PSEC Collaboration Meeting Agenda
Friday and Saturday Morning, December 9 and 10, 2011: Argonne National

Laboratory 2nd Floor Conference Room (TBC); Bldg. 360

Scaling PMT Alkali Photocathode Recipes to Large Area Transfer Cathode (Chalice)

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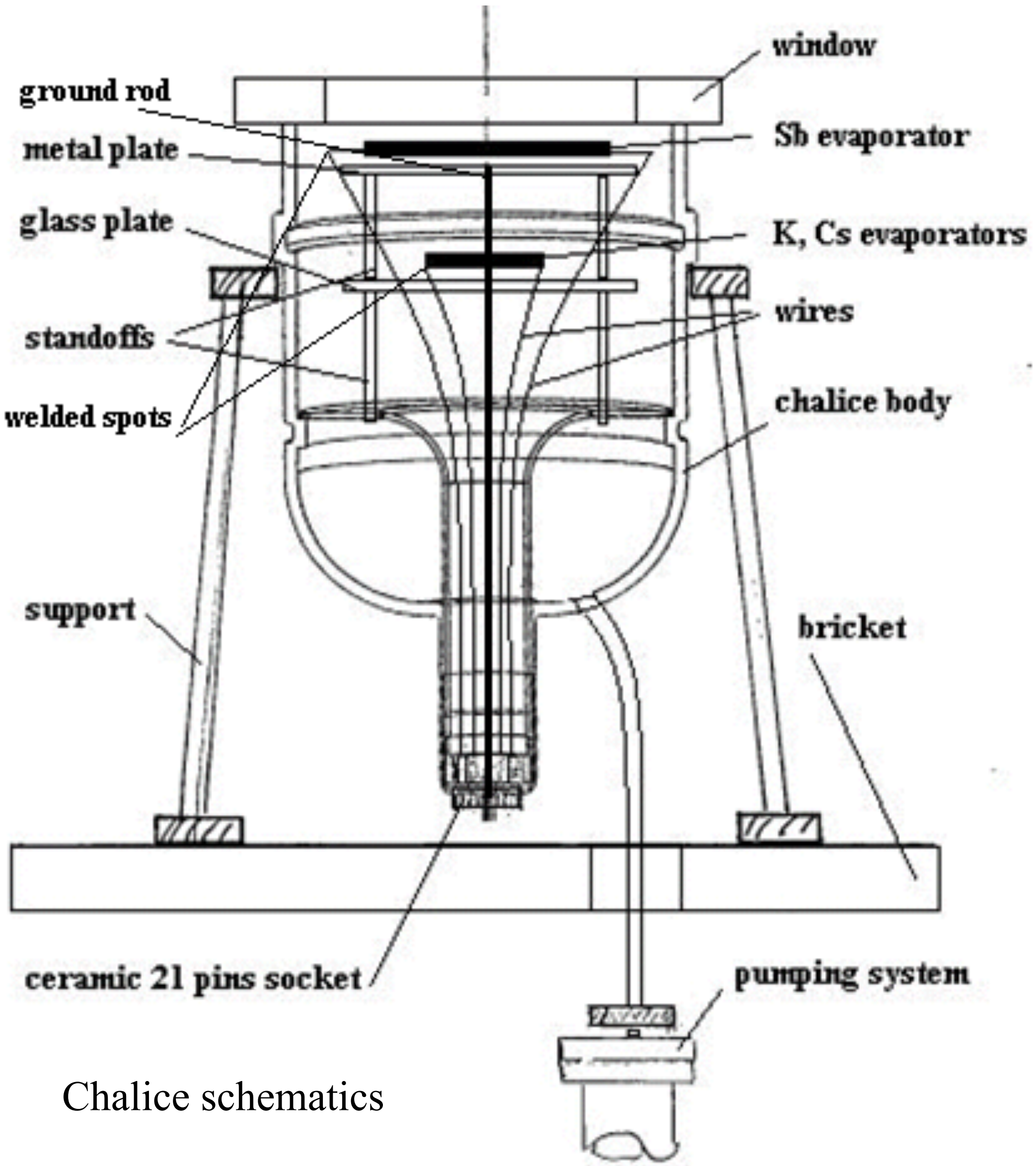
Chalice status, as of Dec.9, 2011

- The chalice main goal is to produce large area (4”x4”) photocathodes (PC).
- Chalice vacuum with cold oven at room temp was $4.8x10^{-8}$ with inner chalice parts.
- RGA placed, hooked up to chalice, shows partial component’s pressures.
- The first approach to start PC making is to eliminate as much as possible not needed inner parts, like screws, nuts, clamps, etc., just for the beginning.
- Spot welder. We decided to complete spot welder test and pass all needed safety and operational issues at FNAL. It is done by Greg Sellberg. The spot welder delivered to Argonne. We will need to pass in Argonne all electrical, safety and training issues, so the welder operation will be totally the ANL responsibility. We have second spot welder as backup.
- PC window electrode wiring. Simple connection proposed. Dean mirrored the chalice window by Al (one side, with 4”x4” transparent part for PC).
- We can start PC making with a few inner parts inside, say, for Sb, K, Cs evaporators, hopefully in 1 weeks. Ed is working on DAQ.
- Chalice temperature range in the oven is up to 350C.

