



TRUE COLOR X-RAY

Spectral photon-counting X-ray Technology Residence

HR-GaAs:Cr Technology

Zeelta Oy
Helsinki

We happened to use the **Magic Eye** for Xray Machine!

What for?

- To facilitate wise and timely decisions in:
 - Medical diagnostic & health care
 - Security/safety
 - Material research
 - Mining and processing of fossil raw materials
 - Radiation control
 - ... and many more
- It is a leap-frog game changer in X-ray methods, like B/W TV and photography were revolutionized by **COLOR**



Like any X-Ray it can see everything inside out, and moreover it can see chemical content of the Materials being X-Rayed by using Direct Spectral Photon Counting!

And we named it **TrueColor X-Ray**

How?

- Noninvasively investigate structure and chemical composition of the matter
- With extremely high spatial, density and time resolution
- ... and do that within constrained time and money budgets

What for, deeper

- Address worldwide trend to use noninvasive and nondestructive analysis methods
- Make structure and chemical composition analysis more applicable and affordable:
 - By bridging achievements of scientific research with state-of-the-art industrial technologies of HR:GaAs:Cr semiconductors
 - Less harmful to live specimens due to a lower X-ray dose
 - Higher spatial and time resolution
 - Better differentiation of chemicals and compositions

How technologically?

- Use penetrative X-ray radiation to enlighten the specimen
- Use a sensor capable to count and measure the energy of X-ray photons propagated through and/or reflected by the specimen
- Enable precise mapping of chemical element distribution within materials
- Leverage AI-driven chemical composition analysis to detect diseases and hidden hazards

What is it – The Magic Eye?

What our unique competitive advantage:

HR-GaAs:Cr spectral sensors

- It is our High Resistivity GaAs doped with Chromium, a room temperature X-ray sensing material for producing X-ray systems
- Our nickname for this sensing material is “TOP”
- There are other sensing materials on the market, CdTe, CdZnTe (CZT), etc.
- TOP provides competitive performance, and
 - Better spectral performance
 - Extremely cheaper
 - Scalable production processes
 - Better response uniformity
- TOP is a material with the best price/performance ratio for the spectral photon counting X-ray sensing

Spectral systems experience

- End-to-end expertise in spectral X-ray systems — from sensing materials to full-stack hardware and software
- In-house development of custom ROICs for spectral photon-counting — a key barrier to replication
- Proprietary AI-driven software platform for real-time spectral data analysis across multiple industries
- Strong and growing IP portfolio covering sensors, electronics, signal processing, and applied use cases
- Proven performance across scientific, industrial, security, and biomedical applications — validated in real environments

TAM MARKET SIZE

\$40Bl

SAM MARKET SIZE

\$3Bl

SOM MARKET SIZE

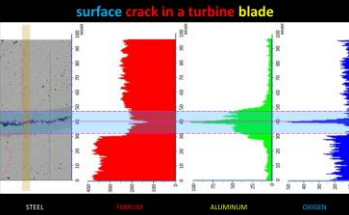
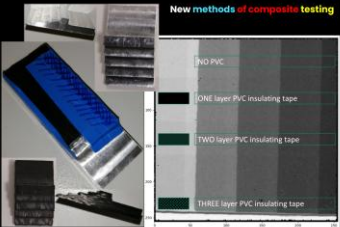
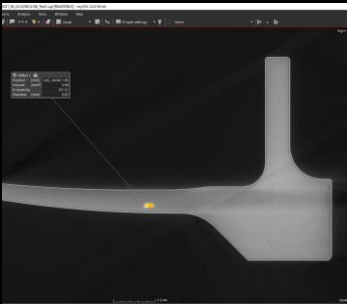
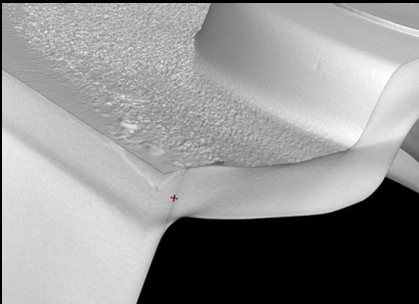
\$1Bl

Who needs it?

