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SECURITY ANALYSIS OF A FULL-BODY SCANNER



Warning: Nudity

talk shows unmodified scanner images
to demonstrate the privacy implications
of full body scanning

FULL BODY SCANNERS

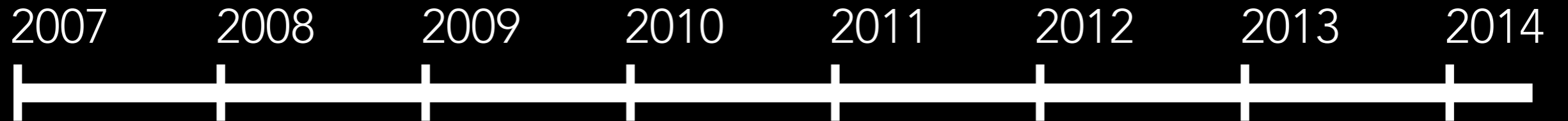


Rapiscan[®]
systems



IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT



Rapiscan[®]
systems

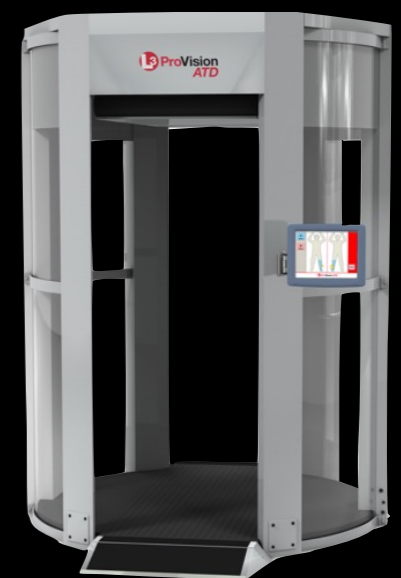
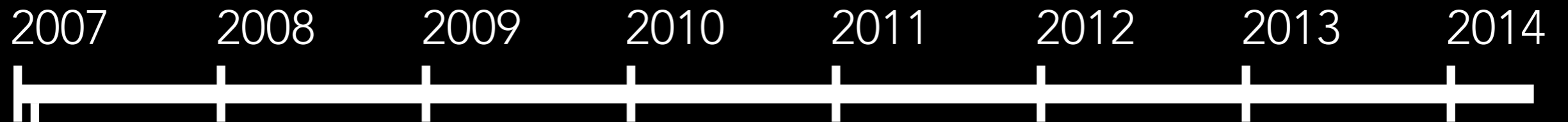


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT



Feb 2007:
TSA introduces FBSs as
'secondary screening'



Rapiscan[®]
systems

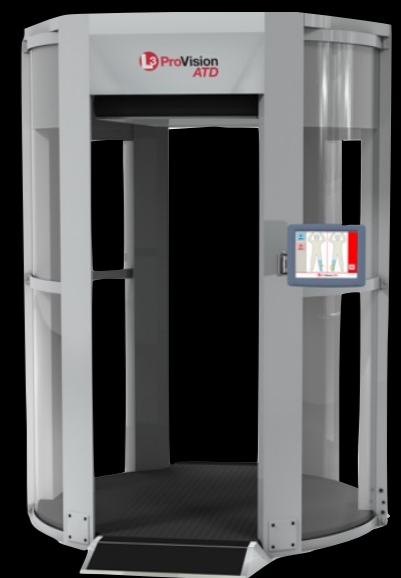


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT



Rapiscan[®]
systems

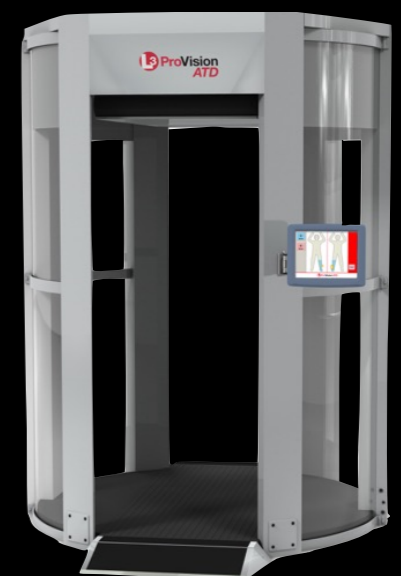
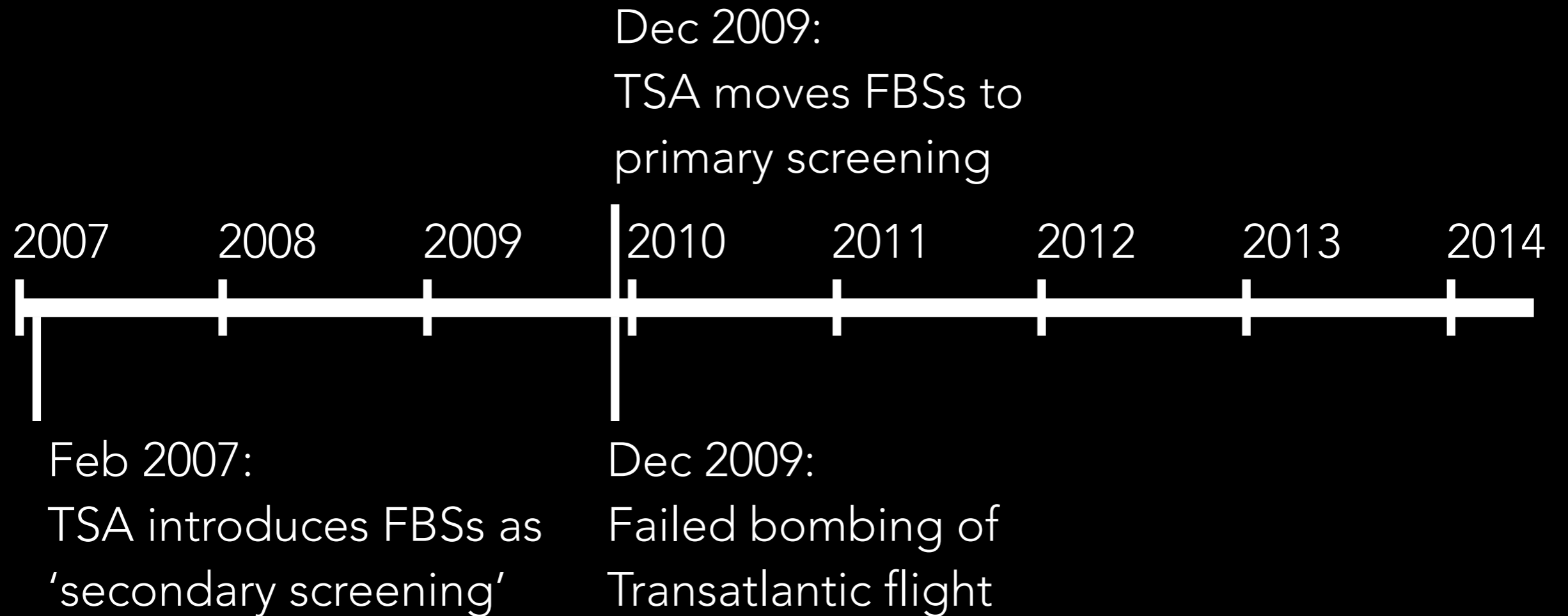


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT



Rapiscan[®]
systems

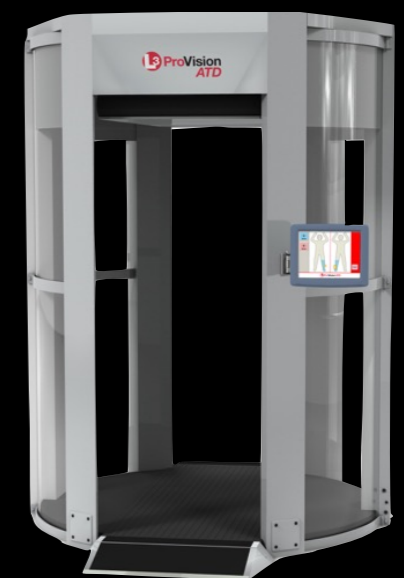
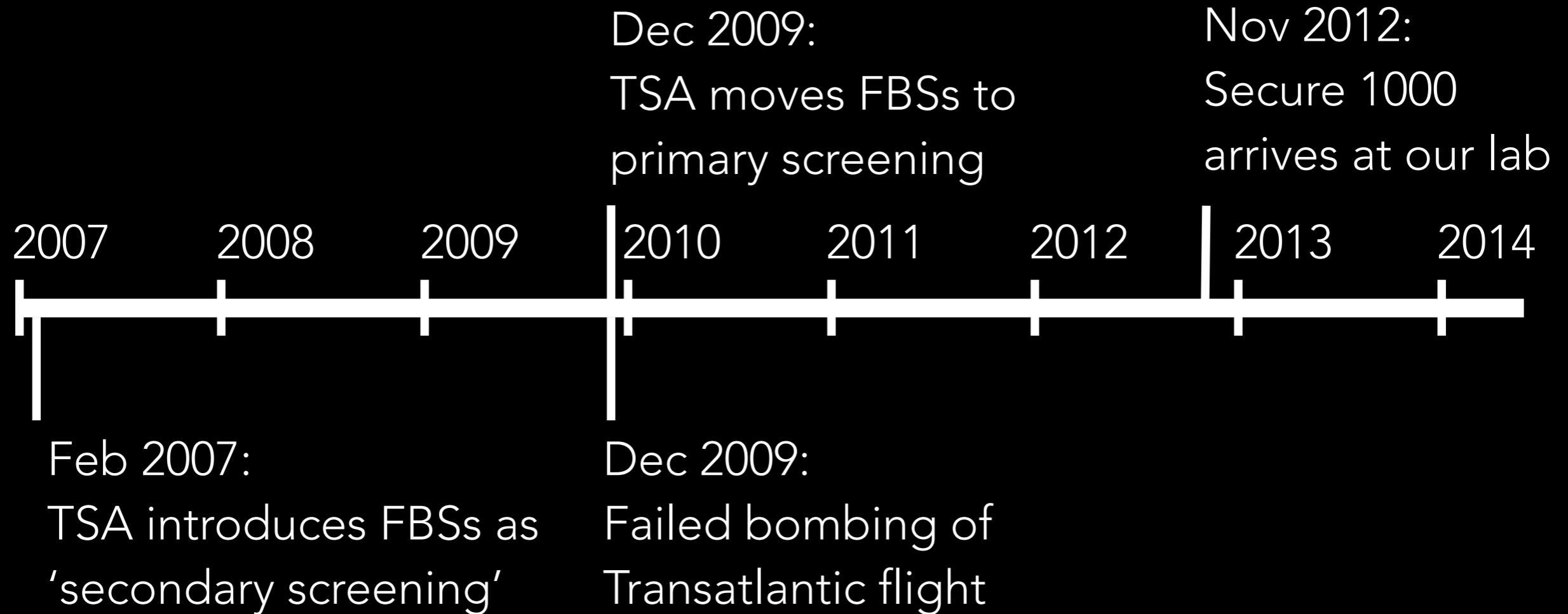


