

Digital X-ray Update 2011

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Advances in Digital Radiography: Physical Principles and System Overview

→ Expand

This Article

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Abstract **Free**

Figures Only

Full Text

Full Text (PDF)

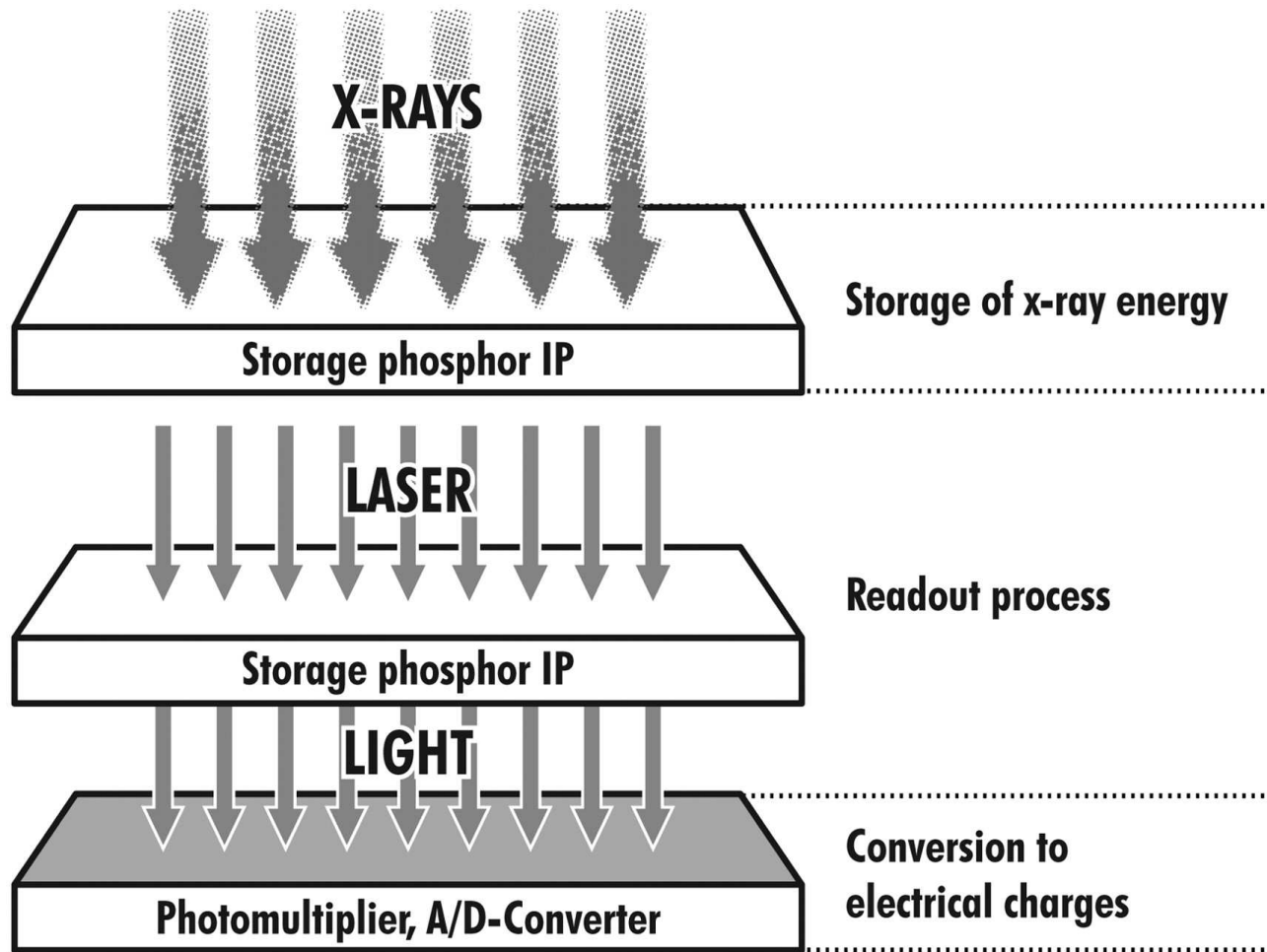
Table 1. Timetable of Developments in Digital Radiography

Year	Development
1977	Digital subtraction angiography
1980	Computed radiography (CR), storage phosphors
1987	Amorphous selenium-based image plates
1990	Charge-coupled device (CCD) slot-scan direct radiography (DR)
1994	Selenium drum DR
1995	Amorphous silicon-cesium iodide (scintillator) flat-panel detector
1995	Selenium-based flat-panel detector
1997	Gadolinium-based (scintillator) flat-panel detector
2001	Gadolinium-based (scintillator) portable flat-panel detector
2001	Dynamic flat-panel detector fluoroscopy-digital subtraction angiography

CR

- X-rays hit a phosphor imaging plate and the energy is stored by the phosphor
- The plate is then scanned by a high energy laser and the stored energy is converted to light
- The light is collected by photodiodes and converted to an electric signal processed by the computer
 - Plates should be read immediately because the store energy decreases over time

Figure 3. Drawing illustrates a CR system based on storage-phosphor image plates.



