

ELECTRON IMPACT EMISSION SPECTROSCOPY FOR THIN FILM DEPOSITION CONTROL

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and

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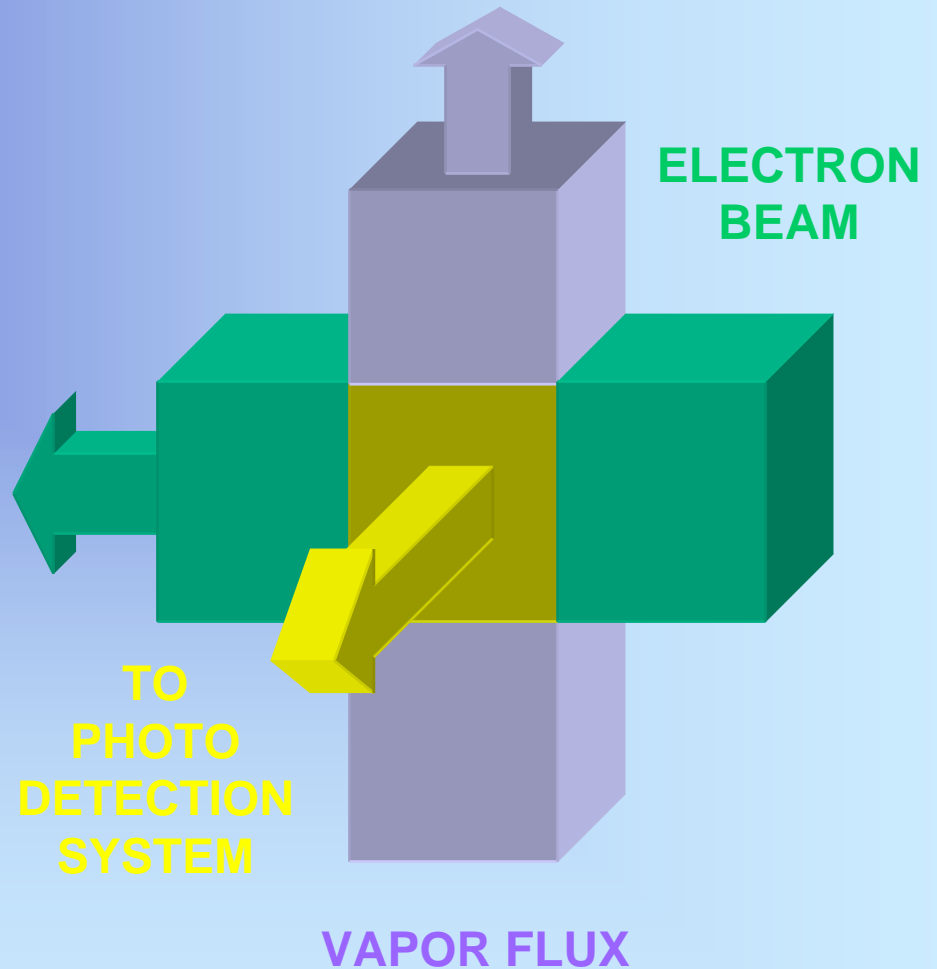
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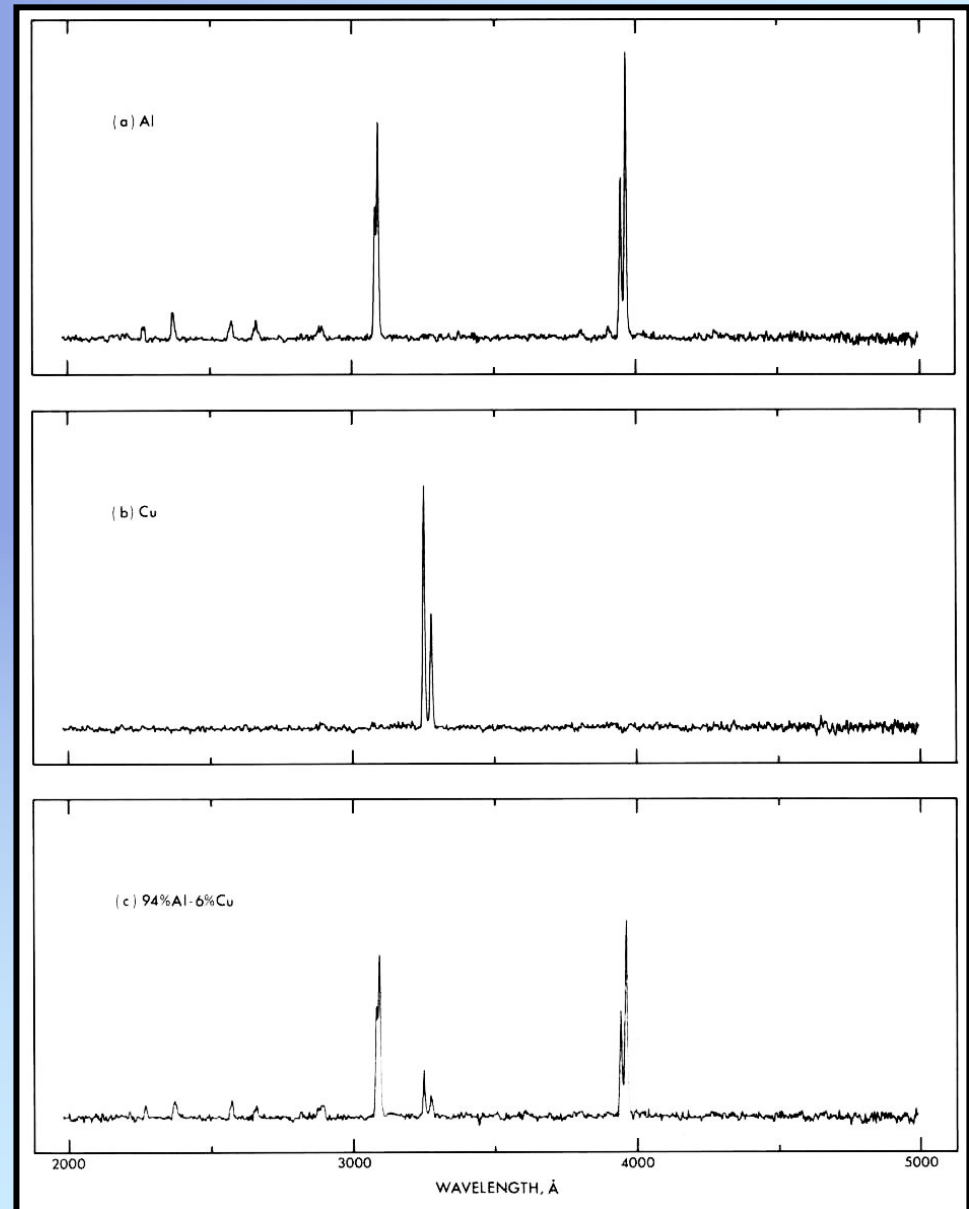
EIES PRINCIPLE