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT



Rapiscan[®]
systems

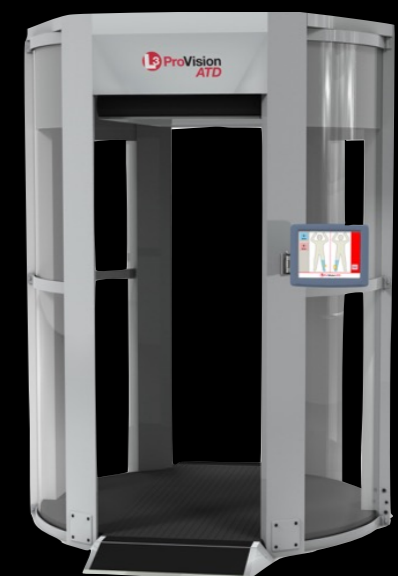


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT

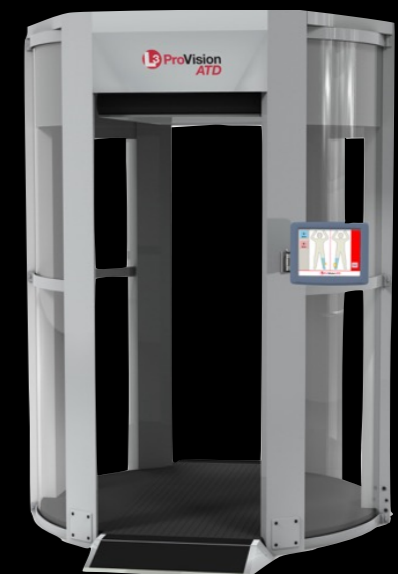
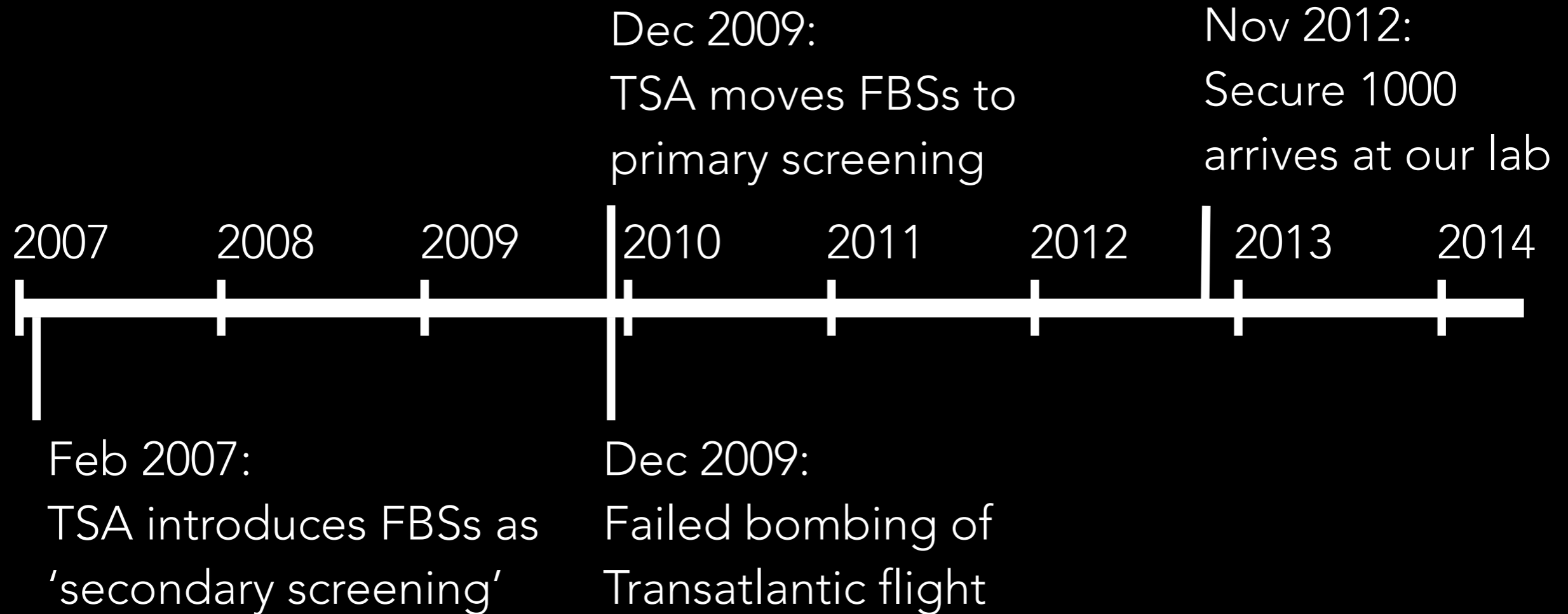


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

FULL BODY SCANNER DEPLOYMENT

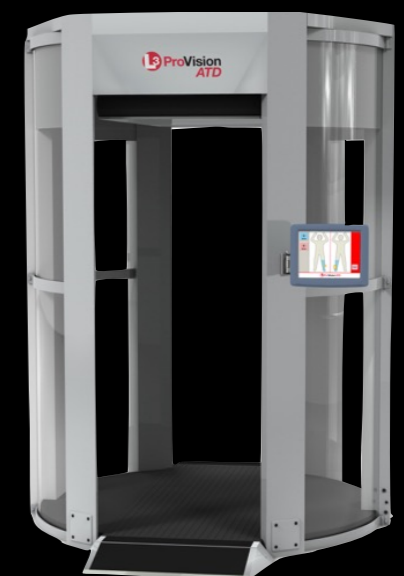
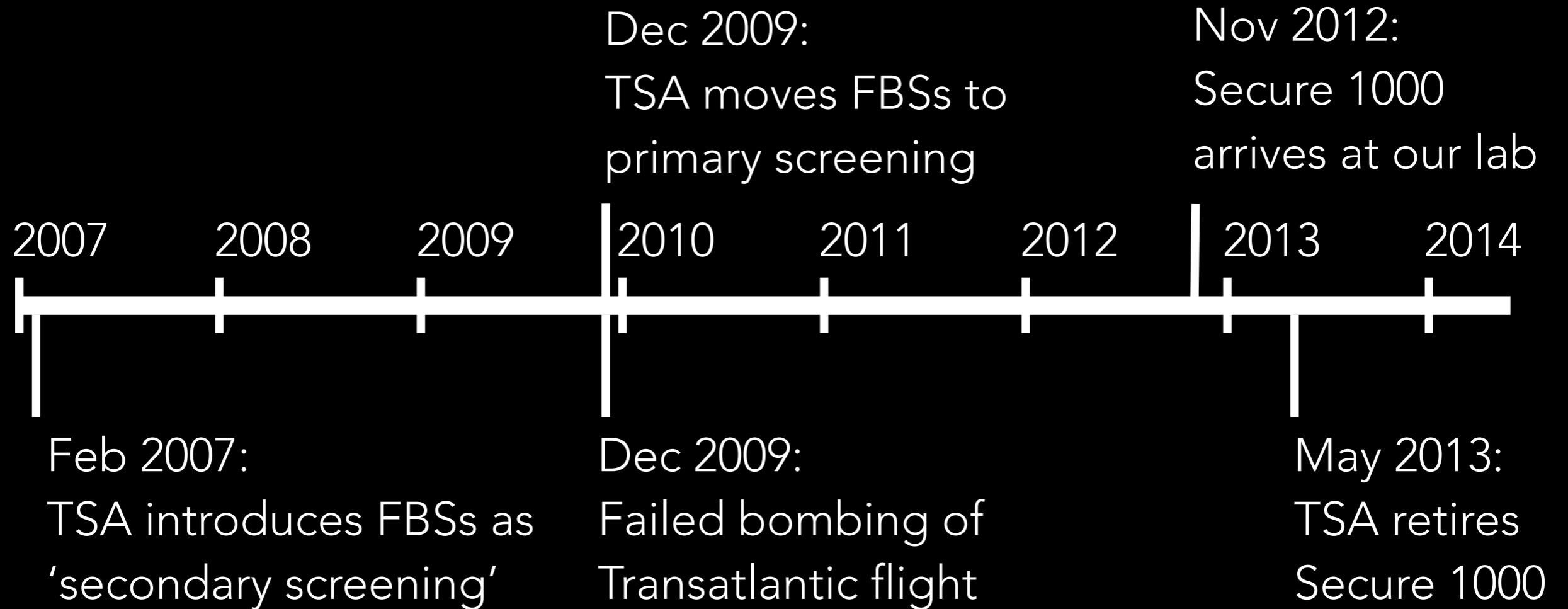


IMAGE: RAPISCAN CORP., L-3 COMMUNICATIONS

PUBLIC DEBATE

PUBLIC DEBATE

"... THE DOSE TO THE SKIN MAY BE DANGEROUSLY HIGH."

Radiological Safety?

