Megavoltage Radiotherapy Machines

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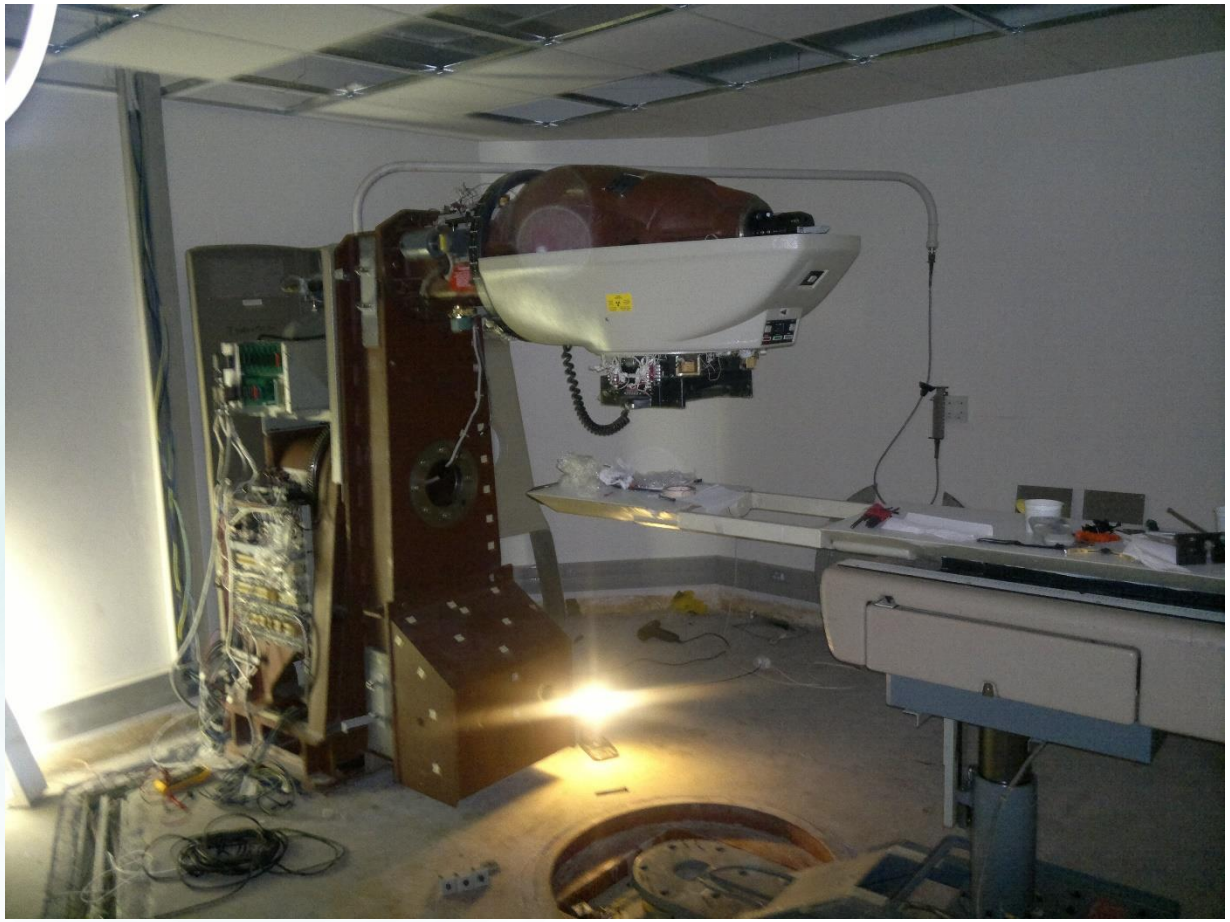
Two broad classes

- Radionuclide – Co-60 teletherapy or afterloader
- OR
- X-ray or electron beam – linear accelerator

Co-60

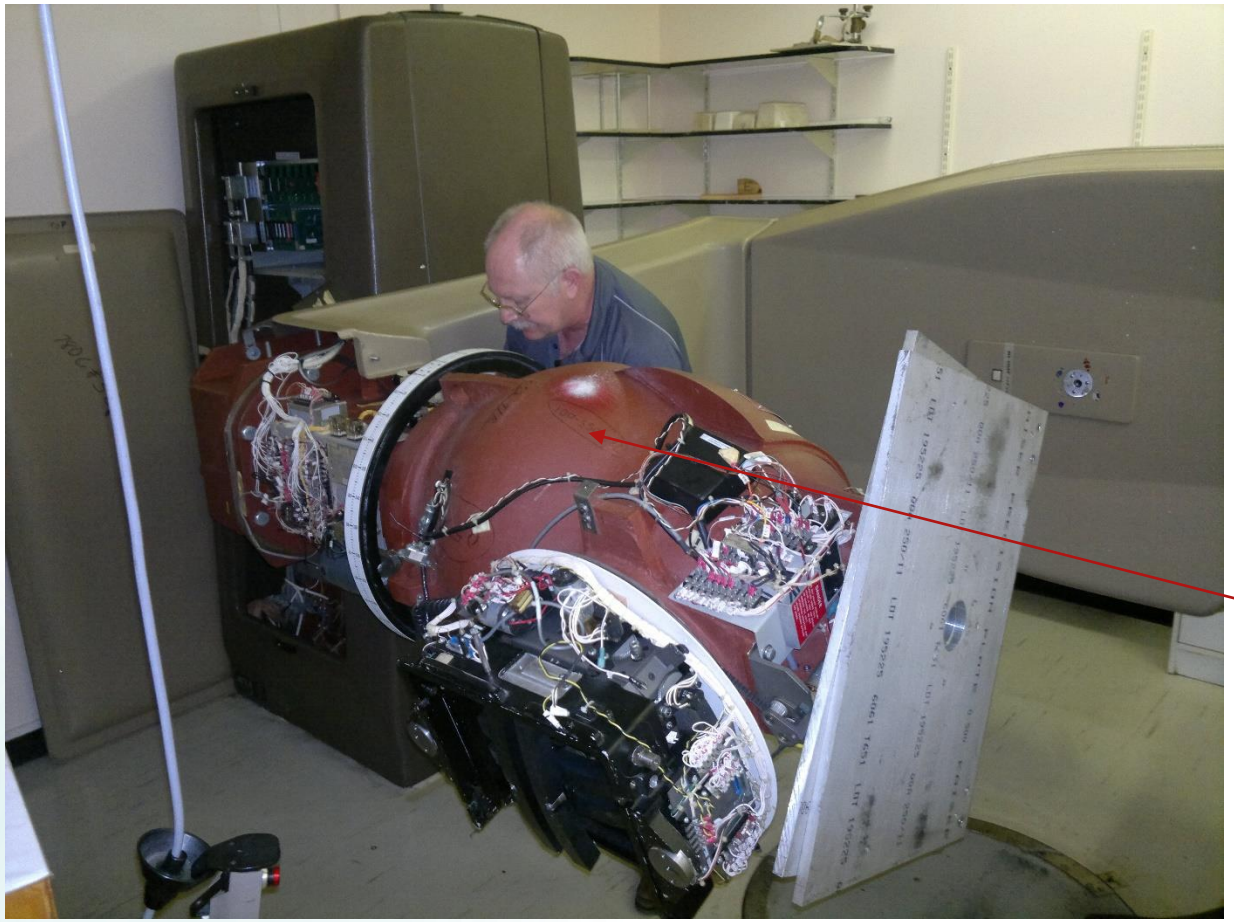
- Has a halflife of 5.26 years
- Manufactured in a nuclear reactor
- Radioactive decay has two gamma rays at 1.17 and 1.33 MeV
- These are used for radiotherapy

