Notes on Electrode Evaporation

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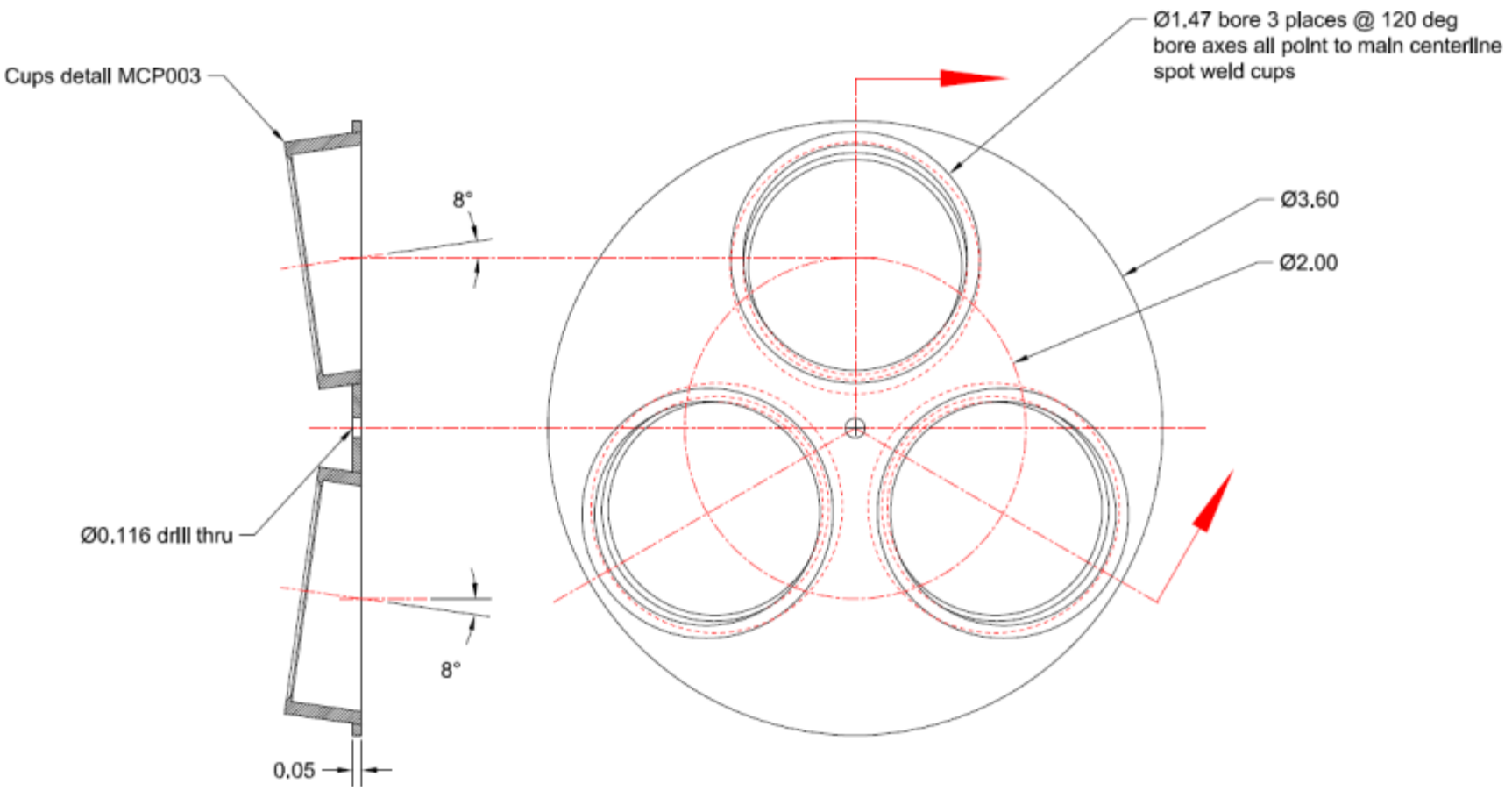
Argonne

MCP Coating Fixture for Electrode Evaporation

These slides show a fixture that Joe Libera and Qing Peng designed and fabricated to hold three Incom glass substrates (33 mm OD, 8° bias angle) during the nichrome electrode evaporation. The substrates are oriented such that the top of each pore is tilted towards the center of the fixture. Next, they are dropped into a cup which is tilted outwards at -8° so the pores end up vertically aligned. This arrangement will allow us to control the end spoiling.

