Large Area CCD Detector Systems

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What is a “Large Area” Detector ?

Area
Bigger than 200 mm by 200 mm

Divided into
More than 3000 by 3000 pixels

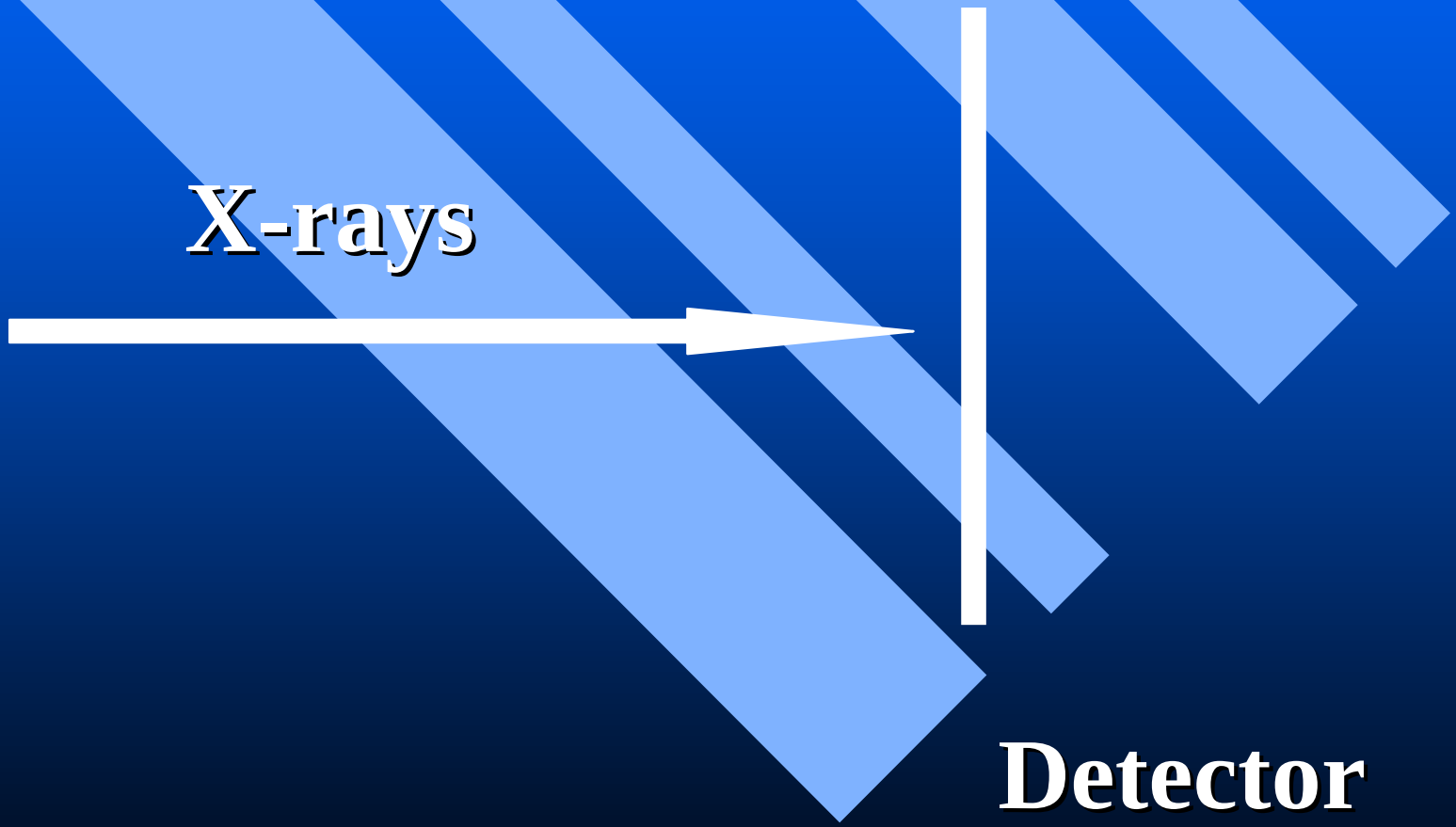
Basic Detector Types

Film and "Film-like" Detectors

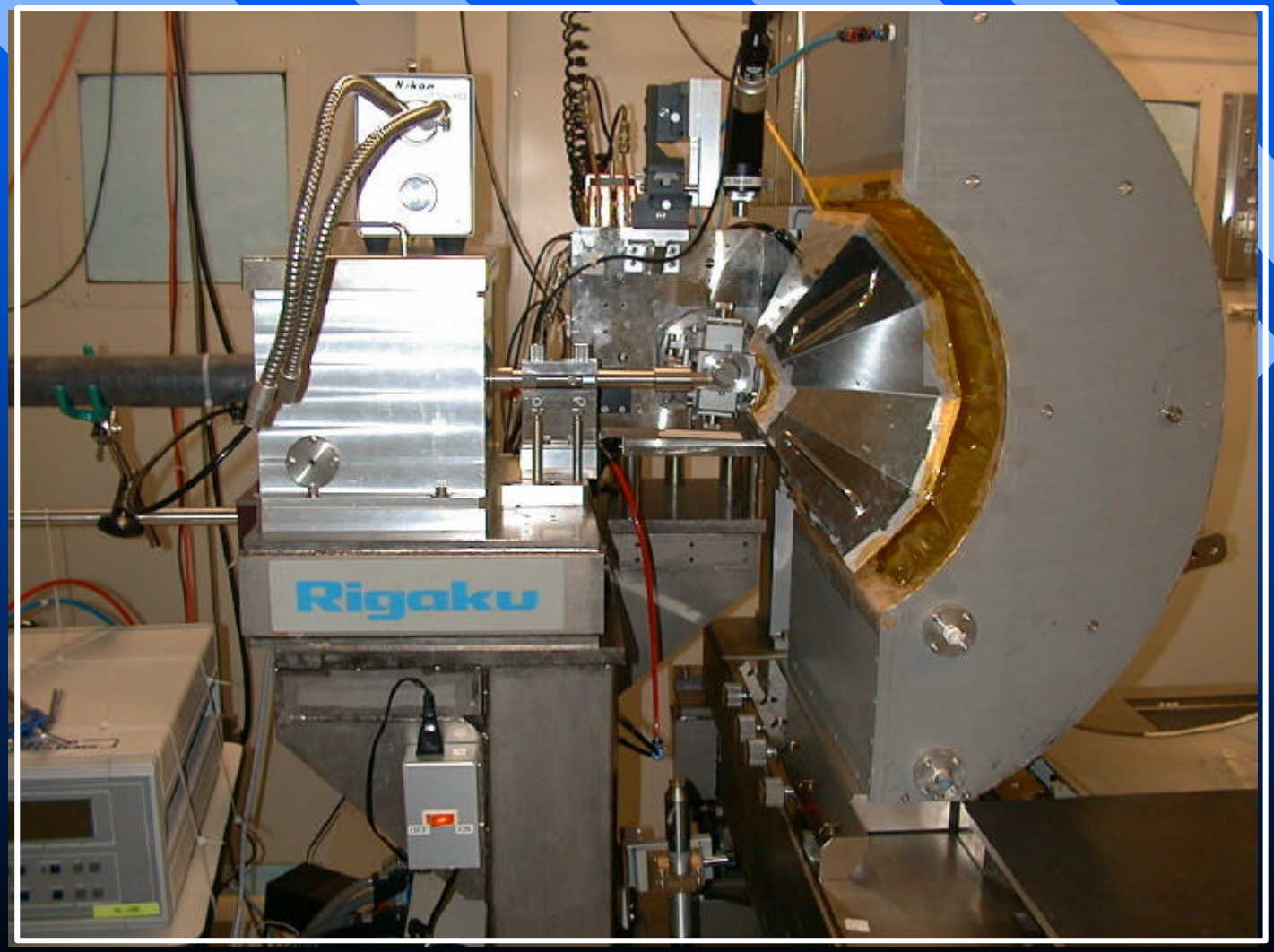
