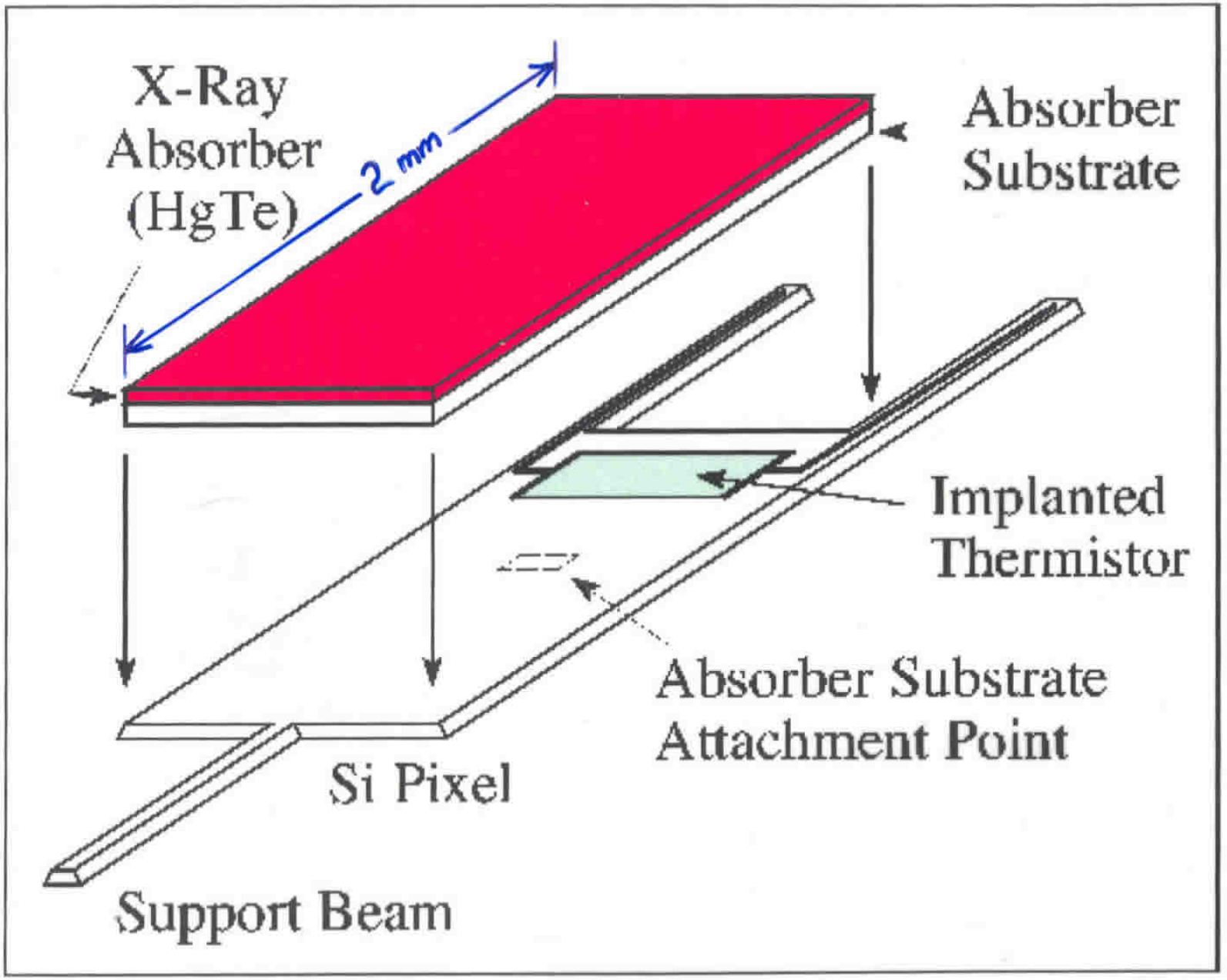
$W \simeq 3.7$ eV/e-h

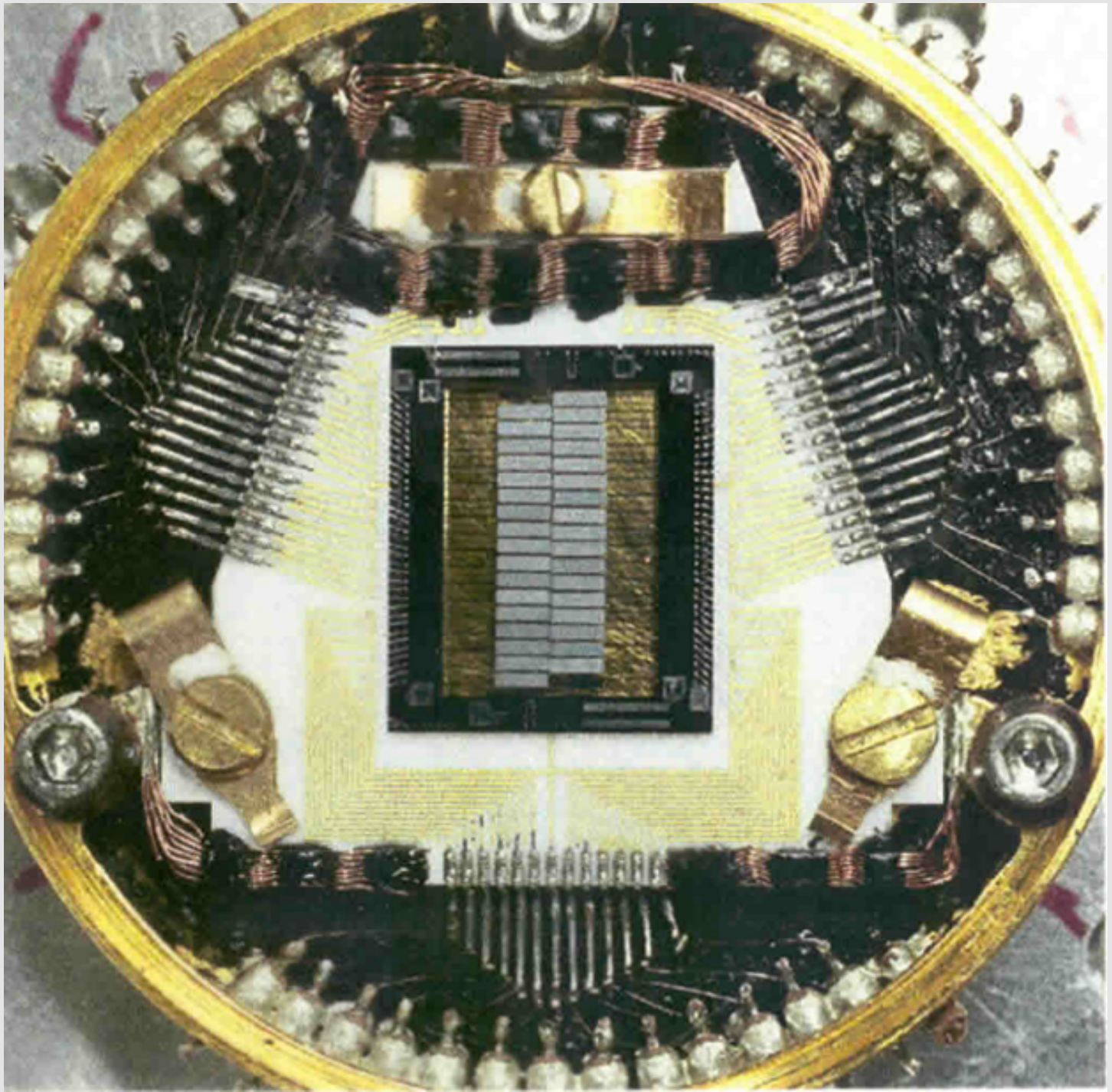