Industrial

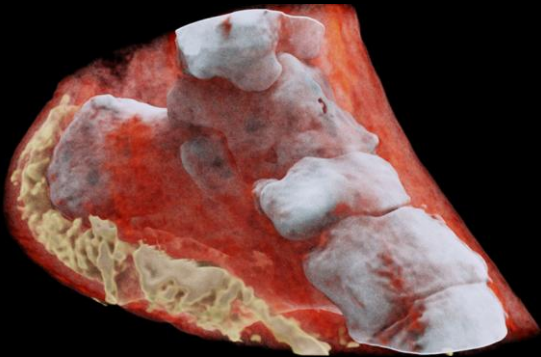
Non-destructive testing

Industrial sample aluminums alloy hazard



Medical

New approach of diagnostic - X-ray as functional diagnostic imaging

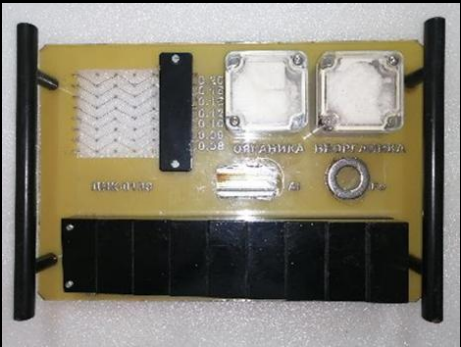


Security

Prototype , luggage scanning



IATA standard testing set



Our competitors

Industry majors are making many attempts to make Color(Spectral) X-ray

Most interested:



ACRORAD

Acquired by Siemens Healthcare



Redlen Technologies

Acquired by Canon Inc

All manufacturers of traditional scintillation detectors. Now, they dominate the market. But their products will become obsolete immediately after the mass appearance of colour detectors

All manufacturers of traditional scintillation detectors At the moment, they dominate the market. But their products will become obsolete immediately after the mass appearance of colour detectors

Why will Zeelta win?

It's a battle of brains, not money.



Siemens/Canon's road

Competitors have invested a huge amount of money (more than \$10 billion).

They even made some prototype and sell it

And they did not develop any new methods of diagnostic
They use another semiconductor CdTe (cadmium telluride) to build detectors and have encountered physical limitations



Zeelta's road

We did it

We have developed a new semiconductor (Hr:GaAs:Cr) for the X-ray sensor.

We are the only manufacturer of this semiconductor in the world (Many attempts to copy our technology have made in China and Europe. Without any results)

Who we are?

- Decades of scientific researches in radiation detection technologies
- Decades of combined expertise in advanced spectral X-ray imaging — from semiconductor sensing materials to complete imaging systems
- Proven capability in developing and deploying high-performance spectral X-ray solutions for critical industrial markets
- Strong software and IP portfolio enabling integration of spectral X-ray technology workflows
- Deep experience in applying AI/ML to enhance imaging and material characterization
- Entrepreneurial track record: in 2022, we founded Finnish deep tech company **Zeelta Oy** and successfully launched production of **top-tier TOP sensing materials** now used in leading spectral X-ray prototypes



Bekhzod Yuldoshev
In Memoriam
President of the Academy of
Sciences of Uzbekistan
Team's adviser 2022-2024



Ivan Olshevskii
Co-founder
Medical CTO.



Vadim Veshchezerov
Founder
CEO



Oleg Tolbanov
Scientific leader



Dinara Veshchezerova
DS/ML+AI IT
angel investor



Andrey Andreev
Non-destructive testing



Jan Kappi
security systems



Alexandr Skripkin
Business development
& sales

Why now?

Market potential – **Big** enough! >\$40B total

MEDICAL DIAGNOSTIC

Spatial and density resolution

- Ultra-high spatial and density resolution reveals the tiniest details

Spectral system

- Next-generation X-ray: enabling functional diagnosis

Mission impossible

- Spectral X-ray turns the impossible into reality
 - Vital Dosimetry in Real Time (VDRT)
 - New Cone beam CT system
 - X-ray of the vitreous body
 - X-ray evaluation of the ocular vitreous
 - And numerous possibilities yet to be uncovered