Lens-based CCD Detectors

Fiberoptic-based CCD Detectors

Film and “Film-like” Detectors

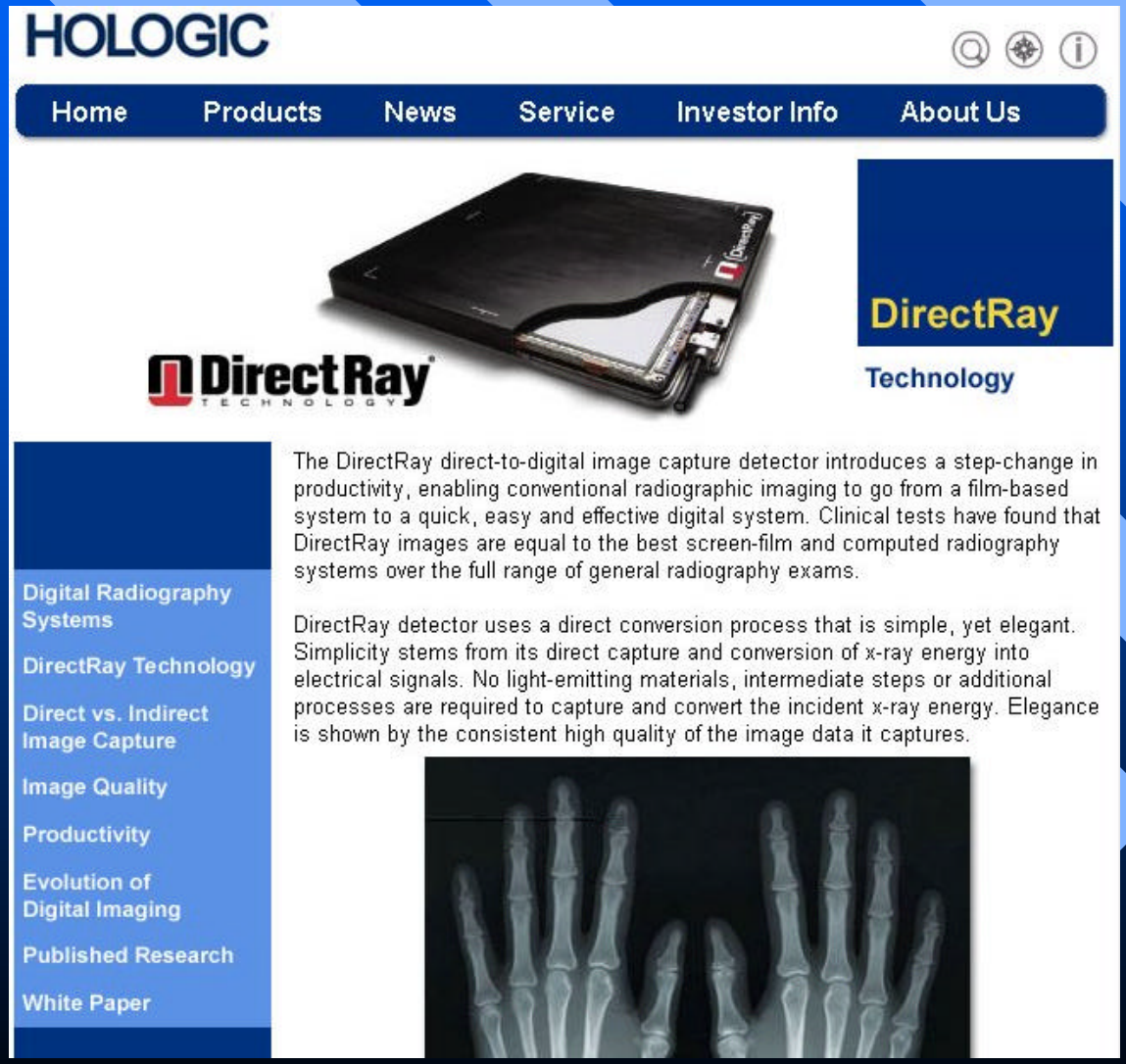


Weissenberg Image Plate Detector at Photon Factory



Generic Flat Panel Detector for Medical Xrays

www.hologic.com



35cm by 43cm

2560 by 3072 pixels

“Sharpness of [ASA] 100 speed film When exposed at 400 speed”