$\Delta E_g = 1.2$ eV

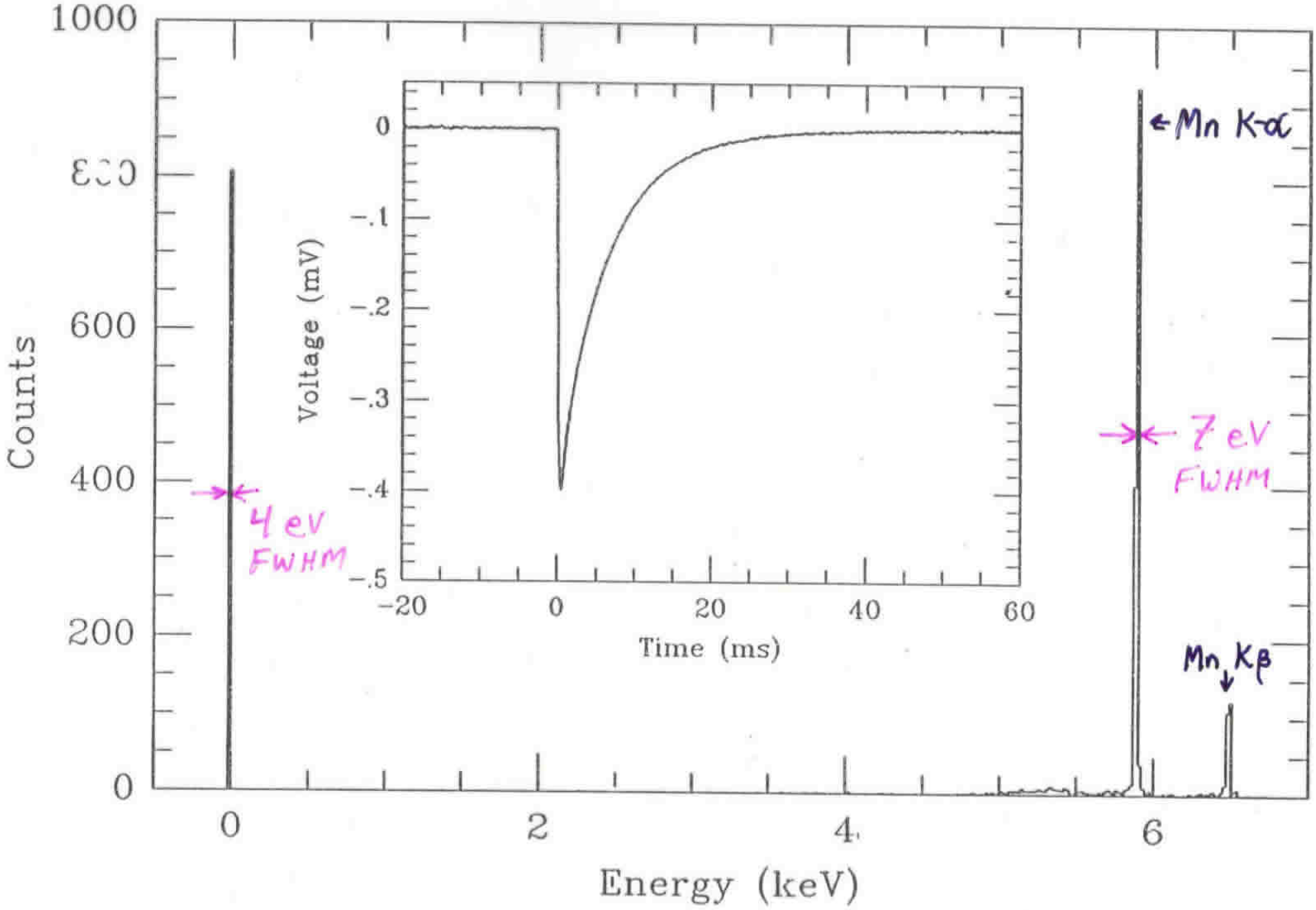
$\Rightarrow$ 32 % in e-h pairs