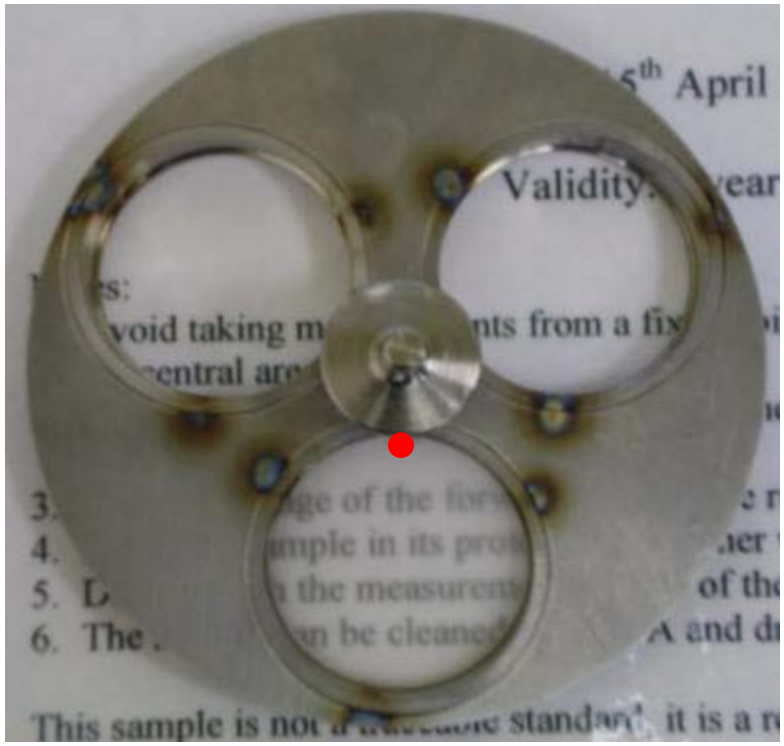
MCP Coating Fixture for Electrode Evaporation



Argonne NATIONAL LABORATORY	DWG NO. ANL-MCP005	TITLE MCP Coating Fixture - Sample Plate	STANDARD TOLERANCES 0.00 +/- 0.01 0.000 +/- 0.002
	DATE 12/15/09	REV 0	Drawn by J. Libera

MCP Coating Fixture for Electrode Evaporation

Fixture is shown loaded with one Incom glass plate in lower opening. When rotation angle of plate is properly aligned, the text below is clear. Otherwise, it is blurry Red dot marks the inclination direction of the 8° bias angle pores. This demonstrates that the fixture holds the plates at the appropriate orientation for controlling the end spoiling during evaporation.



<u>bias angle aligned with center post</u>:
Pores now point straight into page and text is visible

<u>bias angle misaligned:</u>
Pores now point diagonally into page and text is blurry

Notes on Nichrome Composition and Thickness

I looked through the logs of some of our depositions to get an idea of our deposition thicknesses and rates. Keep in mind these are depositions on windows, not MCPs, but I believe the principle should still hold (I've not done any MCPs myself). We shoot about 2000Å of Nichrome at about 2-3 Å/s. As regards the total thickness; I believe the MCP manufacturers actually use an edge-to-edge resistivity measurement to determine the desired thickness (probably a one time calibration then they shoot a certain thickness thereafter). I believe the desired surface resistance is about 100. I've read of surface thicknesses of about 1000Å in several places, but clearly this will depend on the size of the MCP.

Our setup is such that the target is about 40cm from the evaporator boat. Pressures tend to run in the 10^-6 torr range.
-Jason

Bibliographic Entry	Result (w/surrounding text)			Standardized Result
Faughn, Jerry S., Raymond A. Serway. *College Physics*. Pacific Grove, CA: Thomson Learning Inc, 2003: 538.	Material	Resistivity (Ωm)	Temperature Coefficient of Resistivity [(°C)$^{-1}$]	1.50×10^{-6} Ωm
	Nichrome	150×10^{-8}	0.4×10^{-3}	

Argonne- Ni:Cr 80:20
Ossy – Inconel 600, Ni:Cr:Fe:Mn = 72:17:10:1
Henry: “Dear Jeff, I'm pretty sure it's 80:20- Jason McPhate will know”

Ossy uses Inconel 600, Ni(72)Cr(15)Fe(10), rho=1.03 x10^{-4} Ohm cm
Photonis says use 300 Ω/☐ => 3.4 nm (?!)