PUBLIC DEBATE

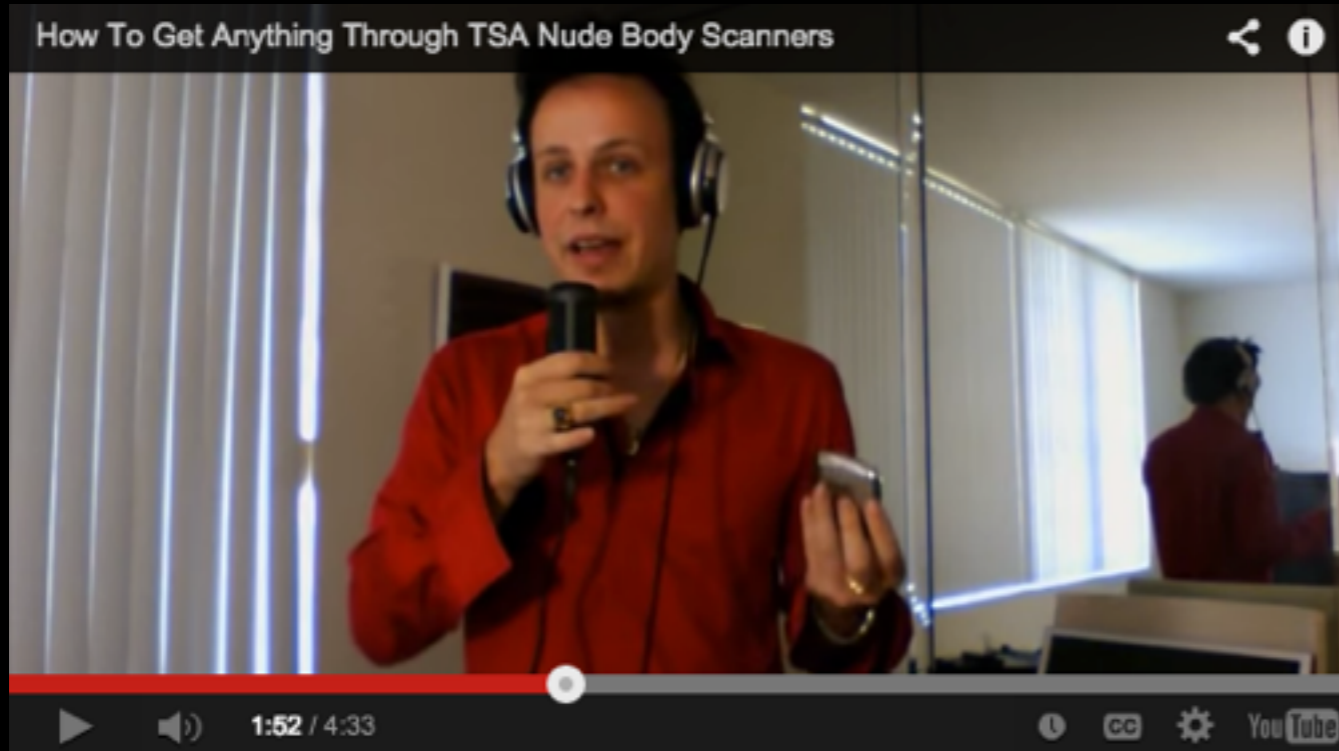
Privacy?

the TSO working the NoS said on his headset, "heads up, got a cutie for you."

"... THE DOSE TO THE SKIN MAY BE DANGEROUSLY HIGH."

Radiological Safety?

PUBLIC DEBATE



Contraband
Detection?

Privacy?

the TSO working the NoS said on his headset, "heads up, got a cutie for you."

security at DEN with his 18 year daughter. As his daughter approached the detector, the TSO working the NoS said on his headset, "heads up, got a cutie for you." He then confronted the TSA clerk with what he said and that neither of us are going through the NoS. The TSA clerk said you must have misunderstood me. 🙄

He is taking it up with Skywest, with this behavior. Normally, crews there go through a different screening area, but since he was with his daughter, he got to see the TSA clerks at their finest in Denver. 🙄

Its stoiries like this, is why I will not go through the NoS (radiation/health issues) and even refuse the the pat-down thus (if it happens while on duty) canceling the flight due to a hostile work environment.

I hope this gets resolves soon!! Got to fly....no NoS checkpoints on this trip so don't worry about a canceled flight from me!! 🙄

"... THE DOSE TO THE SKIN MAY BE DANGEROUSLY HIGH."

Radiological Safety?

TSA RESPONSE

Table 8-7 provides the exposure and background readings for the master unit and Table 8-8 provides the readings for the slave unit. Figure 8-10 provides the locations of the readings. As shown in Table 8-7 and 8-8, the dose above the units

5 USC 552(b)(4)

that occurs at the beginning of each scan. When the Single Pose system executes a scan, the start position (for the first scan) of the X-ray generator

When the scan is initiated, the X-ray generator (and therefore x-ray beam)

Therefore, the primary beam points toward

During this phase

are not monitored because as they are out of tolerance.

At this time it is assumed that

and these parameters are monitored. Therefore,

there is approximately 0.5 seconds at the beginning of each scan where vertical motion has not reached peak velocity and may result in slightly higher doses at the position where the scan starts.

ACQUISITION

The screenshot shows an eBay listing for a Rapiscan Secure 1000 DP (Dual Pose) Backscatter Body Scanner. The listing includes a main image of the scanner in its wooden shipping crate, a price of US \$49,500.00, and a shipping cost of \$2,000.00. The seller is ivw-agne(353) with a 99.6% positive feedback rating. The listing also features a 'Buy It Now' button, an 'Add to cart' button, and a 'Make Offer' button. The item is described as 'New other (see details)' and is located in Castrop-Rauxel, Germany. The estimated delivery date is between Monday, October 22 and Friday, October 26. The listing is covered by eBay Buyer Protection.

ebay Shop now
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CATEGORIES | ELECTRONICS | FASHION | MOTORS | TICKETS | DEALS | CLASSIFIEDS | eBay Buyer Protection Learn more

Back to home page | Listed in category: Business & Industrial > Industrial Supply & MRO > Safety & Security > Alarm Systems & Accessories > Other

Rapiscan Secure 1000 DP (Dual Pose) Backscatter Body Scanner (Never installed)

Item condition: **New other (see details)** | Add to Watch list

History: 1 offer

Price: US \$49,500.00 | **Buy It Now** | **Add to cart**

Best Offer: | **Make Offer** | Add to Watch list

Shipping: **\$2,000.00** Standard Shipping | See details
International items may be subject to customs processing and additional charges.
Item location: **Castrop-Rauxel, Germany**
Ships to: **Worldwide**

Delivery: **Estimated between Mon. Oct. 22 and Fri. Oct. 26**
This item has an extended handling time and a delivery estimate **greater than 10 business days**.
Please allow additional time if international delivery is subject to customs processing.

Payments: **PayPal** | See details

Returns: No returns or exchanges, but item is covered by **eBay Buyer Protection**.

Seller information
ivw-agne(353) 99.6% Positive feedback
Save this seller
See other items
Visit store: **IWW AGNE**
Registered as a Business Seller

AdChoice

Mouse over image to zoom

Sell one like this

ebay MONEY BACK GUARANTEE
Covers your purchase price and original shipping.
Learn more

OUR CONTRIBUTION: THE FACTS

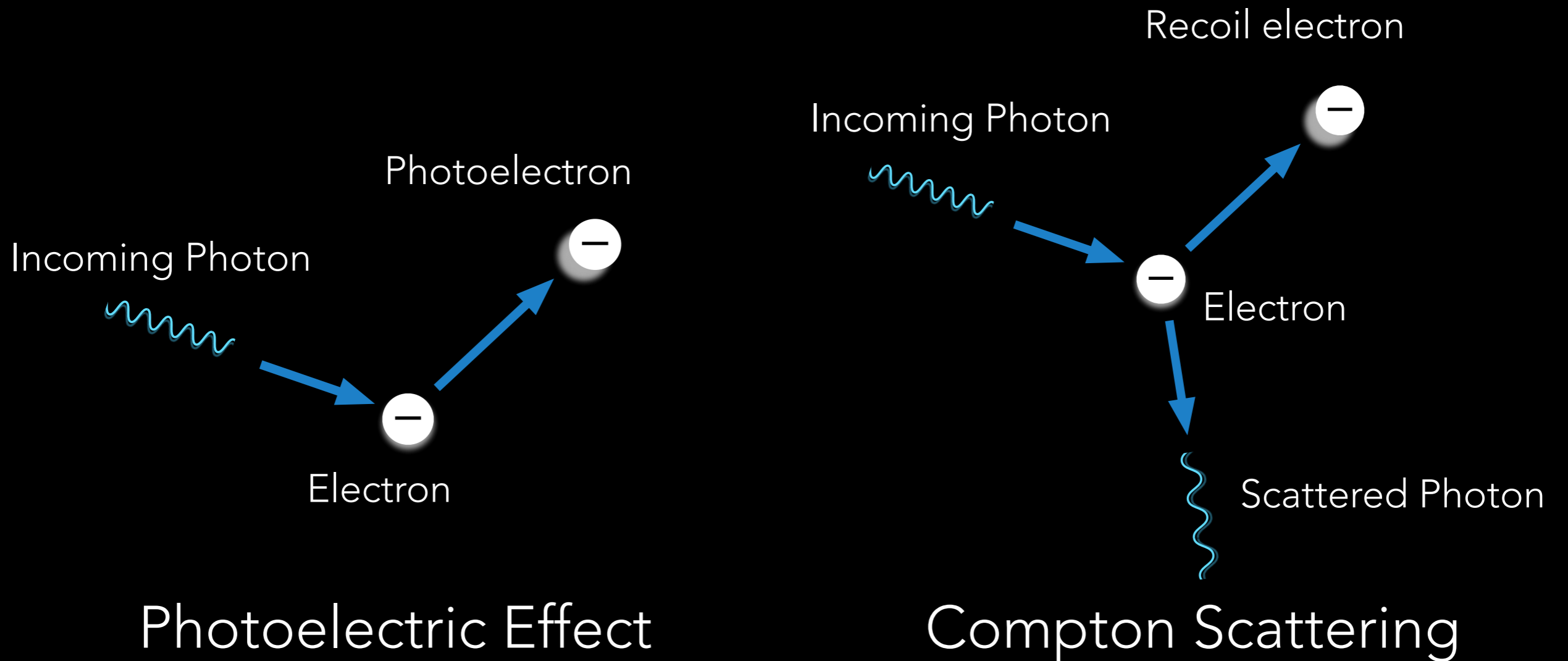
1. Is the Secure 1000 radiologically **safe**?
2. What **privacy** safeguards exist?
3. How **effective** is it at detecting contraband?

Cyberphysical systems use software!