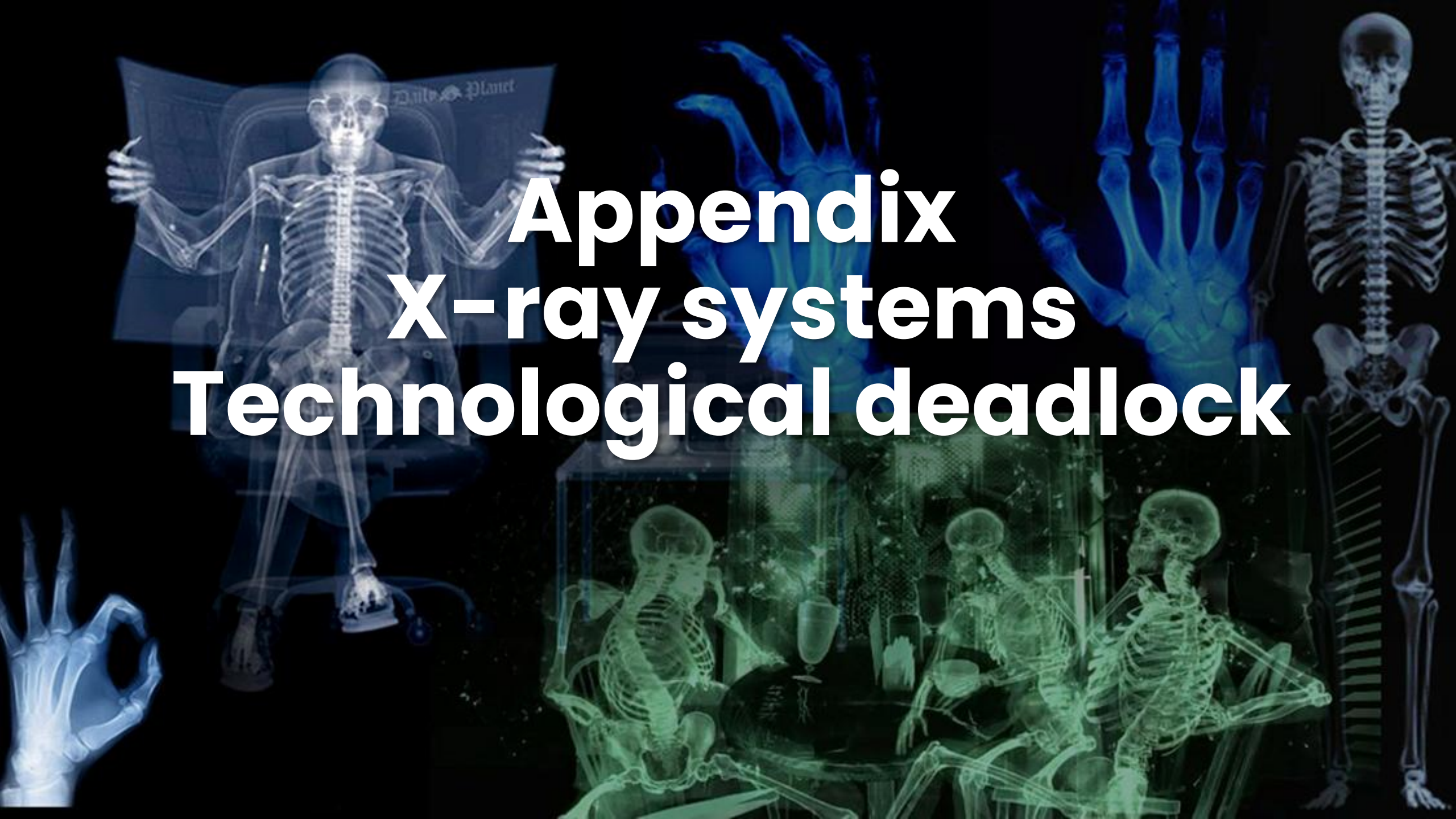
MANY OTHER APPLICATIONS

- Industrial nondestructive testing
- Food quality control
- Security
- Scientific application

- **Proven Technology:** We have successfully launched Zeelta Oy, producing advanced sensors based on proprietary HR:GaAs:Cr material.
- **Validated Prototypes:** Developed and tested spectral X-ray system prototypes for aviation security and industrial non-destructive testing (NDT).
- **Extensive Expertise:** Deep experience of the team in designing spectral X-ray systems and developing advanced software for spectral image analysis.
- **Ready to Scale:** Our systems are mature and ready for industrial scaling and commercialization.
- **Competitive Advantage:** Despite multiple attempts, competitors have not yet delivered spectral X-ray systems suitable for real-world industrial deployment — we will be first to market with a proven solution.

Targets of our team

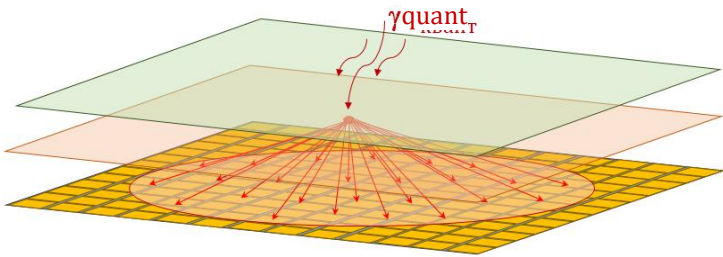
- Start sells of TOP material (HR:GaAs:Cr) to early adopters till the beginning of 2026
- Start pre-clinical testing and joint researches with medical teams to develop new diagnostic methods and applications of spectral (color) X-ray systems
- Early revenue stream from selling spectral system to early adopters companies
- Prepare seed and A Round of \$0,25...1M
- Prepare and start licensing of our technologies of spectral X-ray systems to manufactures of X-ray equipment
- Register patents
- One of the key targets is to develop practically obtained empirical knowledge and experimentally proved results with spectral X-ray systems into a solid theoretical and mathematical model. This is vital to pave the road for future developments of the HR:GaAs:Cr material, custom ROIC and further improvements of the existing technology.
- Ultimately sell packaged IP to a tier one player



Appendix X-ray systems Technological deadlock



The MAIN method for obtaining
**DIGITAL x-Ray (γ) images is a
scintillator – PHOTOCELL pair**



The METHOD has reached the physical limit
of data collection capabilities, as for the
main permissions :

- **SPATIAL**
- **CONTRAST** (density)

So, and on secondary:

- **TEMPORAL**

**The amount of information about the object
collected during the research,
can not be **INCREASED**
and it is – **NOT ENOUGH****

TECHNOLOGY CRISIS

WAYS TO FIND A WAY OUT OF THE CRISIS

Search for a **NEW DETECTOR BASE:**

The focus of the study:
monolithic direct-conversion semiconductor
SENSORS.