Metal Coating (Electrodes)

Over the input and output surfaces of a MCP, Inconel, Ni-Cr or Cr is evaporated to form electrodes. The thickness of the electrodes is controlled to have a surface resistance of 100 to 200Ω between the MCP edge. In general, the electrodes are evaporated to uniformly penetrate into the channels. The penetration depth significantly affects the angular and energy distributions of the output electrons, and usually chosen to be in the range of the channel diameter multiplied by 0.5 to 2. In such demanding applications as image intensification where spatial resolution is of prime importance, the penetration depth of the electrodes is controlled to be deeper in order to collimate the output electrons.

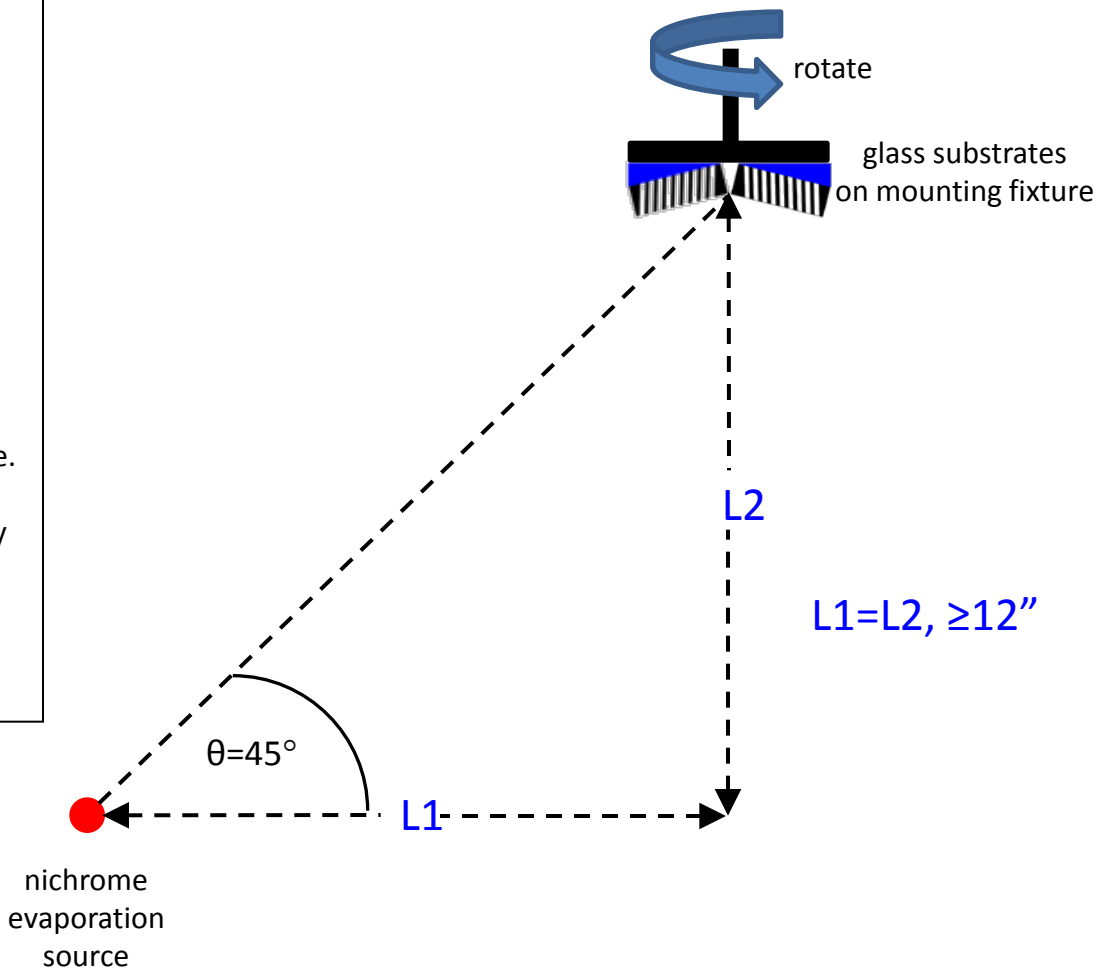
Specifications for Nichrome Electrode Coating on Glass Capillary Array Substrates

Substrates to be coated: 33mm OD circular glass plate, 1.2 mm thick with parallel pores (20 micron diameter) extending through plate and aligned at 8° bias angle with respect to plate normal.