INSIDE THE SECURE 1000

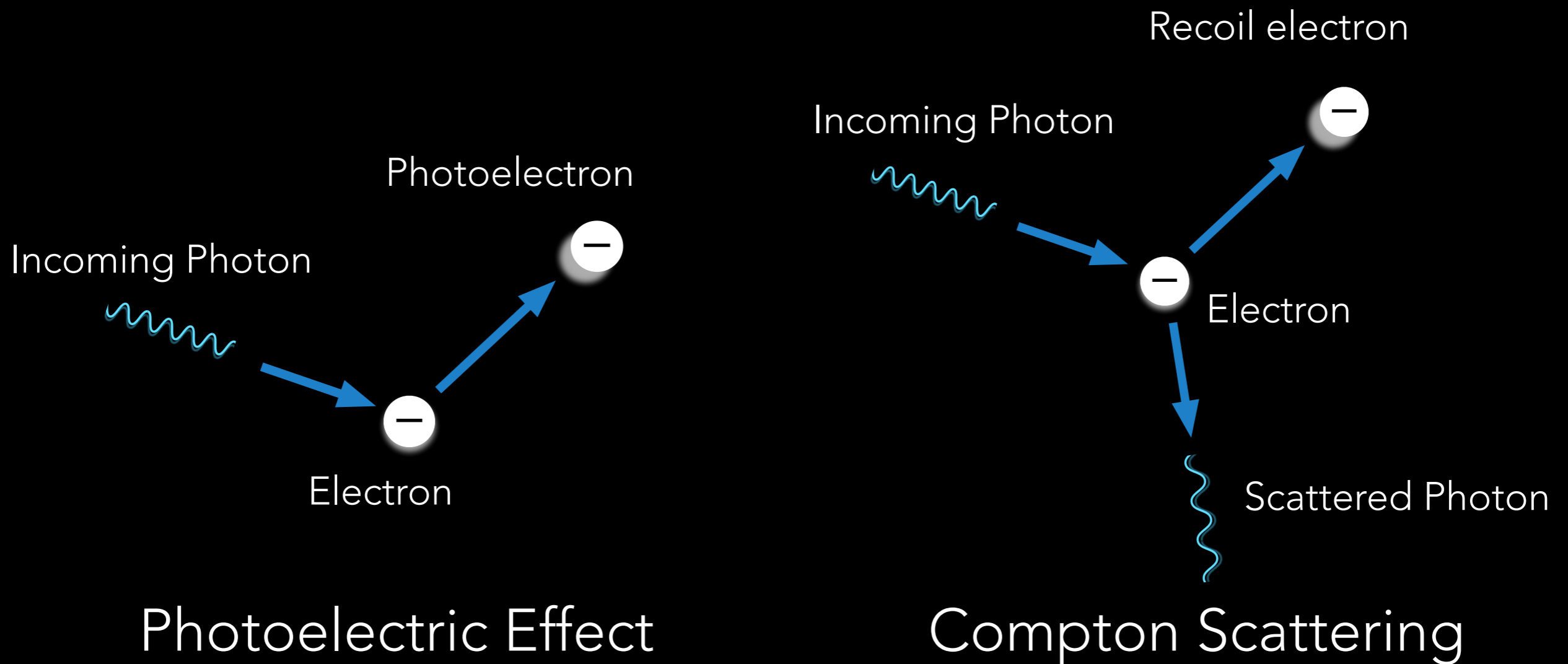


X-RAY PHYSICS 101



Low energy X-ray: 50 KeV at 5 mA

X-RAY PHYSICS 101



Dominant effect depends on material's
"effective atomic number"

SECURE 1000 X-RAY HARDWARE

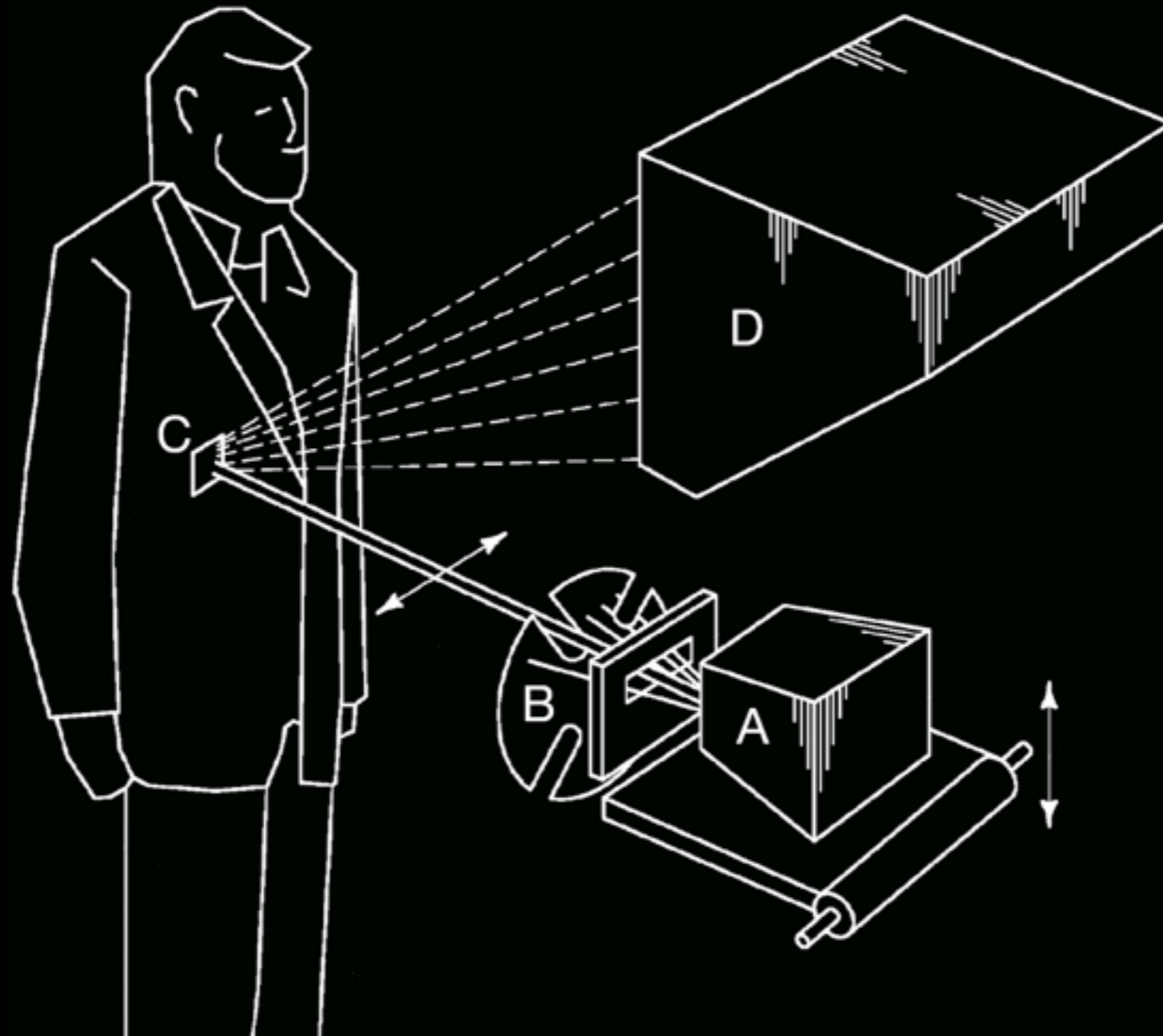


FIGURE ADAPTED FROM U.S. PATENT 8,199,996
R. HUGHES, JUNE 2012

SECURE 1000

- Chopper spins
- Head assembly moves vertically



SECURE 1000

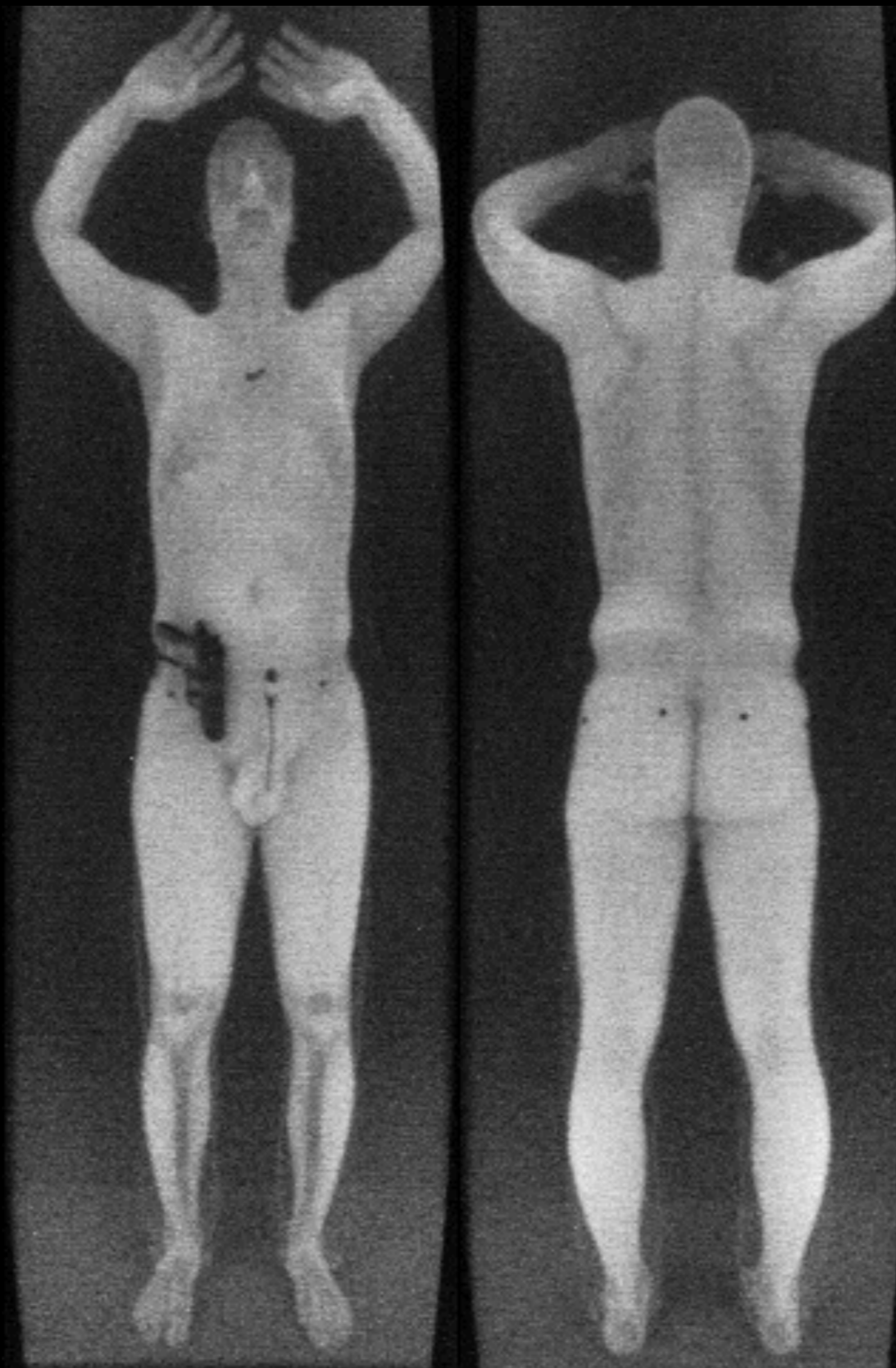
- Chopper spins
- Head assembly moves vertically



SECURE 1000 X-RAY HARDWARE



IMAGE PRODUCTION



OUR RESULTS

RADIATION SAFETY



RADIATION SAFETY

- X-ray energy: 50 KeV at 5 mA
- Dose per scan: 70-80 nSv
 - ~24 minutes of background exposure
 - Similar results by AAPM (2013)



CYBERPHYSICAL RADIATION SAFETY

- Safety controls on radiological output
 - Not security controls!
- Simple, modular design
 - Cannot over-irradiate scan subject without ROM replacement

OPERATOR SOFTWARE



SECURE 1000™ personnel screening system
Rapiscan Security Products, Hawthorne, CA

FOR USE BY QUALIFIED OPERATORS ONLY

scan
zoom
clear
redraw
→ save
recall
comments
options

Press ENTER to
save images to
the harddisk.

