128nm study for TPB coated plates

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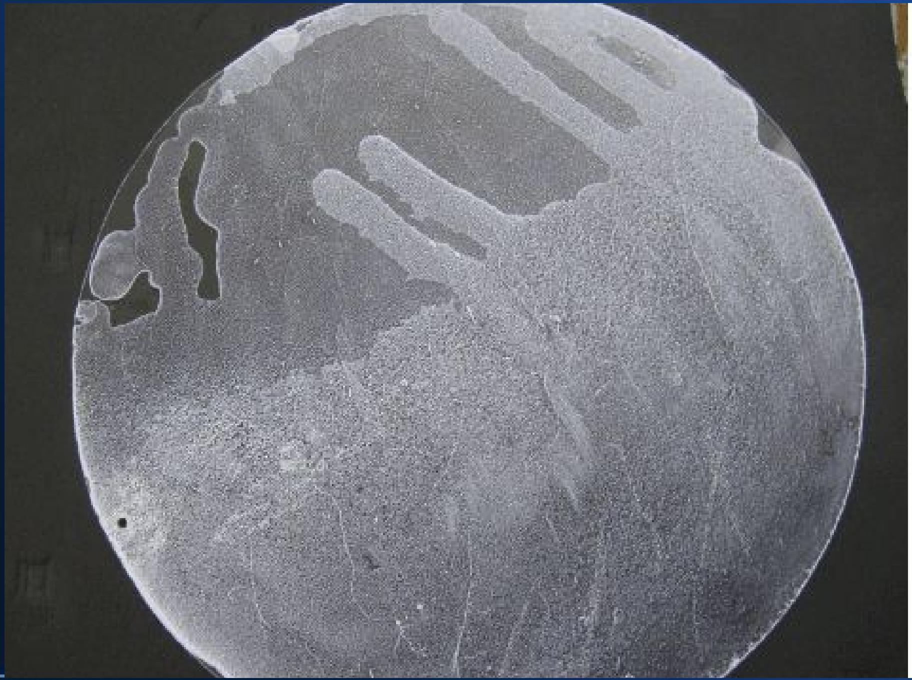
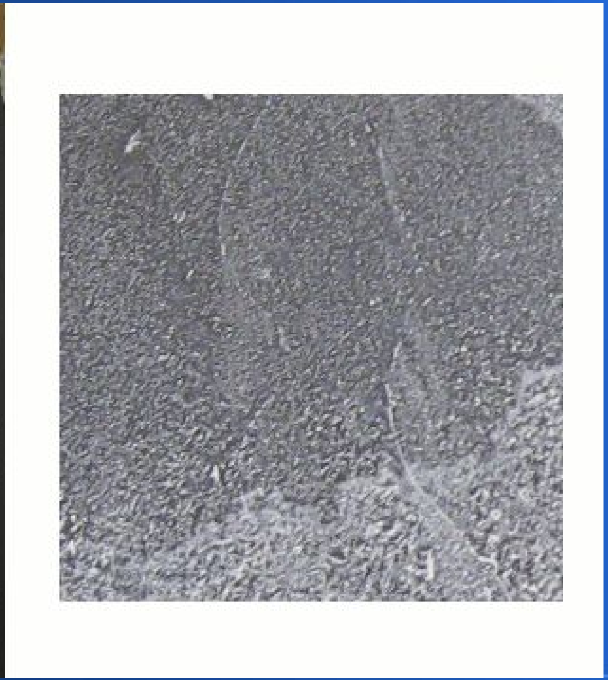
Coating Method

