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APS test capabilities

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ps timing workshop, 2009-02-26

Breakdown of Tasks

Need to develop and characterize:

- photocathode: photon yield, time response
- MCP: gain, time response
- readout strip lines: attenuation, dispersion, coupling to external comp.
- readout electronics:
- assembled device / interplay of components
- optional: fast scintillators

What can be done at the APS

- Photocathodes
- Streak camera to measure gain and time dependence of amplified current from MCP
- Test chamber for MCP gain and microwave strip lines
- Ti:Sapphire laser system(s) available, $<$ 100 fs pulses

Using a streak camera for testing MCPs

- A streak camera is a (sub)picosecond-resolving detector
- streaks out an electron current onto a phosphor
- deflects current from a photocathode by a sudden voltage pulse
- here: generate photoelectrons with laser, amplify in MCP
- streak out amplified current to determine time response, gain

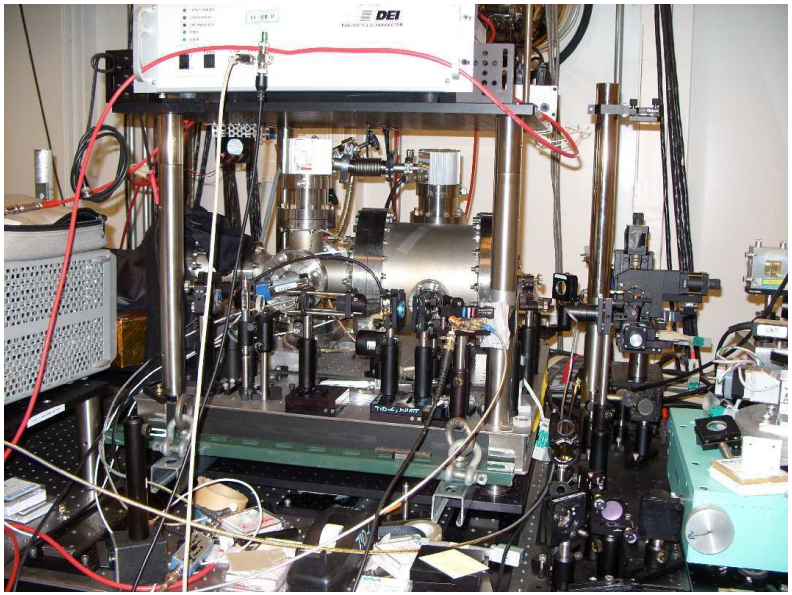
X-ray streak camera at APS

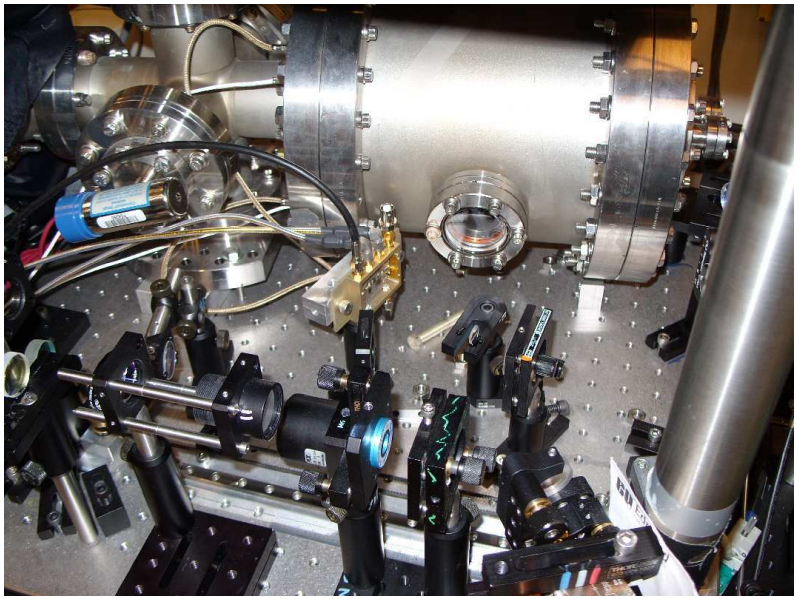
Measures x-ray intensity to 1 .. 2 ps by deflecting