Press the ↑↓
keys to select
another action.

08-14-14 11:16

CONSOLE MALWARE



"Secret knock"



Visible light



X-ray

CONSOLE MALWARE

Operator's View



"Secret knock"

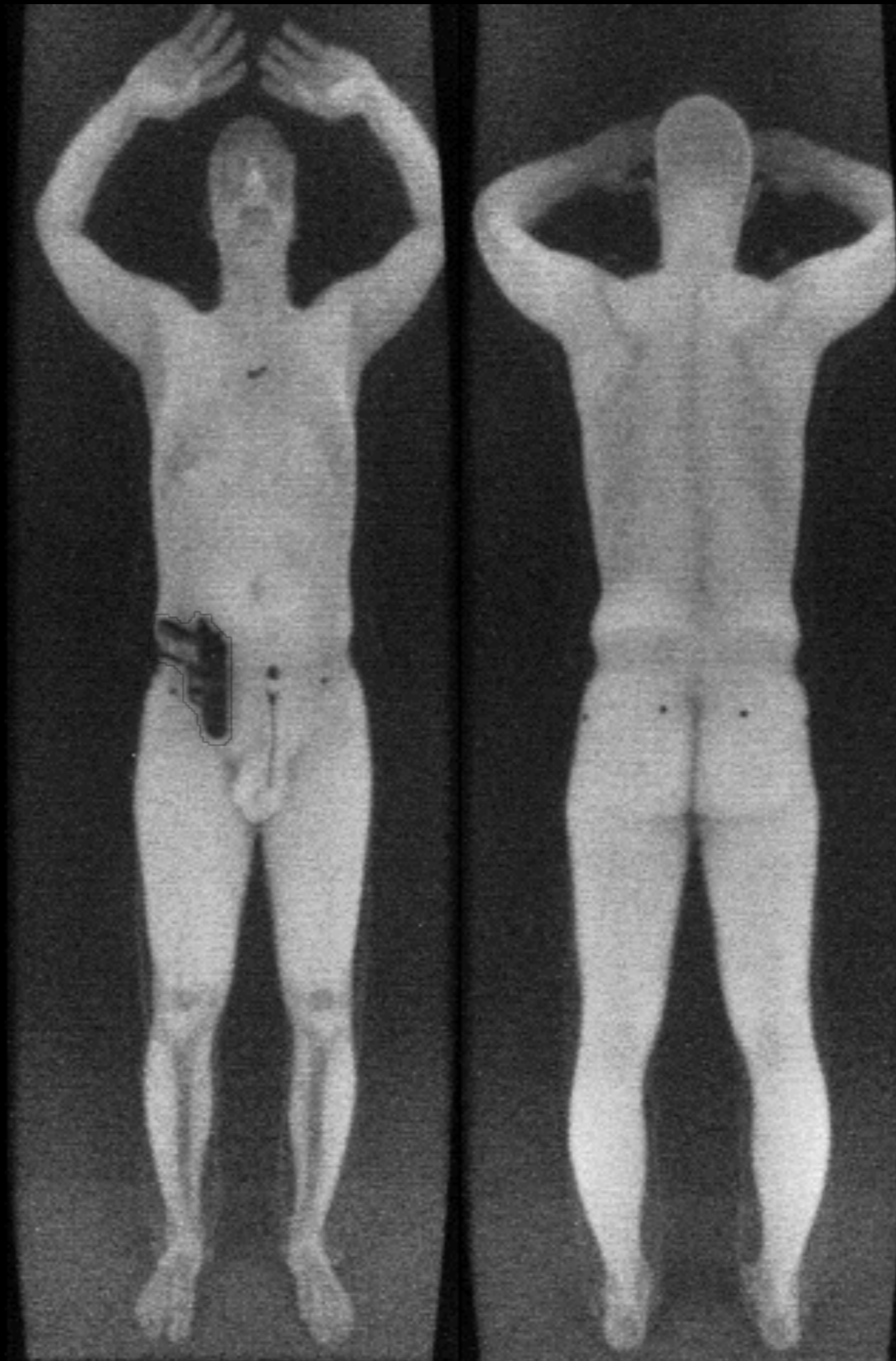


X-ray

HANDS-OFF ATTACKS



ADVERSARIAL PHYSICS



ADVERSARIAL PHYSICS



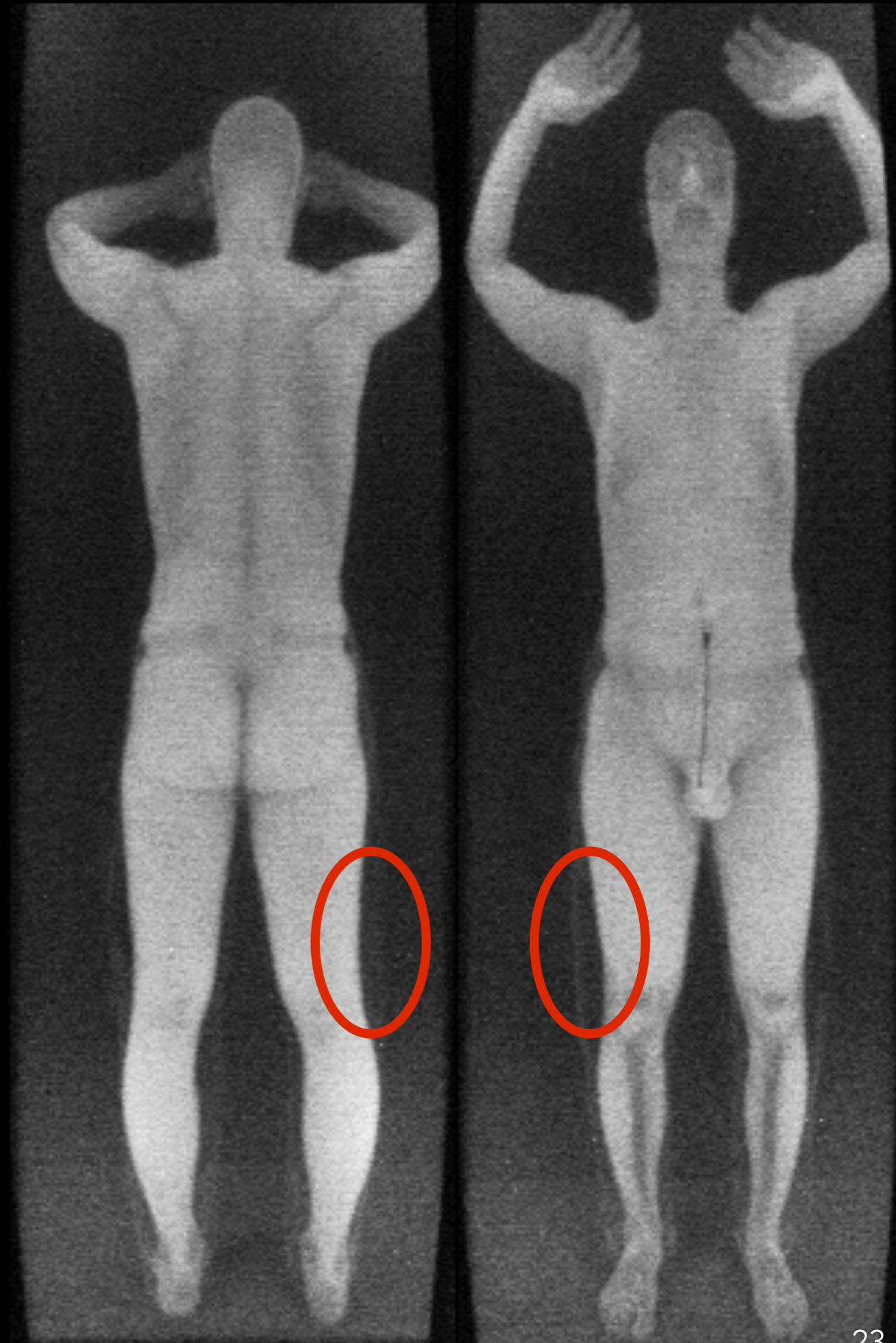
FIREARMS

- Subject is carrying a .380 ACP pistol



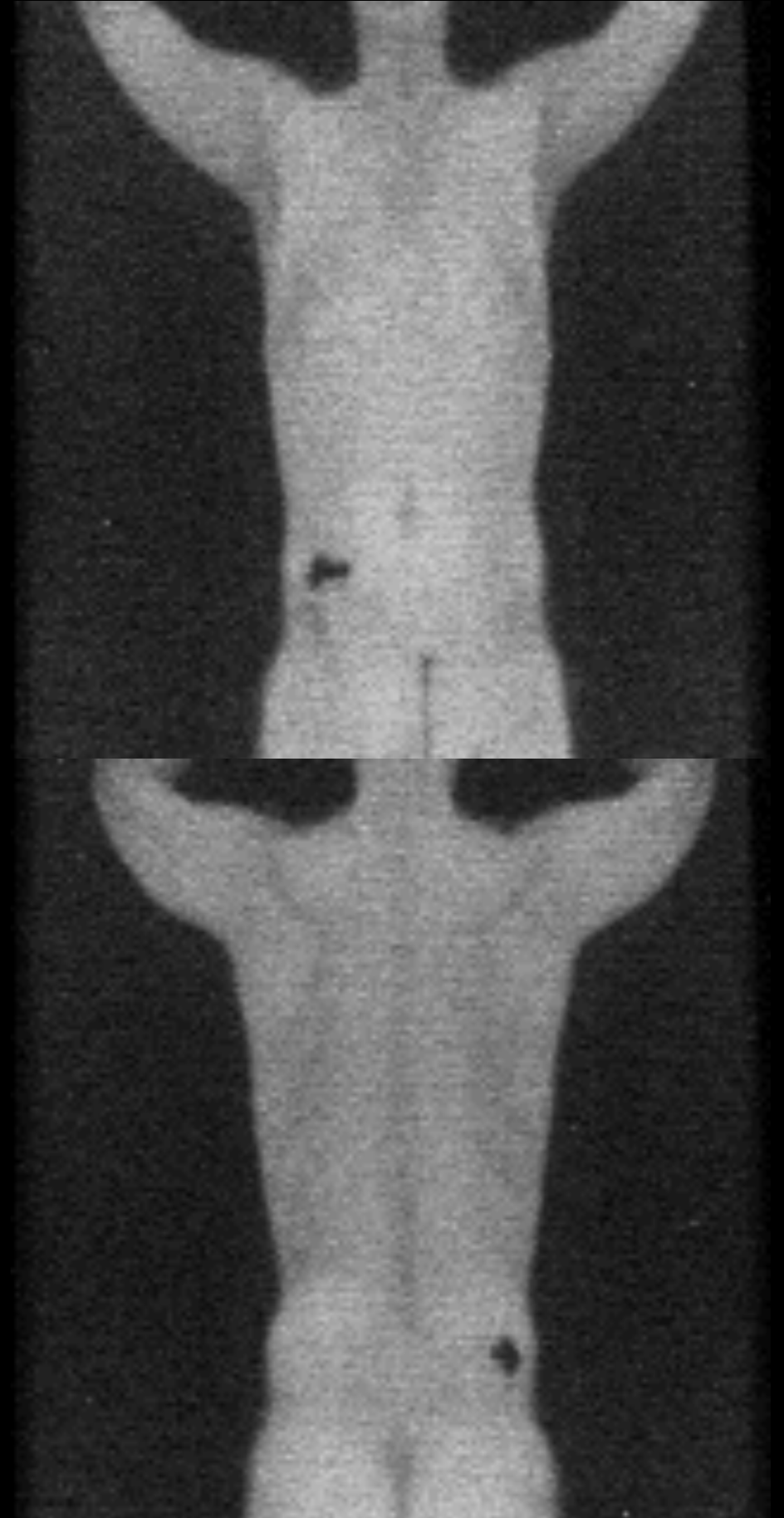
FIREARMS