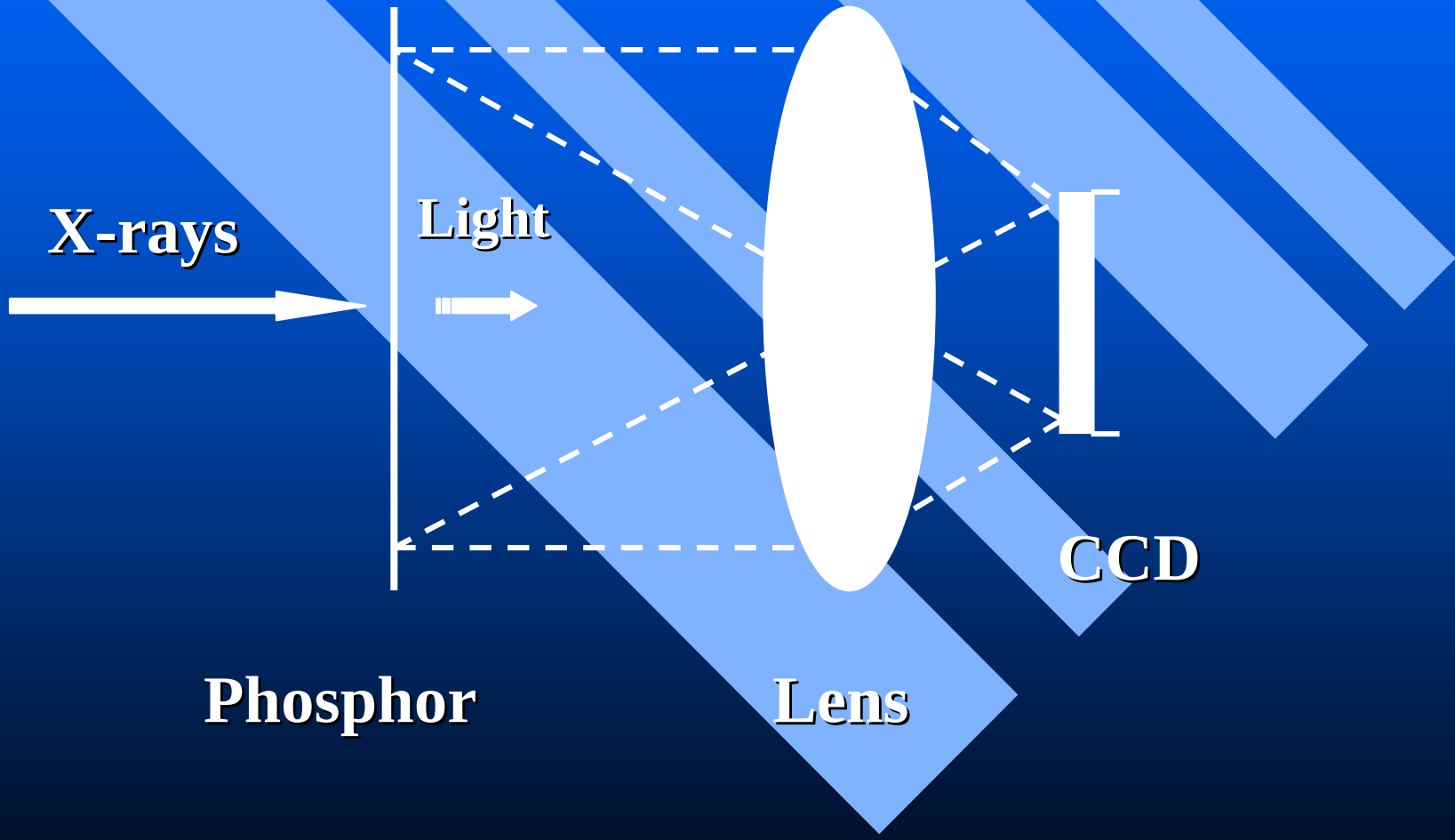
Special Requirements for Protein Crystallography at Synchrotrons

- 1 second readout time
- Sensitivity at least 10X film
- Resolution of at least 400 Diffraction orders
- Full capability to do MAD data collection

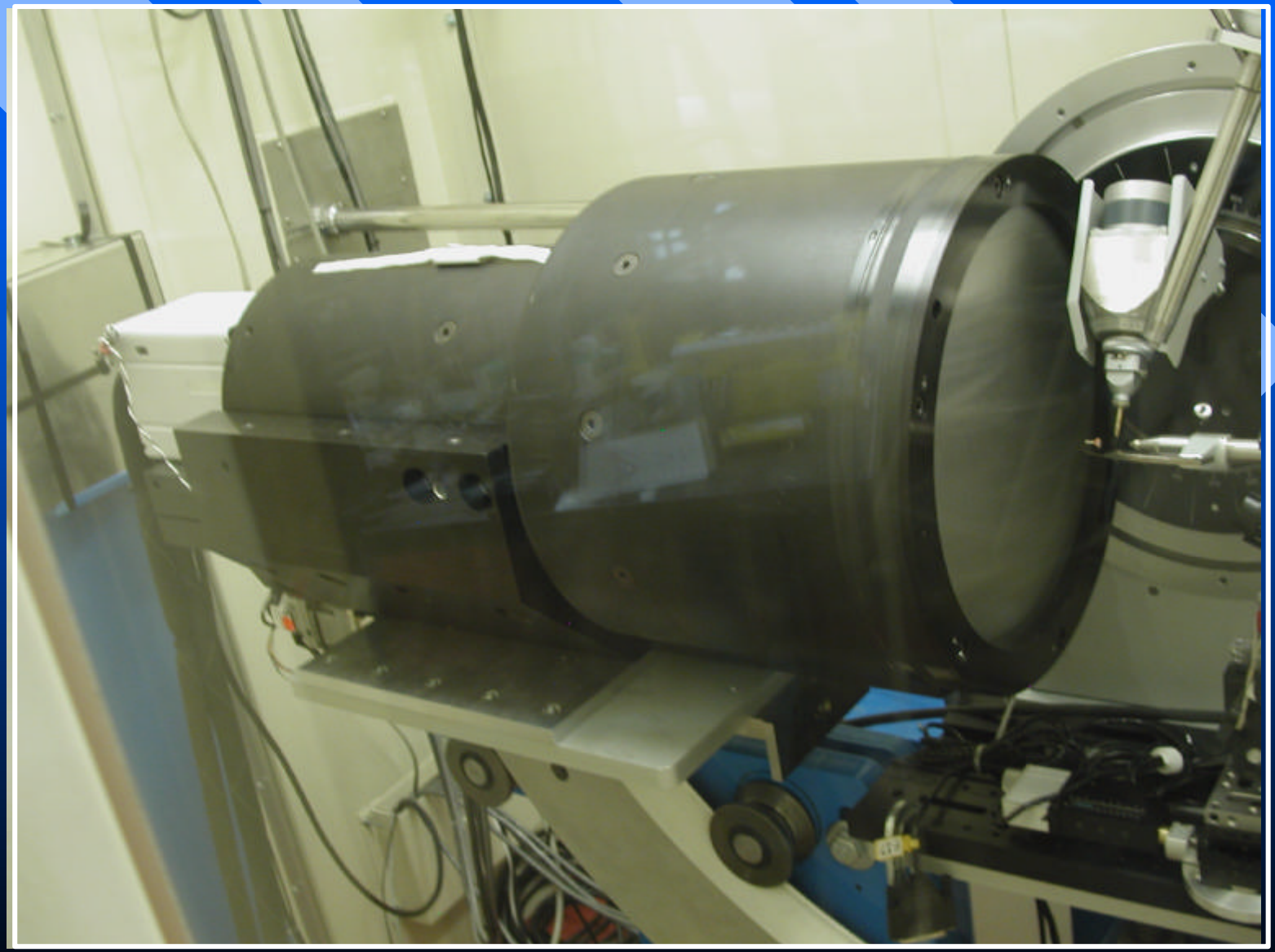
Film and “Film-like” detectors

	1 sec readout	10X film	400 orders	for OK MAD
Film	NO	-----	YES	?
I.P.	NO	YES	YES	YES
Panel	(?)	(?)	(YES)	NO
P.A.D.	(YES)	(YES)	(YES)	(YES)