TWO-POWER SYSTEMS :

The focus of the study:
sequential exposure of an object in x-Ray of
different energy.

MATHEMATICAL PROCESSING

The focus of the study:
Deepening **MATHEMATICAL image
PROCESSING** and understanding of Decision
Support Systems (CAD; Assistive applications)

THE RESULTS OF THE SURVEY

PROMISING RESULTS WERE OBTAINED

in the field of monolithic semiconductor sensors:
a-Se; CdTe (CdZnTe); GaAs:Cr
(see the Slides below):

The research **did NOT** lead to a significant
increase in the amount of diagnostic information
collected

The research led to a change of CAD generations.
However, further development in this direction is
IMPOSSIBLE without increasing the volume of
diagnostic information collected.



ISSUES OF THE CURRENT X-Ray:

THE PROBLEM WITH THE CURRENT SYSTEMS

(same for all industries):

The technology has EXHAUSTED development possibilities in all parameters (resolutions):

- SPATIAL
- CONTRAST (density)
- TEMPORARY

The amount of **INFORMATION** about the object collected during the study is **LIMITED** by the physical principles on which the system operates.

It CANNOT BE INCREASED...
AND IT IS NOT ENOUGH!!!

GENERATION CHANGE in X-ray imaging



- ❖ Improving image quality
- ❖ New (now unavailable) data on the object under study
- ❖ Radiation dose reduction (for biological objects)

X-ray systems changes are like this:

NOW



BLACK&WHITE TV:
CRT, Scan 25 Hz, Diagonal - 45 cm.

WITH TRUE COLOR X-RAY



4K UHD OLED panel;
32 million colors, Screen refresh - 60 Hz.
Diagonal 125 cm.

