# Diagnostic Imaging Tour! Welcome!

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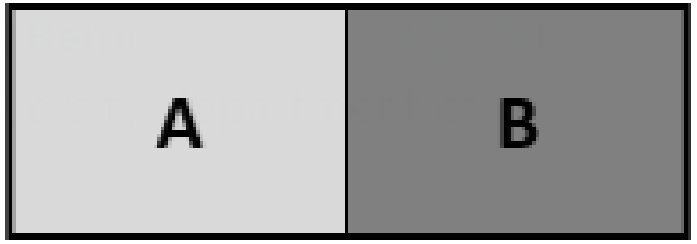
# Objectives

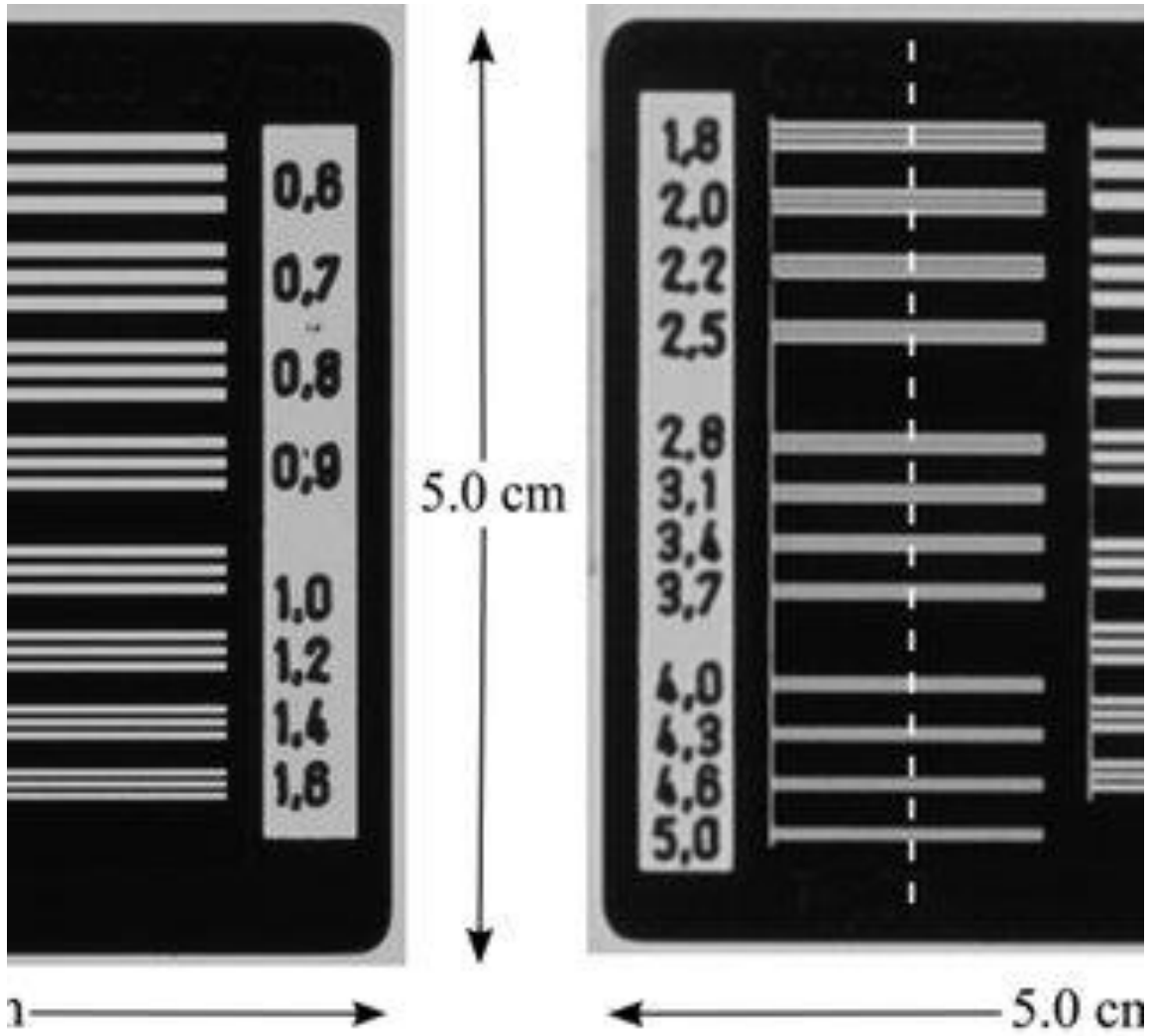
- Introduction to concepts in imaging concepts from software design
- Introduce the vendors