- Vapor flux of evaporated material enters sensor
- Collides with electrons emitted from a filament
- Raising energy state of valence electrons
- Electrons return to lower energy, emitting photons
- Wavelengths are characteristic of the material



TYPICAL SPECTRA

- Aluminum, Copper, and 94%Al-6%Cu spectra
- Atomic and some molecular species show strong lines
- Select specific wavelengths with a monochromator or band pass filter
- Emission intensity is proportional to rate



RELATIONSHIP OF EMISSION TO RATE

For any material

$$J \sim i N$$

J = EMISSION INTENSITY

i = ELECTRON BEAM CURRENT

N = NUMBER DENSITY OF ATOM

and

$$D = m v N$$

D = MASS DEPOSITION RATE

m = MASS OF ATOM

v = AVERAGE VELOCITY OF ATOMS

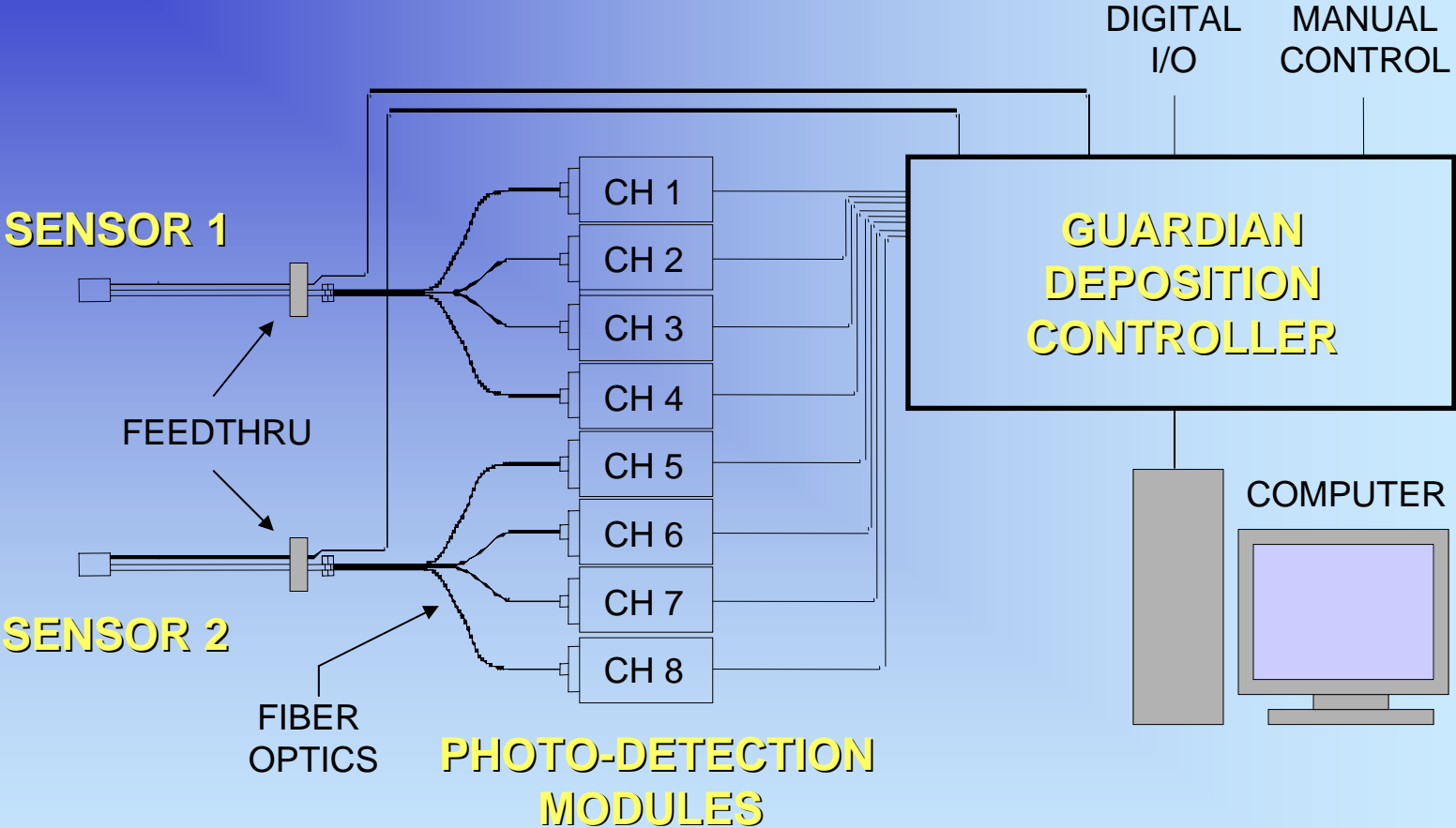
for constant v

$$J = k D$$

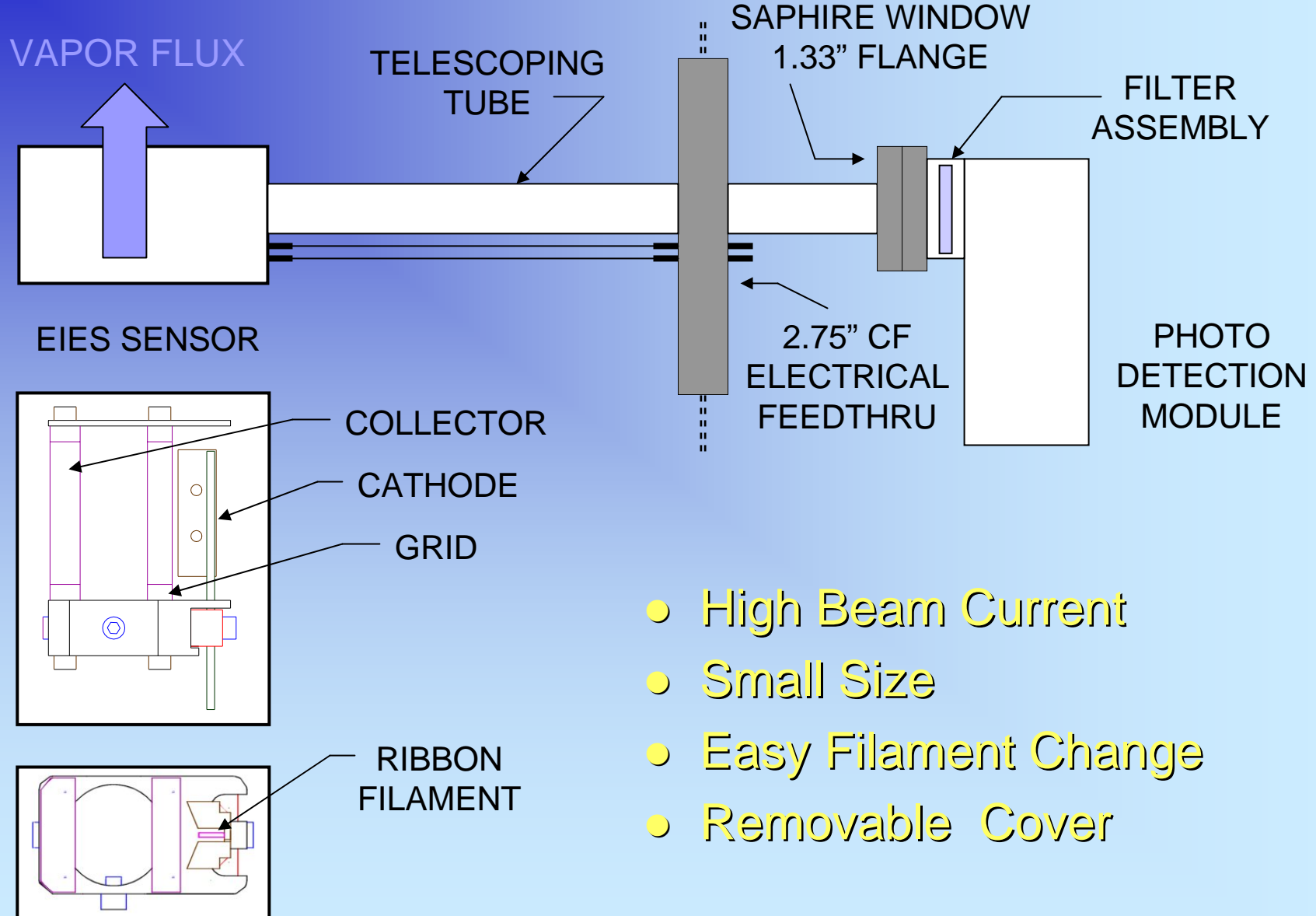