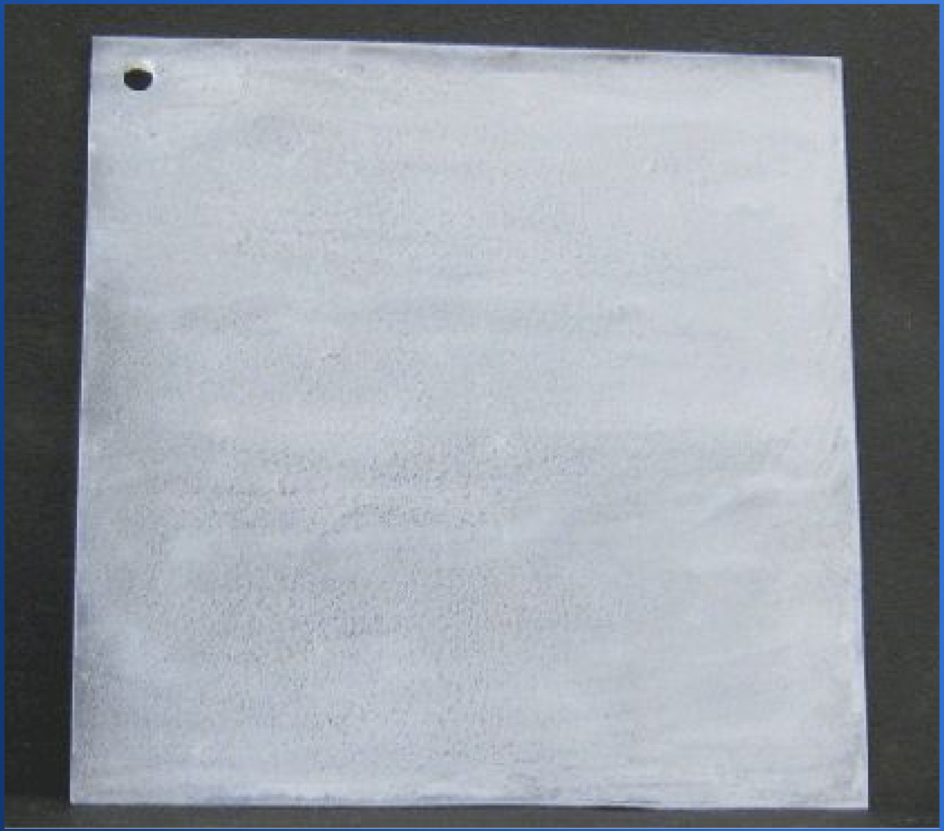
- TPB-PS skin
- Above 33% TPB in the mixture, the TPB will crystallize out of solution.

- 50% TPB – 50% PS mixture (1 g TPB + 1 g PS in 50ml toluene)