Coating: 100 nm nichrome on both top and bottom.

Mounting Geometry: As shown in diagram. 45° incident angle of nichrome ensures that each pore becomes coated on the inner wall to a depth equal to the pore diameter (20 microns – this is called "Endspoiling=1" since it is 1 pore diameter). Sample rotation ensures that coating on inner wall is radially uniform. L≥12" ensures that the incident angle only deviates by ±5° across the ~2.6" plate mounting fixture.

Mounting fixture: 3 plates are arranged radially equally spaced around a circular plate with OD~2.6" (only 2 plates shown in sketch). Each plate is held on an 8° wedge so the pores point down. We can supply this fixture.



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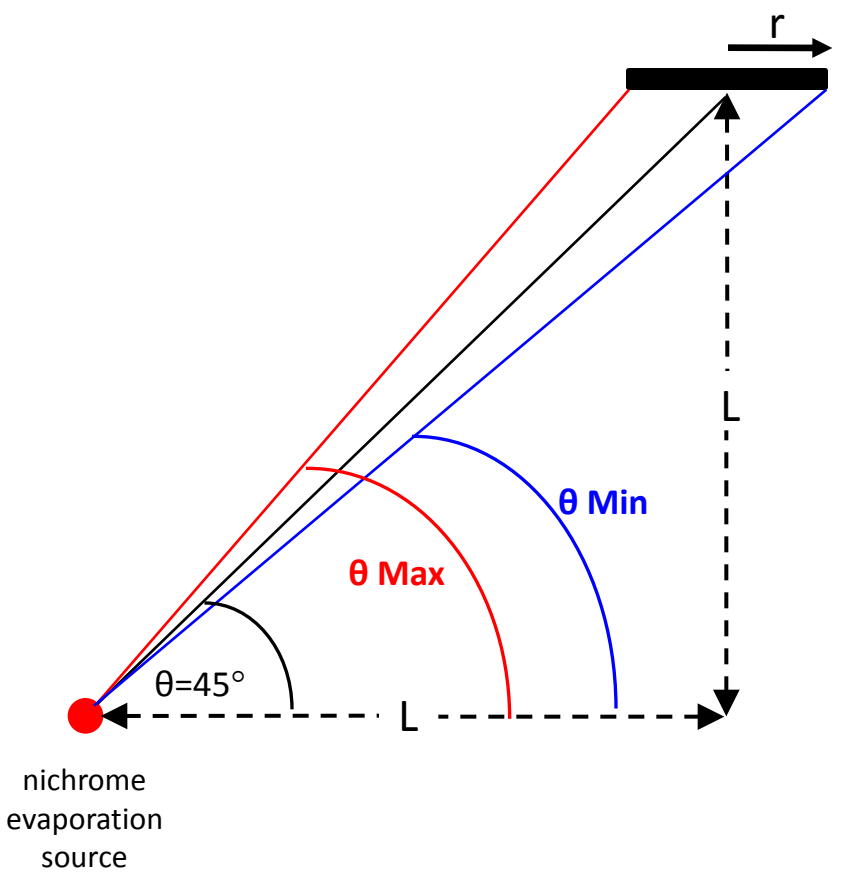
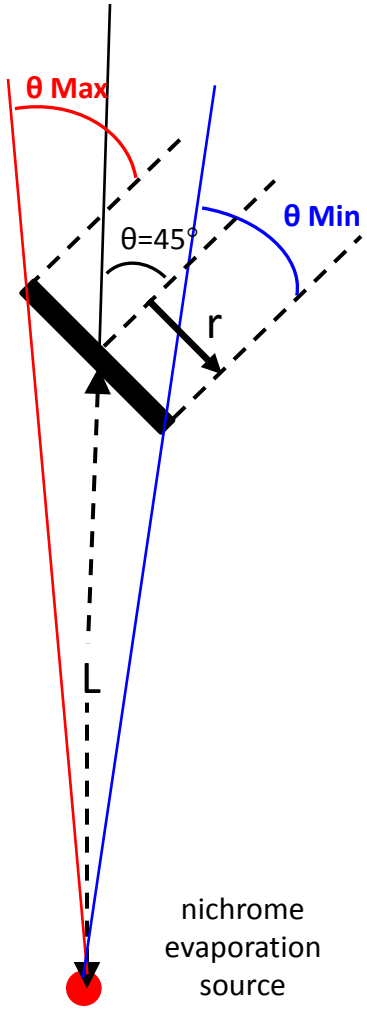
Offset Geometry