- Tiny source: around 1 cm x 1.5 cm cylinder
- 300 TBq or so



Similar Geometry as a Linac:

Gantry
Collimator
Treatment Couch
all rotate around isocenter



Lead Shielding

- Co-60: Halflife of 5.26 years
- Initial doserate about 2 Gy / min

- Need to replace source

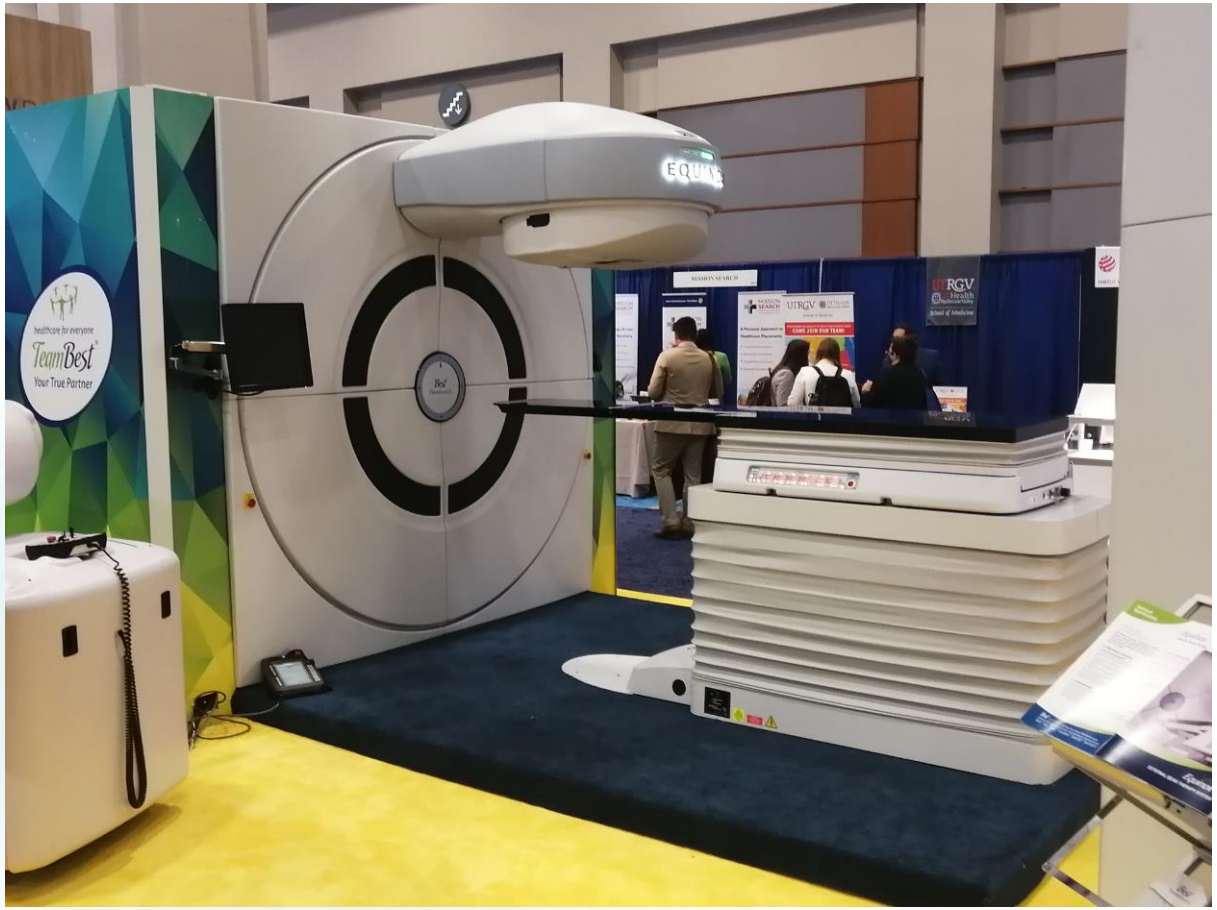

RADIOACTIVE III
CONTENTS Co-60
ACTIVITY 316.64 TBq
5.0
TRANSPORT INDEX
7
RQ
OP-1
RAD-MONITOR™
Radiation/Contamination Survey Meter
AC POWER
ALARM
ON
OFF
BAT