# Contrast

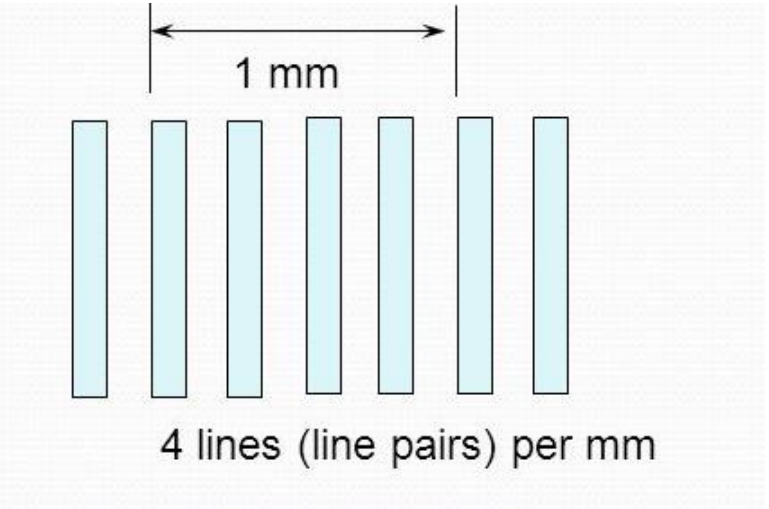

$$C_s = \frac{A - B}{B}$$



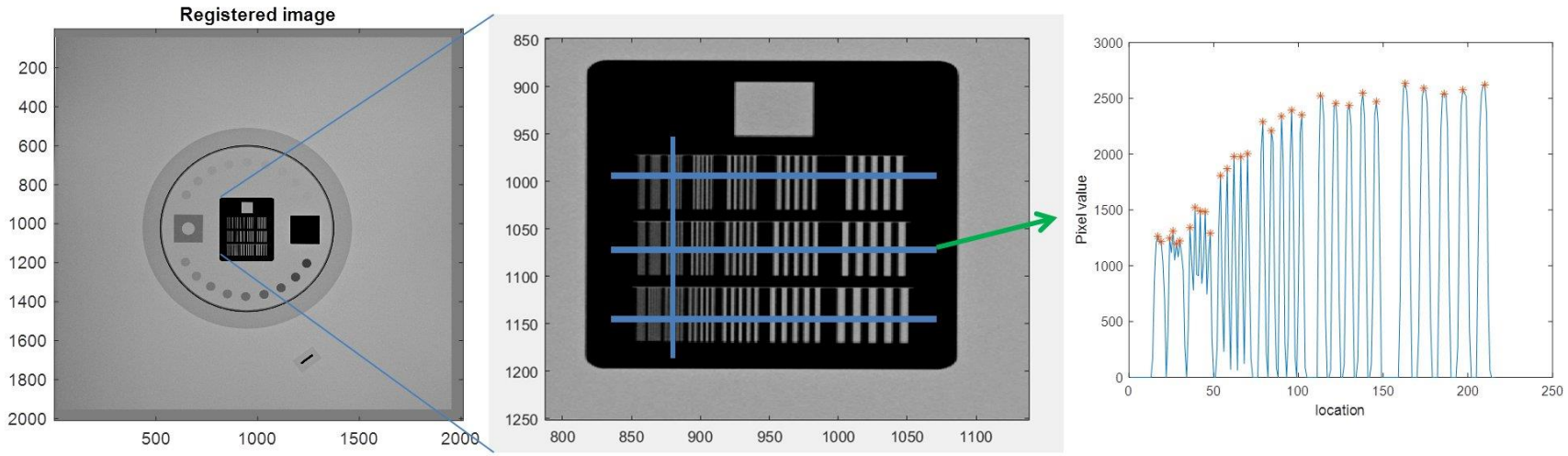
# Resolution



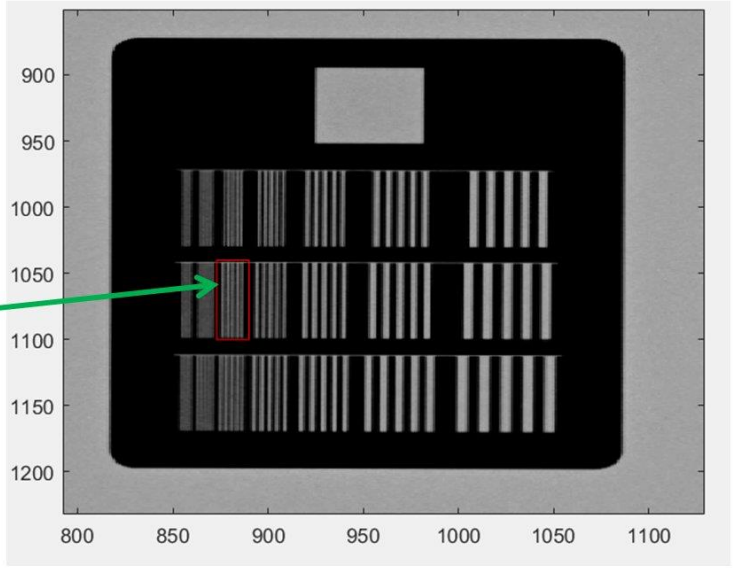

- Line pairs per distance
- Express limiting resolution
- Limiting resolution implies high contrast situation
- Does not indicate how well system preserves contrast