θ Max = atan((L+r)/L)

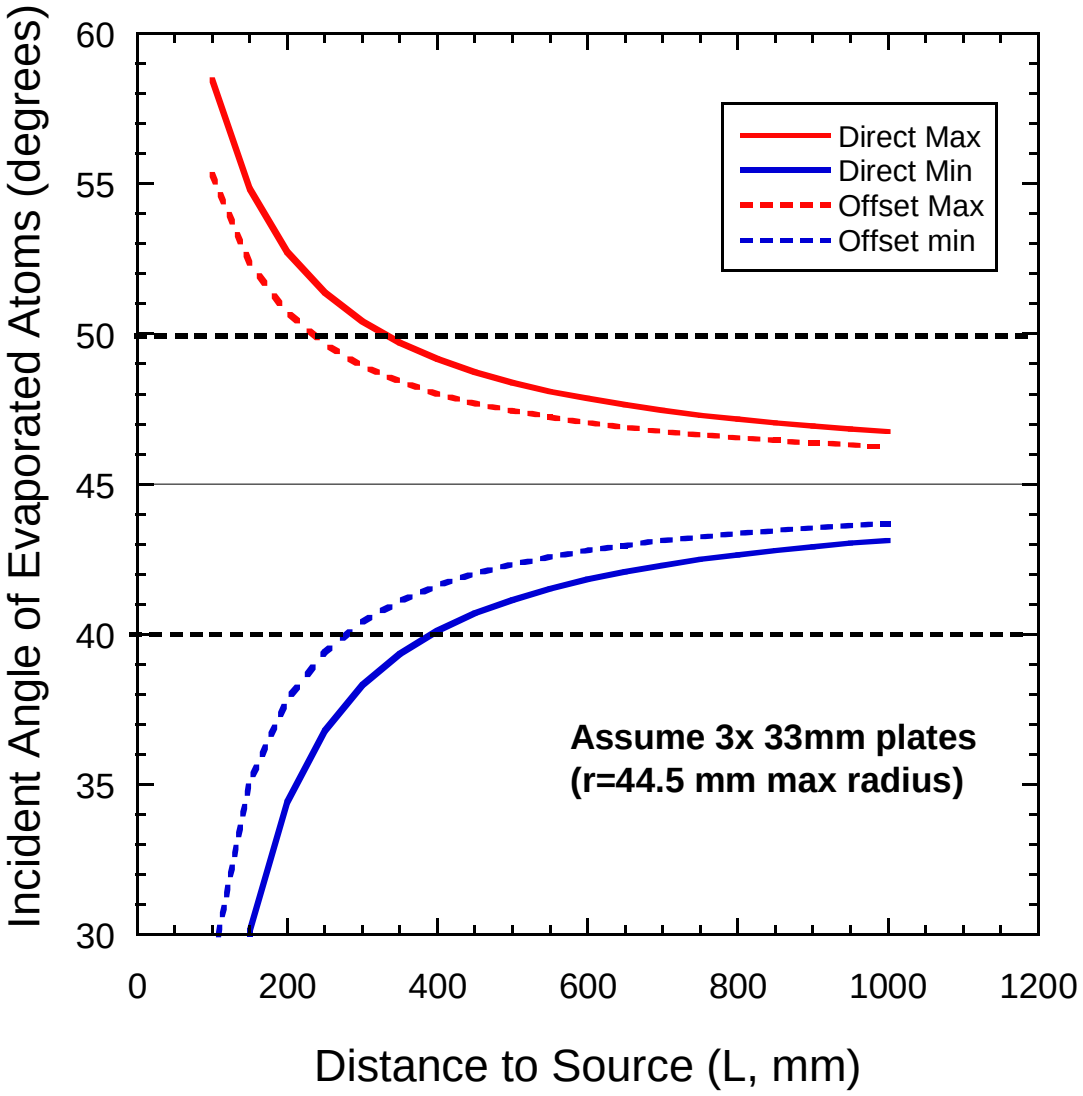
θ Min = atan((L-r)/L)

Direct Geometry



θ Max = 90-asin(L/sqrt(2(L^2+r^2+2LR/√2)))

θ Min = asin(L/sqrt(2(L^2+r^2-2LR/√2)))-90



For ±5°, 3x33 mm (r=44.5)