Lens-based CCD Detectors



Brucker Proteum

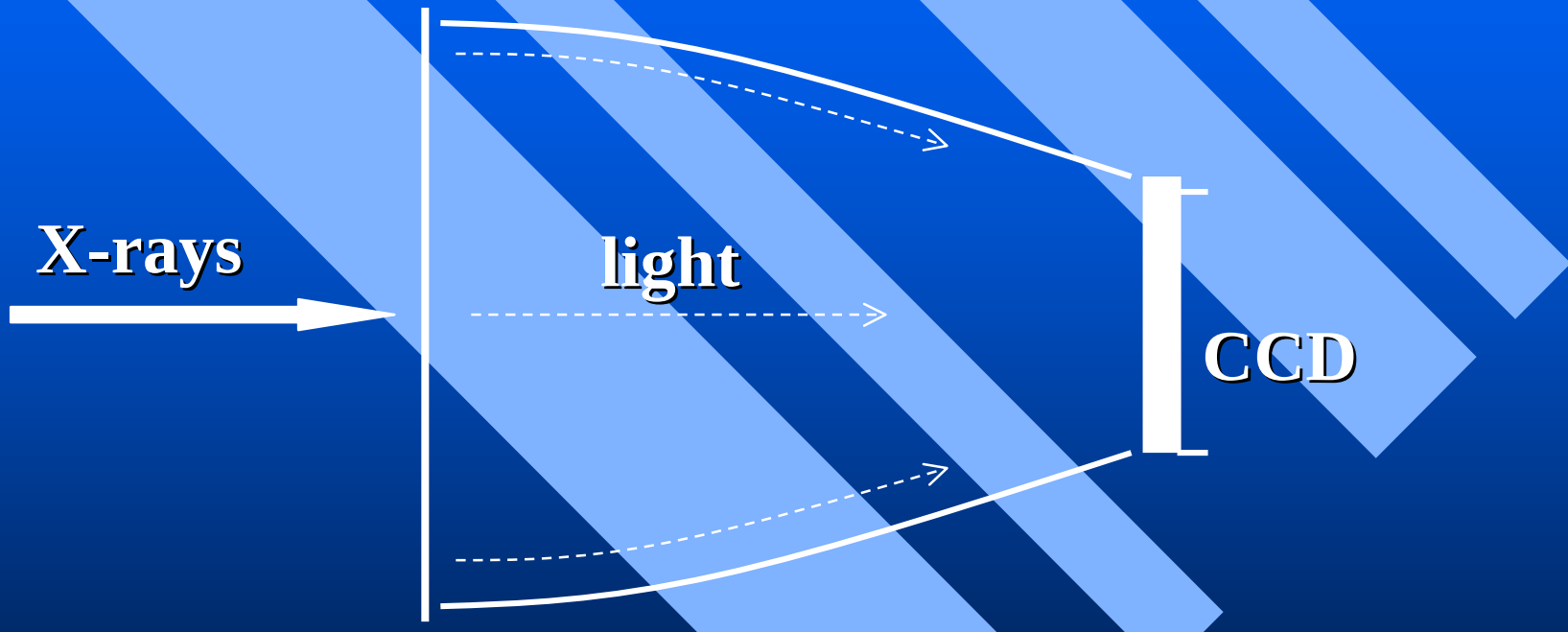


Large Lens-based CCD detector

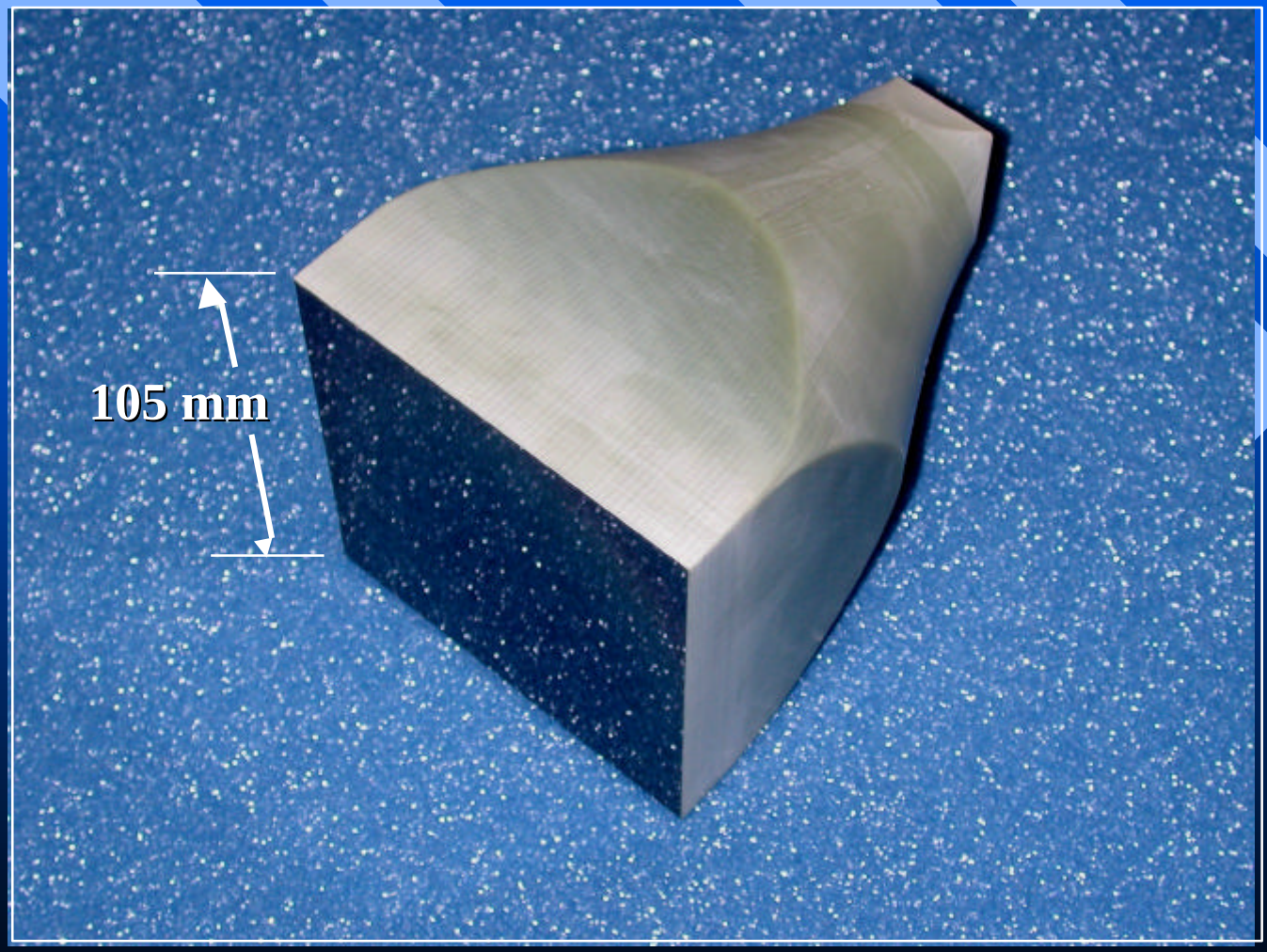
	1 sec readout	10X film	400 orders	OK for MAD
Proteum	NO	Yes	NO	?