Co-60 source change

- Co-60 not used routinely any more in most departments
- Single energy
- Often smaller SSD, which only allows for SSD treatments and not SAD treatments
- Security concerns – stolen sources

But:

- Not so affected by power cuts
- Needs less power


healthcare for everyone
TeamBest
Your True Partner
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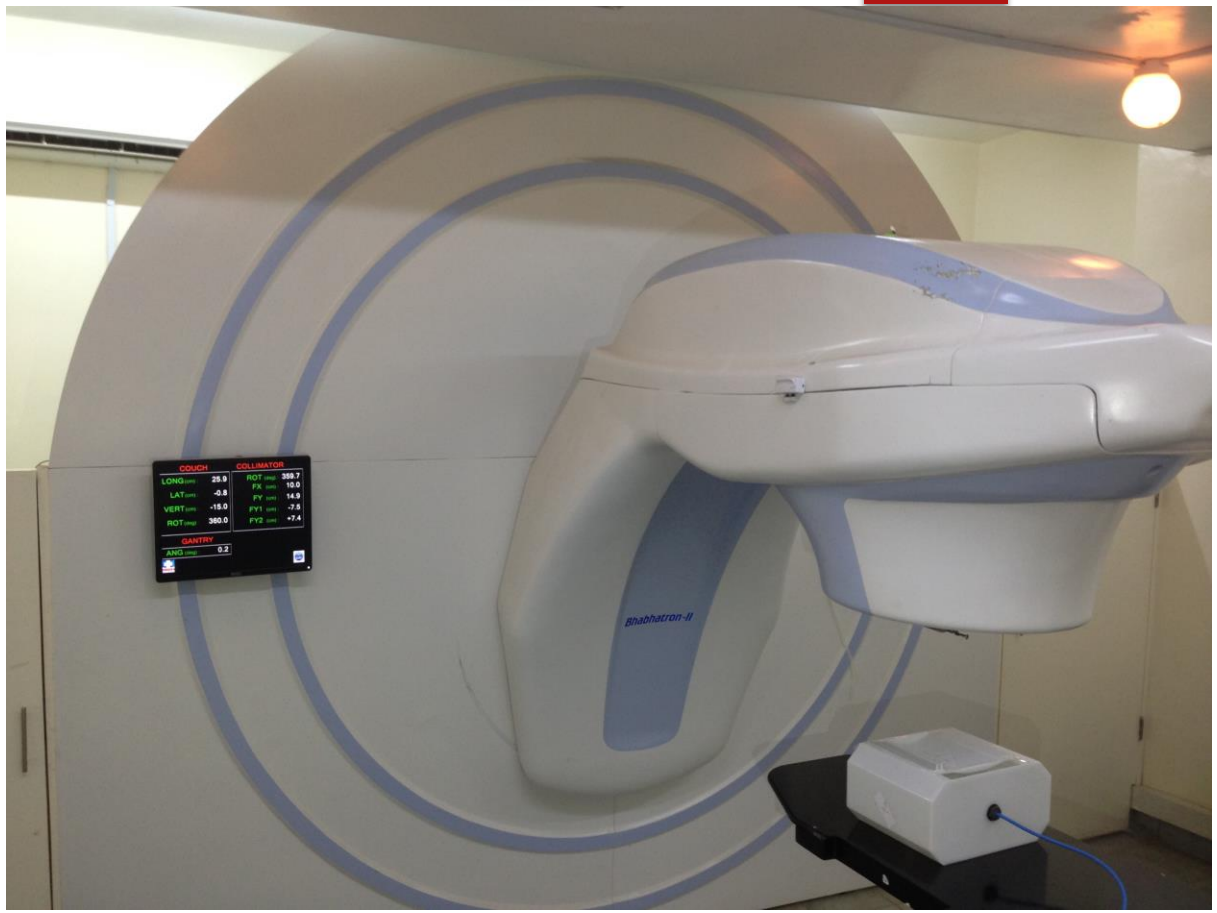
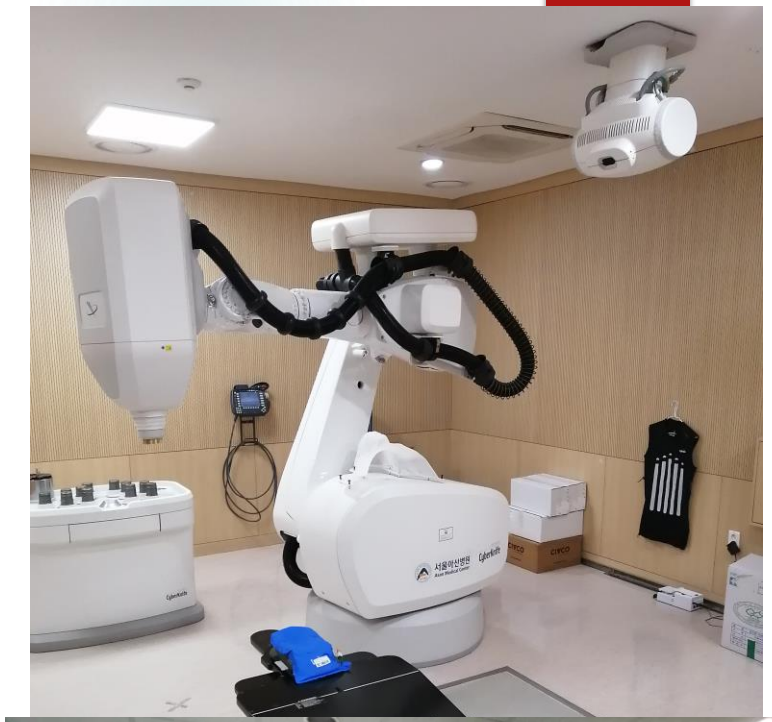
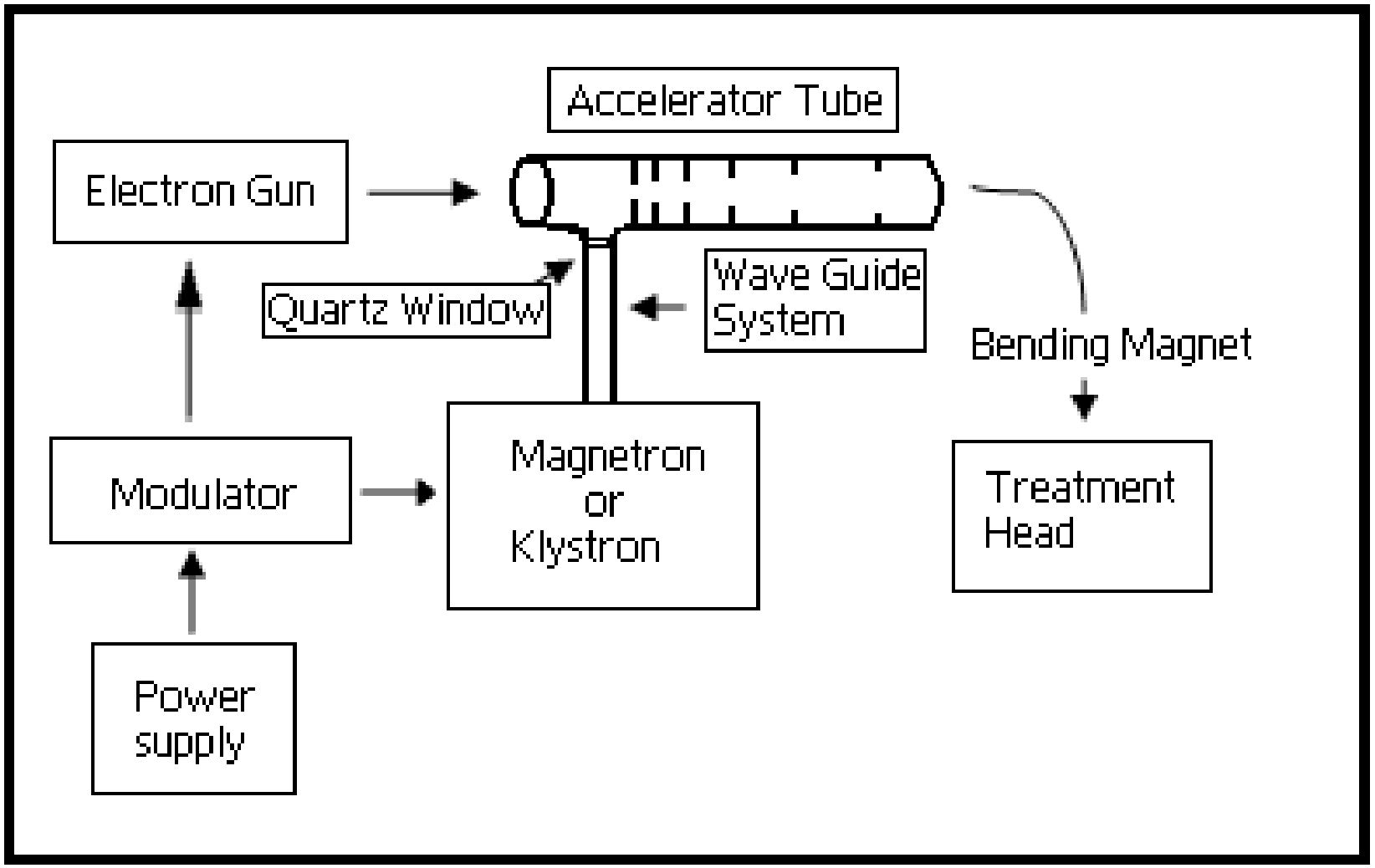