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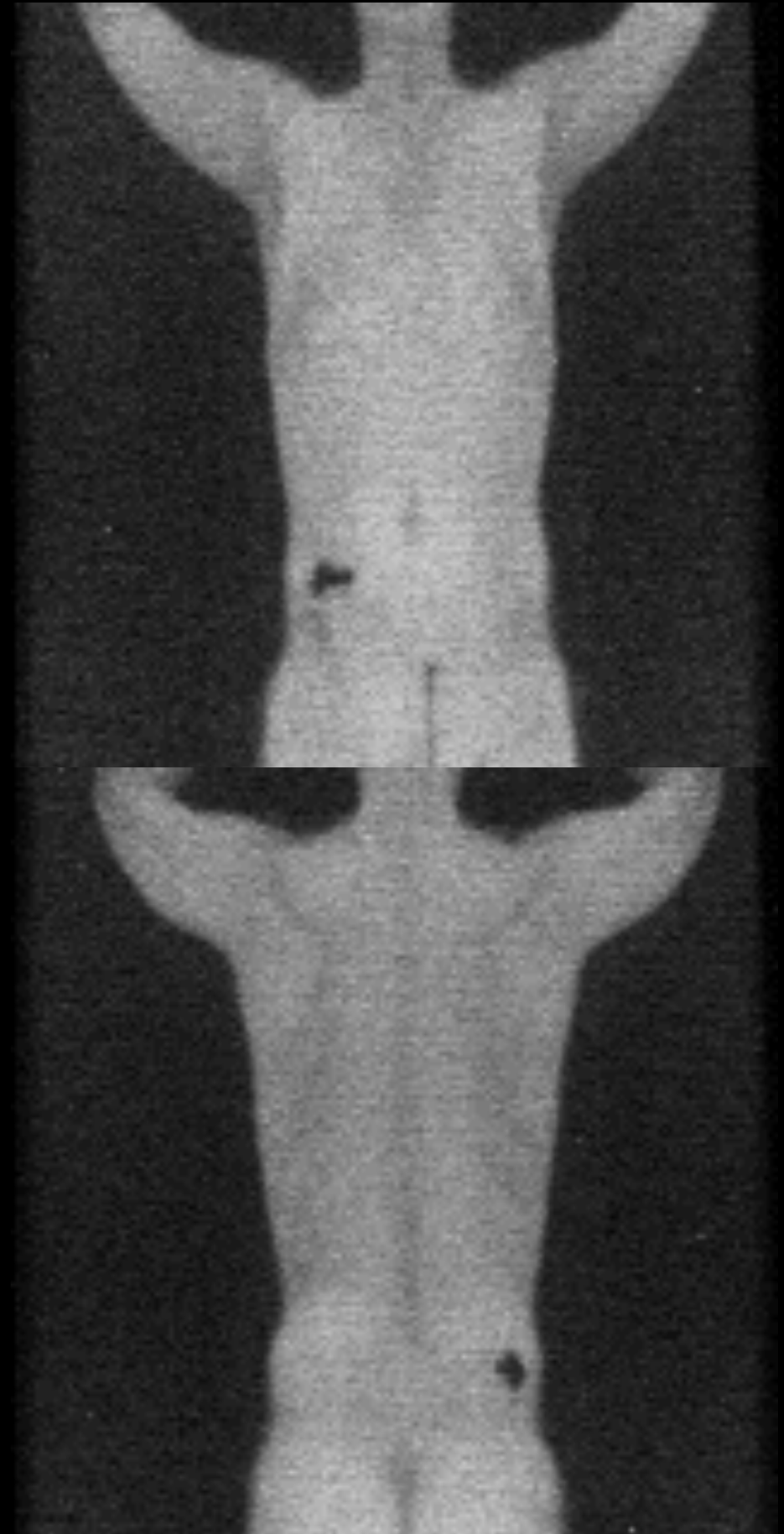


FOLDING KNIFE

- Subject is carrying a folding knife



FOLDING KNIFE



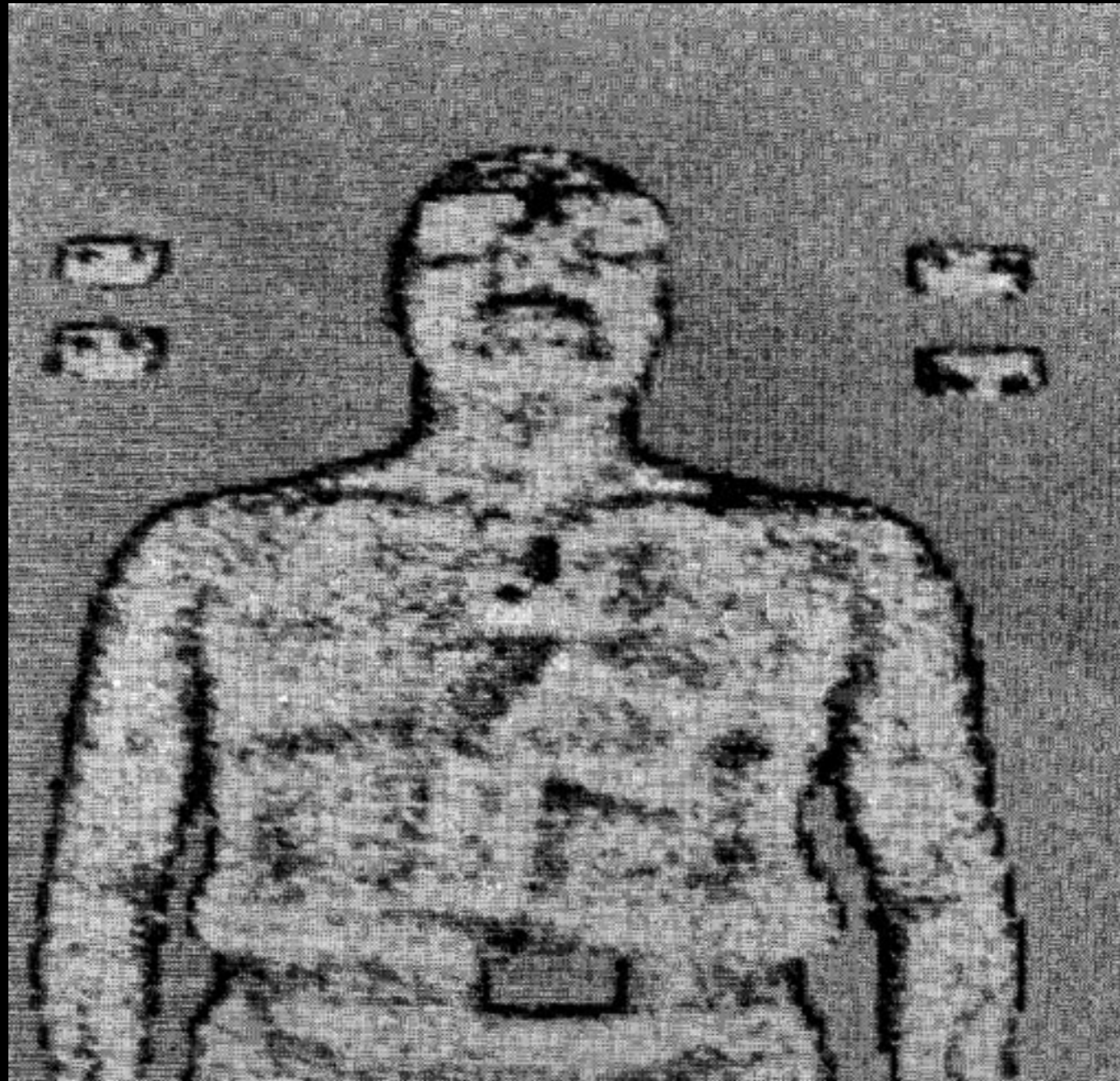
PLASTIC EXPLOSIVES



After the failed Christmas Day “underwear bombing” attempt in 2009, Napolitano launched a worldwide and “historic” effort — in 190 countries — to enhance passenger screening and counter the threat of “nonmetallic devices” on aircraft, she said.