Fiberoptic Tapers

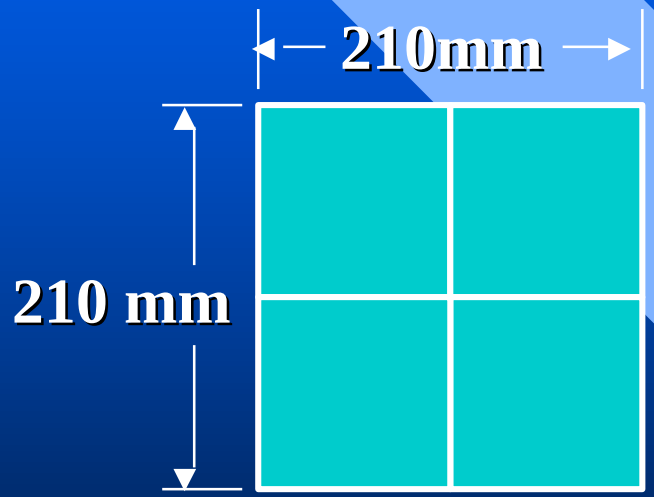
Fiberoptic-based CCD Detectors



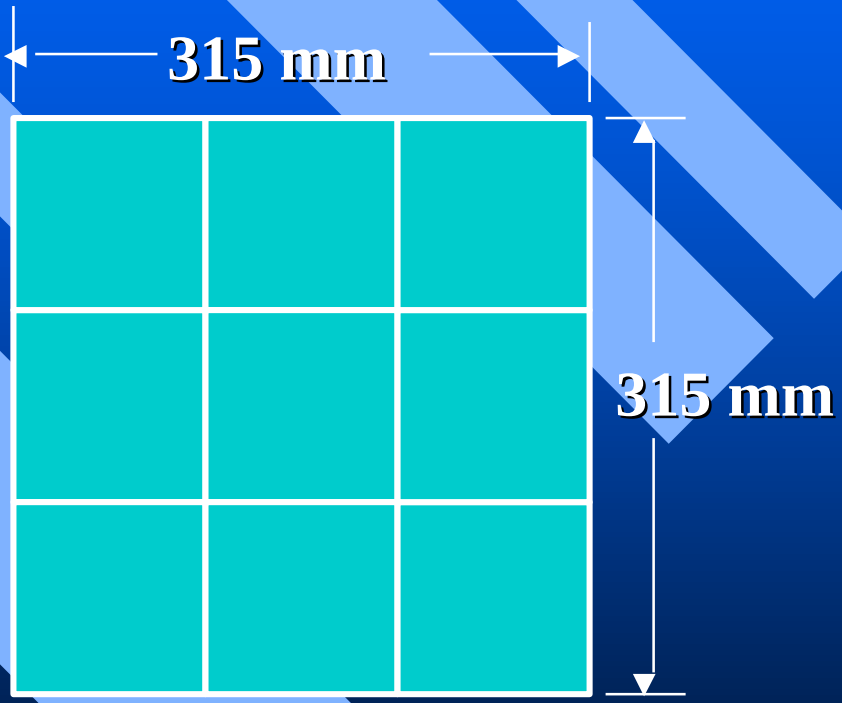
Single Fiberoptic taper cut square for use in an array