COUCH
COLLIMATOR
LONG
LAT
VERT
ROT
RDT
FX
FY
FY1
FY2
GANTRY
ANG
Bhabhatron-II

Linear Accelerator





The RF from the magnetron travels at a velocity that is too high to synchronize with the electrons from the gun
An input mode transformer slows the RF to about 0.4c to match the velocity of the electrons from the gun.

Electron gun

Magnetron

A magnetron produces microwaves.
It functions as a high-power oscillator with a repetition rate of several hundred pulses per second.
The frequency of the microwaves is about 3000 MHz.

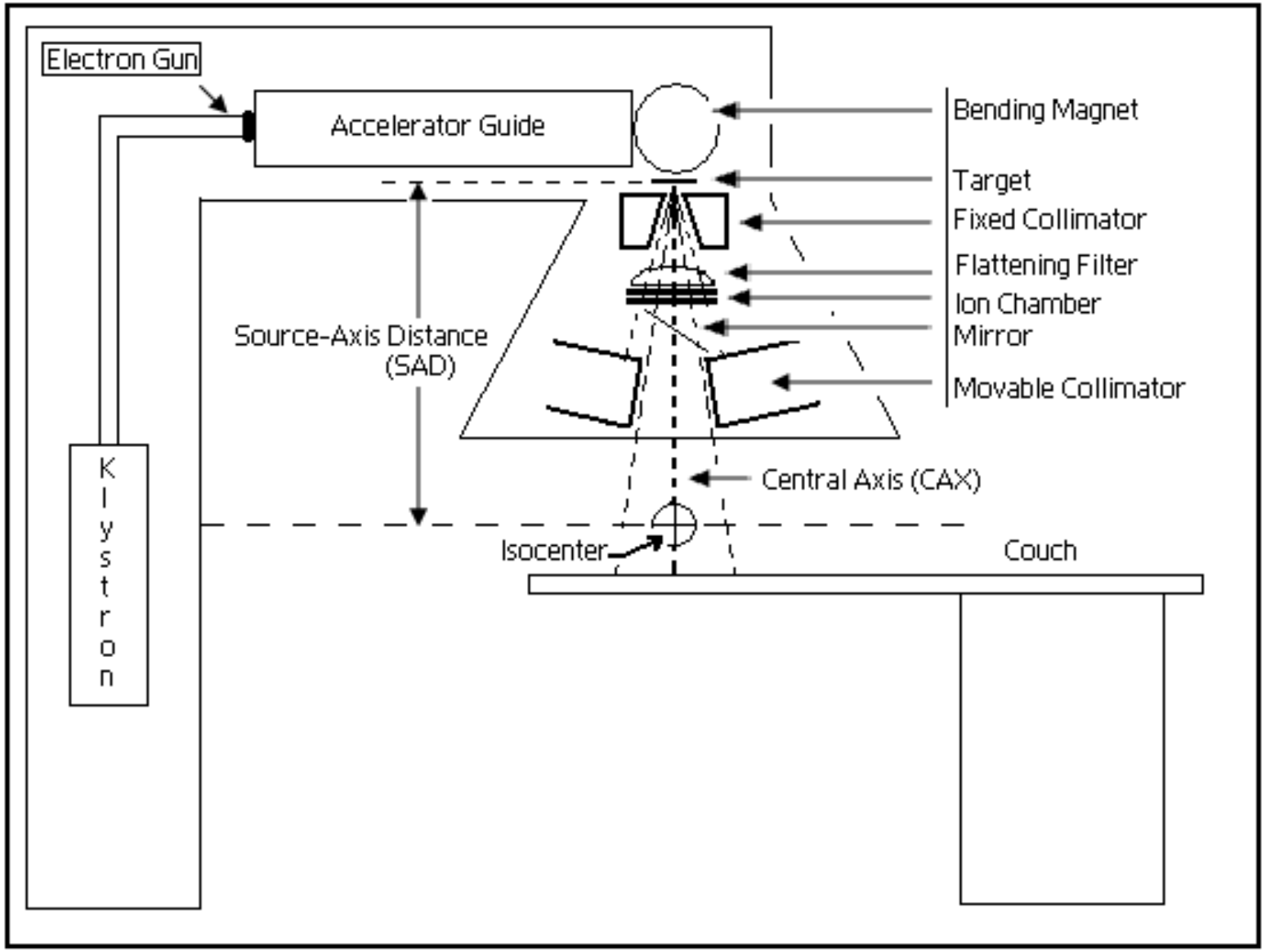
Cylindrical construction: Central cathode and an outer anode with resonant cavities, made of copper. Static magnetic field is applied.
The electrons emitted by thermionic emission are accelerated towards the anode. Under the simultaneous influence of the magnetic field, the electrons move in complex spirals towards the resonant cavities, radiating energy in the form of microwaves.

Waveguide

Standing vs
travelling waveguide

Microwaves are absorbed at the end of the waveguide, or fed back to the input

Microwaves reflect from the distal surface to produce a standing wave

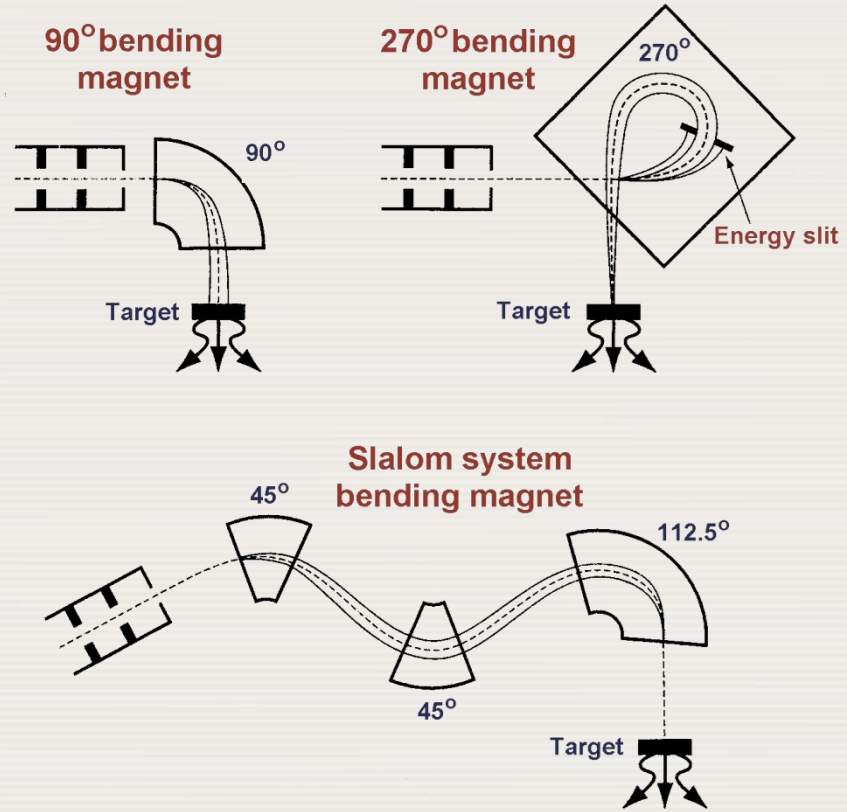


Target
Primary scatter filter
Primary collimator
Secondary flattening filter
Ion chamber
Wedge
Diaphragm