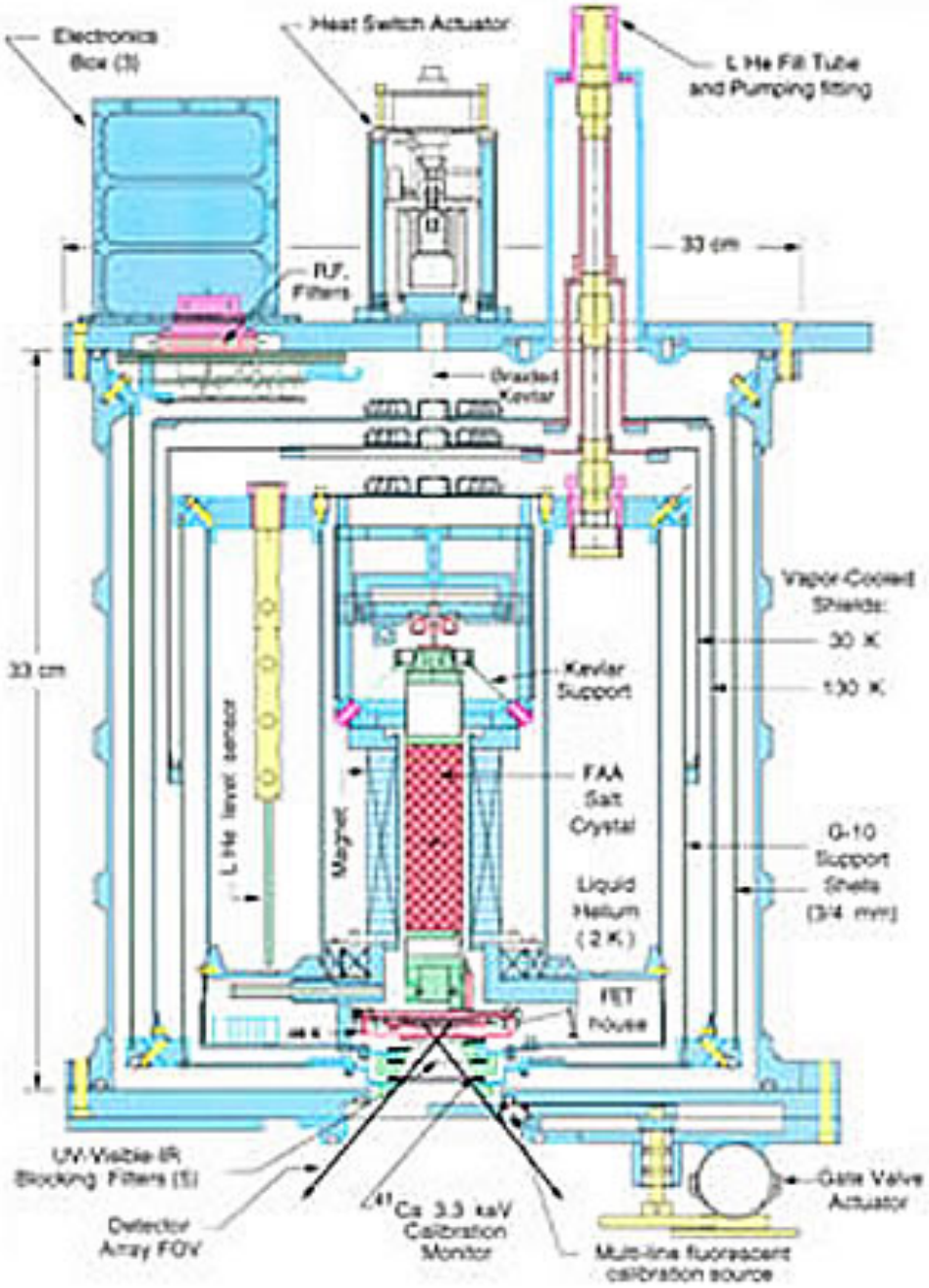
The Single-Photon Calorimeter