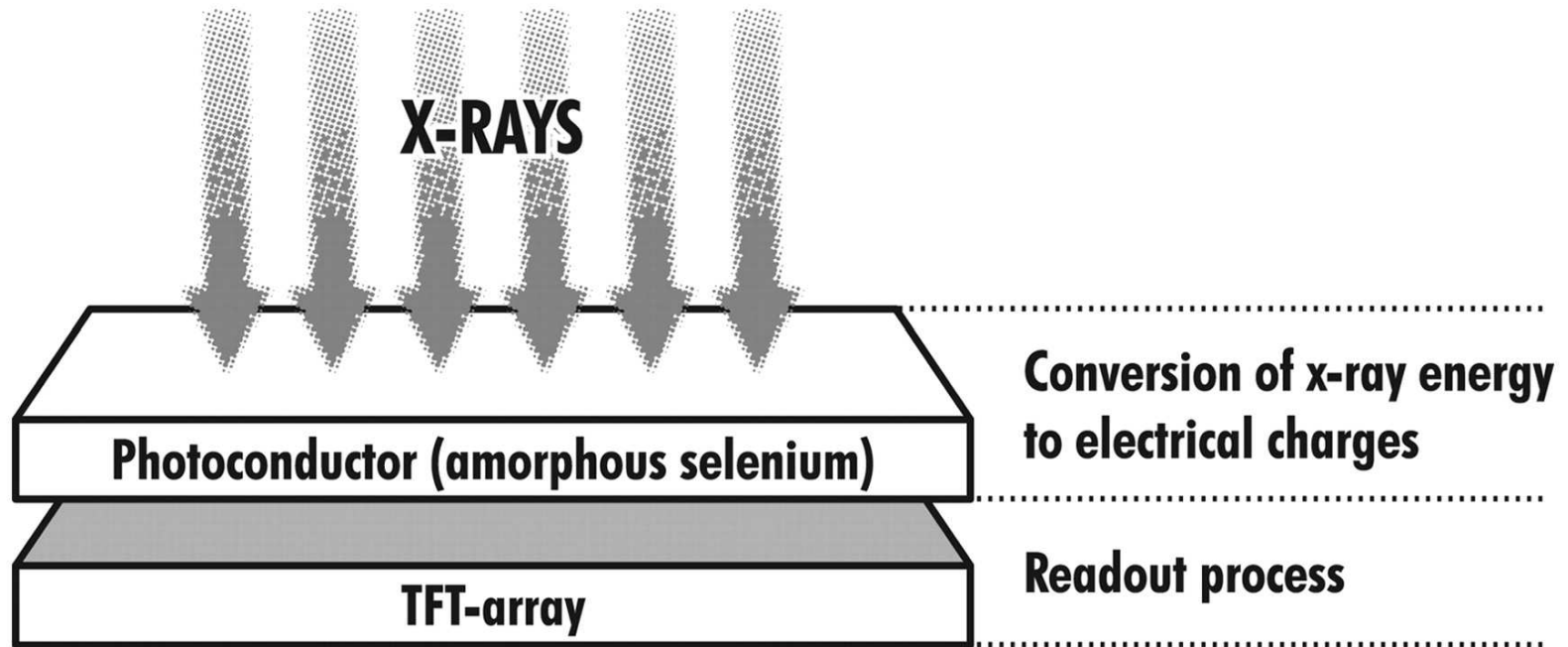
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Flat Panel (direct conversion) DR

- X-rays hit a layer of selenium which converts the energy into a charge
- The charges are registered on an adjacent layer of “thin-film transistors” (TFT’s)
- These charges create an electric current which is processed by the computer
- Most expensive

Figure 4b. Amorphous selenium–based direct conversion DR systems.