x-ray-generated photoelectron current

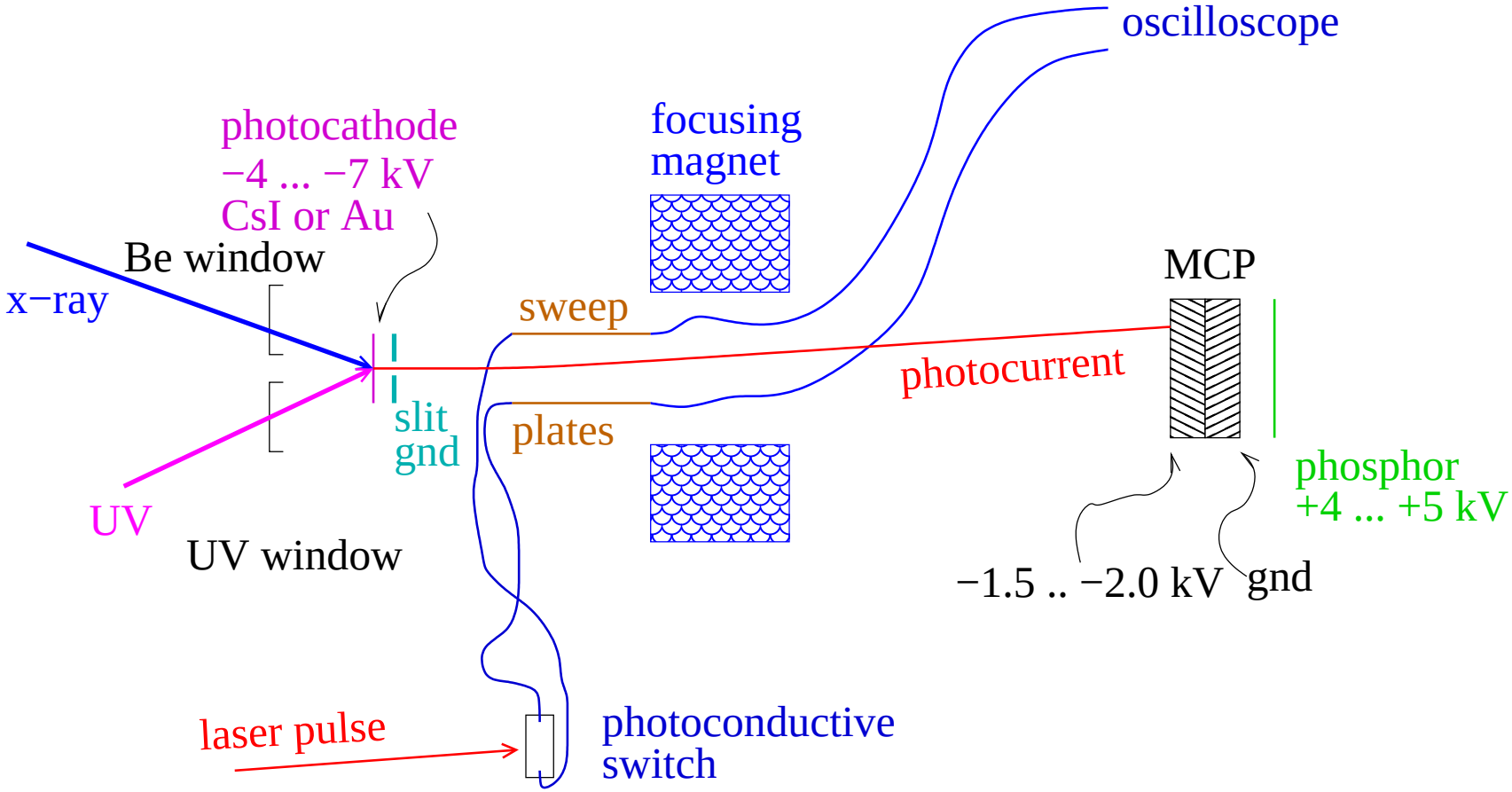
deflection voltage pulses from pulsed-laser-triggered