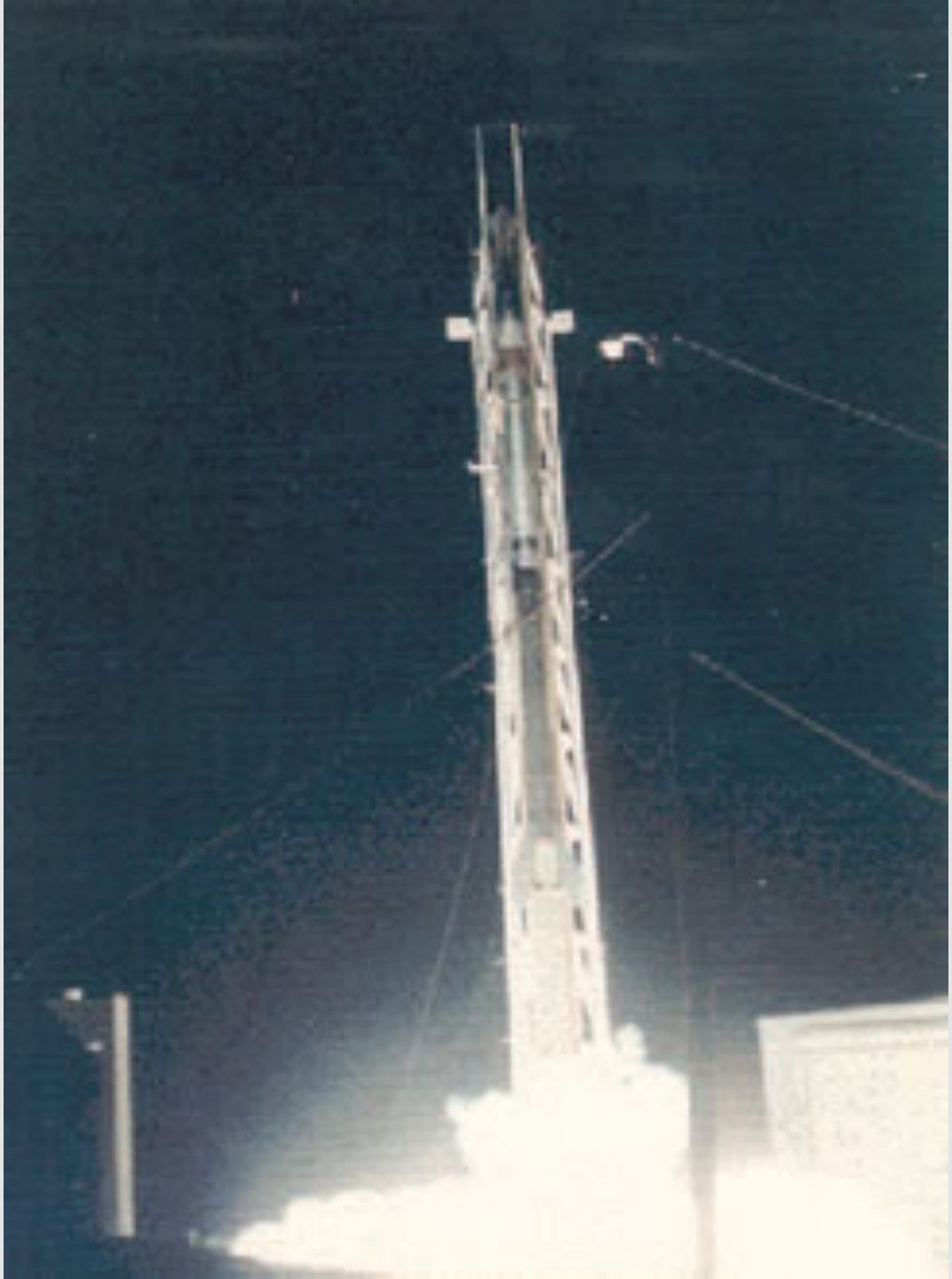


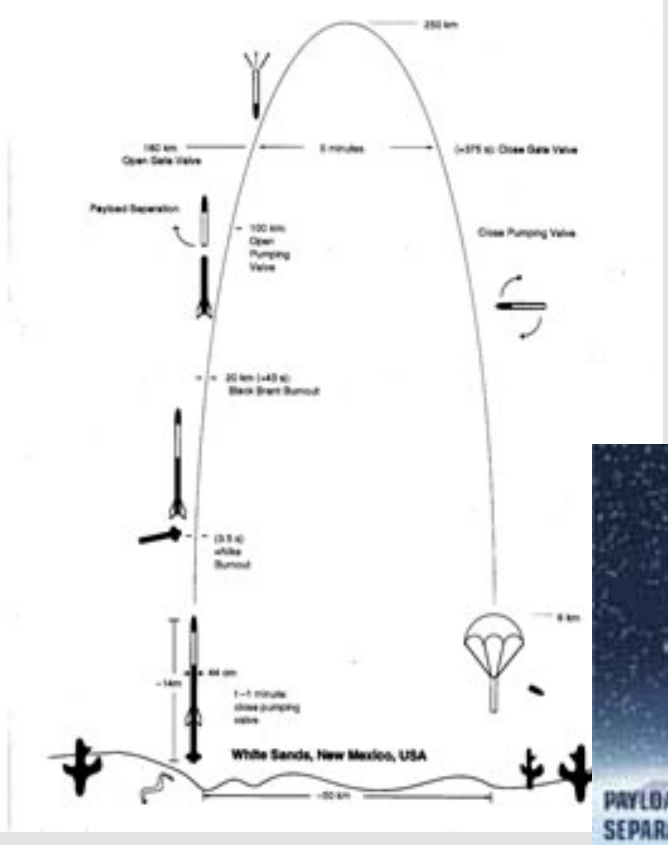

X-Ray
Absorber
(HgTe)
2 mm
Absorber
Substrate
Implanted
Thermistor
Absorber Substrate
Attachment Point
Si Pixel
Support Beam