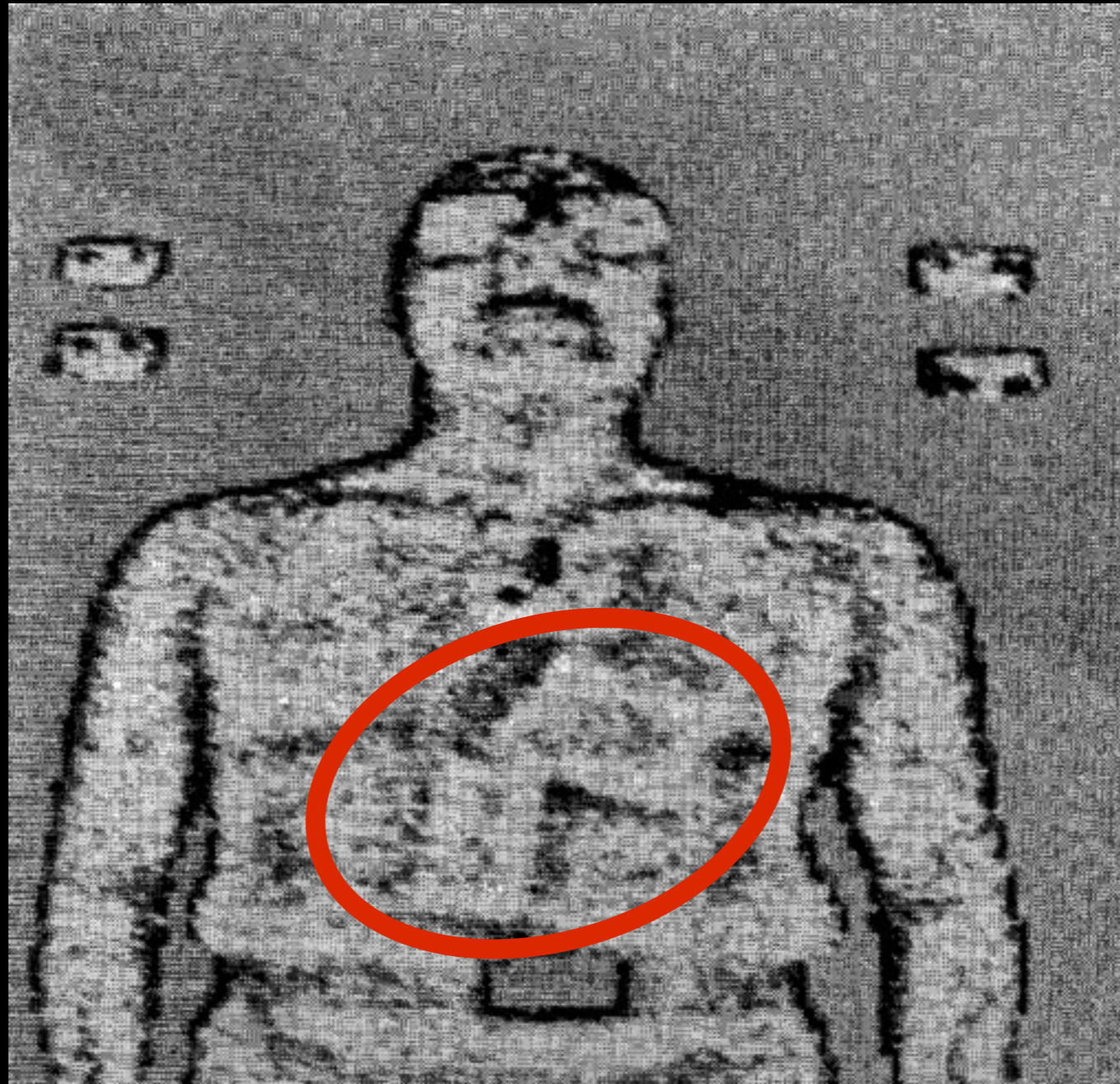
QUOTE: [HTTP://ABCNEWS.GO.COM/BLOGS/POLITICS/2013/08/OUTGOING-DHS-SECRETARY-JANET-NAPOLITANO-WARNS-OF-SERIOUS-CYBER-ATTACKUNPRECEDENTED-NATURAL-DISASTER/](http://abcnews.go.com/blogs/politics/2013/08/outgoing-dhs-secretary-janet-napolitano-warns-of-serious-cyber-attackunprecedented-natural-disaster/)

SANDIA: C4 DETECTION (1992)



REPRODUCED FROM "EVALUATION TESTS OF THE SECURE 1000 SCANNING SYSTEM"
TECHNICAL REPORT SAND 91-2488, UC-830, SANDIA NATIONAL LABORATORIES, APR. 1992.

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THINK ADVERSARIALLY!



THINK ADVERSARIALLY!



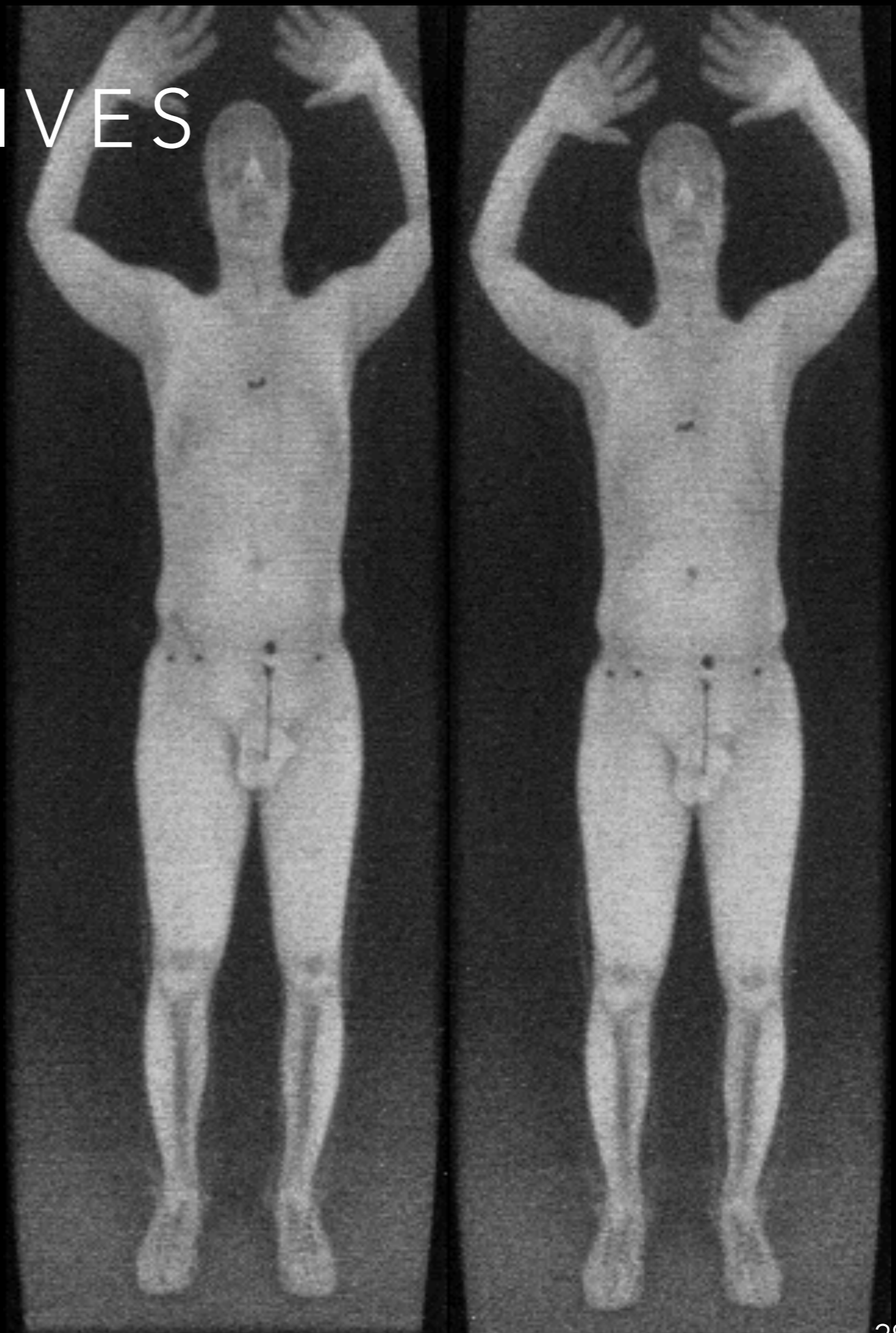
Plastic!

PLASTIC EXPLOSIVES

Subject carrying
200+ g of C-4
simulant

vs.