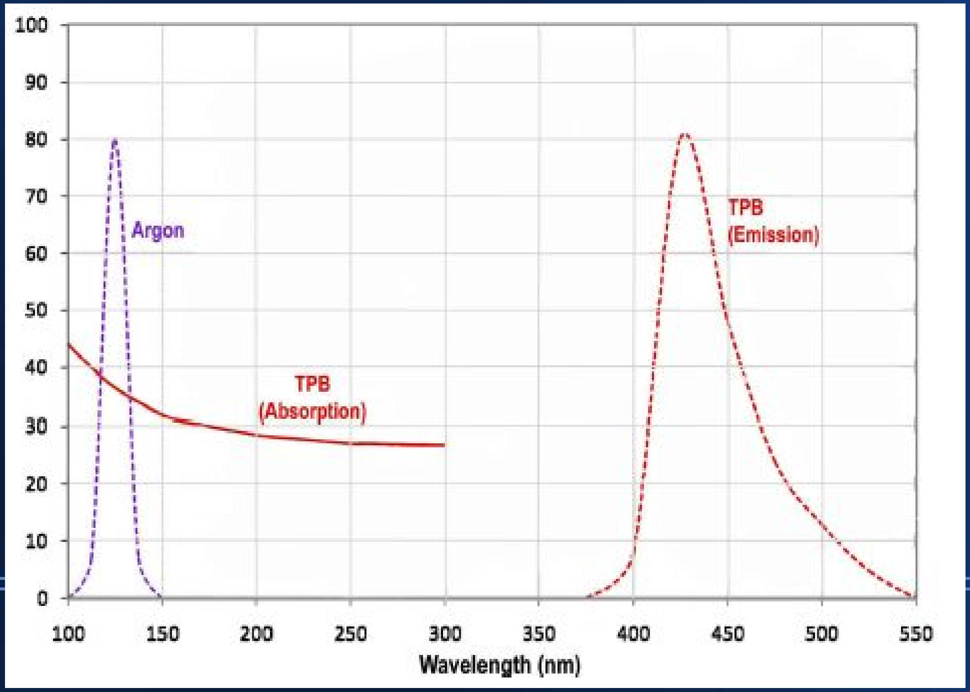
Coating Method

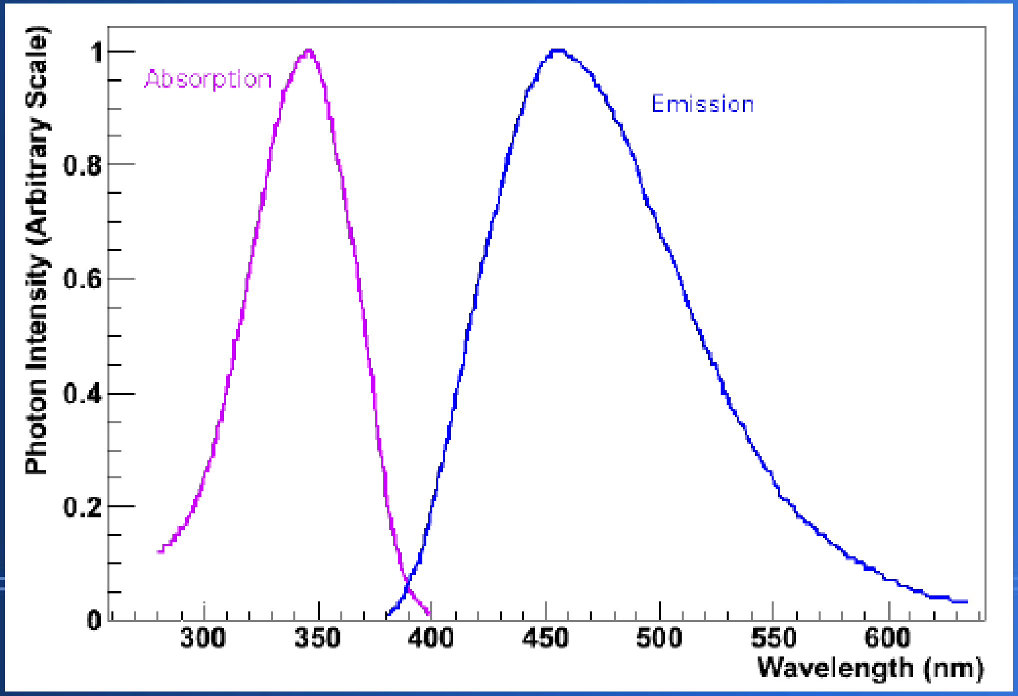
- Adding ethanol to this mixture breaks up the surface tension, making the coating look smooth and uniform
- This also gives a much higher light output than the 33% plates
- Use 3 coats for a more even coating



Why testing at 128nm is important

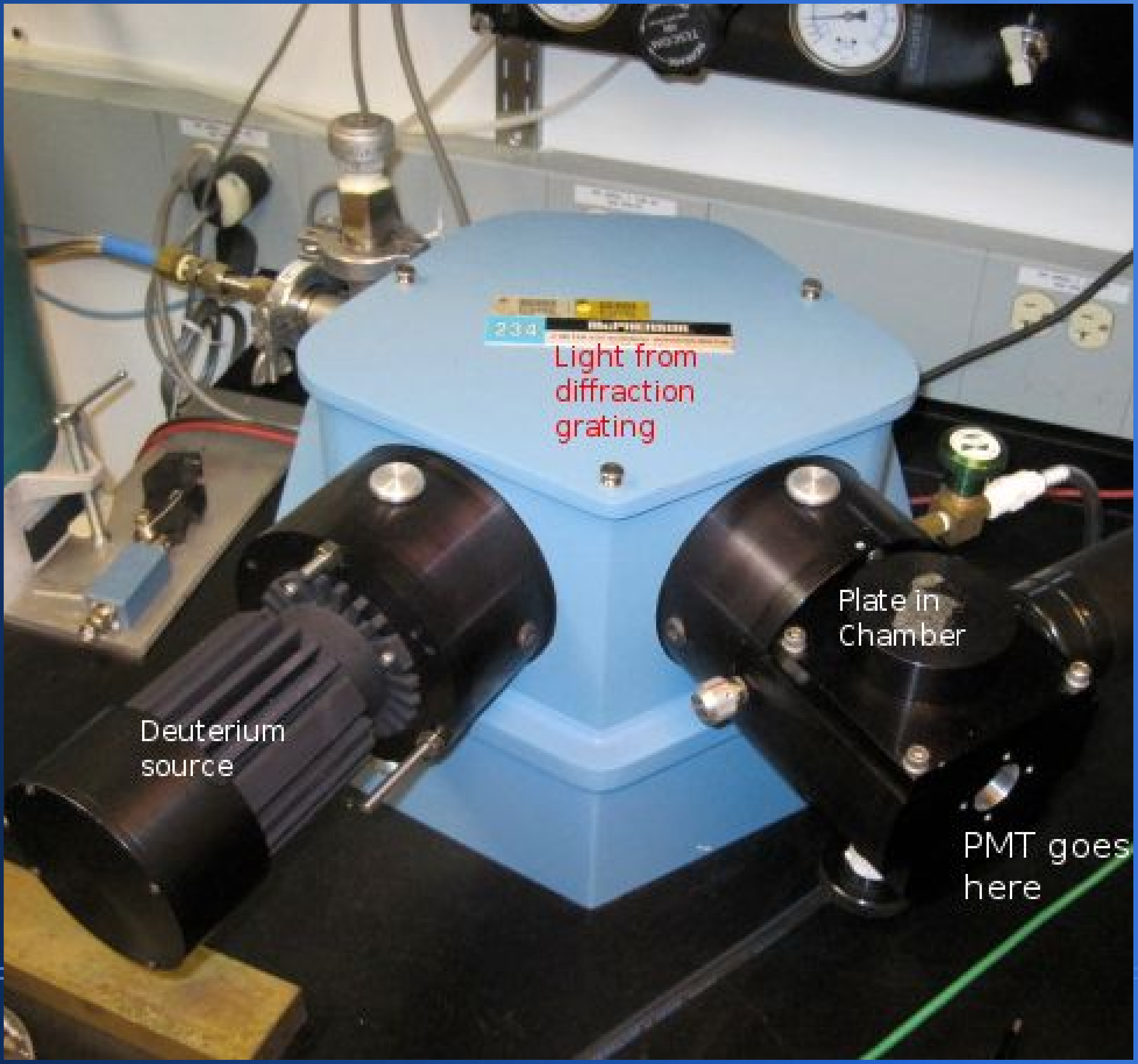
- 255nm light is expected to penetrate TPB-PS coatings more than 128-nm light
- Limited information about absorption and emission efficiency of TPB as a function of the wavelength