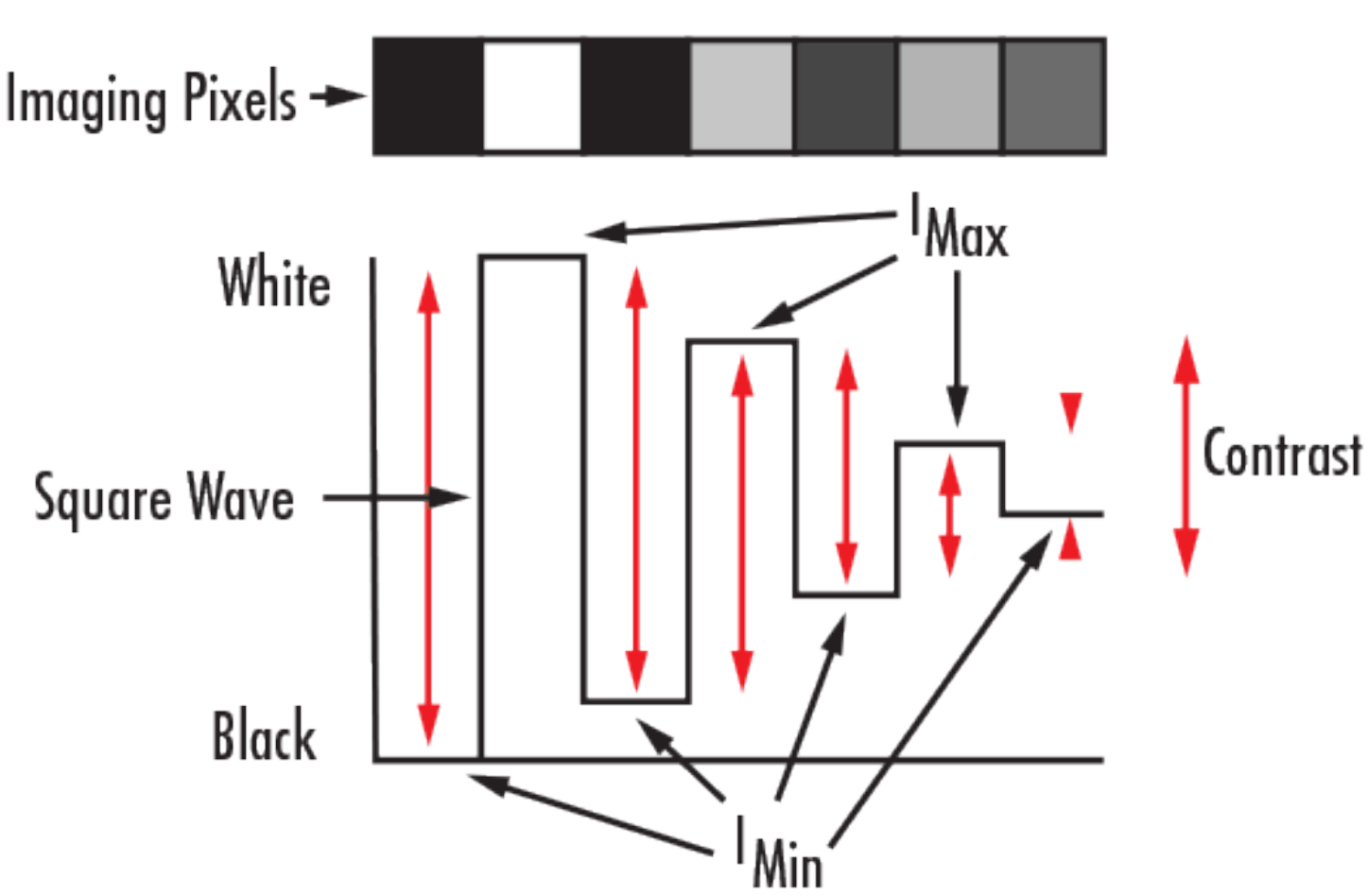
# Resolution

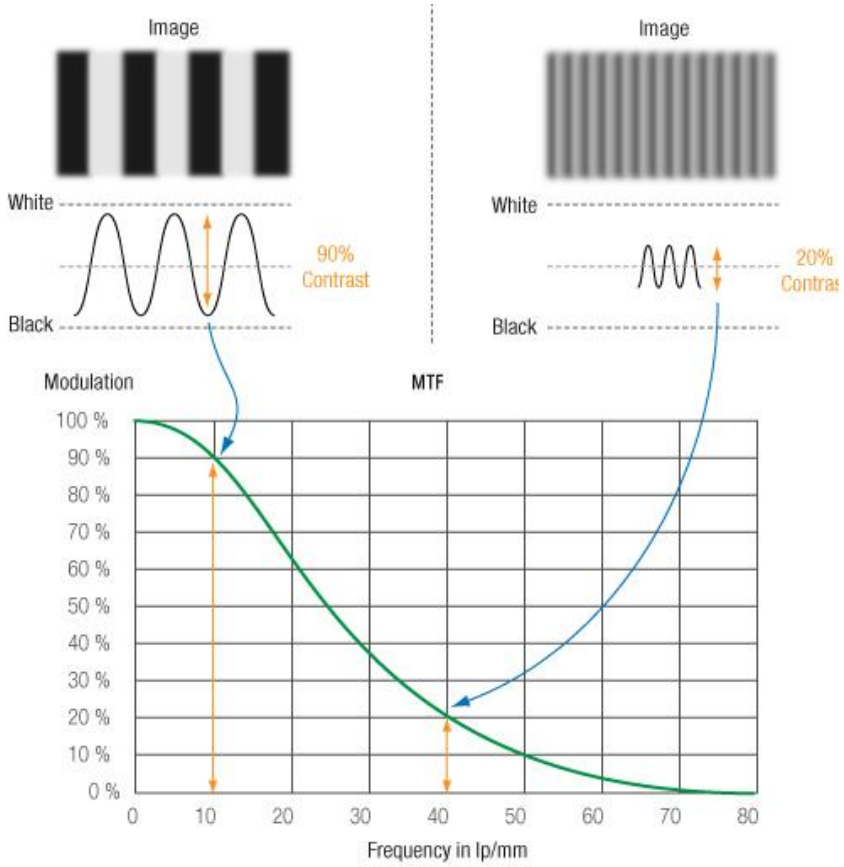



| | | |
|---|---|---|
| 5 | 5 | 5 |
| 5 | 5 | 5 |
| 5 | 5 | 5 |
| 5 | 5 | 5 |
| 3 | 3 | 2 |
| 2 | 2 | 2 |



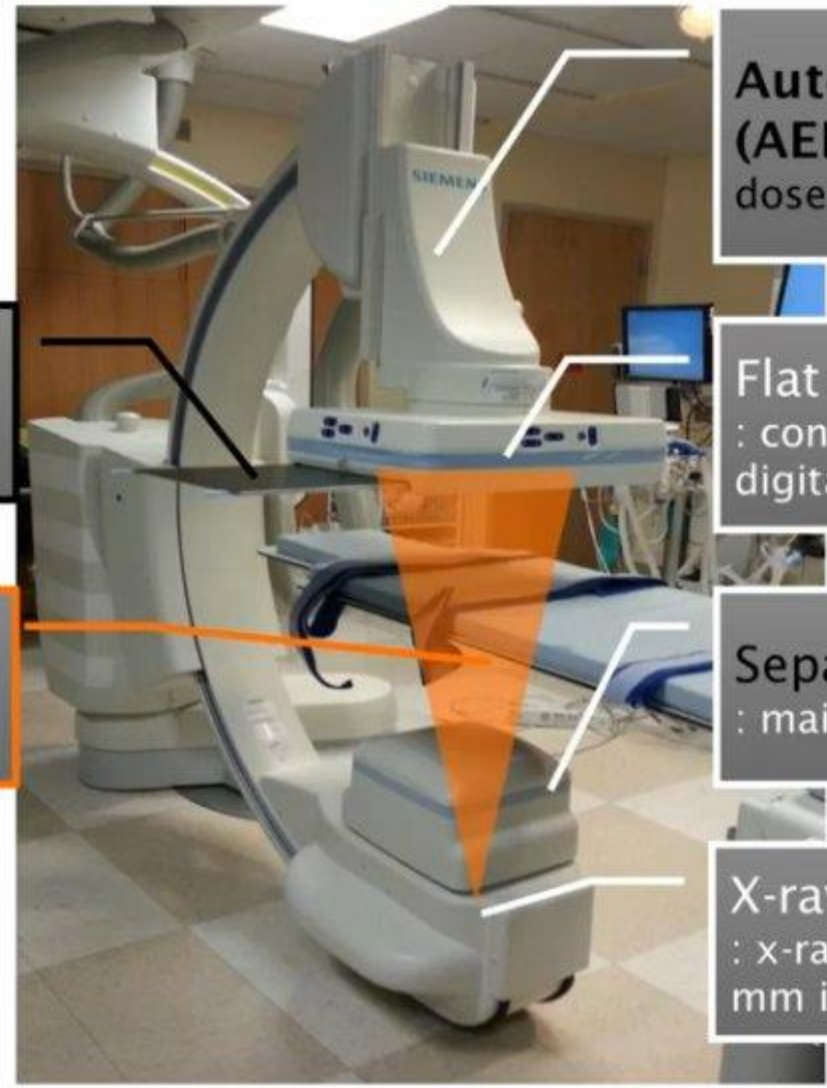
# Modulated Transfer Function (MTF)