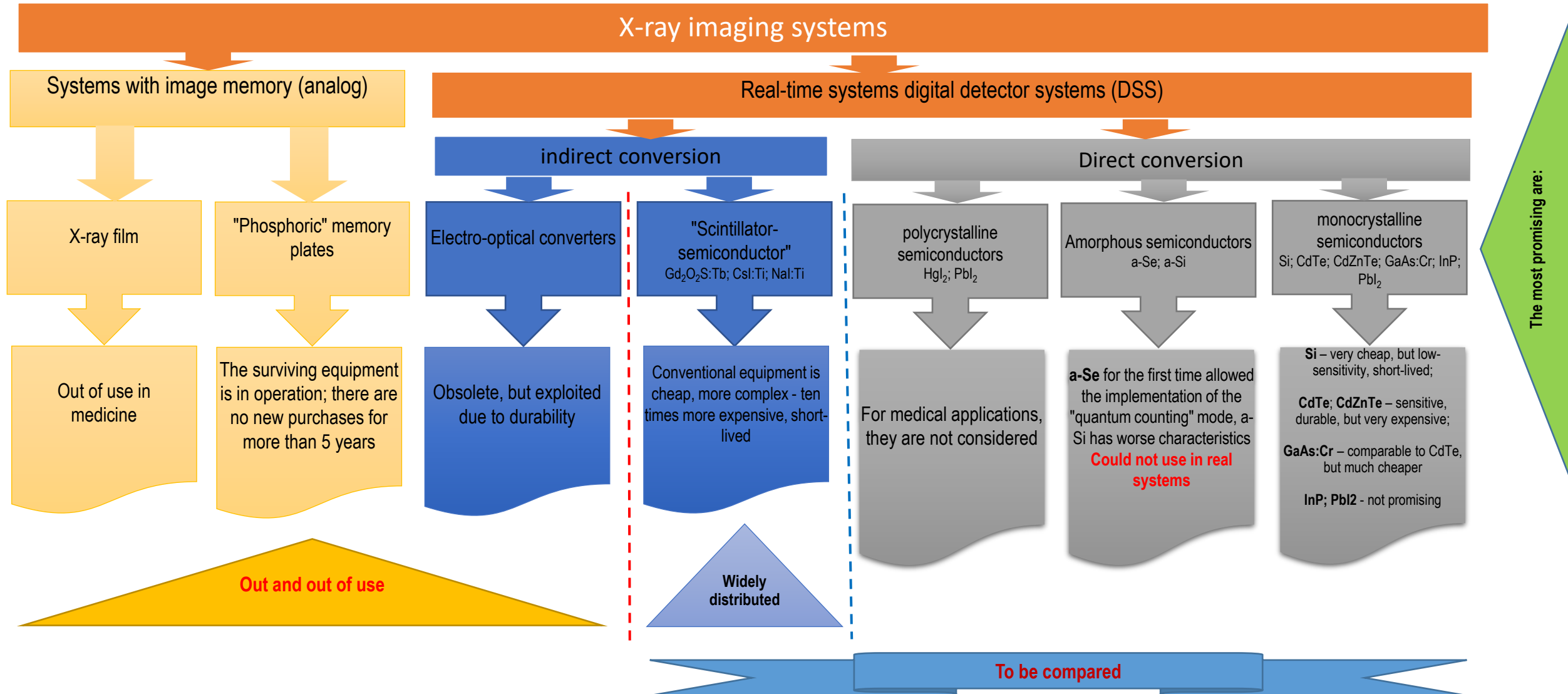
OR

THE PROBLEM IS RECOGNIZED

by representatives of all industries:
For the last 25 - 30 years, ACTIVE SEARCHES FOR its solutions made.

More than €10 Bln. spent



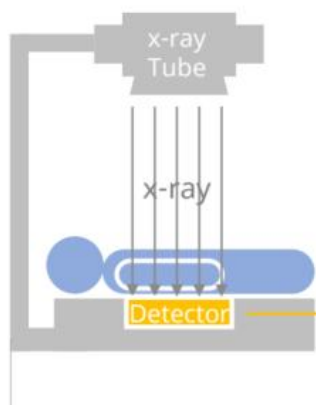


X-ray detector sensor comparison

CMOS X-ray detector sensor

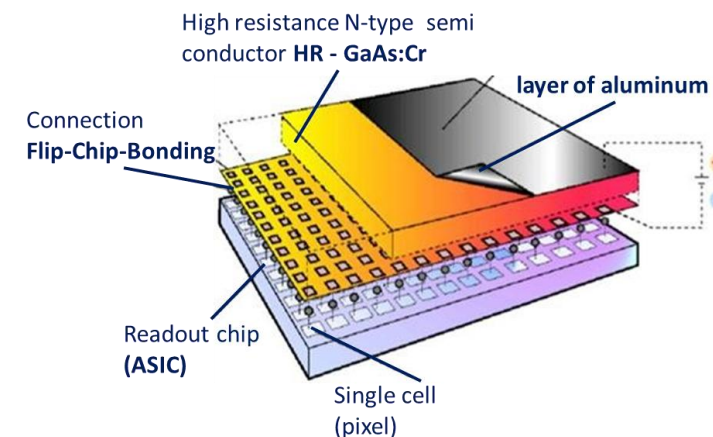
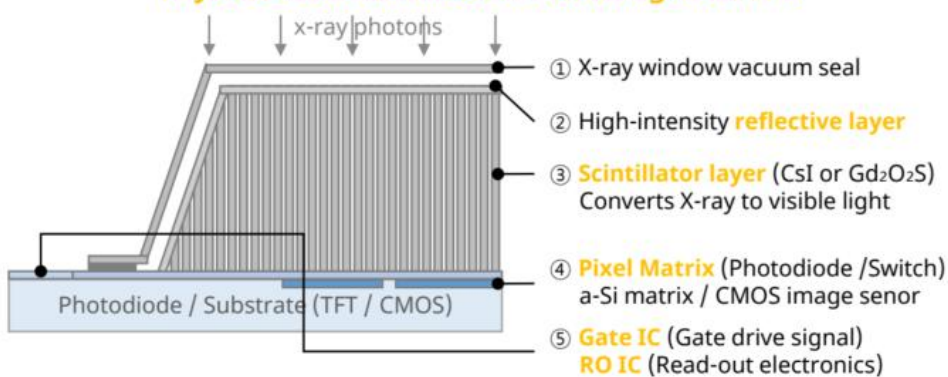
HR-GaAs:Cr X-ray detector sensor

[Digital X-ray System]



[Technologies of Digital X-ray Detector]