Vacuum setup at Fermilab

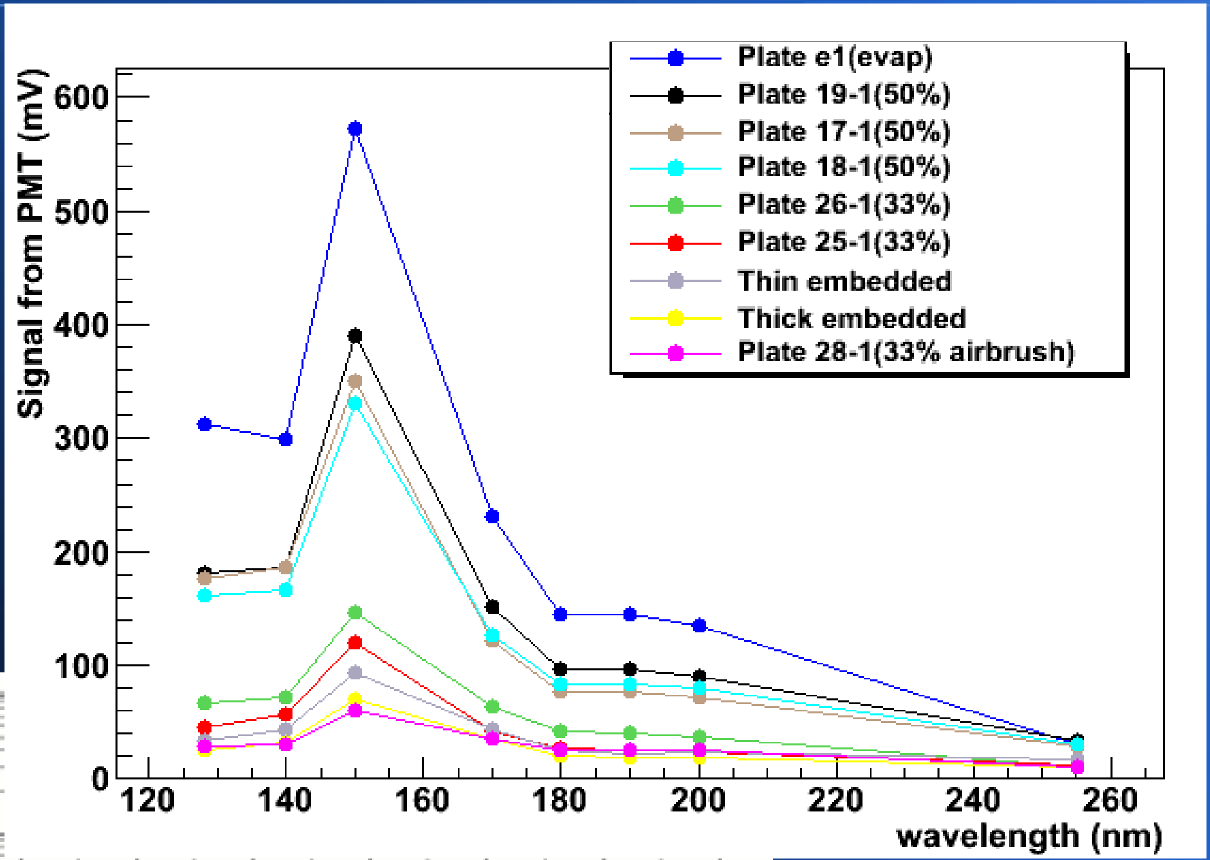
- McPherson 234 vacuum monochrometer
- Light from diffraction grating hits the plate and the output is measured by the PMT on the other side