photoconductive switch

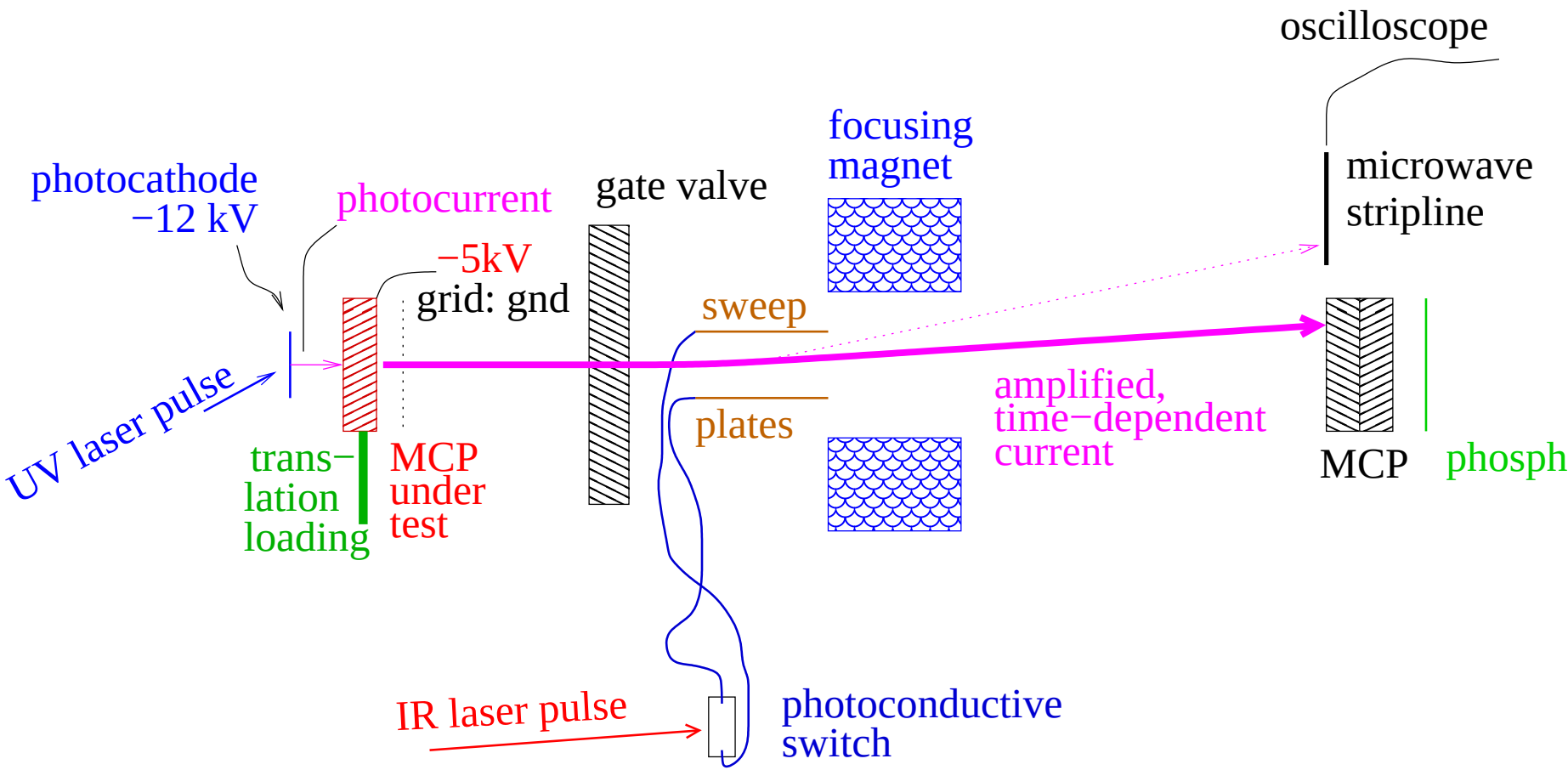