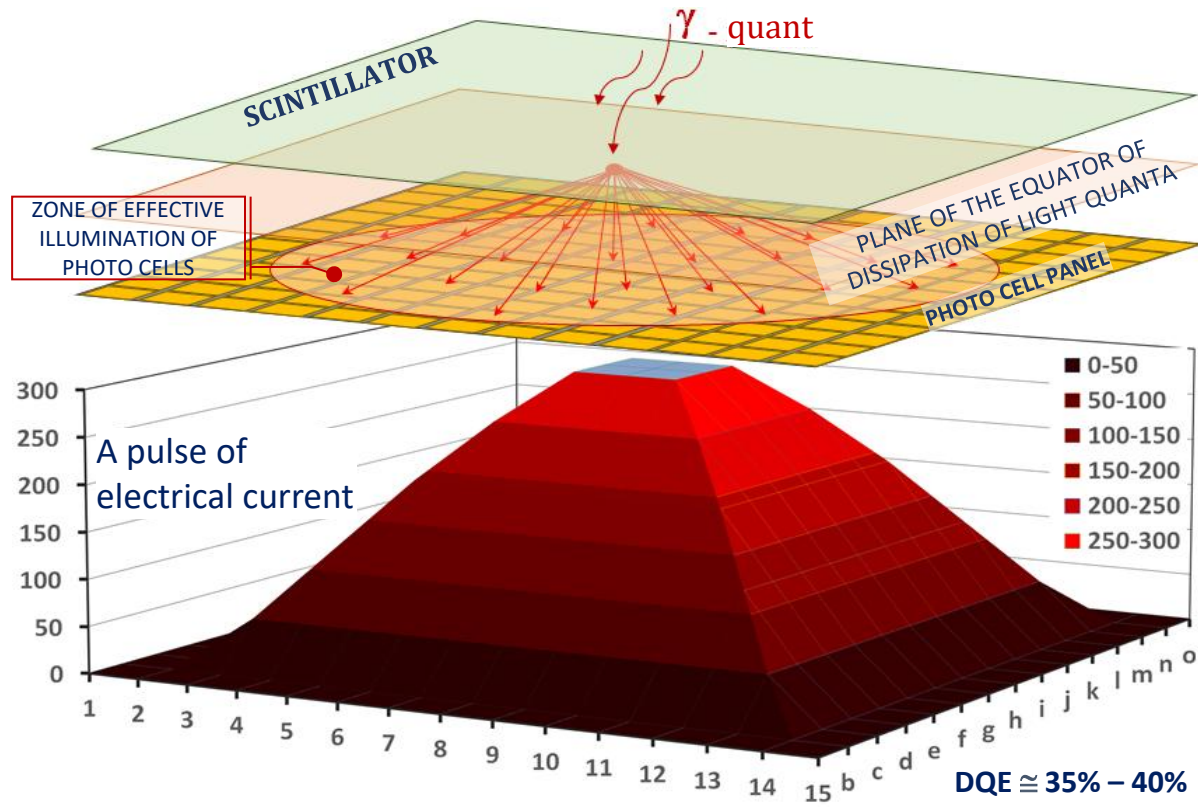
Rayence has Internalized All Technologies for FPD



X-ray detector sensor description

- CMOS sensors use a different approach where X-rays are first converted into visible light by a scintillator, and then the CMOS sensor detects this visible light. This indirect method is common in CMOS X-ray sensors.
- CMOS sensors may have lower sensitivity and resolution compared to direct-conversion sensors.
- While durable, CMOS sensors may experience pixel degradation under continuous radiation exposure, which can reduce their lifespan relative to GaAs detectors.

- This detector is based on high-purity gallium arsenide (GaAs) doped with chromium, which enhances its ability to absorb high-energy X-rays. GaAs provides high radiation resistance and responds quickly, making it efficient for direct X-ray detection.
- Thanks to its direct conversion process, it offers high sensitivity and resolution, enabling high-quality imaging even at low X-ray doses. This makes it particularly advantageous for medical imaging.
- With high radiation resistance, these detectors have a long lifespan and strong durability, even in high-radiation environment



γ -quant is compatible with scintillant and invokes its fluorescence in optical absorption.