k = CALIBRATION CONSTANT

Σ

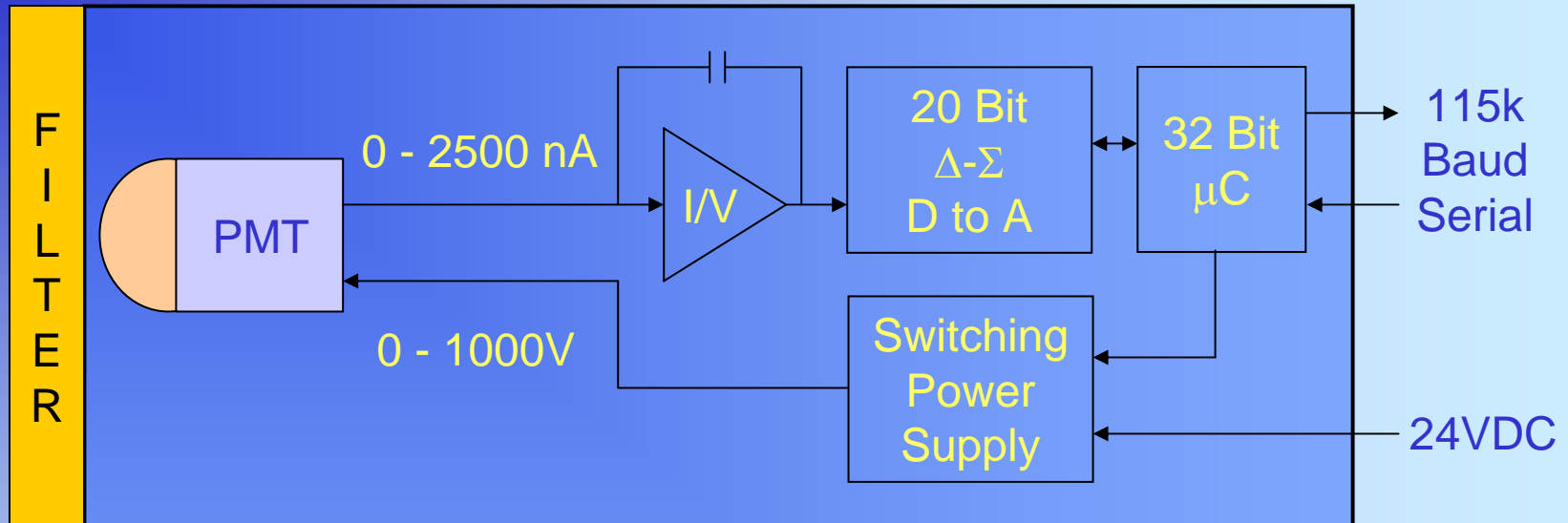
GUARDIAN SYSTEM BLOCK DIAGRAM



EIES SENSOR & FEEDTHRU

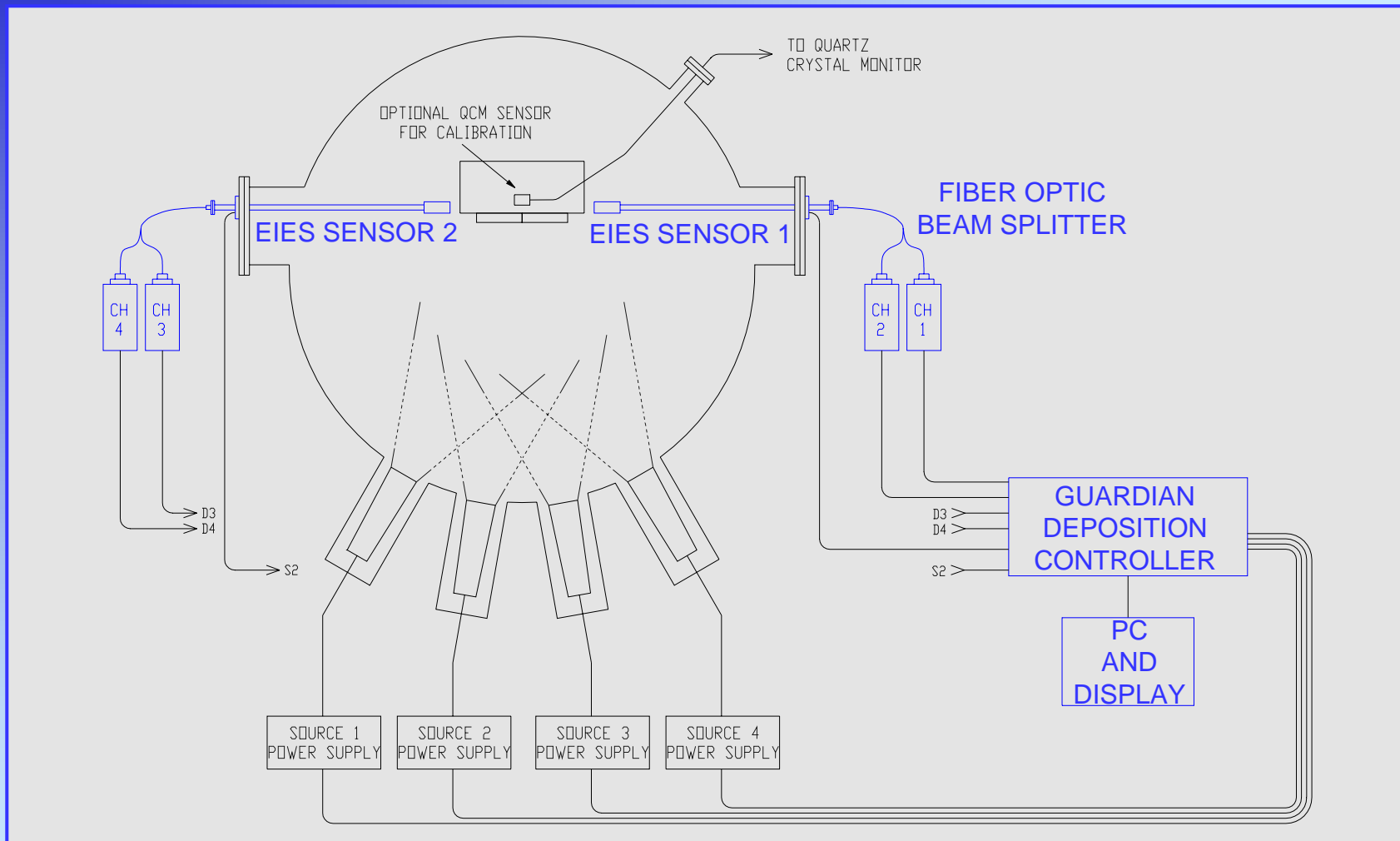


DETECTOR MODULE



- Wide Dynamic Range
- On-Board Signal Conditioning
- 1ms Sample Rate with Variable Averaging
- No Gain Switching Non- Linearity
- Small Package
- Small Opto-Isolated Cable/Connector

TYPICAL INSTALLTION



Multi-Channel CoDeposition