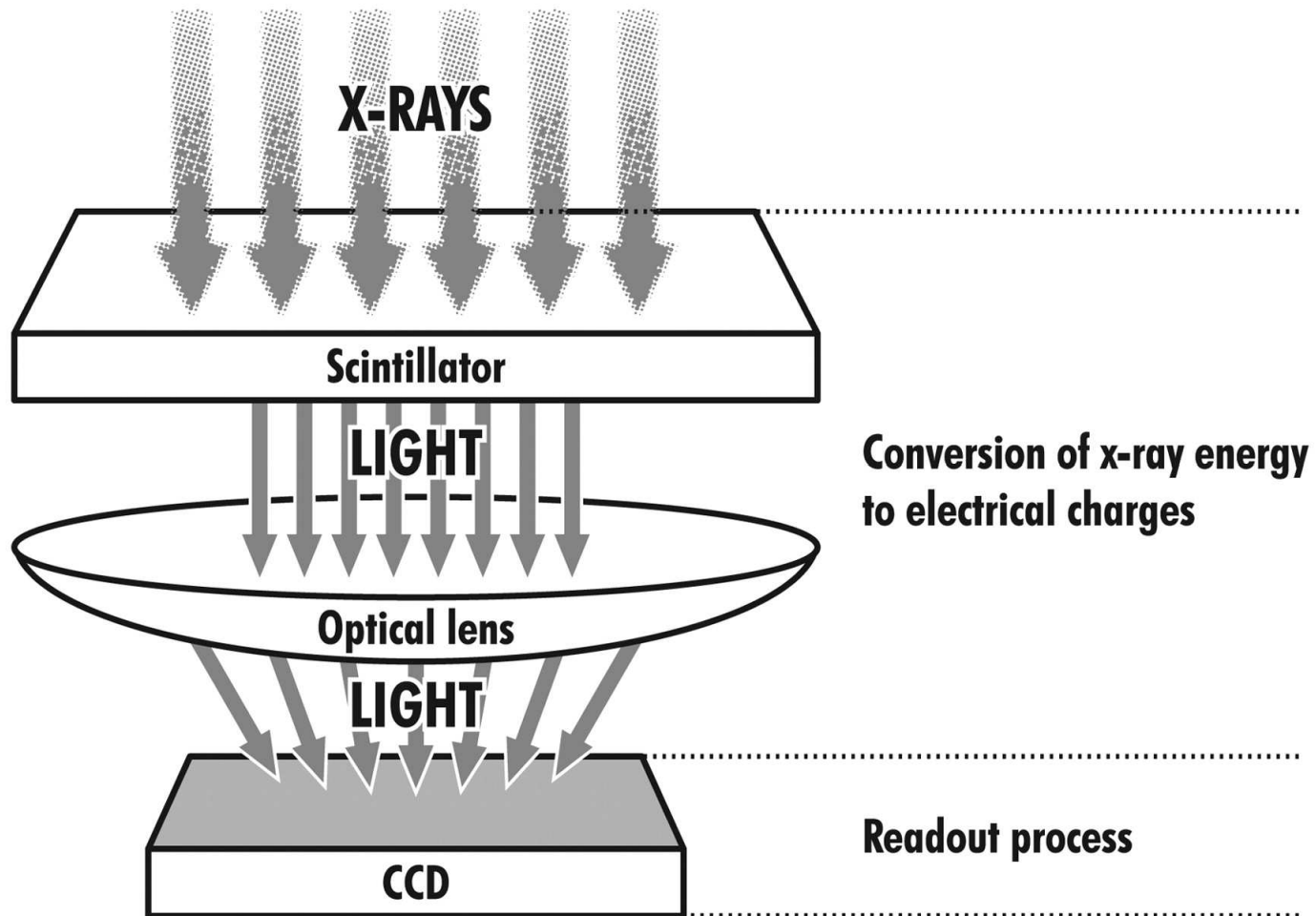
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Single Detector CCD (indirect conversion) DR

- X-rays hit a layer of Cesium which emits light
- The light is focused by one lens to a large CCD (charge couple device)
- The CCD converts light to an electrical charge which is transmitted to the computer and processed

Figure 5a. CCD-based indirect conversion DR system.



