

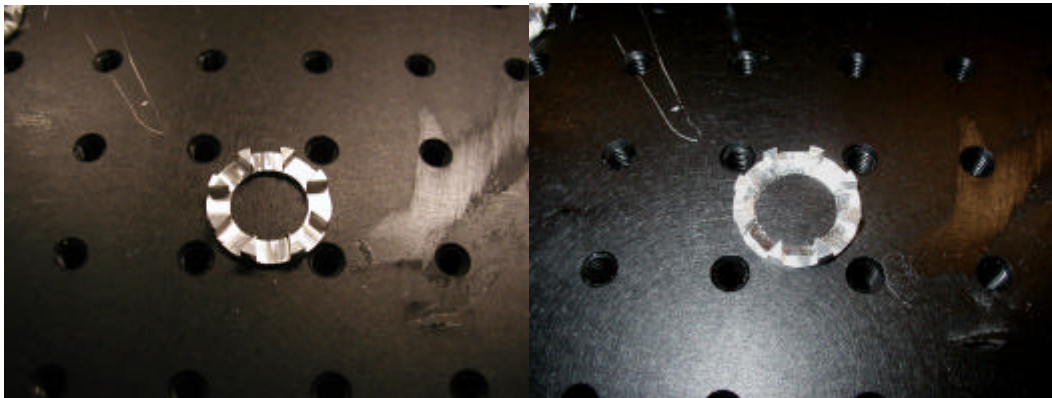
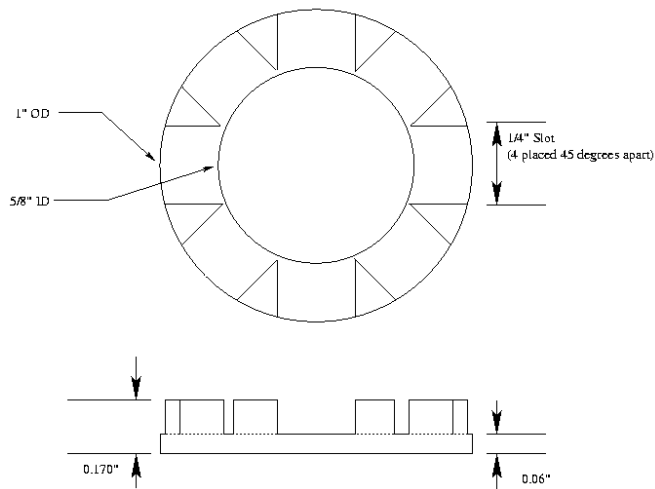
Making a Photo X-ray Eye

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The X-ray eye described in the following is used to determine beam intensity and and image the beam position or profile.

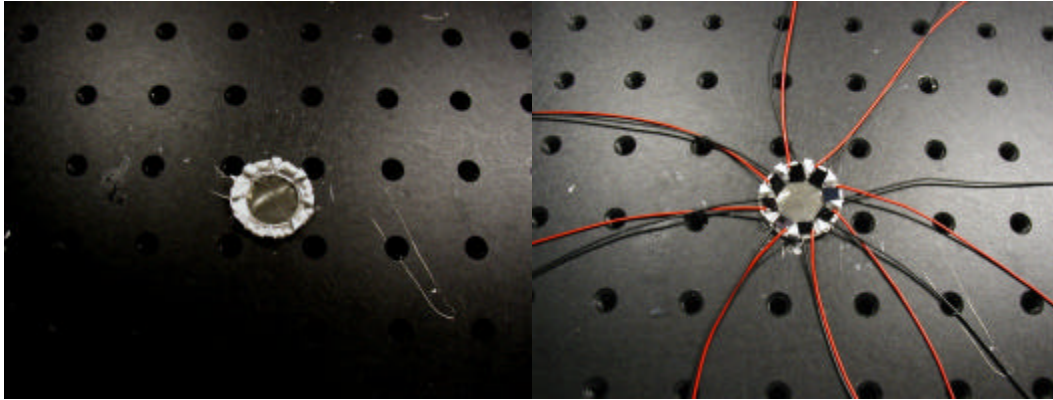
Most components for the X-ray camera are stock items – part numbers and supplier are provided whenever possible. One component, the diode-mount spacer plate, is custom made (its dimensions are determined by the diodes to be used). I had the shop make the plate as shown below.

X-ray eye photodiode mount
Material: Al



The first step is filing the slots in the diode-mount spacer plate (above left) to a slant (above right). McMaster Carr square file 4235A12 works best for this. File the slots by holding the spacer with leather gloves over a slightly open vise.