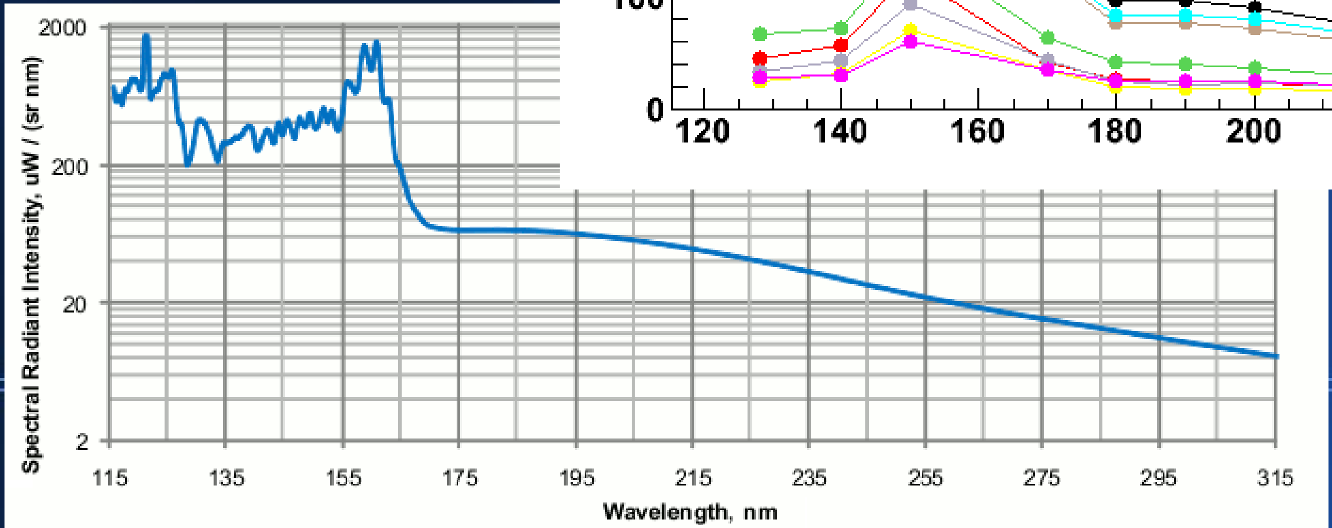


VUV wavelengths Study

- Samples:
  - Three 50% TPB-PS plates
  - Three 33% TPB-PS plates (one with an airbrushed coating)
  - One evaporatively coated plate
  - Two TPB-embedded acrylic plates of different thicknesses.
- Measurements every 10nm from 128 to 200nm and for a variety of plate angles for 128 and 255nm
- Measurements done after all plates have been sitting out for many days (will need to be repeated with dry plates)