No contraband

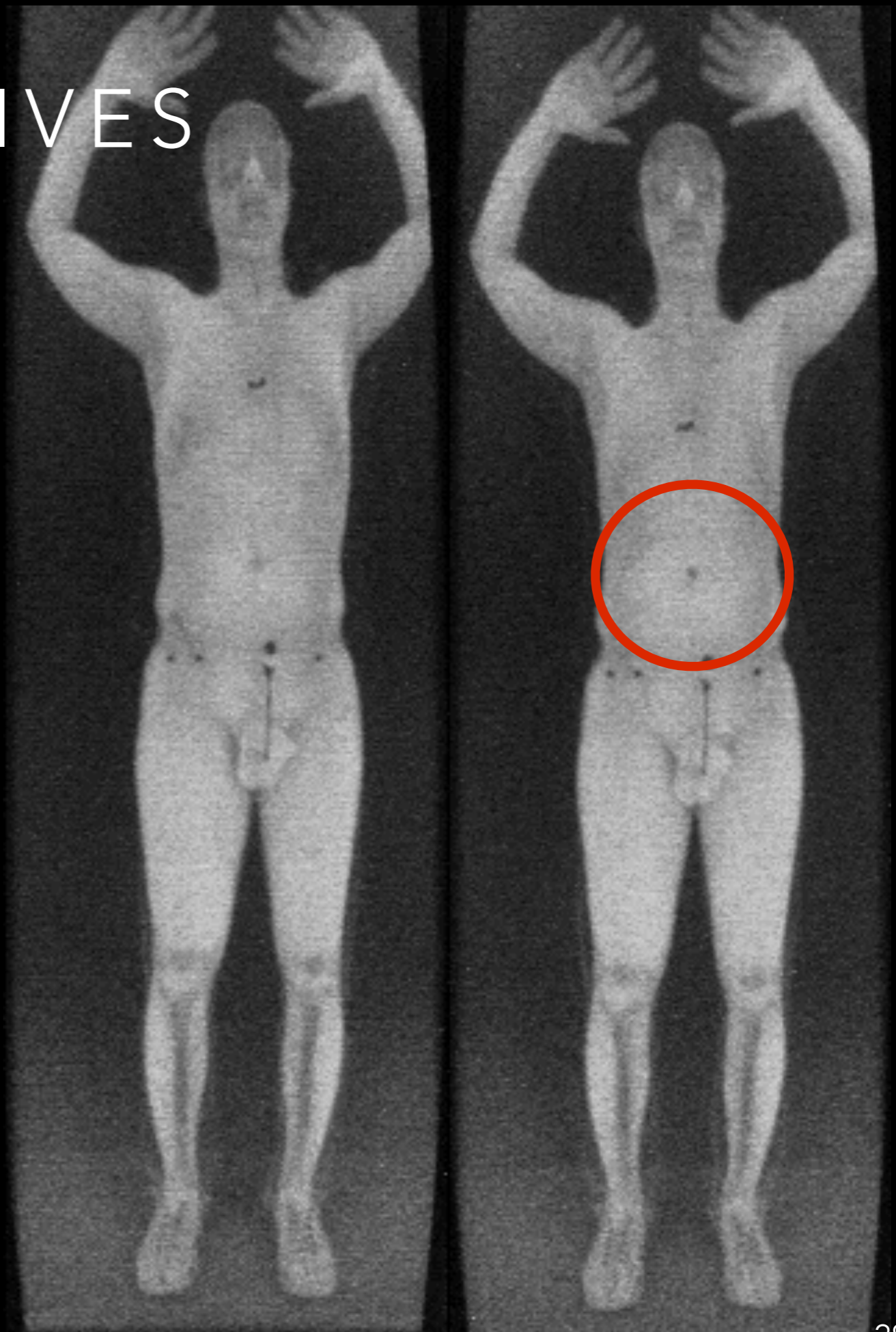


PLASTIC EXPLOSIVES

Subject carrying
200+ g of C-4
simulant

vs.

No contraband

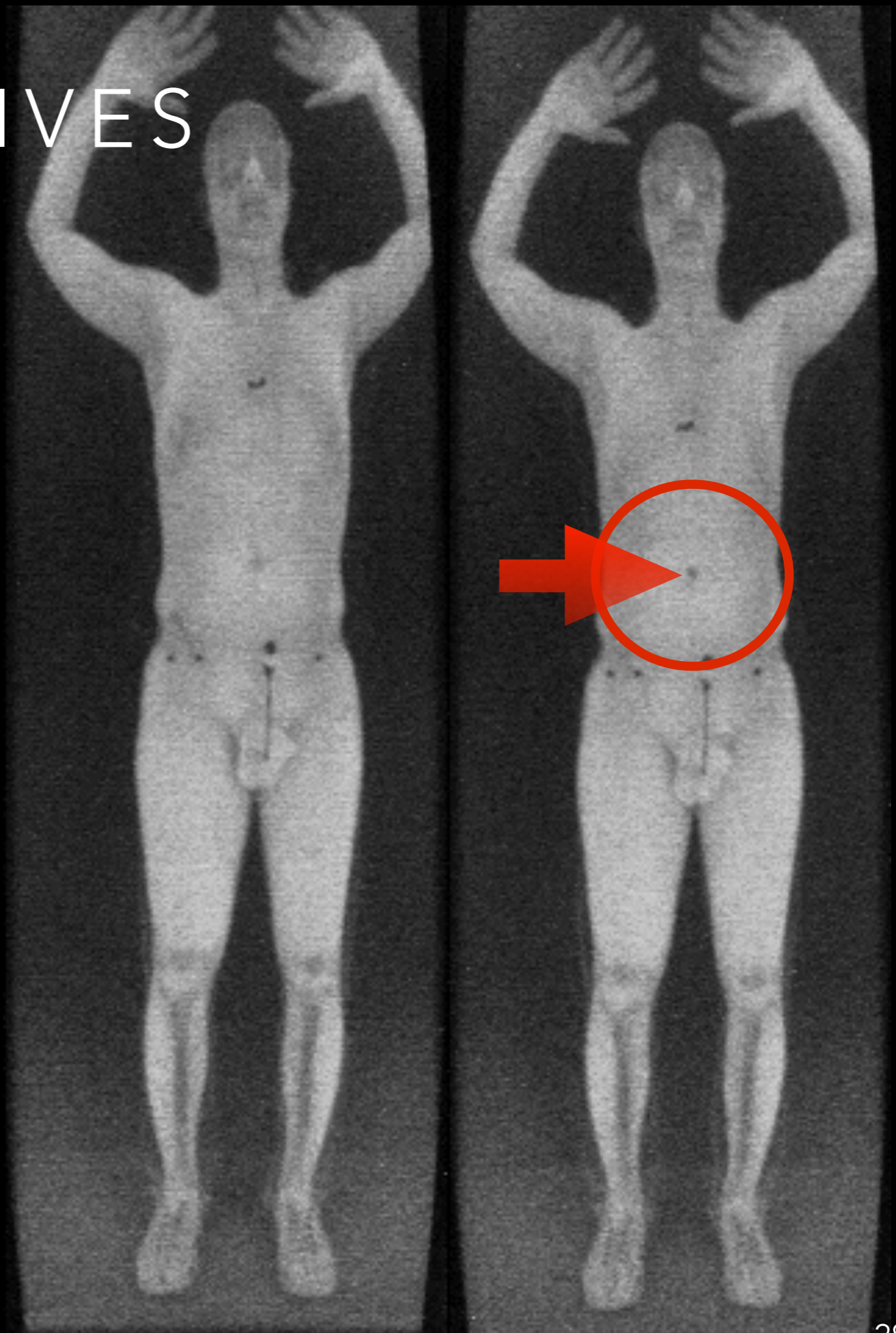


PLASTIC EXPLOSIVES

Subject carrying
200+ g of C-4
simulant

vs.

No contraband



EFFICACY RESULTS

- Our results imply adversaries can conceal:
 - Knives
 - Firearms
 - Plastic Explosive & Detonators
- Access to Secure 1000 allows attack refinement

DISCUSSION AND LESSONS

POLICY IMPLICATIONS

- Secure 1000 used at airports despite major flaws
 - Either TSA didn't know (inadequate testing) or didn't act
- Critical security infrastructure needs independent, rigorous, transparent testing
 - Including cyberphysical security testing!
 - Apply adaptive adversarial thinking

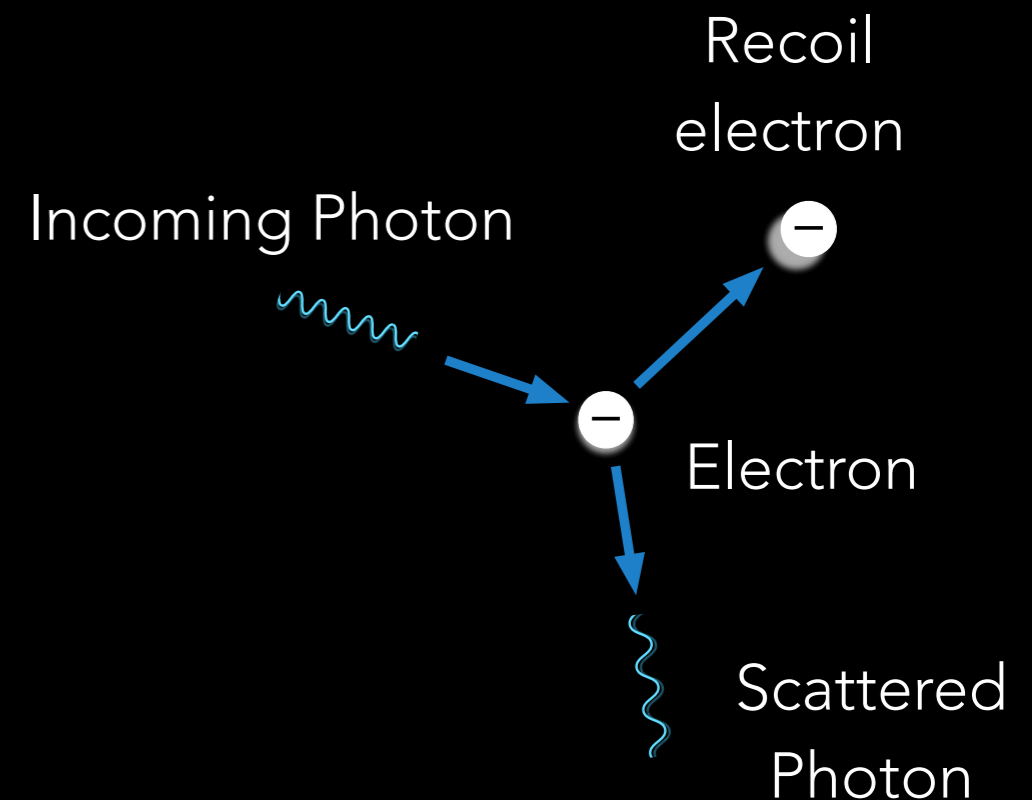
LESSONS FOR DEVELOPERS

- Simple, modular design
 - Remote malicious X-ray emittance not possible in Secure 1000

- Physics matters

- But only if software is safe!

- Compromised software -> complete security failure



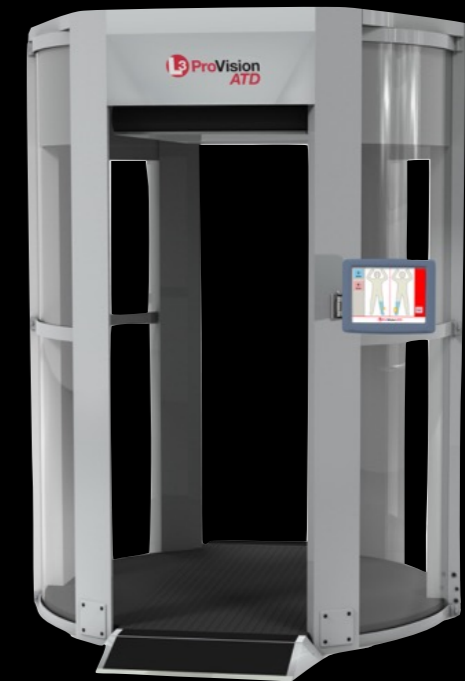
MITIGATIONS

- Disclosed results to DHS and Rapiscan in May 2014
- Procedural mitigations
 - Perform side scans
 - Pair with metal detectors



FULL BODY SCANNERS: TODAY & TOMORROW

- FBS deployed at nearly 160 U.S. airports
 - L-3 ProVision (millimeter wave)
 - Automated Threat Recognition
- TSA testing new X-ray backscatter FBS



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Questions?

More information at
<https://radsec.org>



CONTRABAND SHIELDING



EXTERNAL PMT RECONSTRUCTION