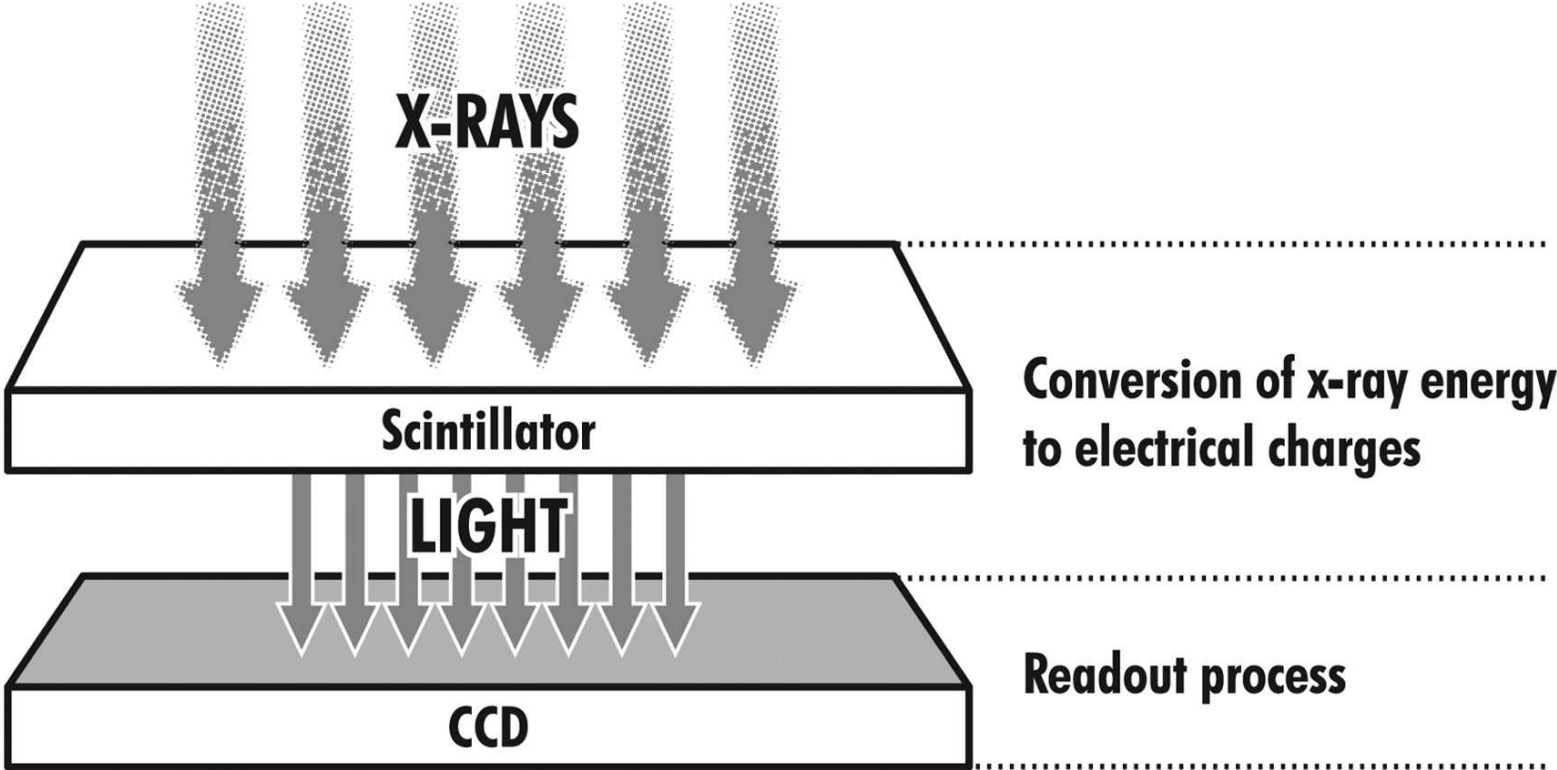
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Multi Detector CCD (indirect conversion) DR

- X-rays hit a layer of Cesium which emits light
- The light is focused by multiple lenses to many small CCD's (charge couple device)
- The CCD's convert light to a electrical charges which are transmitted to the computer and processed
- Least expensive form of DR
- Post imaging processing crucial in this type

Figure 5b. CCD-based indirect conversion DR system.