# Fluoroscopic x-ray system

**Interventional** fluoroscopy



**Automatic Exposure Rate Control (AERC)**: Image quality, dose rate, and dose control feedback circuits

Anti-scatter Grid
: blocks scattered x-ray
: increases radiation dose

Flat panel image receptor
: converts transmitted x-ray pattern to digital image

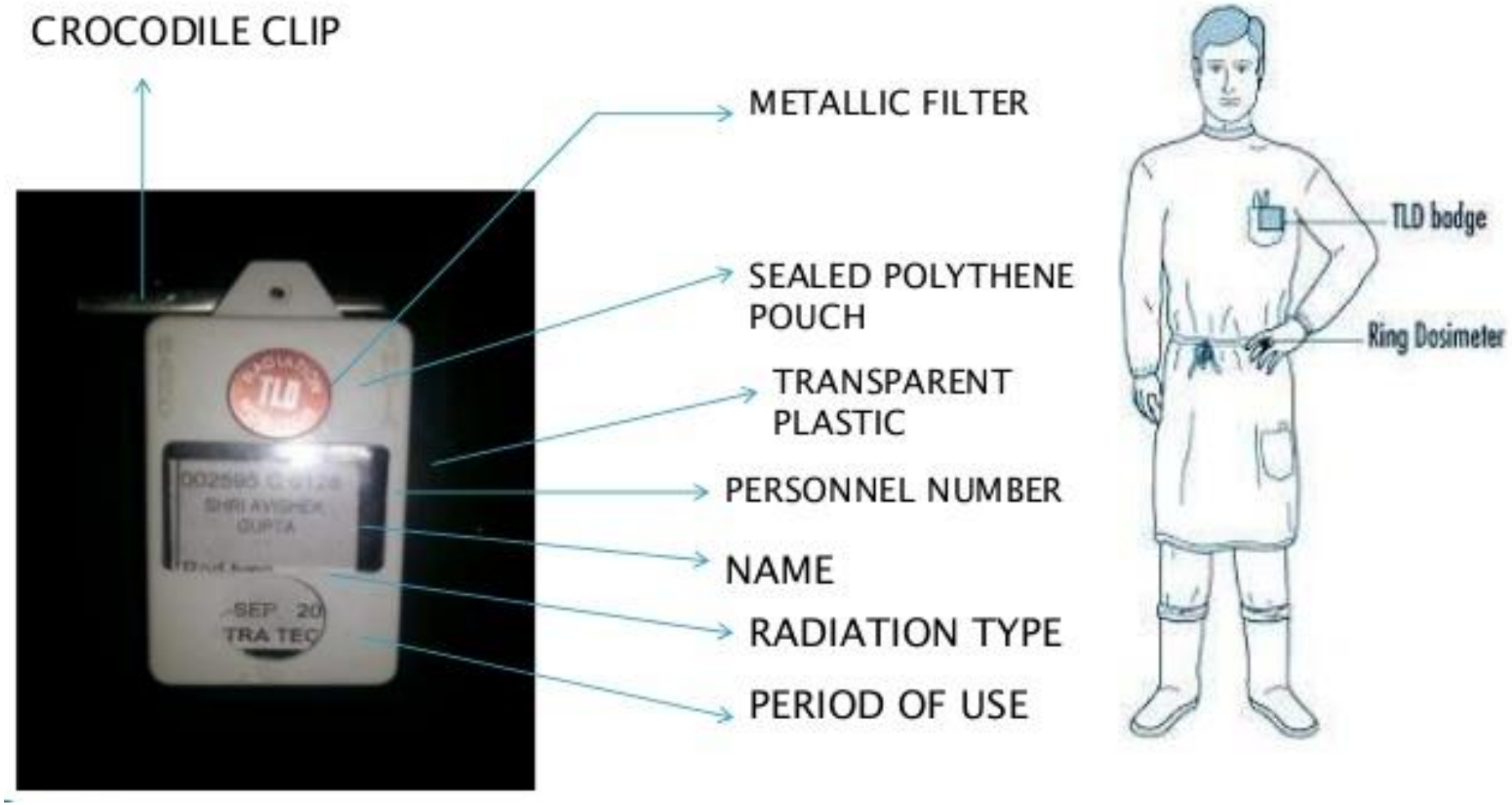
Collimated x-ray beam
: controls dimension of x-ray

Separator cone
: maintain minimum distance from patient

X-ray tube
: x-ray beam fans out from point about 1-mm in size

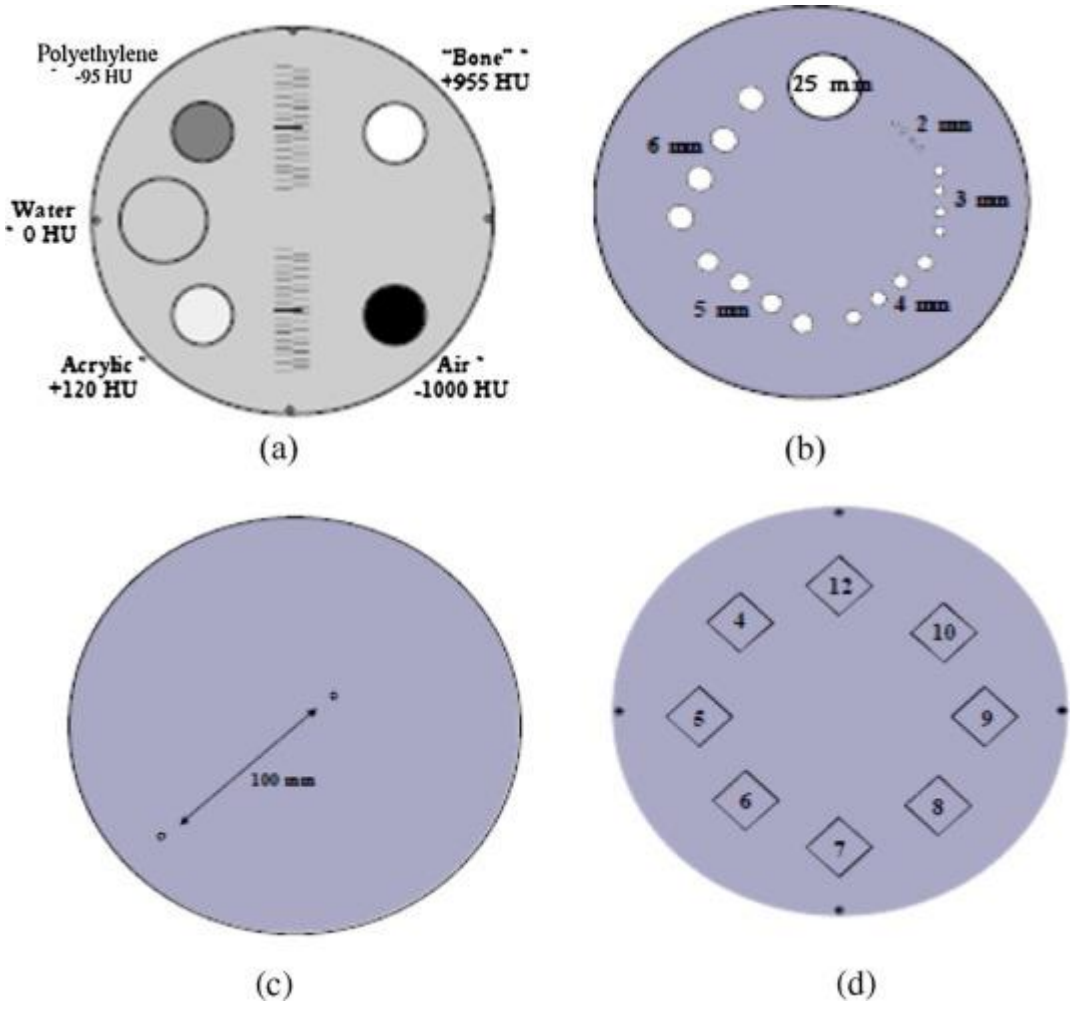
Skin entrance dose doesn't depend on focal spot size.