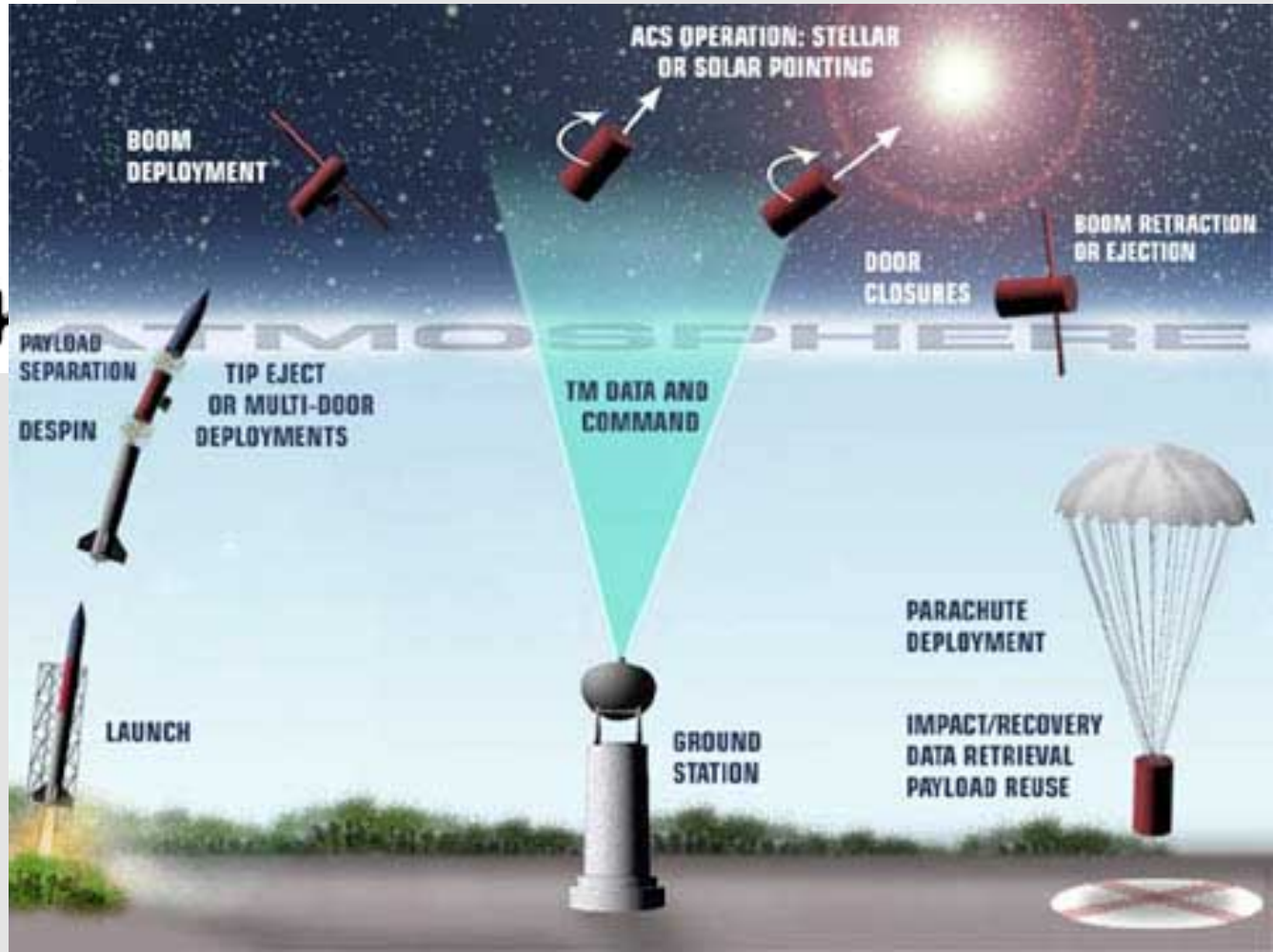


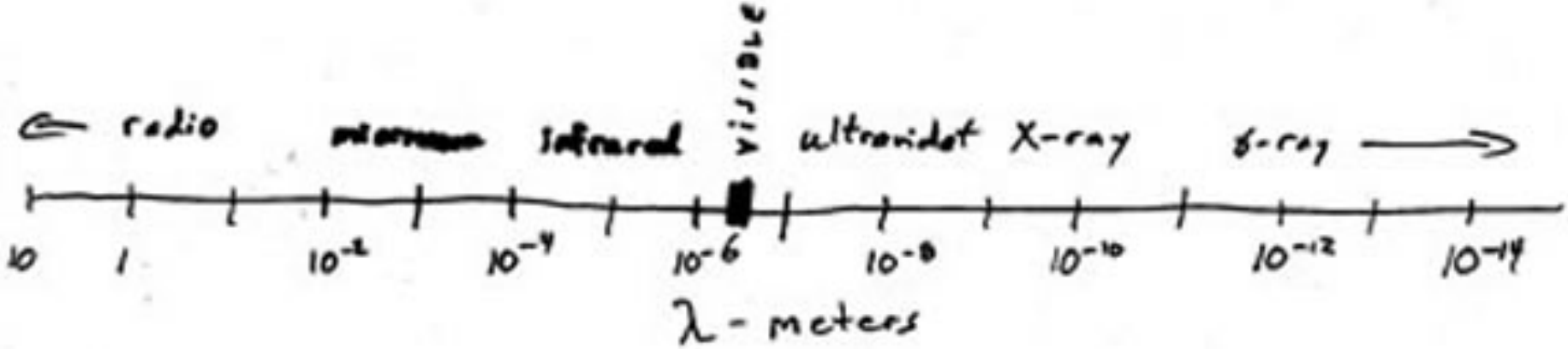

1000
800
600
400
200
0
Counts
0
2
4
6
Energy (keV)
4 eV
FWHM
7 eV
FWHM
Mn Kα
Mn Kβ
0
-.1
-.2
-.3
-.4
-.5
Voltage (mV)
-20
0
20
40
60
Time (ms)