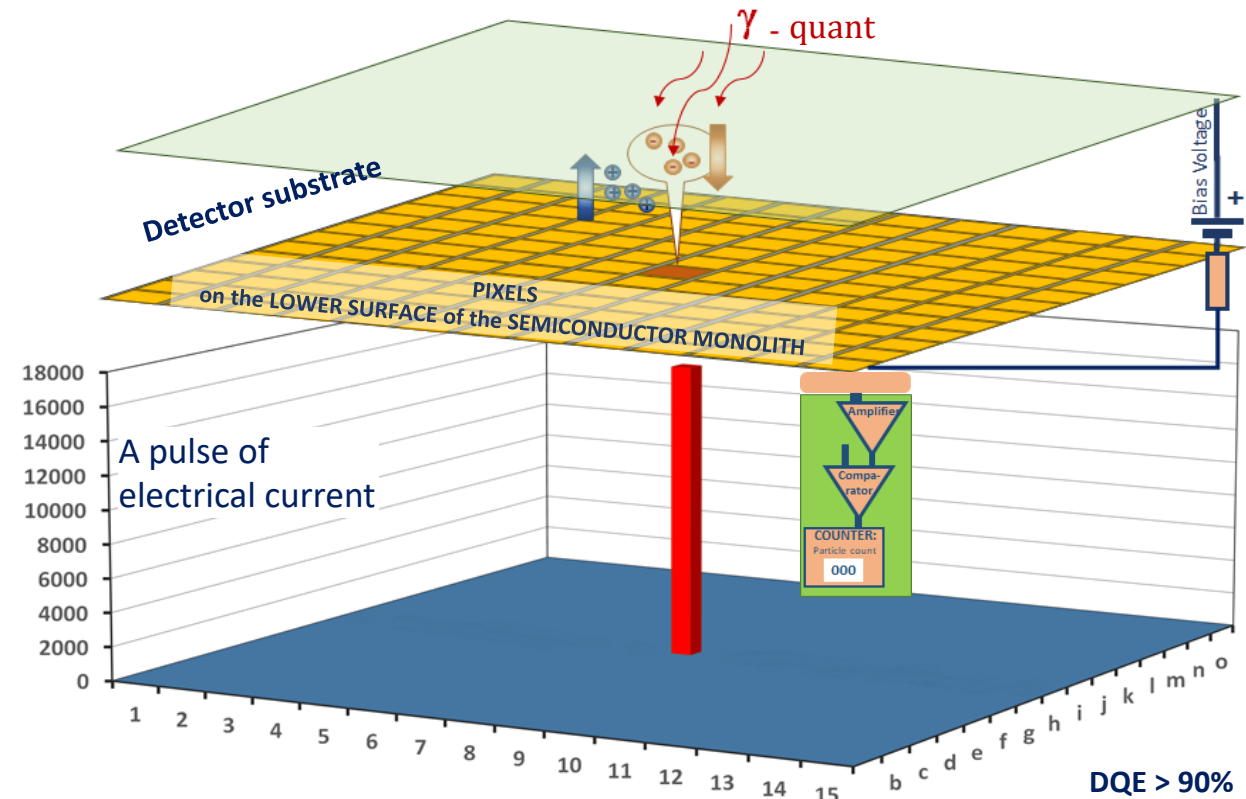
Light quanta spread out in sphere content. Quanta that appear

- OVER the plane of sphere equator – will miss the photocells.
- UNDER the plane of events equator – will <<get exposed>> of photocells group.

Light-striking of some photocells will not allow:

- authentically localize the event (will decrease a spatial resolution of detector)
- evaluate the energy of a γ -quant absorbed by scintillator.

The zones of light-striking of spatially proximal simultaneous events will add up each other and sum up into one event with total energy and with bigger area of light-striking. QUANTUM MODE (quanta calculation mode) of detector operation is EXCLUDED.



γ -quant is compatible with an array of semiconductor and causes the amount of charges which is proportional to its energy. Under the influence of divergent voltage (BIAS VOLTAGE) the charges are drifting into the contrary directions. All positive charges will <<flow>> on the SINGULAR ELECTRODE (pixel). Which results in:

- Coordinate of the event will be defined UNAMBIGUOUSLY (detector spatial resolution is even to the pixels pitch – starting from 35 μ .)
- the number of charges will allow to measure the energy of absorbed γ - quant. (differentiation of quanta energy – **ENERGY-DISPERSITY**, analogue of color vision)

Two spatially close simultaneous events will be recorded as isolated.

QUANTUM MODE (quanta calculation mode) of detector operation might be REALIZED.

**SIDE TECHNOLOGIES,
implemented beyond the Project's framework**

PRODUCTION of GaAs
Well-proven technology of the production of
distinct clearness monocrystal GaAs
Manufacturers: Germany, Slovakia, Russia, China,

**TECHNOLOGIES GEAR TO THE APPLIANCE
WITHIN THE FRAMEWORK OF THE PROJECT**

Zeelta additional technological competence
Used for engineering support of partners, customers and suppliers

DEVELOPMENT OF ORIGINAL ANALOG-DIGITAL
DATA SENSING ELECTRONIC CHIP
(ASIC)

Job-proved generally accessible technology:
Generation of the materials for the manufacturing of
lithographic matrix for direct reading electronic chip with
inner intensification

PRODUCTION OF THE ORIGINAL DIRECT READING
ELECTRONIC CHIP
Job-proved generally accessible technology

MANUFACTURE OF SEMI-INSULATING GaAs,
COMPENSATED BY CHROME (GaAs:Cr)
MAIN KnowHow:
Production of BASIC MATERIAL for the creation of the
components of element base of quantal-sensitive sensors.

MANUFACTURING OF THE PLATES OF HIGH-
OHMIC SEMI-INSULATING GaAs:Cr
KEY KnowHow №1:
Manufacturing of BASIC COMPONENT of element base of
various sizes quantal-sensitive sensors.

MANUFACTURING OF METAL CONTACTS OF PIXELIZED
(MATRIX) SENSORS BASED ON THE PLATES OF HIGH-
OHMIC SEMI-INSULATING GaAs:Cr
KEY KnowHow №3:
Technological stage of interfacing the BASIC PRODUCT with
direct reading electronic chip with inner intensification.