# TLD BADGE

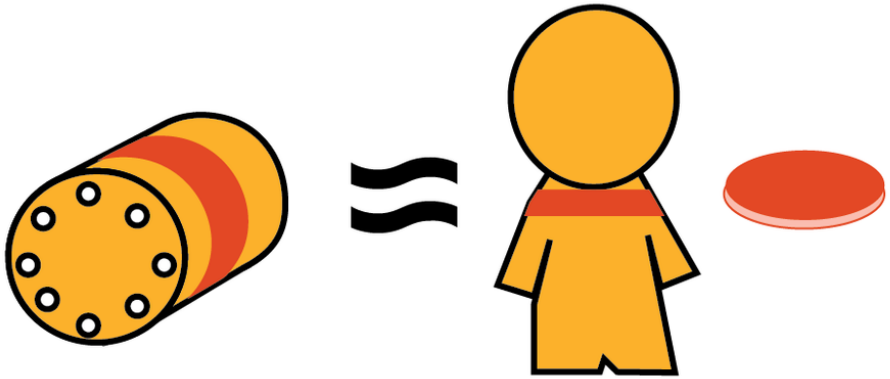



NCRP 116 , occupation equivalent dose limit 0.5 Sv

# CTDIvol

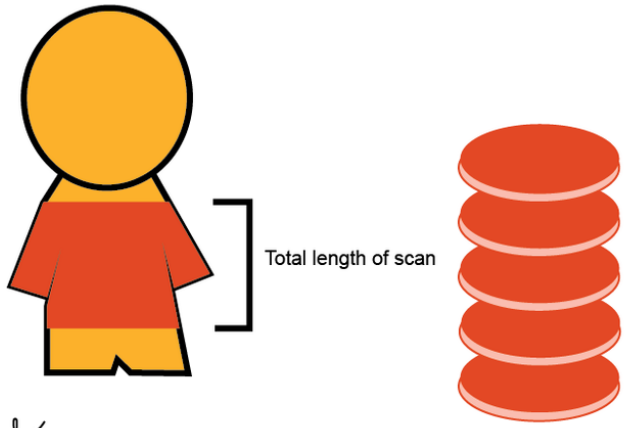



CTDIvol: approximate dose to a "slab" of patient, estimated from a measurement made on a phantom



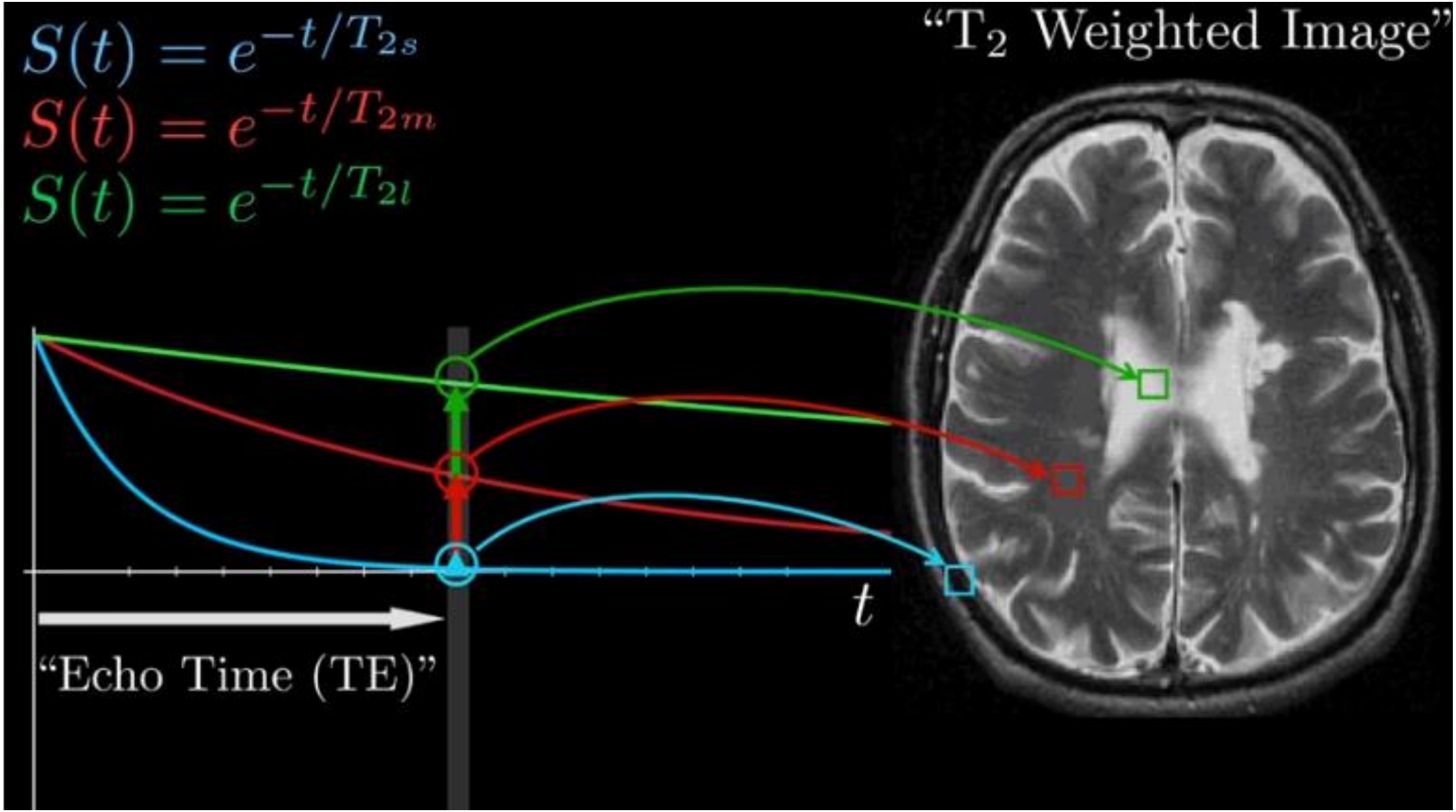
"Phantom"

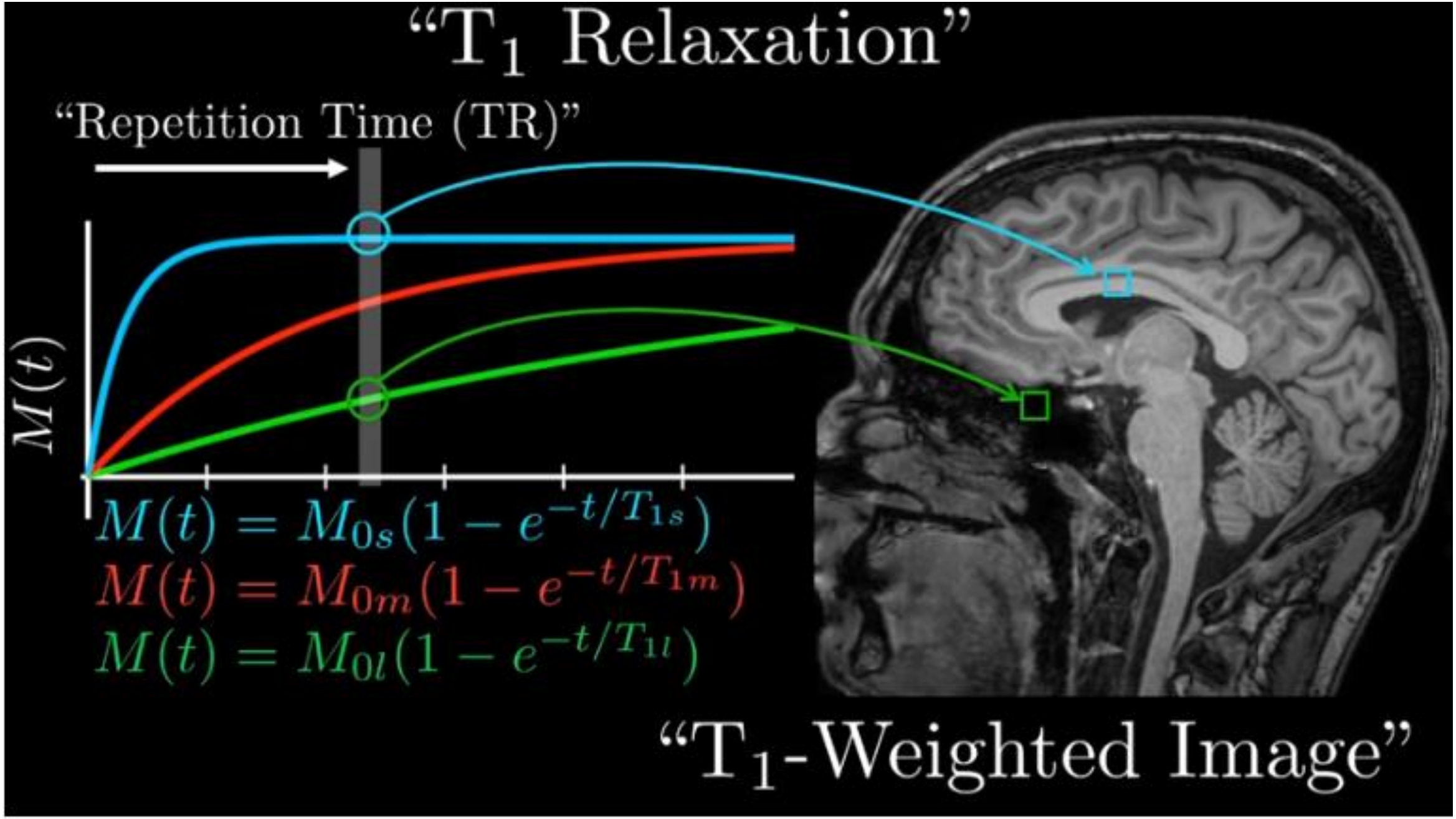
DLP: CTDIvol x total length of the scan.
This is expressed in mGy*cm