Electronics Box (3)
Heat Switch Actuator
L He Fill Tube and Pumping fitting
33 cm
U.V. Filters
Braided Kevlar
33 cm
Vapor-Cooled Shields:
30 K
130 K
Kevlar Support
L He level sensor
Magnet
FAA Salt Crystal
G-10 Support Shells (3/4 mm)
Liquid Helium (2 K)
FET house
UV-Visible-IR Blocking Filters (5)
Detector Array FOV
^{41}Ca 3.3 keV Calibration Monitor
Multi-line fluorescent calibration source
Gate Valve Actuator




Payload Separation
Close Pumping Valve
White Sands, New Mexico, USA


ACS OPERATION: STELLAR OR SOLAR POINTING
BOOM DEPLOYMENT
BOOM RETRACTION OR EJECTION
DOOR CLOSURES
ATMOSPHERE
PAYLOAD SEPARATION
DESPIN
TIP EJECT OR MULTI-DOOR DEPLOYMENTS
TM DATA AND COMMAND
PARACHUTE DEPLOYMENT
LAUNCH
GROUND STATION
IMPACT/RECOVERY DATA RETRIEVAL PAYLOAD REUSE



2 eV

10,000 eV

GeV

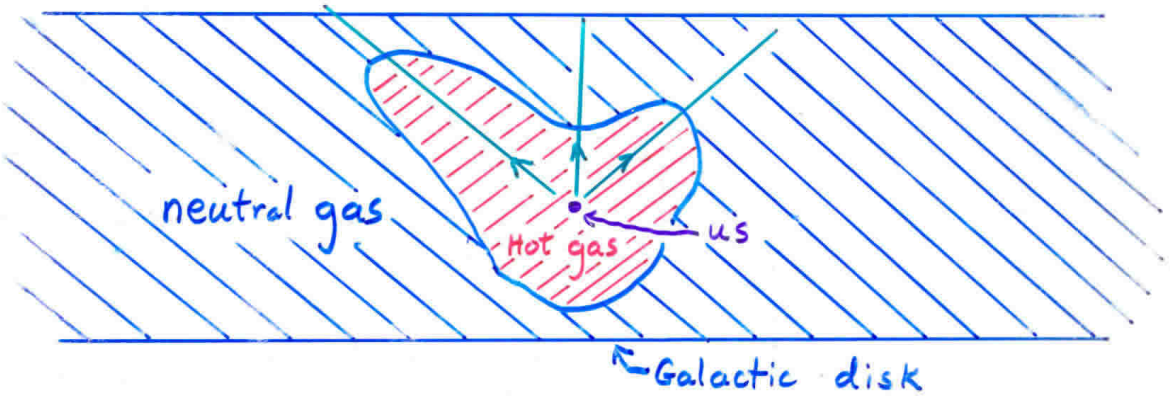
1 J = 10^{19} eV

General anti-correlation with neutral hydrogen:

Directions with high hydrogen column densities have generally low soft X-ray flux, and vice versa.

But: Absorption cross section $\propto \frac{1}{E^3}$, and, if any energy-dependence is seen, it has the wrong sign.

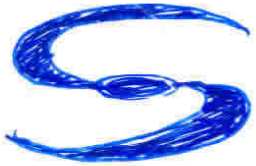
Possible implication: Displacement effect



But displacement ⇒ both neutral gas and hot gas must occupy large fractions of available space.

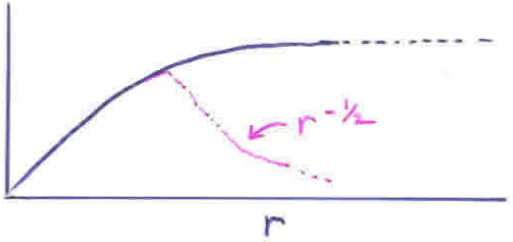
"DARK MATTER"
or
the "MISSING MASS PROBLEM"

Spiral Galaxies:



$\frac{M}{M_\star} = 2\text{-}3$

HI (21 cm)



Elliptical Galaxies:

- no HI
- measure $V_\star$ (random)
- $\Rightarrow \frac{M}{M_\star} \sim 1$
- Where is ISM.?