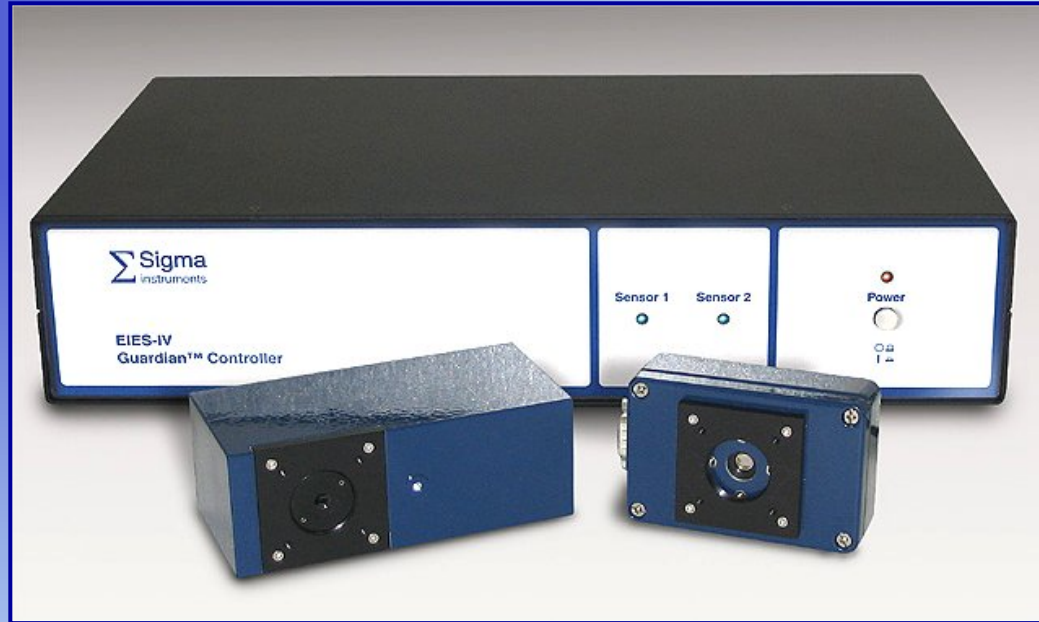
SYSTEMS

- CO-DEPOSITION
- MBE
- CONTINUOUS IN-LINE
- ROLL COATERS

PROCESSES

- COMPOUND SEMICONDUCTORS
- HI TEMP SEMICONDUCTORS
- SOLAR CELLS (CGIS)
- NEW MATERIAL RESEARCH
- HEAVY METALLIZATION

SUMMARY



- **WIDE RANGE** $<.01 \text{ \AA/s}$ to $>1000 \text{ \AA/s}$
- **MATERIAL SELECTIVE**
- **CONTINUOUS OPERATION**
- **SMALL SENSORS AND DETECTORS**
- **EXCELLENT RELIABILITY**