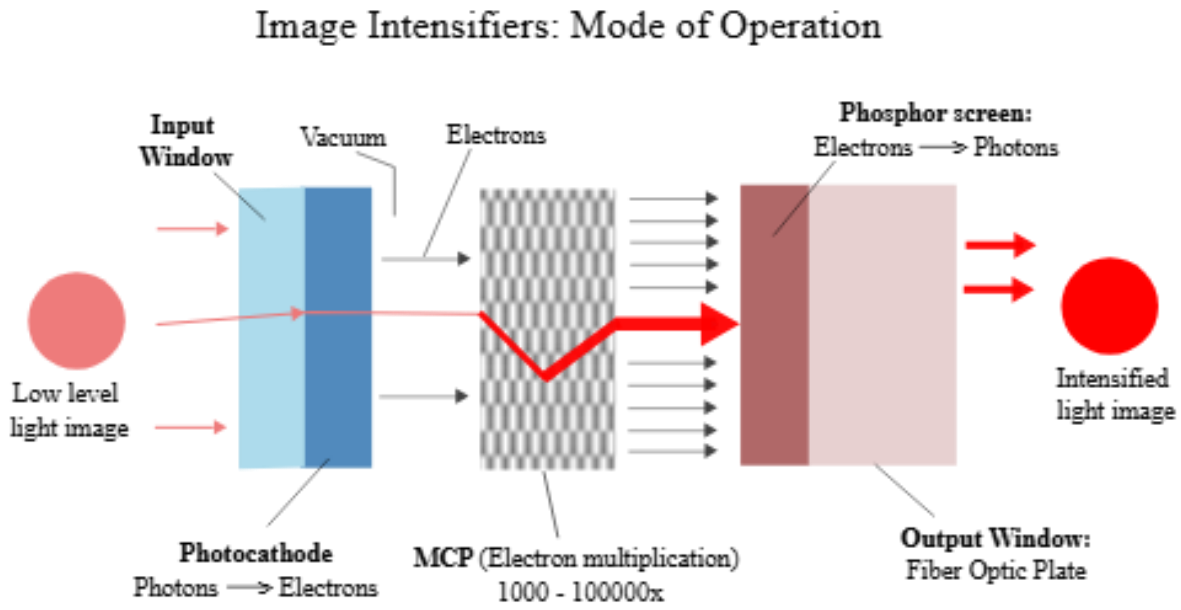
INTENSIFIER (SIMPLIFIED)

Intensifier Anatomy

Three main stages:

1. **Photocathode (S20, S25, GaAs, etc.)**: Converts incoming photons → electrons. Sensitivity depends on material.
2. **Microchannel Plate (MCP)**: Multiplies electrons (gain up to 10^6).
3. **Phosphor screen (P43, P46, etc.)**: Converts electrons → photons (green light), which are then relayed to a CCD sensor.

So, **S20/S25** describe the *front end (wavelength sensitivity)*, and **P43/P46** describe the *back end (decay time + color)*.



Photocathodes (input)

- **S20**:
  - Standard multialkali photocathode.
  - Sensitive from ~180 nm (UV) up to ~850 nm.
  - Peak sensitivity: blue–green region (350–450 nm).
  - Quantum efficiency (QE): ~10–15% in visible.
  - Good general-purpose, especially for UV–blue chemiluminescence (OH*, CH*, etc.).

- **S25 / "red-extended S20" (sometimes called S23)**:

- Similar to S20, but "red-extended."
- Covers ~180–900+ nm.
- More sensitive in red–NIR region (>650 nm).
- Useful for CN*, C2*, or other chemiluminescence in red, and for IR applications.
- Slightly higher dark current than S20 (so noisier at long gate times).

MCP (amplifier)

MCP is a **thin glass wafer** (≈0.2–1 mm thick) containing **millions of microscopic channels** (tiny capillaries).

- Each channel is about **6–25 μm in diameter**, angled slightly (~8–15°) so electrons don't go straight through.

Function

1. **Electron entry:** A photon first hits the **photocathode** (S20, S25, etc.), releasing a photoelectron.
2. **Electron multiplication:** That electron enters one of the MCP's channels. Inside, the walls are coated with a **semiconducting material** that releases secondary electrons when struck.
    a. The incoming electron bounces along the channel wall, knocking out **more electrons** each time.
    b. Typical gain: each channel multiplies by ~10^3–10^6.
3. **Electron exit:** A cascade of amplified electrons exits the channel → hits the phosphor screen → produces a bright light spot (which is then imaged onto the CCD).

Phosphors (output)

Phosphor screen choice determines **image brightness vs decay speed**:

- **P43 phosphor**:
    - Emission: green (~545 nm).
    - Decay time: ~1.5 ms.
    - Bright, efficient, but *long persistence* (ghosting if you do fast gating).
    - Good for low-light, steady signals where brightness matters more than temporal resolution.
- **P46 phosphor**:
    - Emission: green–yellow (~530 nm).
    - Decay time: ~300 ns (fast!).
    - Dimmer than P43, but allows **nanosecond time resolution** without smearing.
    - Standard for **time-resolved laser/plasma/combustion diagnostics**.

Putting it together

Combination	Use case
S20 + P43	General UV–visible detection, slower events, steady chemiluminescence. Bright but limited temporal resolution.
S20 + P46	UV–visible detection, **fast time-resolved imaging** (laser-induced fluorescence, PLIF, fast chemiluminescence).
S25 (S23) + P43	Extended red/NIR detection for slow signals, e.g. CN*, C2* chemiluminescence, soot radiation.
S25 (S23) + P46	Extended red/NIR + fast nanosecond gating. Used for fast imaging of red/NIR species.