MANUFACTURING OF PIXELIZED (MATRIX)
SENSORS BASED ON THE PLATES OF HIGH-
OHMIC SEMI-INSULATING GaAs:Cr
KEY KnowHow №2:
Manufacturing the BASIC PRODUCT - coordinate quantal-
sensitive SENSOR (various sizes).

INTERFACING THE BASIC PRODUCT WITH DIRECT
READING ELECTRONIC CHIP
Job-proved generally accessible technology:
Manufacturing of Coordinate quantal-sensitive energy-
dispersive detector with inner intensification

**SIDE TECHNOLOGIES implemented
beyond the Project's framework**

PROCURATION OF OFF-SITE
ANALOG-DIGITAL DATA SENSING ELECTRONIC CHIP (ASIC)
Generally accessible product.
Manufacturers: Medipix; Detrix

BASIC SOFTWARE
Job-proved generally accessible technology

Scintillant + Si vs HR - GaAs:Cr: The Comparison of detector systems qualities

	SPATIAL	SPECTRAL (COLOR)	DENSITY RESOLUTION
Scintillator + Si	MAXIMUM exponents of digital detector systems: Physical pixels pitch – 110 micrometers. Actual resolution – starting from 330 micrometers.	within this detector base – the function is beyond the reach. Investigations in two-energetical x-ray diffraction technique with successive multiple exposure of an object in different energy x-Ray by means of modulation of operation of one roentgen tube or application of two different radiation sources are conducted.	It depends on structural system of the unit and its assignment: •Routine roentgenograph – 256 gradations of light within "grey scale" •Expert level mammographer – 512 gradations of light. •Mult-spirally computer tomography (64 sps) – 4'960
HR – GaAs:Cr	Compares to the sensor physical pixels pitch: starting from 35 micrometers. Actual resolution – compares to the sensor topology.	HR – GaAs:Cr – allows to measure the g-quanta energy with accuracy that provides data acquisition in both qualitative and quantitative element composition of investigated sample	Differentiable gradations of density are 1 : 150 or about 4'000 gradations of light within <<grey scale>>. Independently for each energy range of γ -radiation detection.
CAPACITIES OF TECHNOLOGIES INTERCHANGES	Interchange is partially POSSIBLE: Efficient limit of spatial resolution in medical visualization lies ahead: dimensional type 35 micrometers (it is more typical for cellular agglomerates). The decrease of the parameter for HR – GaAs:Cr detectors might be efficient.	Interchange of the systems is IMPOSSIBLE: capacity of Spectral (color) is beyond the reach of digital scintillator + Si detector systems.	Interchange of the systems is IMPOSSIBLE: The reception of isolated "grey scale" for every energy channel is beyond the reach of scintillator + Si detector systems.

MONOLITHIC SEMICONDUCTOR SENSORS

suitable for integration with channel-by-channel **Read-out – ASIC**



**Silicon
(Si)**

It is effective as a sensory material at very low energies (units, tens and hundreds of eV), which are not applicable in medical practice. Subject to rapid radiation degradation

**amorphous Selenium
(a-Se)**

Effective as a sensory material. Not applicable in General practice due to the requirements for thermal stabilization and only the horizontal position of the detection panel

Cadmium Telluride (CdTe)

Cadmium-Zinc-Tellurium (CdZnTe; CZT)

It has a high efficiency of fixing g-quanta in the energy range of 10-120 Kev (typical for medical imaging).

Extremely expensive: 293,1 \$/rp.

Does not allow forming detector panels of an area that is significant for medical visualization:

max.: 84.5 x 28.16 mm.

**High-resistive Gallium Arsenide compensated
with Chromium (HR – GaAs:Cr)**

DQE at 40 kEv (the lower boundary of the energy medical imaging)	>95%
DQE at 120 kEv (the upper limit of the energy medical imaging)	+/- 75%
Radiation resistance :	before 10 GGray.
Operating temperature range :	до 70°C
Cost	7,2 \$/g.
Size of available flat panels	> 430 x 430 mm.

By set of characteristics

HR – GaAs:Cr

**There are NO ALTERNATIVES for implementing
NEXT-GENERATION x-Ray IMAGING**

The project team has a monopoly on production

**HR – GaAs:Cr
for the next 5 - 7 years**



New methods of diagnostics

Spatial and density resolution

Spectral system:

- Next-generation X-ray: enabling functional diagnosis

Mission impossible

- Spectral X-ray turns the impossible into reality
 - Vital Dosimetry in Real Time (VDRT)
 - New Cone beam CT system
 - X-ray of the vitreous body
 - X-ray evaluation of the ocular vitreous
 - And numerous possibilities yet to be uncovered



Contact Us

Vadim Veshchezerov

Phone:

+358-468904791

+33-745152636

E-mail:

vvv@zeelta.com

Address:

Annankatu 25 LH 44,
00100, Helsinki, Finland