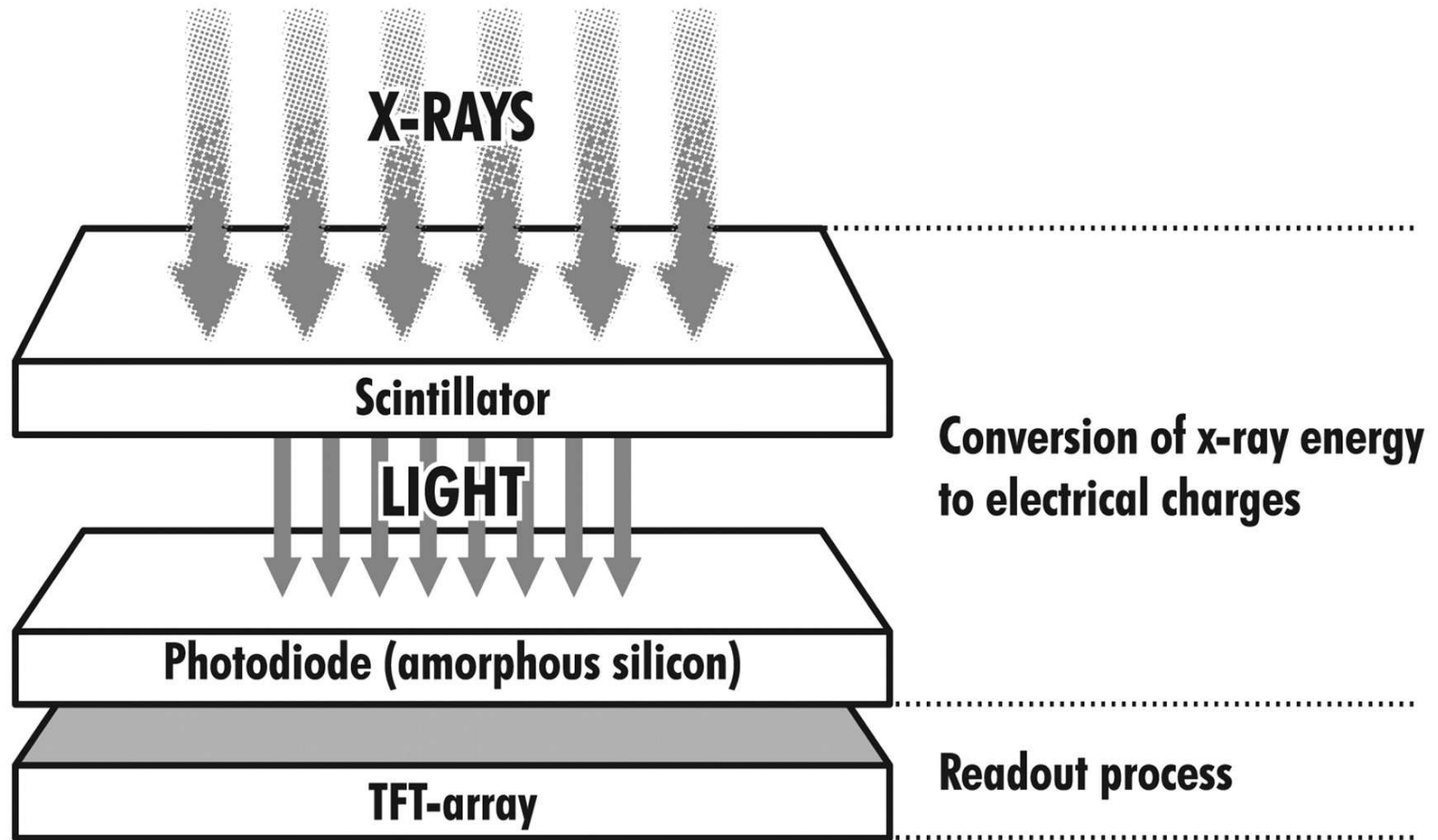
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Flat Panel (indirect conversion) DR

- X-ray hits a phosphor layer that emit light
- Light hits a layer of selenium which converts the light energy into charges
- The charges are registered on an adjacent layer of “thin-film transistors” (TFT’s)
- These charges create an electric current which is processed by the computer
- Intermediate cost (the next BIG thing)

Figure 6. Drawing illustrates an amorphous silicon-based indirect conversion DR system.



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Post Imaging Processing

- Each manufacturer is different
- Enhances image between detector and the computer
- A limiting factor in image quality

Figure 7. Image postprocessing.



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Viewing Software

- Many on the market
- Does not have to match the company that made the digital receptor – IT IS ***YOUR*** CHOICE TO FIND THE ONE YOU LIKE BEST
- Cost ranges from ~\$1K-\$3K

Viewing Station

- The monitor is also a limiting factor
- Even the best of images look different on different monitors
- A MEDICAL GRADE MONITOR IS A MUST
- Some offices like to give patient reports on high definition TV's (bells and whistles add to the cost)

Other Advantages

- Easily save marked images electronically or to paper
- Burn CD's instead of copying film
- For interpretation, send electronically instead of by mail or FedEx
- No storage space

Approximate Cost (2011)

- Flat plate direct DR \$150K+
- Flat plate indirect DR ~\$40K+ (not many on market)
- Single detector indirect DR ~\$35-40K+
- Multi-detector indirect DR ~26-30K
 - ~\$450.00/month on a 5 year lease with a \$1 buy out