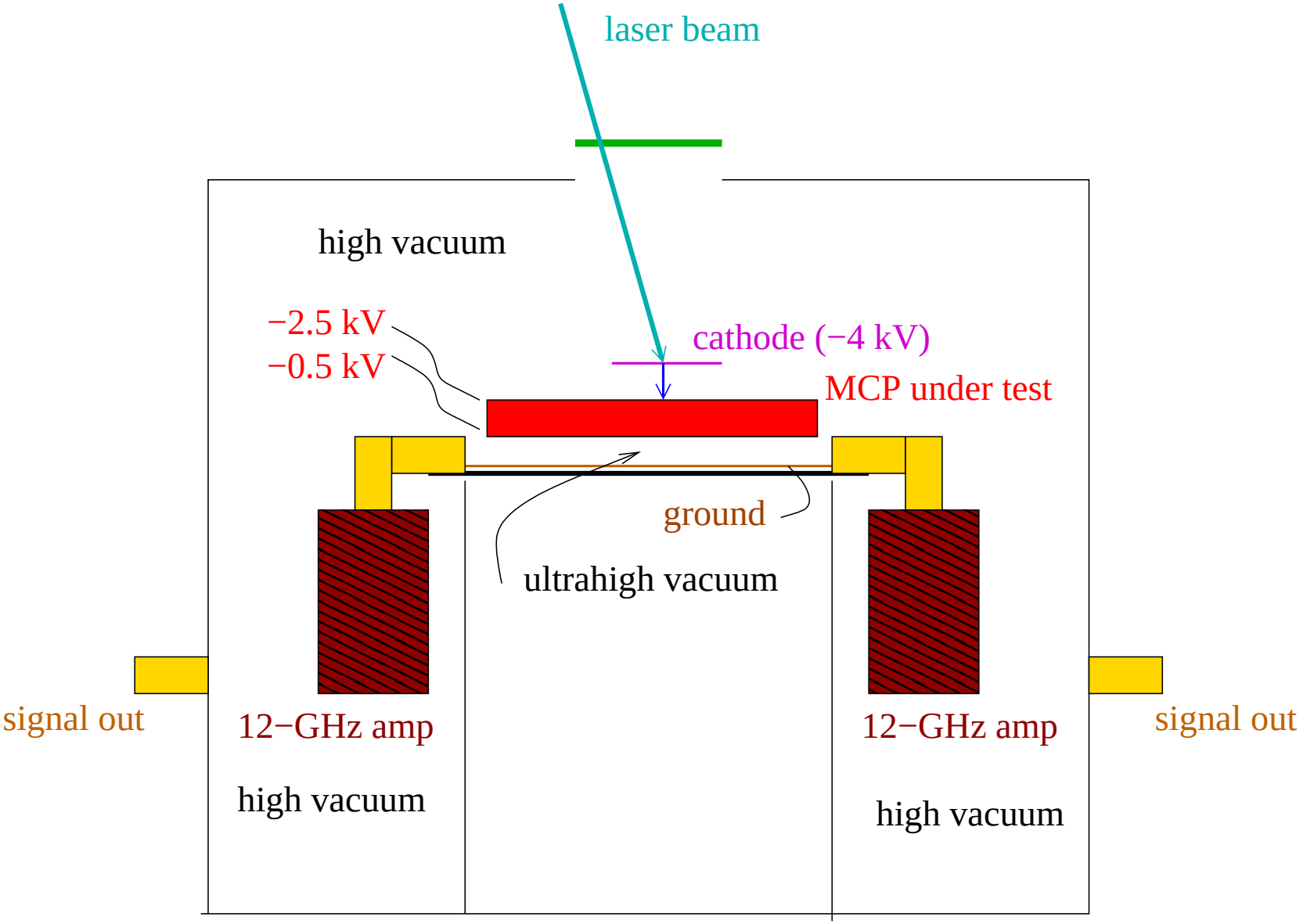
Streak camera configured for testing photocathodes