Direct: L=400 mm (16”) L/r=9.0
Offset: L=300 mm (12”) L/r=6.3

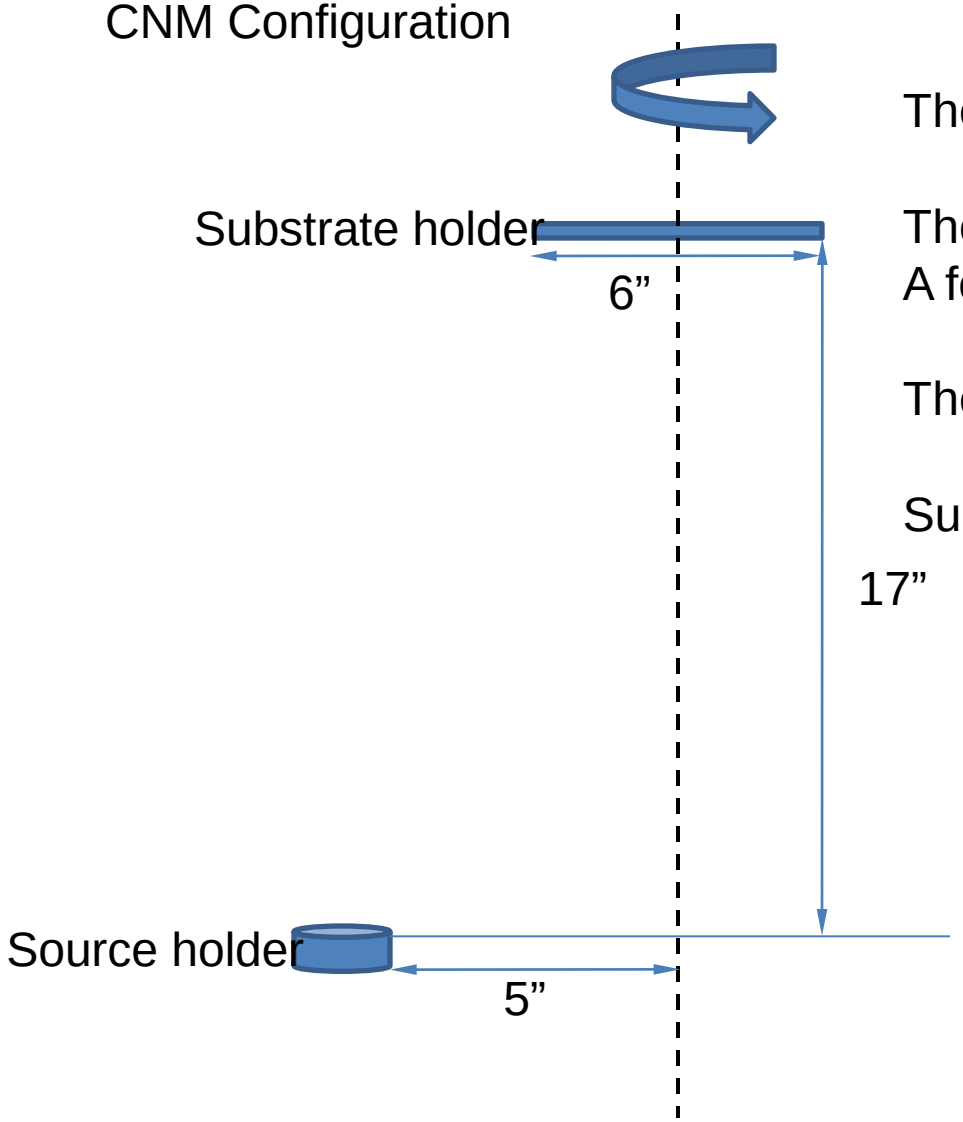
For ±5°, 1x8” plate (r=144 mm diagonal)

Direct: L=1300mm (51”) L/r=9.0
Offset: L=900 mm (35”) L/r=6.7

Jason: Uses direct. Bell jar 20” diameter, 30” tall. Evap distance ~16”, does 1 MCP at a time (could do 3x33 mm) L/r=9.1

Ossy: in Brive, 75mm MCP, 18” throw. L/r=12.0

CNM Configuration



The configuration of Ebeam in CNM

The substrate can move up and down for
A few mm.

The substrate can not be moved off cente

Substrate holder: 6” in diameter.

3/23/10 – phoned Dan Rosenmann – He is willing to vent chamber and try different configurations, but said it is not possible to tilt rotation motor to 45deg. Also not possible to move motor laterally ~17”. So we can’t do proper endspoiling on this system.