Results

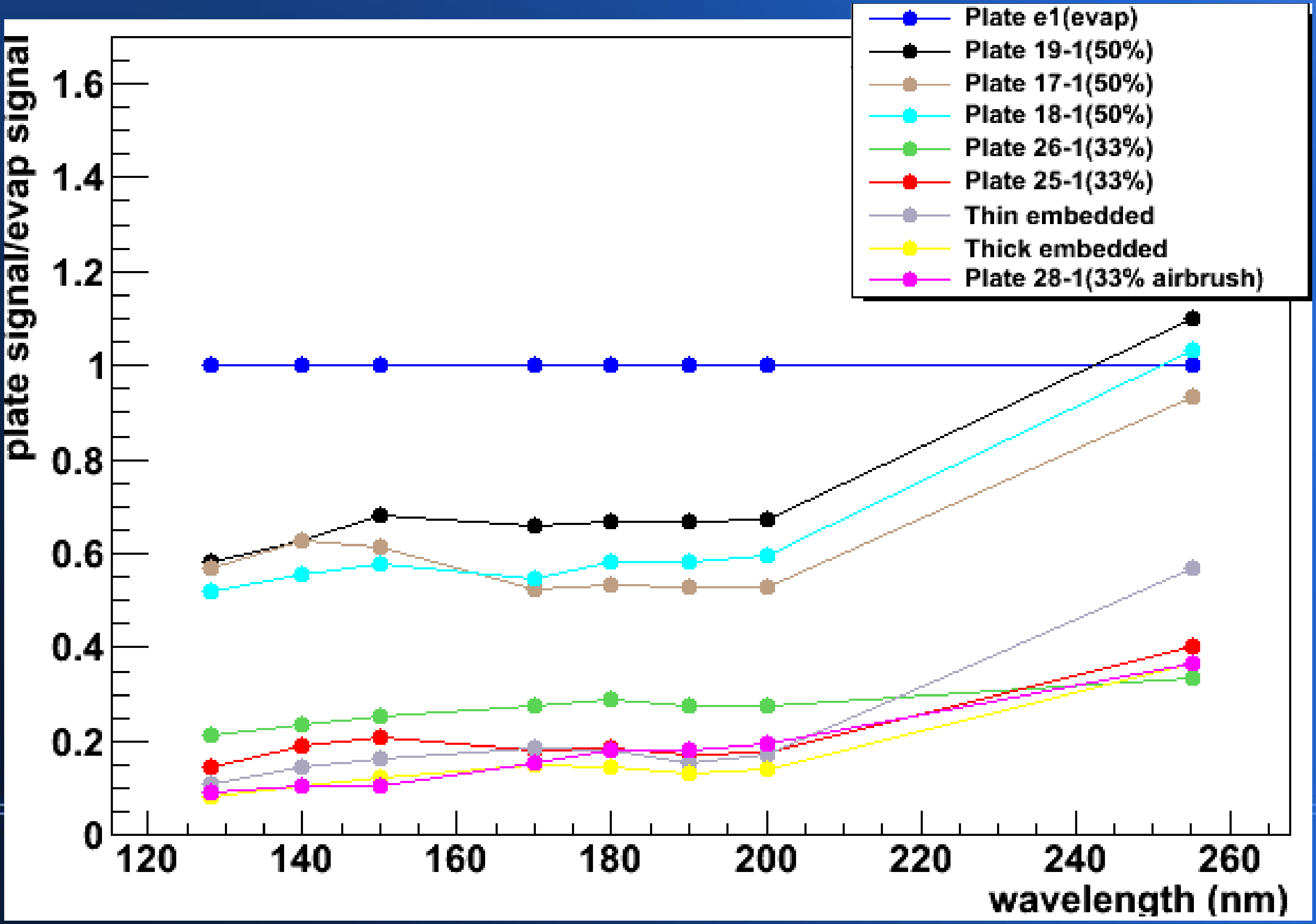




McPherson model 632 UV Deuterium Lamp (Logarithmic scale)

Results

Normalized to evaporatively coated plate



Still planning to use 50% plates

- ~55% light output as evaporative plates at 128nm (preliminary)
  - Better than any of the other options explored
- Seeing “flaking off” of the evaporative coatings in LAr, which reduces light output
  - Consistency in light output is important
  - The evaporative plates are also very expensive to produce

