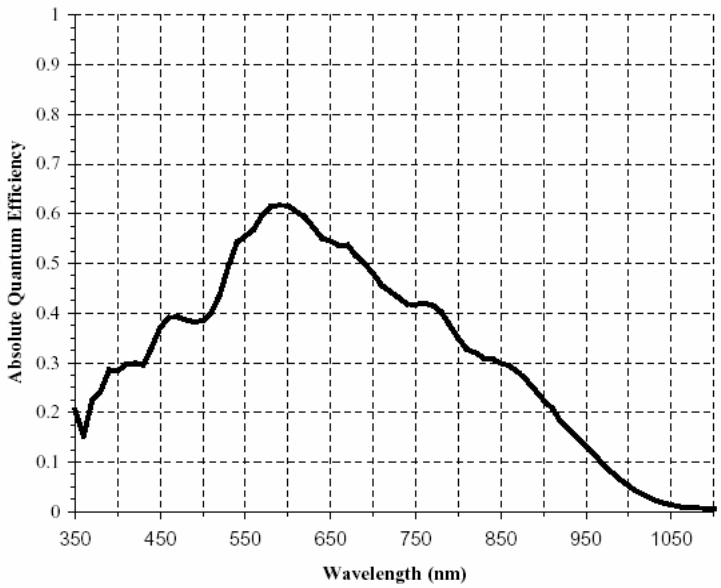
Possible photodetectors/readout

”300,000 channels /20 kTon
”50 photons from 20 m (1 mm fiber)
”150 photons from 10 m

- Photocathode-based with 10-12% qe:
  - PMT (M64+base) ” $40/ch + electronics
  - HPD
- Silicon-based with qe 50-80%
  - APD ” $15-20/ch inc. amplifiers (Hamamatsu 2◇16 pix array @ $320; quote to R. Rusack)
  - VLPC ” $50/ch (hearsay?)
  - CCD < $10/ch inc readout electronics

A CCD solution for readout?

- Kodak KAF-0401E 768◇512 (9❍) pixel
- 6.9 ◇ 4.6 mm
- $300 (+ ” $300 readout electronics)
- 50% quantum eff.
- Open gate for 10 ❍s/spill
- Readout over 1s bet spills



- Can get ” 30 tight-packed 1 mm fibers
  or ” 120 tight-packed ½ mm fibers on to CCD
- This corresponds to 10^4 pix/1 mm fiber
  (there are CCDs with 25 ❍ pix but still 10^3 pix/fiber)
- Could gain factor 4 –5 with focusing lens so cost/fiber is small

- The problem is read noise from amplifiers, typically 10 e rms/pixel read out (dark current negligible because of short gate)
- So make pixels bigger by ganging together (P.Border)
- e.g. at 4 pix/fiber read noise is 400⊕20 e and need signal of 100 pe for 5♦ signal – background
- This is borderline or below for 20 m detector with single-ended readout - **unless can find a CCD with low read noise**