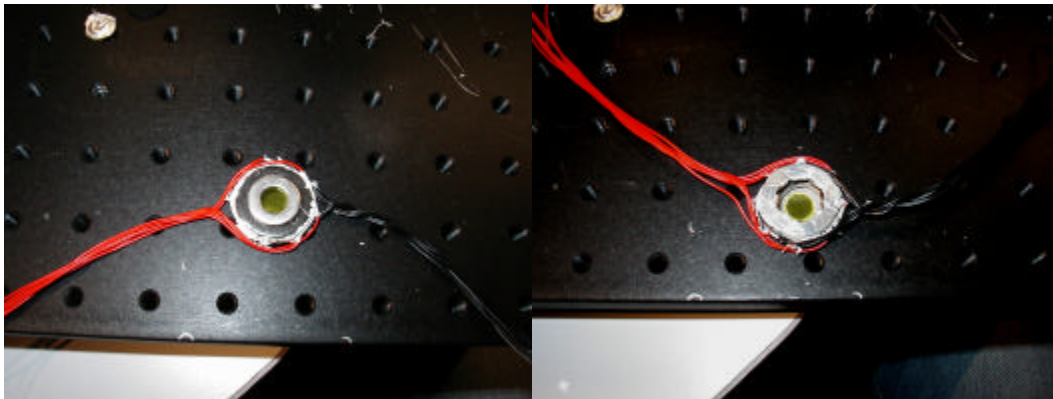
Next the photodiodes are bonded to the spacer. It sometimes helps to put some tape on the back of the diode spacer plate for mounting and to protect the crystal until gluing to the lens.



Apply silicone glue (McMaster Carr 74915A654) to each slot (above left) and place each diode (Newark VTS3085) on the slot (above right). Allow the glue to dry.

The crystal, either Cadmium Tungstate (CdWO_4 : 11mm x 11mm x 5mm) or YAG (10mm OD x 500 μm Star Tech Instruments), can be glued to a washer (11/32" ID 11/16" OD) with silicone (for CdWO_4) or 5-minute epoxy (for YAG; McMaster Carr 7541A76). It is best not to use super-glue for this process, since it causes the YAG to frost.

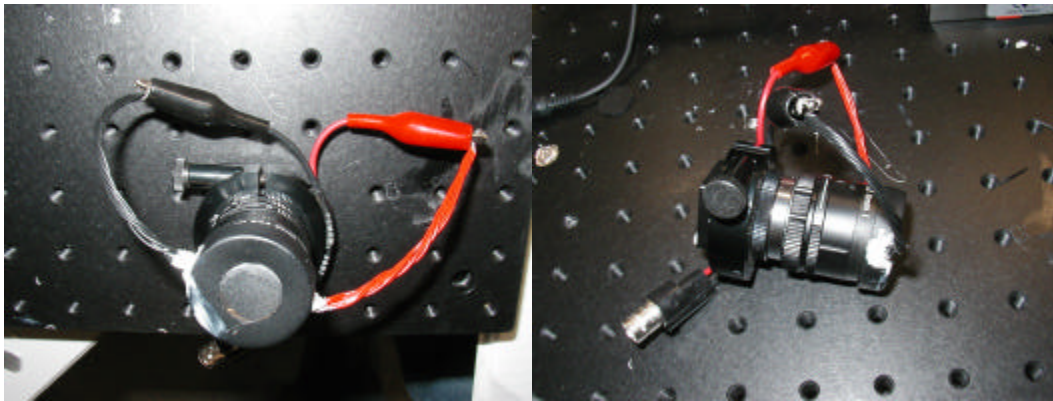
Glue the crystal washer to a black spacer washer (15mm ID x 25 mm OD x 5mm McMaster Carr 98035A108) with the crystal side down using super-glue (McMaster Carr 74765A54) and a syringe (McMaster Carr 7510A651 with 75175A695 teflon needle). You may have to file a part of the spacer washer for the CdWO_4 crystal.



Apply super-glue to the 8 posts of the diode spacer plate and glue the black spacer washer to the top such that the diodes are facing the crystal (above). Cut a piece of aluminum foil (thinner is better) to the crystal washer size (11/16") and then super-glue it to the washer in order to protect the crystal.