- Easy and inexpensive to produce and test

Backup slides

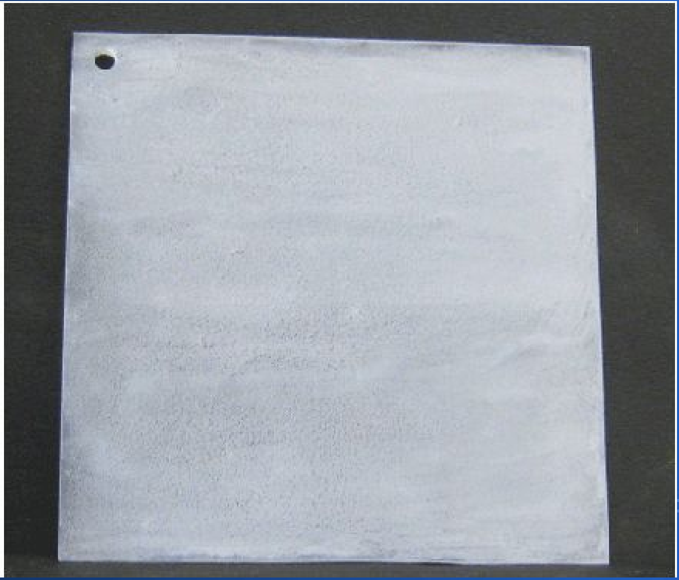
255nm setup at MIT

- Picoquant laser
- Plate slides between light source and PMT from above
- At 255nm, we find that the 50% plates have a response equal to evaporatively coated plates
- The 50% plates have about a factor of 5 more light than the 33% plates
  - Both sets of plates have around the same average coating mass
  - Measurements done with "fresh" plates (no water effects)

1 vs 3 Coats

- This mixture is brushed onto the plate in 3 coats
  - More uniform coating and highest light output
- Some of the TPB ends up on the surface, but adheres well to the PS.
- Plates are wiped after coating to remove any loose TPB, after which they do not degrade further and are very resilient

1 coat

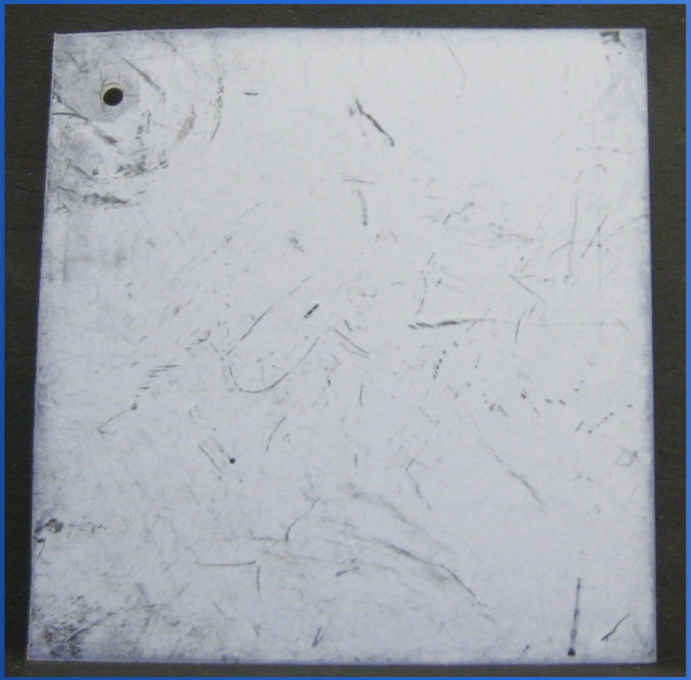


3 coats

Why Not Evaporative Plates?

They are too fragile!

Plate which was put into the displayed brass holder, allowing the central region to be exposed to LAr. Abrasion is clearly visible, and light output is reduced



Evaporative plate after moderate handling during testing (in air)

Water effects

- Water adheres to the TPB coating, reducing the light output of the plates
- We notice that our plates degrade to about a third of their initial light output several days after coating
  - The mass of the plates also goes up during this time
- We plan our own tests to study this in early autumn
- Studies by other groups suggest that this water can be removed by vacuum pumping or putting the plates in a dry environment
- Right now we are allowing our new plates to sit for several days before comparing to evaporatively coated plates

Plate Production and Storage

- We are planning on making the plates next summer
- Production and testing will be quick, easy, and inexpensive
- We plan to store the plates in a cool, dark, argon-filled environment
- We plan to make about 60 plates, where only 30 are needed
- We will test the plates again shortly before mounting so we can either choose plates which have not degraded or choose to make new plates all together
  - They are very inexpensive and easy enough to make to do this

Future work

- Water study
  - Exactly how bad is this effect?
  - Does it affect all of our types of plates the same?
  - Can it be prevented?
  - Can it be reversed (and how exactly)?
- Designing storage unit
- Better statistics for prototype plates at 255nm and vacuum setup