Arrays of fiberoptic tapers required to achieve large area

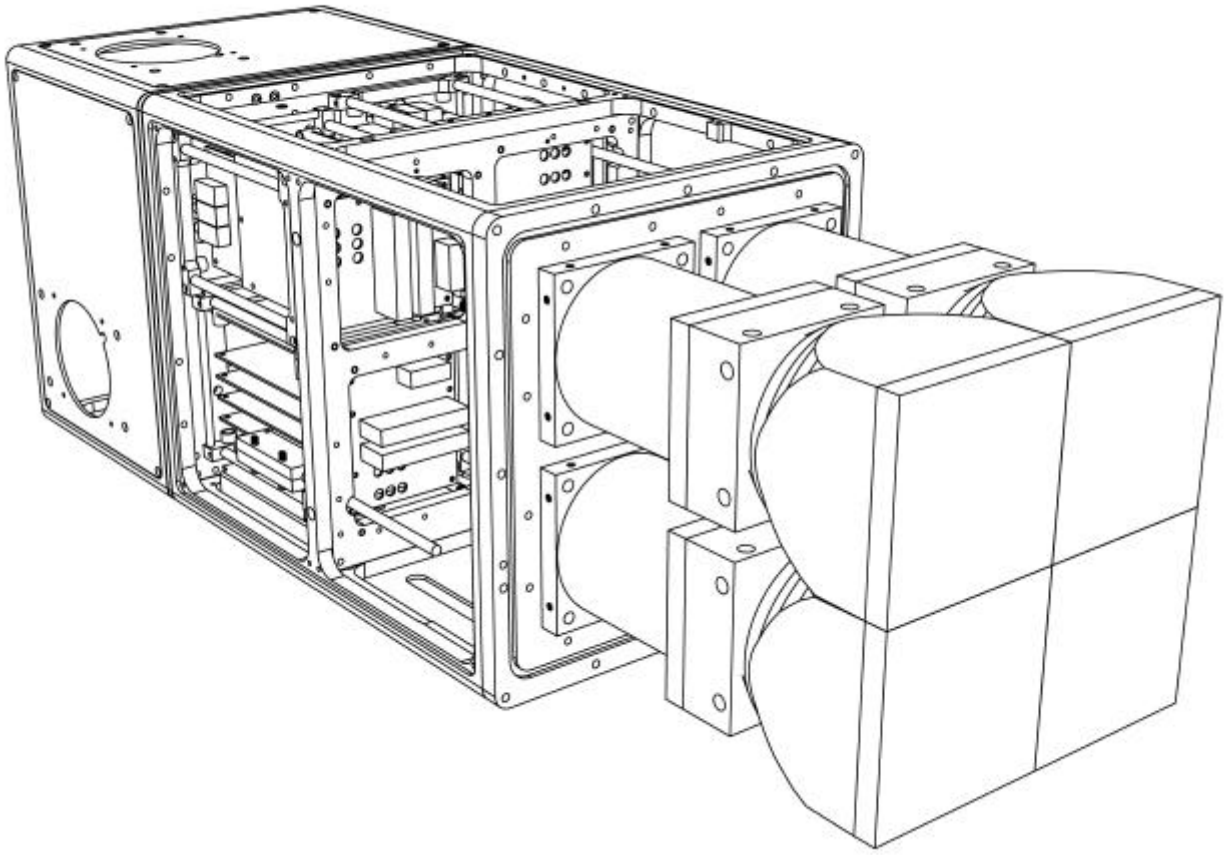


Quantum 210
4K by 4K



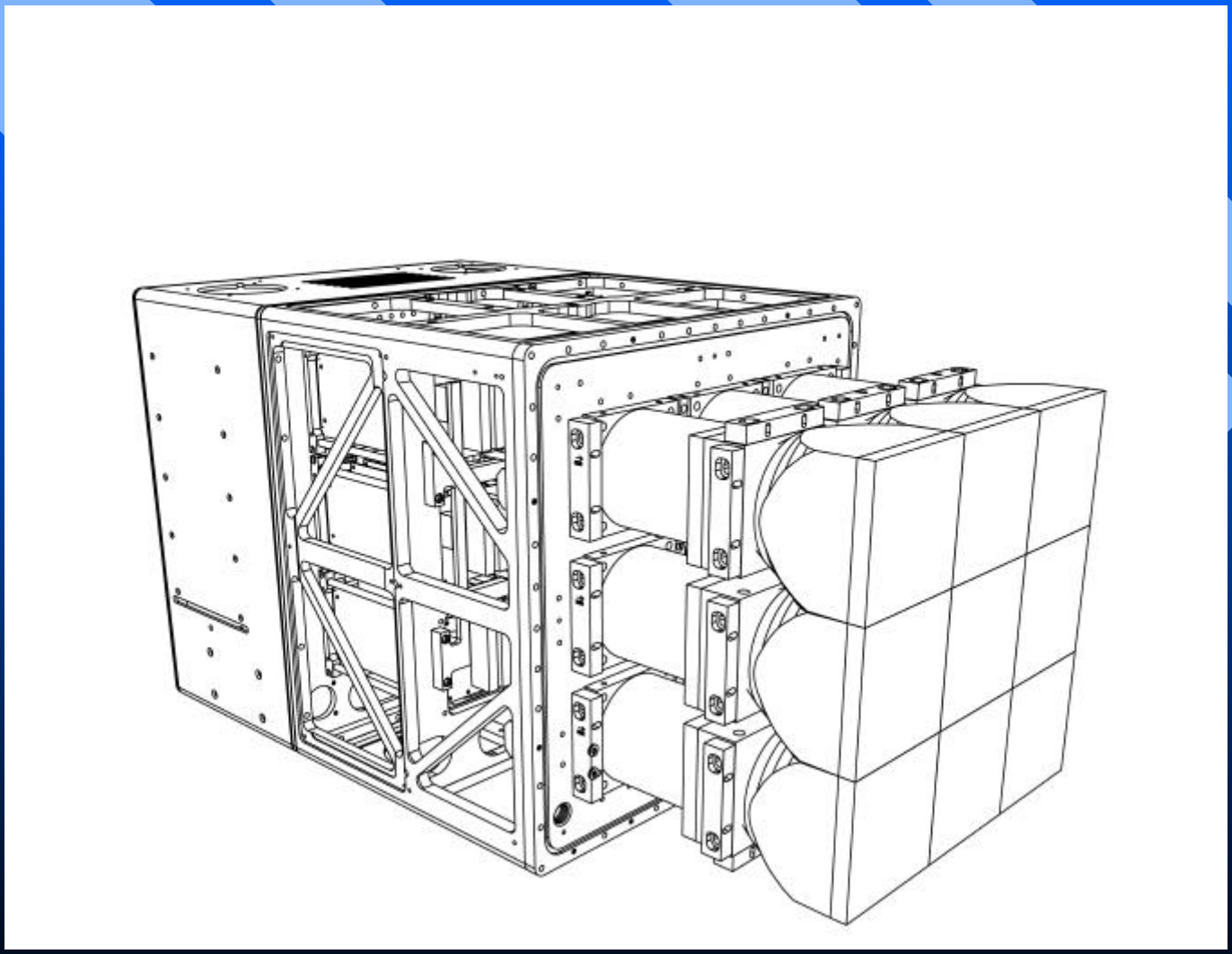
Quantum 315
6K by 6K

Quantum 210

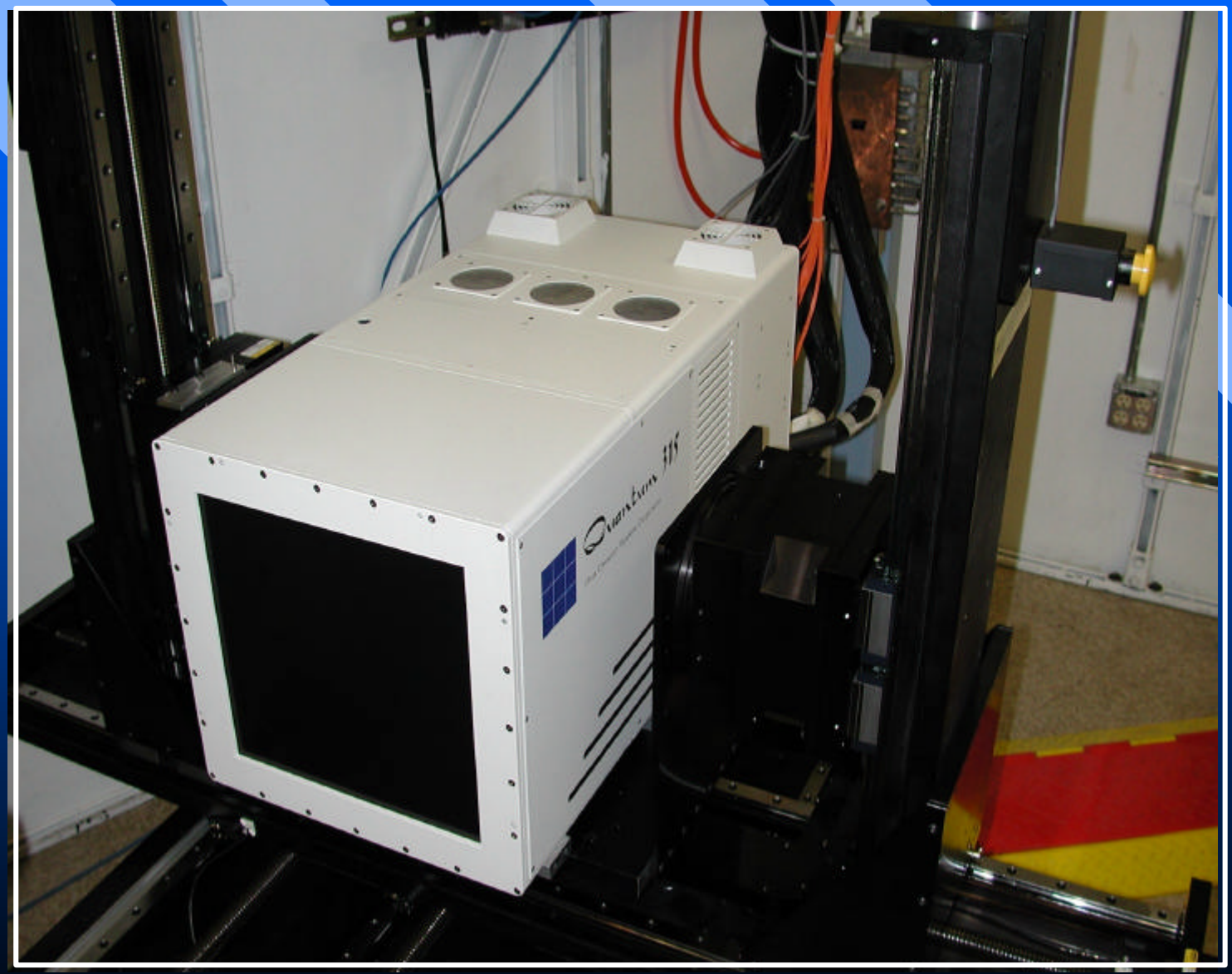


Quantum 210

CAD drawing of Quantum 315



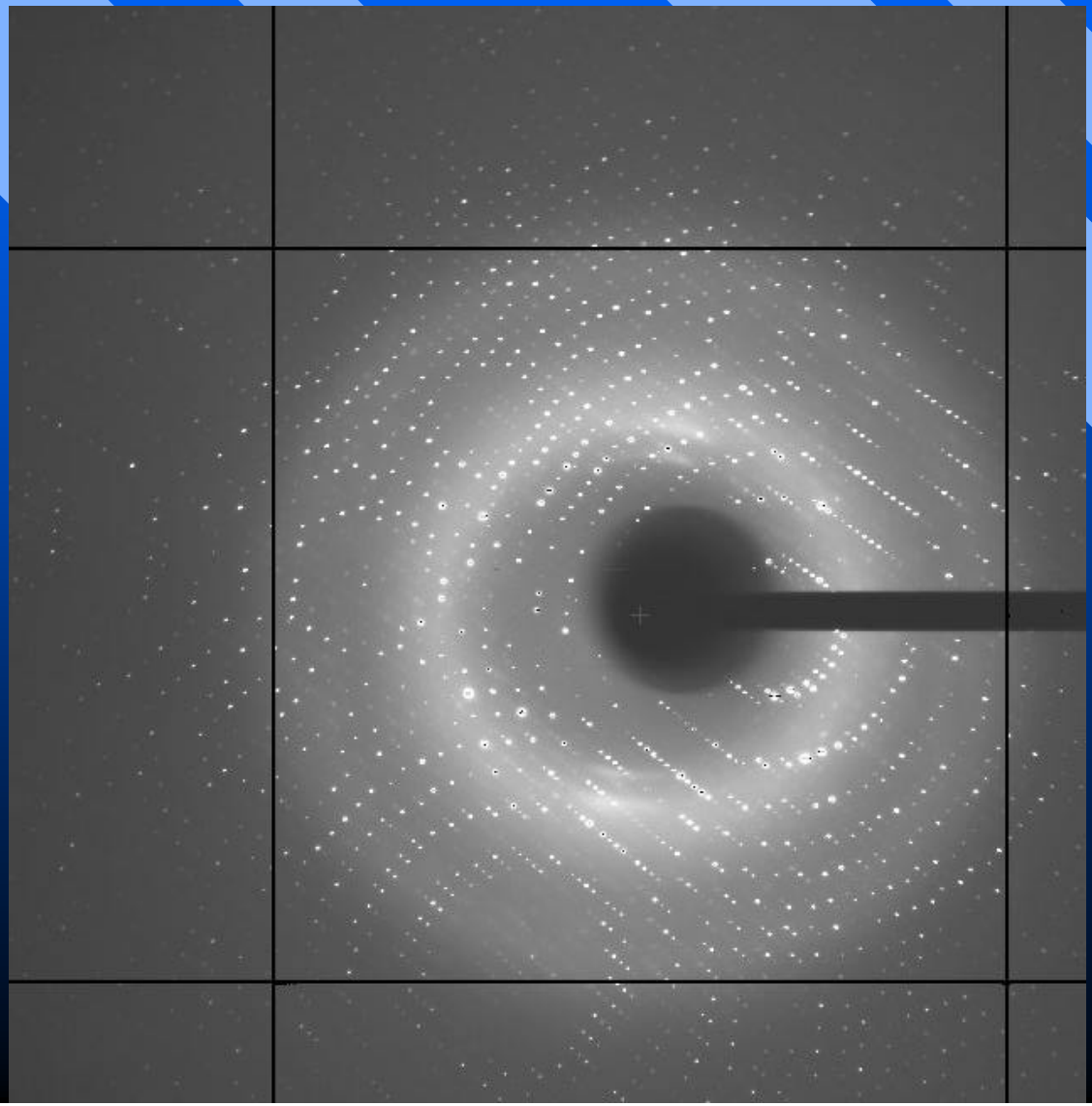
Quantum 315 at SSRL



Specifications

	Quantum 210	Quantum 315
Array Size	2 by 2	3 by 3
dimensions	210 by 210 mm	315 by 315 mm
pixels	4K by 4K	6K by 6K
Full Resolution Readout time	1 second	1 second
Raw image size	36 MB	80 MB
D.R. full res.	16,000 : 1	16,000 : 1
D.R. 2x2 sw bin	30,000 : 1	30,000 : 1

Part of an image from a Quantum 315



Are large fiberoptic-based CCD detectors suitable for SR protein crystallography ?