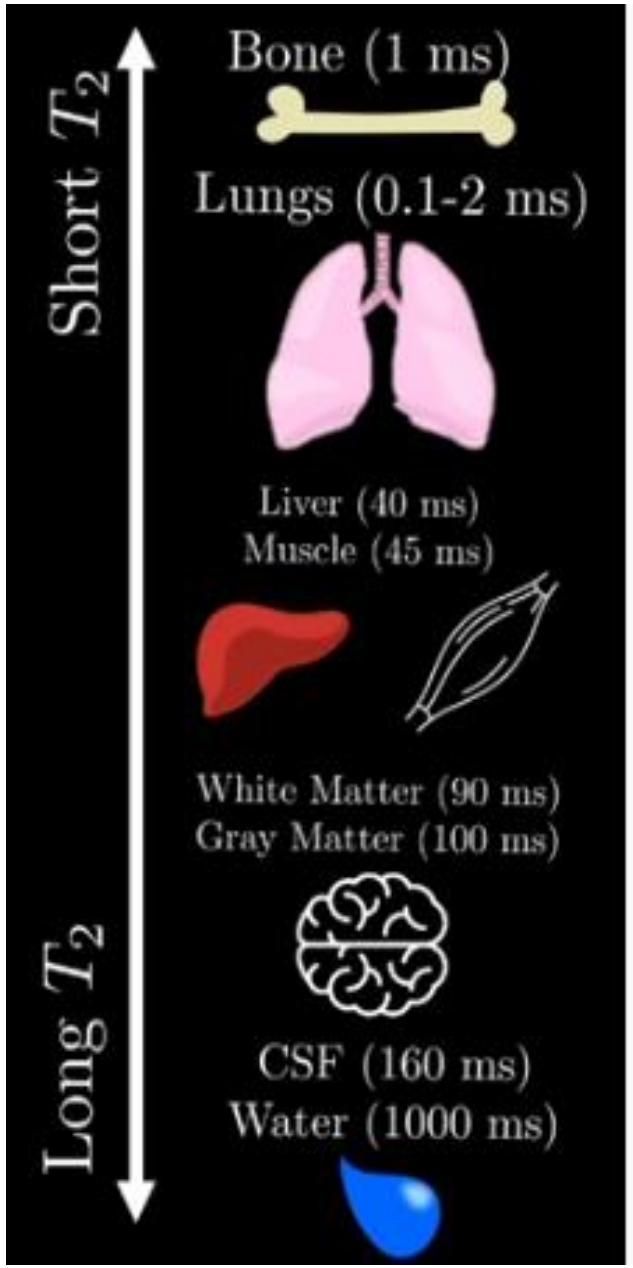


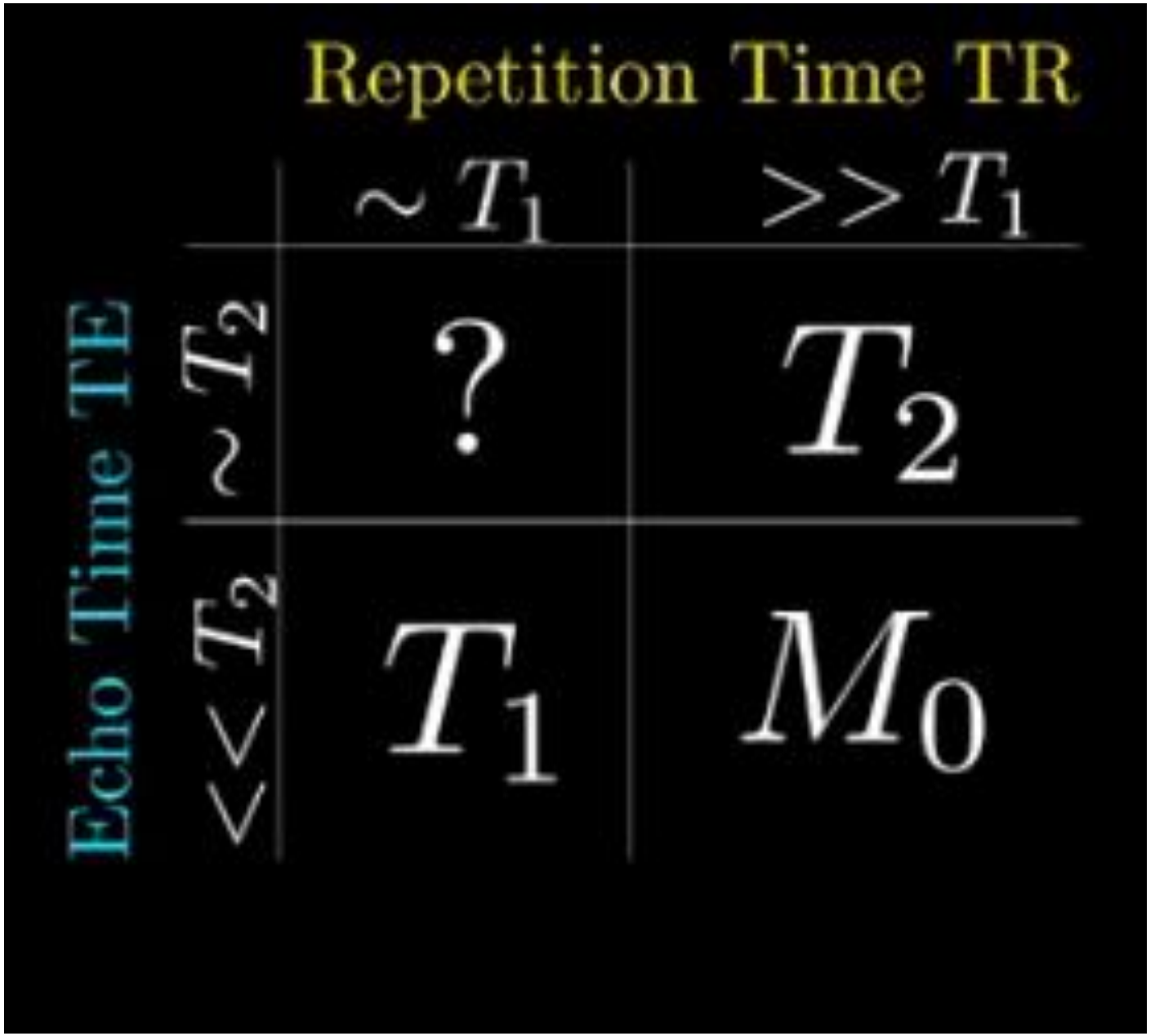
# Contrast: Hounsfield Unit

| CT Number Ranges in Hounsfield Units (HU) | |
|---|---|
| Bone | +1000 |
| White matter | +20 to 30 |
| Muscle | +20 to 40 |
| Gray matter | +30 to 40 |
| Hemorrhage | +65 to +95 |
| CSF (water) | 0 |
| Fat | -30 to -70 |