We chose a KPC-500P micro camera from SuperCircuits (PC-21XC) for the assembly. The camera is held in a counter-bored (1-11/32" ϕ x 0.1" deep) 30mm ring-mount from Edmund Industrial Optics (L52-930). A KOWA 8mm F/1.2 TV lens from SuperCircuits (CML8MMIF) is attached to it with a 6mm extension (comes with the camera).

Glue the diode/crystal assembly to the front of the lens with silicon and allow to dry face down with a weight on the camera to hold the assembly in place. When dry, gather the red and black wires from the photodiodes to either side and hold them with a small-parts positioner (McMaster Carr 5007A14). Prepare a protective cover by cutting a hole with the size of the crystal washer and slots for the wires in the plastic lens cover. Glue the cover with silicone over the crystal and wires and allow the assembly to dry – use a ring-weight to hold down the cover and keep the weight off the crystal.



Epoxy a BNC Mini-Gator adapter (Newark 34F965) to the tube clamp holding the camera (this is to relieve the tension on the photo diode wires). Finally cut and strip the photo-diode wires, twist the wires together and connect them to the adaptor (above).

Cost of initial Photo X-ray Eye

	Vendor	Item Number	Description	Price	Quant	Subtotal
1	APS shop		diode-mount spacer plate (estimated 2hrs @ \$65/hr)	\$ 130.00	1	\$ 130.00
2	McMaster Carr	4235A12	sqare file 6" long 1/4" wide	\$ 5.40	1	\$ 5.40
3	McMaster Carr	74915A654	Dow Corning 748 silicone rubber	\$ 5.80	1	\$ 5.80
4	Newark	VTS3085	0.032 sq in active area photo-diode	\$ 3.71	8	\$ 29.68
5	StarTech Instruments Inc.	F10G500	10mm OD, 500µm thick YAG	\$ 255.00	1	\$ 255.00
6	McMaster Carr	7541A76	5-minute Epoxy	\$ 2.84	1	\$ 2.84
7	McMaster Carr	74765A54	Loctite low odor super glue	\$ 3.54	1	\$ 3.54
8	McMaster Carr	7510A651	10 pack -- 0.10 oz Platic Syringe	\$ 4.53	1	\$ 4.53
9	McMaster Carr	75175A695	10 pack -- 22 gauge disposable teflon needle	\$ 15.57	1	\$ 15.57
10	McMaster Carr	98035A108	15mm ID X 25mm OD X 3mm thick washer	\$ 0.73	1	\$ 0.73
11	McMaster Carr	91950A030	50 pack -- 11/32" ID X 11/16" OD X 1/16" thick washer	\$ 9.94	1	\$ 9.94
12	McMaster Carr	9012K11	0.001" thick 6" roll aluminum foil	\$ 11.04	1	\$ 11.04
13	SuperCircuits	PC-21XC	KPC-500P micro camera w/ extension	\$ 99.95	1	\$ 99.95
14	SuperCircuits	CML8MMIF	f1.2 8mm manual iris lens	\$ 69.95	1	\$ 69.95
15	Edmund Industrial Optics	L52-930	30mm ring mount	\$ 60.60	1	\$ 60.60
16	Newark	34F965	Molded breakout female BNC to minigator clip	\$ 12.24	1	\$ 12.24
17	McMaster Carr	5007A14	Small Parts Positioner	\$ 30.76	1	\$ 30.76
Total						\$ 748

Cost for second Photo X-ray Eye (made at the same time)

	Vendor	Item Number	Description	Price	Quant	Subtotal
1	APS shop		diode-mount spacer plate (estimated 1hr @ \$65/hr)	\$ 65.00	1	\$ 65.00
2	Newark	VTS3085	0.032 sq in active area photo-diode	\$ 3.71	8	\$ 29.68
3	Star Tech Instruments Inc.	F10G500	10mm OD, 500µm thick YAG	\$ 255.00	1	\$ 255.00
4	McMaster Carr	98035A108	15mm ID X 25mm OD X 3mm thick washer	\$ 0.73	1	\$ 0.73
5	SuperCircuits	PC-21XC	KPC-500P micro camera w/ extension	\$ 99.95	1	\$ 99.95
6	SuperCircuits	CML8MMIF	f1.2 8mm manual iris lens	\$ 69.95	1	\$ 69.95
7	Edmund Industrial Optics	L52-930	30mm ring mount	\$ 60.60	1	\$ 60.60
8	Newark	34F965	Molded breakout female BNC to minigator clip	\$ 12.24	1	\$ 12.24
Total						\$ 593