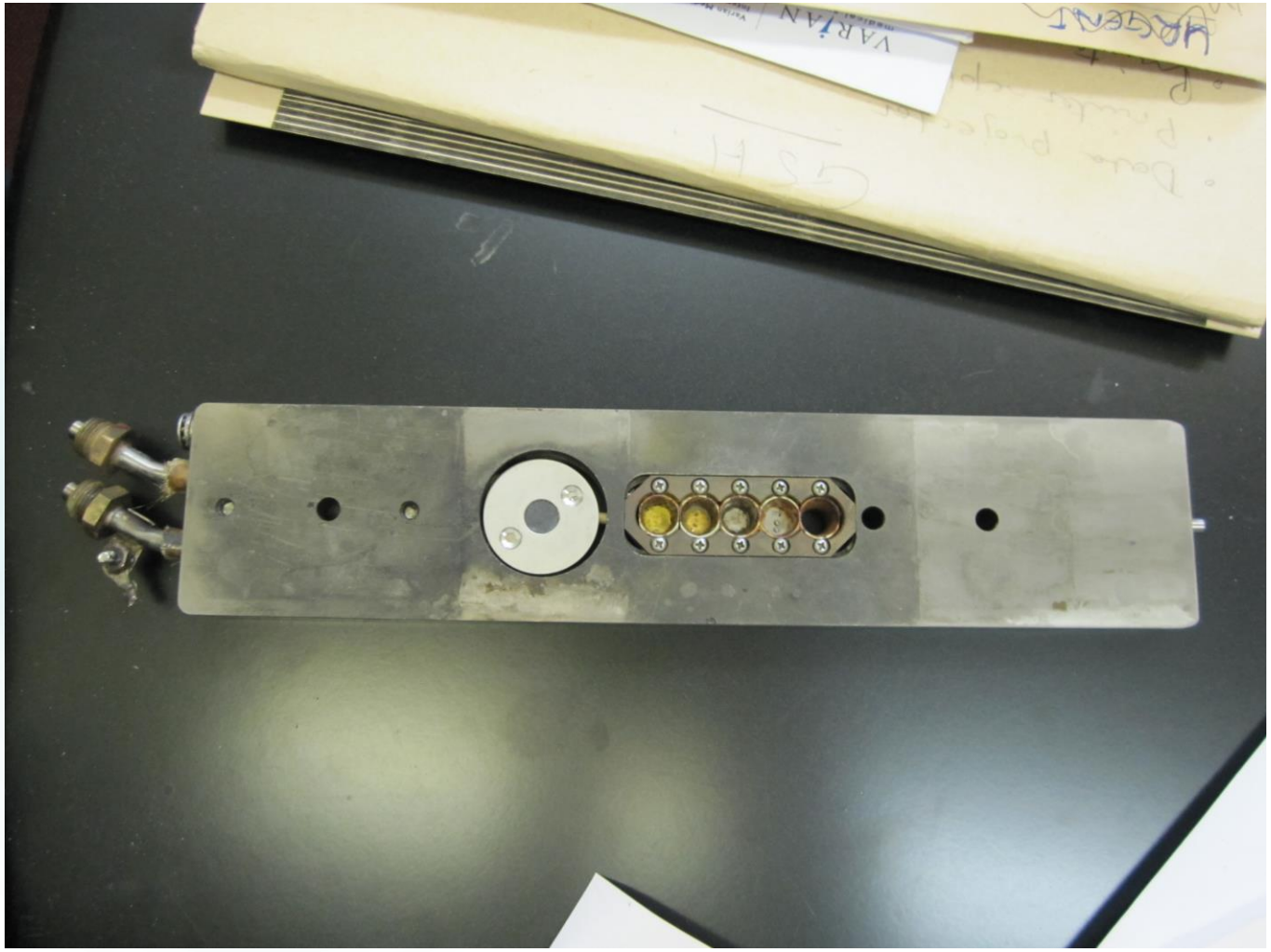
5.5 LINACS

5.5.10 Electron beam transport (from IAEA slidepack)

- Three systems for electron beam bending have been developed:
  - 90º bending
  - 270º bending
  - 112.5º (slalom) bending