| Air | -1000 |

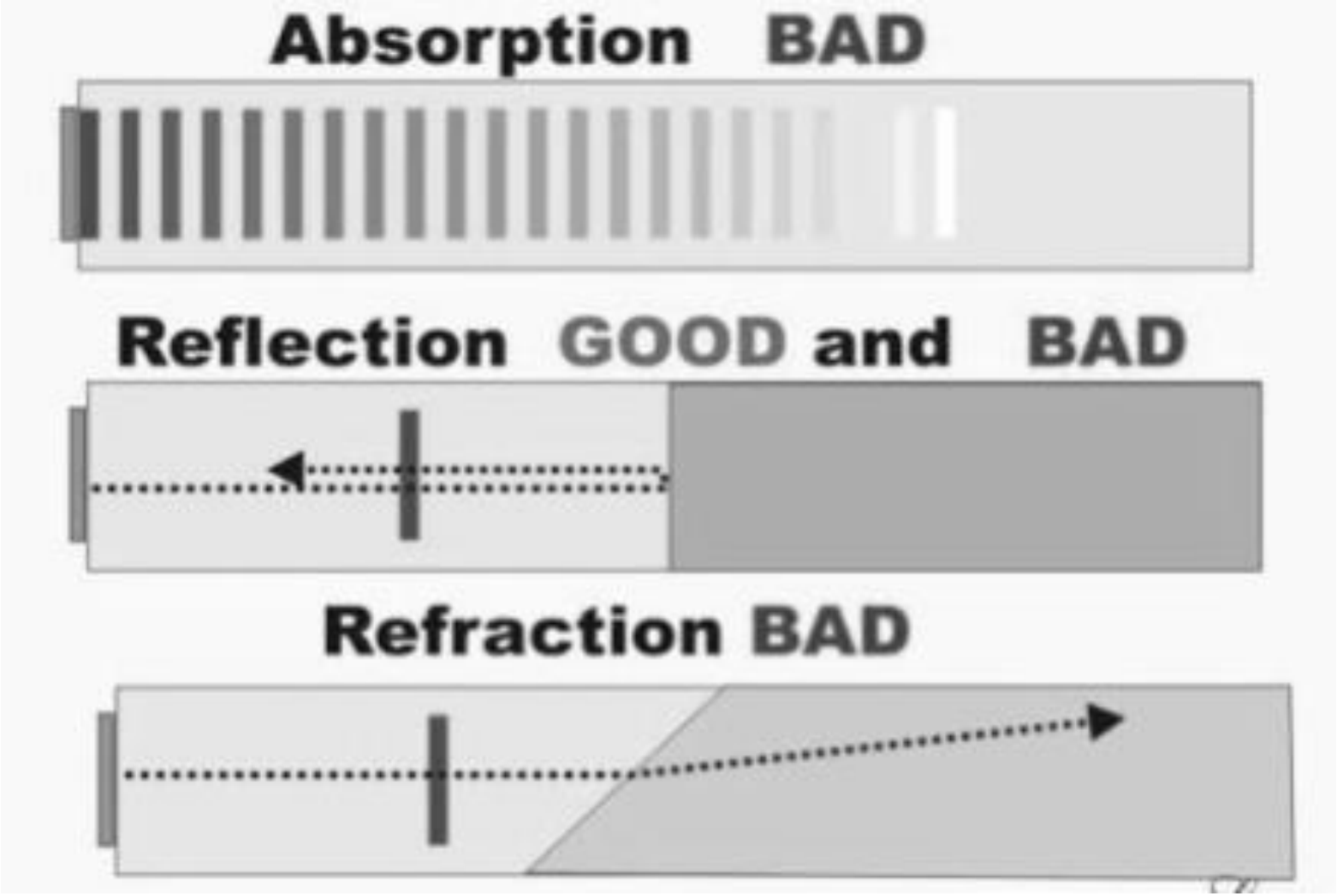

$S(t) = e^{-t/T_{2s}}$
$S(t) = e^{-t/T_{2m}}$
$S(t) = e^{-t/T_{2l}}$
"$T_2$ Weighted Image"
$t$
"Echo Time (TE)"


"$T_1$ Relaxation"
"Repetition Time (TR)"
$M(t)$
$M(t) = M_{0s}(1 - e^{-t/T_{1s}})$
$M(t) = M_{0m}(1 - e^{-t/T_{1m}})$
$M(t) = M_{0l}(1 - e^{-t/T_{1l}})$
"$T_1$-Weighted Image"