	1 sec readout	10X film	400 orders	OK for MAD
Quantum 210	YES	YES	YES	YES
Quantum 315	YES	YES	600	YES

Current Installations as of 15 Feb. 03

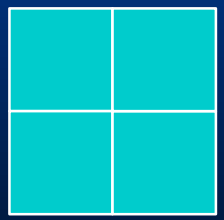
	Quantum 210	Quantum 315
ALS Berkeley	3	2
APS Chicago	1	1
Brookhaven	1	2
CHESS	2	
ESRF	1	
PhotonFactory	1	
SSRL		3
Totals	**9**	**8**

de novo Protein Structures solved using Q210 and Q315 data from 2 of the 17 installed detectors

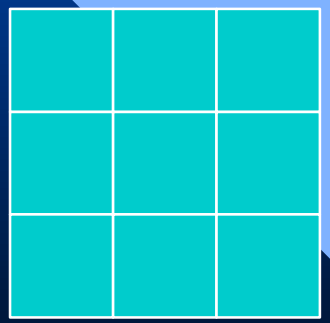
	MAD	Other	Contact
APS 1 Q315	10	14	Malcolm Capel (630) 252-0638 Capel@slate.imm.aps.anl.gov
ALS 1 Q210	30	100	James Holton (510) 468-4587 (510) 928 5556

Possible further improvements in CCD detector systems

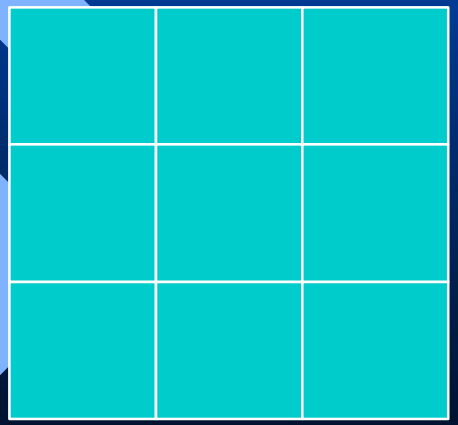
- Even bigger area
- Even faster readout
- Even better sensitivity



Quantum 210

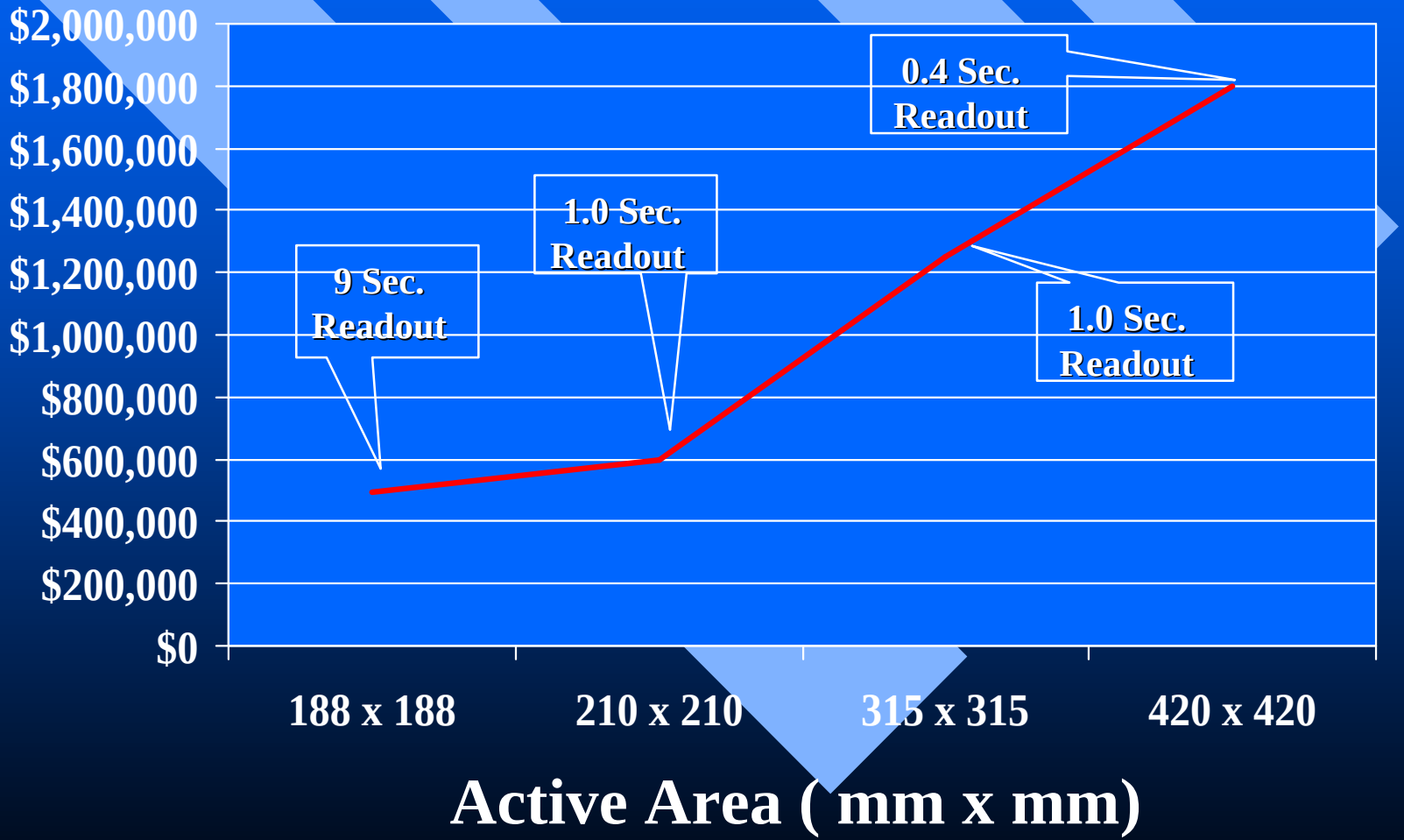


Quantum 315



Quantum 420

Cost of Detector Size and Speed



Summary

Given today that we can build CCD-based detector systems with active area of $(315\ mm)^2$ by and 1.0 sec readout time, would there be a technical need to increase the area and speed up to $(420\ mm)^2$ and 0.4 sec? Even if this requires a price increase of 50% ?