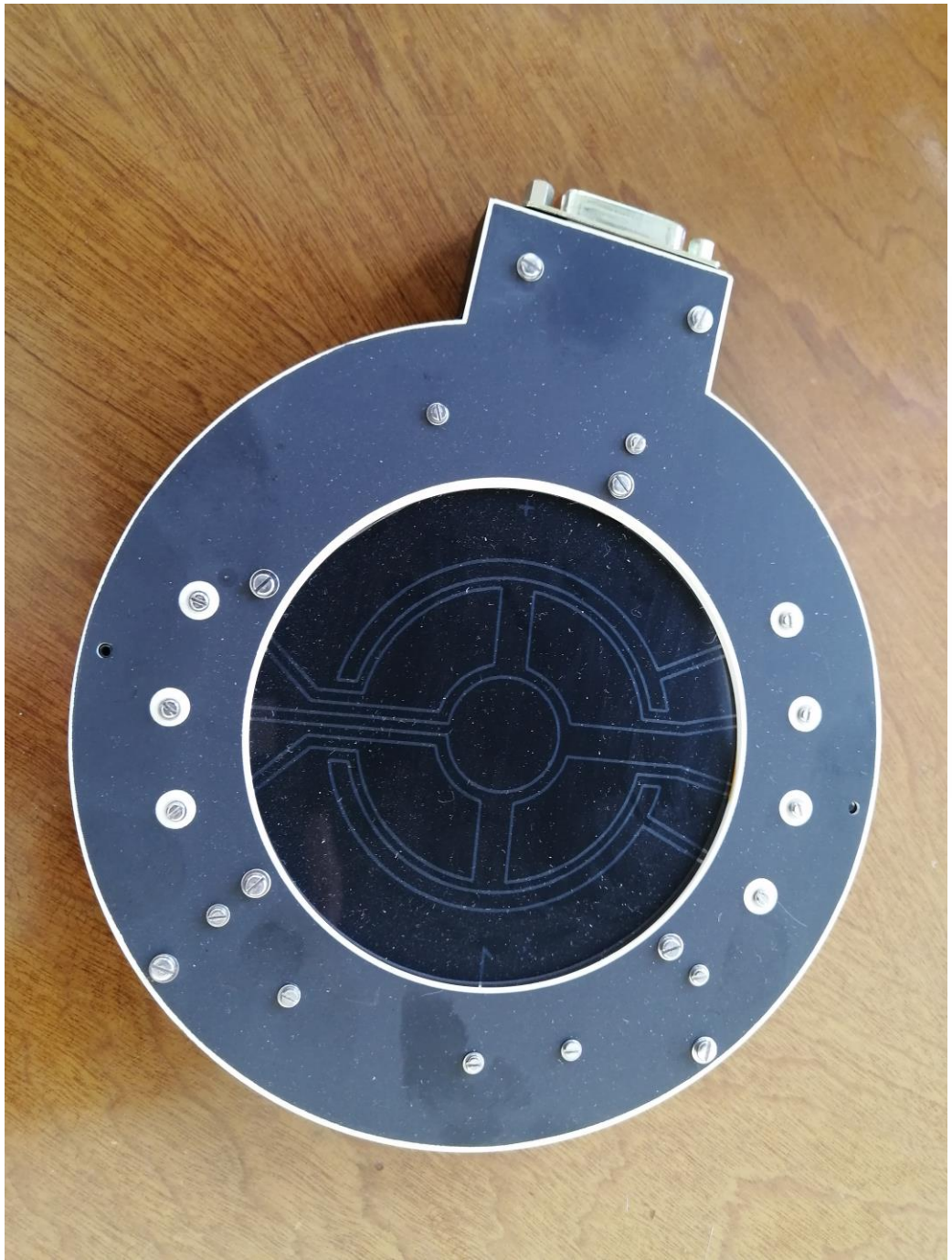


Target

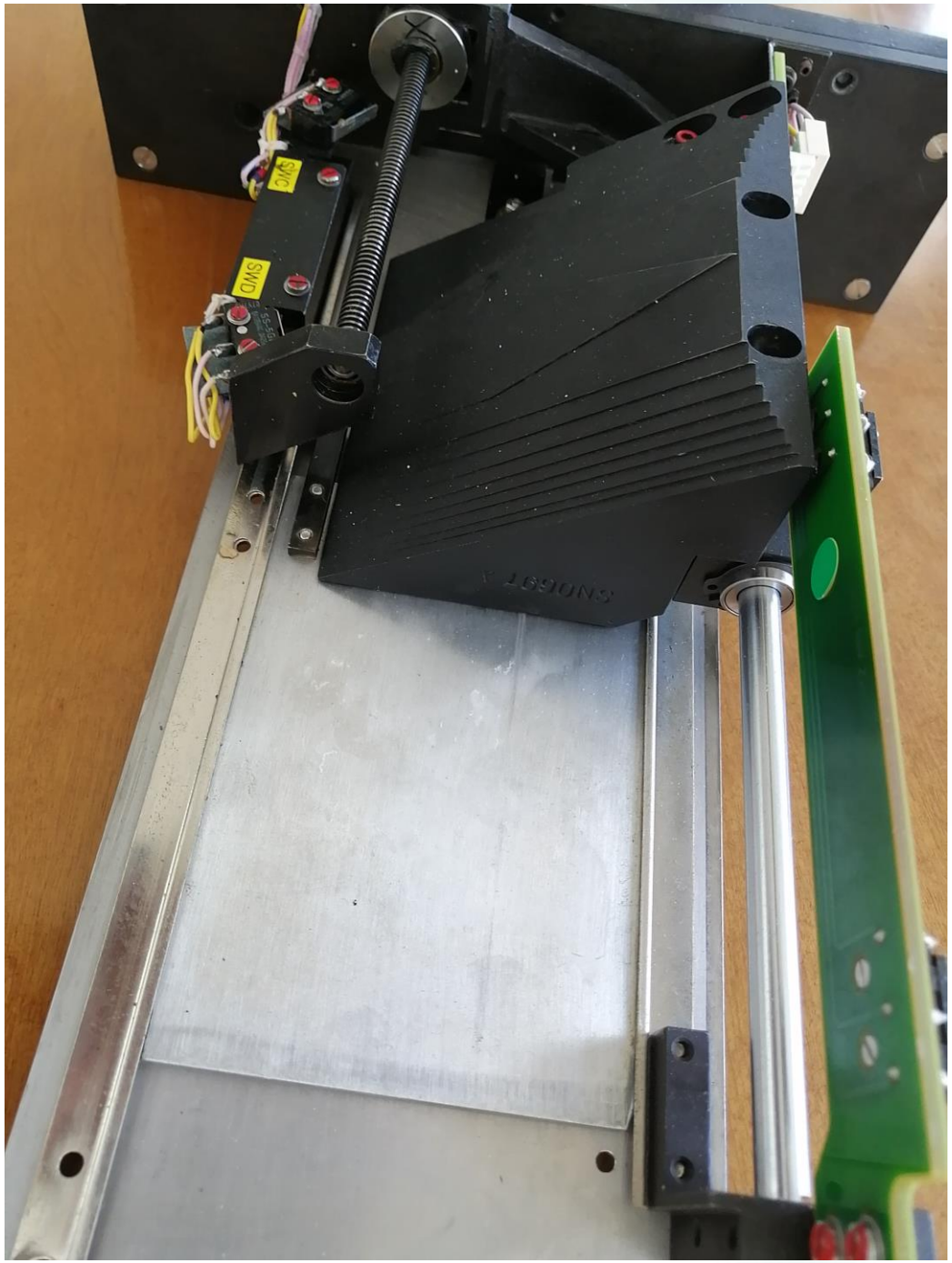


Flattening filter

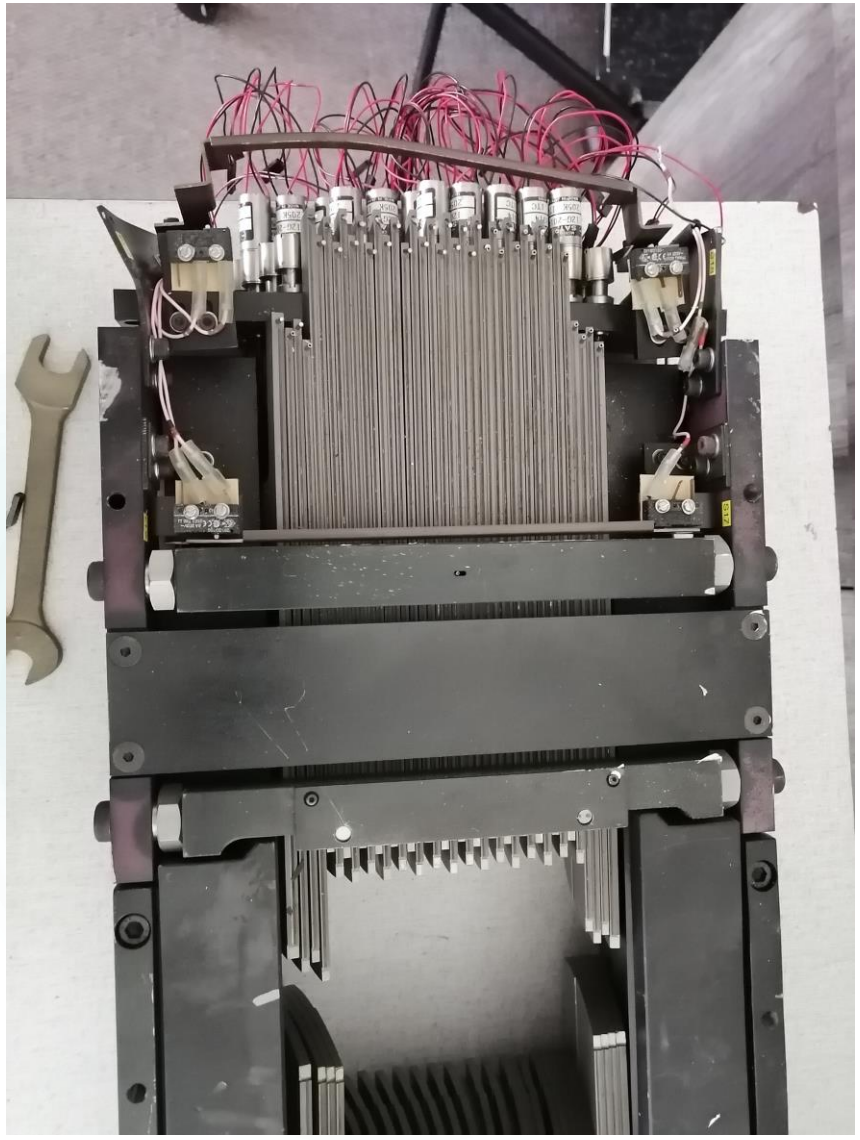
Ion Chamber

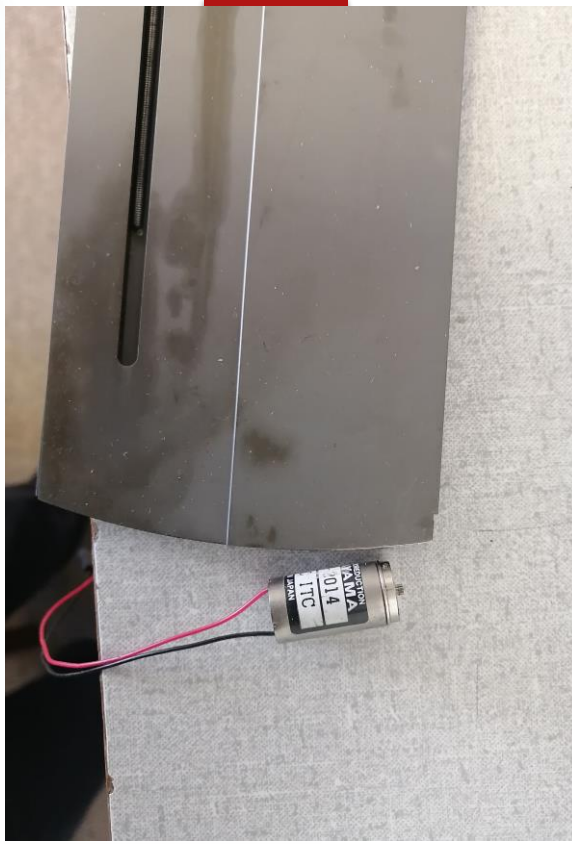


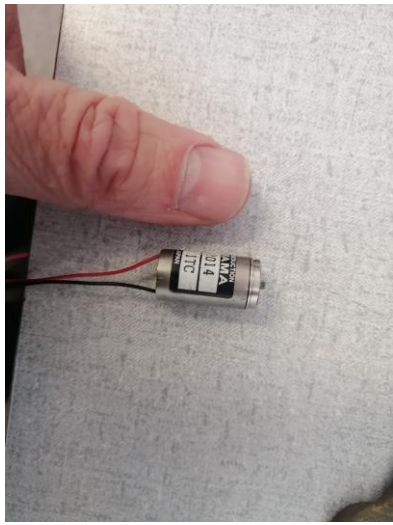
Elekta Wedge



MLC







Field shaping

- Combination of jaws and / or MLC

- All movements around isocenter

- Other systems required:

- Vacuum pumps to maintain vacuum in waveguide
- Cooling system to cool target
- Shielding

- Thank you!