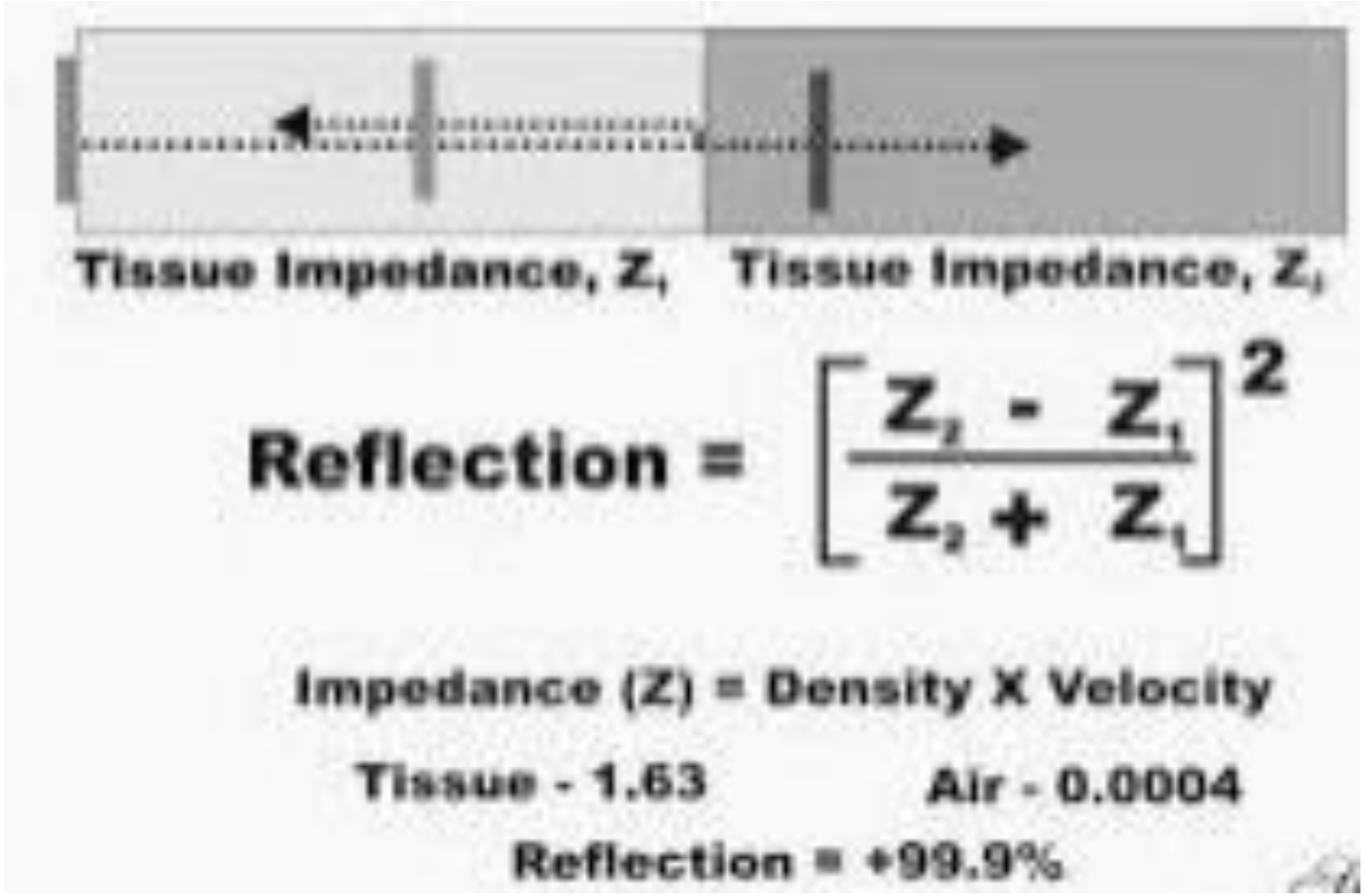

Short $T_2$
Long $T_2$
Bone (1 ms)
Lungs (0.1-2 ms)
Liver (40 ms)
Muscle (45 ms)
White Matter (90 ms)
Gray Matter (100 ms)
CSF (160 ms)
Water (1000 ms)


Repetition Time TR
$\sim T_1$
$>> T_1$
Echo Time TE
$\sim T_2$
$?$
$T_2$
$<< T_2$
$T_1$
$M_0$

# Ultrasound Pulse Interactions



# Ultrasound Pulse Reflection

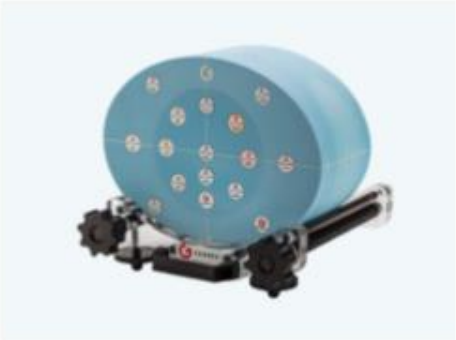



Air is a strong reflector.

SUN NUCLEAR corporation

Mercury 4.0 Phantom

405 GSX LE



Advanced Electron Density Phantom

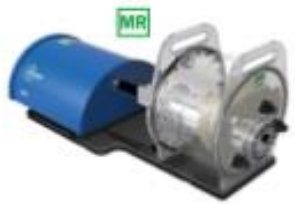
Advanced iqModules

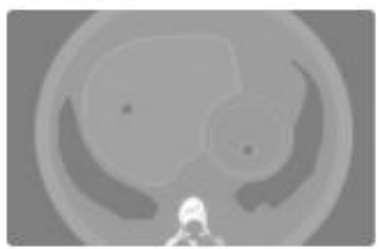
Beam Geometry & Alignment Testing

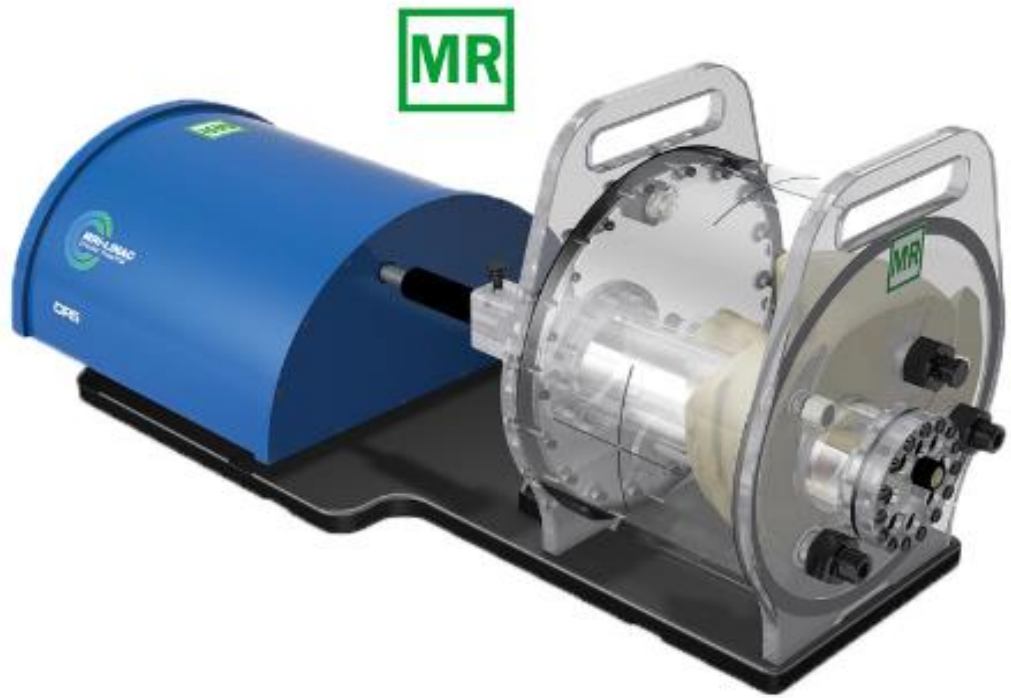
Beam Quality & Half-Value Layer

# MRGRT MOTION MANAGEMENT QA PHANTOM

MODEL 008Z







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# Enjoy the tour!

Christiane Sarah Burton