Streak camera configured for testing MCPs



A vacuum test stand for testing microwave striplines



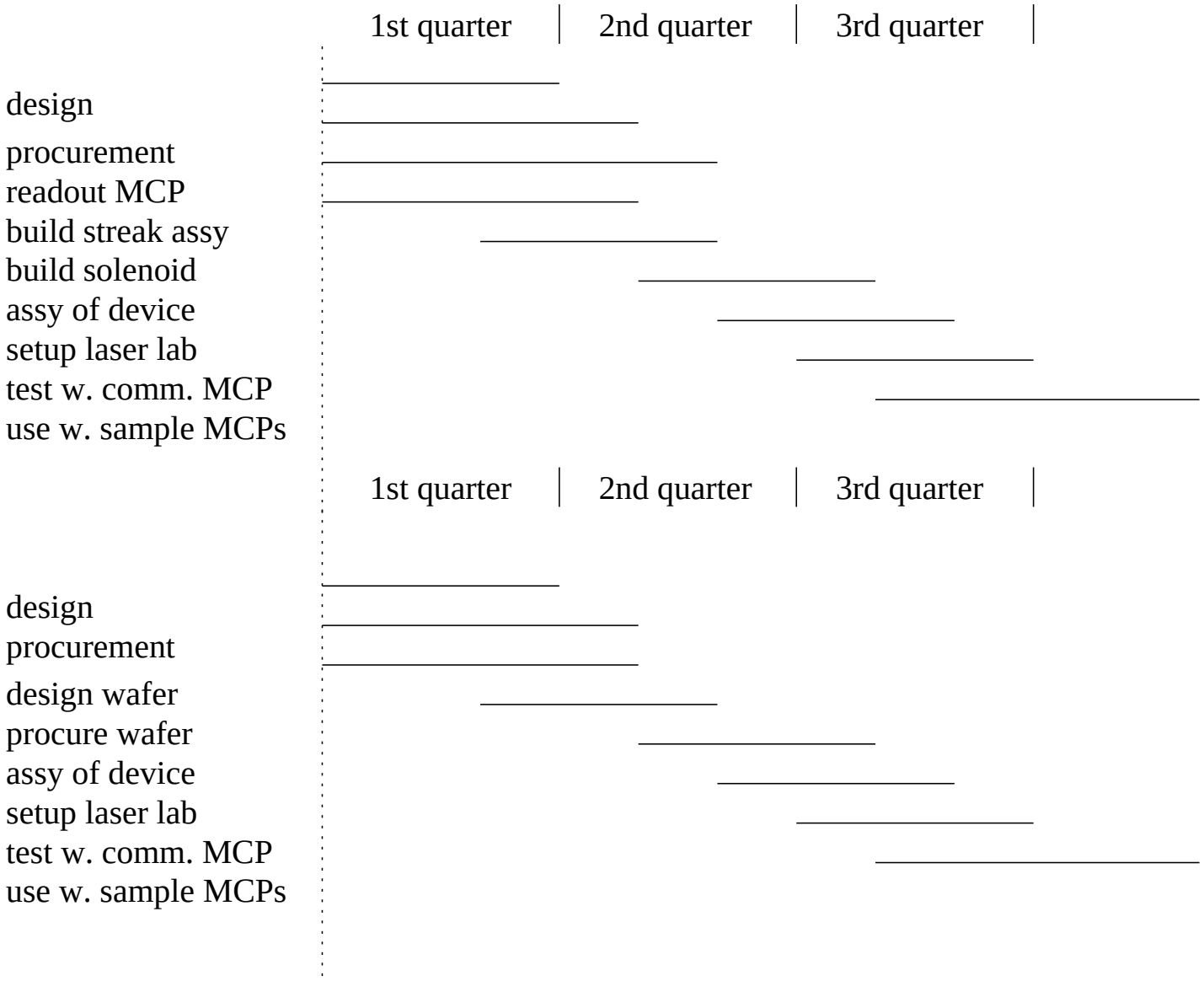
Budget

streak camera			
item	amount	cost	
effort for design & construction	6 mo., 1 FTE	90 k	
effort for design & construction	6 mo., 1 postdoc	50 k	
effort for operation	2 1/2 yr., 1 FTE		450 k
effort for operation	2 1/2 yr., 1 postdoc		250 k
photocathodes	3	2k	
vacuum components	misc	20k	
gate valves	2	8k	
streak assy.	1	4k	
focusing solenoid	1	4k	
MCP as test sample	1	5k	
readout MCP	1	11k	
turbo pump	1	7k	
optics		5k	
access to Ti:Sapph. laser		N/A	
sum design & construction		206k	
sum operation			700k

Budget

MCP/stripline test chamber			
item	amount	cost	
effort for design & construction	6 mo., 1 FTE	90 k	
effort for design & construction	6 mo., 1 postdoc	50 k	
effort for operation	2 1/2 yr., 1 FTE		450 k
effort for operation	2 1/2 yr., 1 postdoc		250 k
photocathodes	3	2k	
vacuum components	misc	18k	
wafer w. strip lines	2	6k	
2nd step, bonding amplifiers onto wafers		14k	
12-GHz, 40dB amplifiers	2	20k	
access to Ti:Sapph. laser		N/A	
sum design & construction		200k	
sum operation			700k

Timeline


1st quarter
2nd quarter
3rd quarter
design
procurement
readout MCP
build streak assy
build solenoid
assy of device
setup laser lab
test w. comm. MCP
use w. sample MCPs
1st quarter
2nd quarter
3rd quarter
design
procurement
design wafer
procure wafer
assy of device
setup laser lab
test w. comm. MCP
use w. sample MCPs

Fast Scintillator

Applications that need to convert a signal (x-ray, etc.) to light:
Atomic fluorescent lifetimes of atoms are too long (>5 ns), given by dipole strengths and EM density of states.
Measured lifetimes down to 200 ps, apparently due to large coherence volume of excitons (NIMA **537**, 66-70 (2004)).
Investigate possibility of superradiant speedup when large number of excitons are in one nanoparticle