The chalice



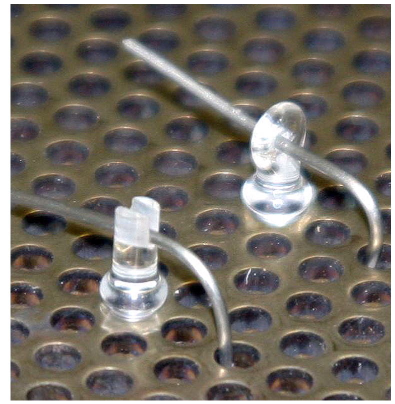
Chalice schematics

Chalice side view

Chalice prototype parts

O-ring side view

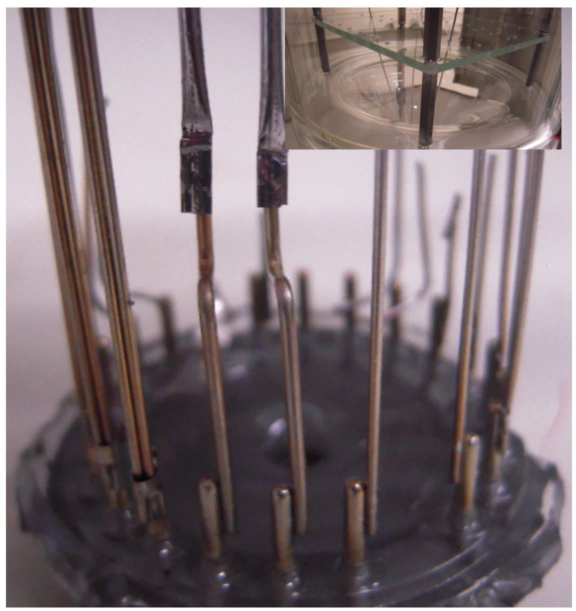
Mirrored PC window with mask



Glass wire support

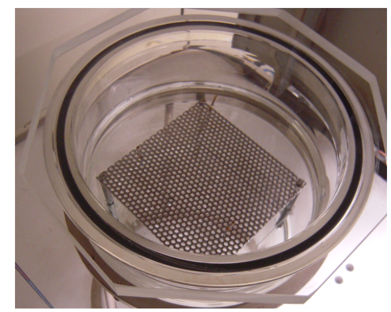
Ceramic 21 pins socket

Mockup of innards

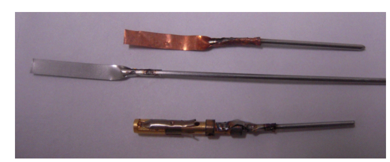


Mockup of spot welding

Chalice side view



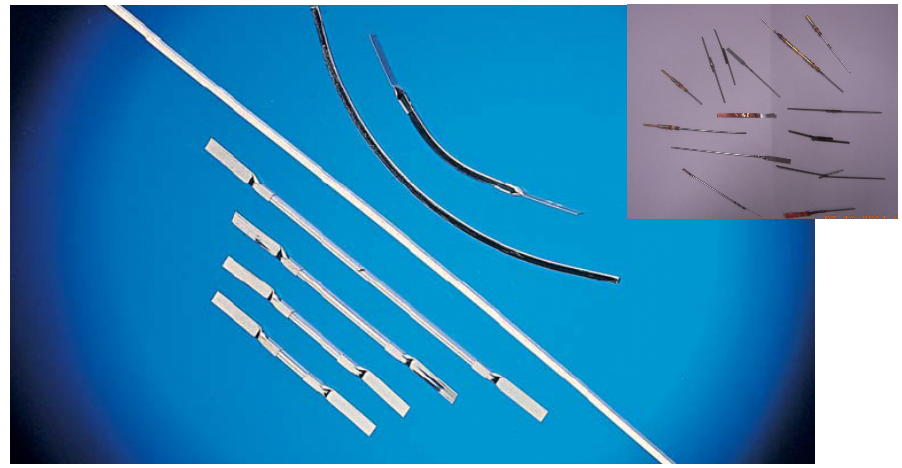
Chalice top view

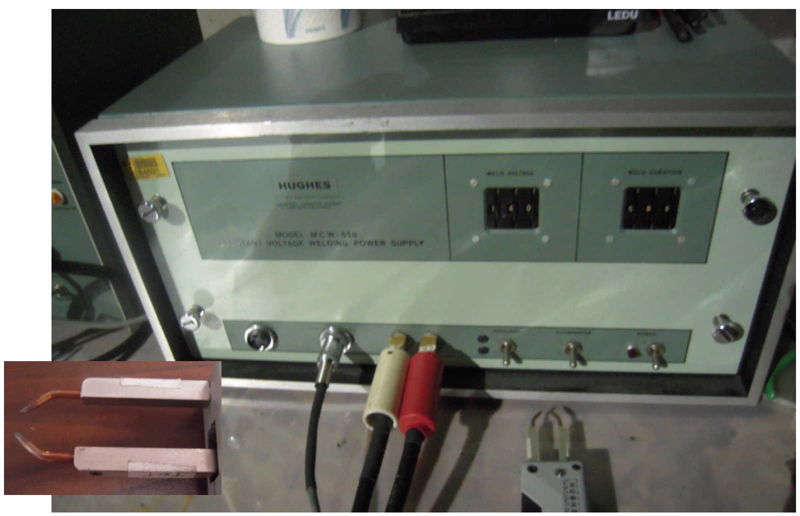


welded samples

Spot welders

Power supply


Alkali Metal Dispensers (from SAES getters)



Hughes MCW-550 Spot Welder

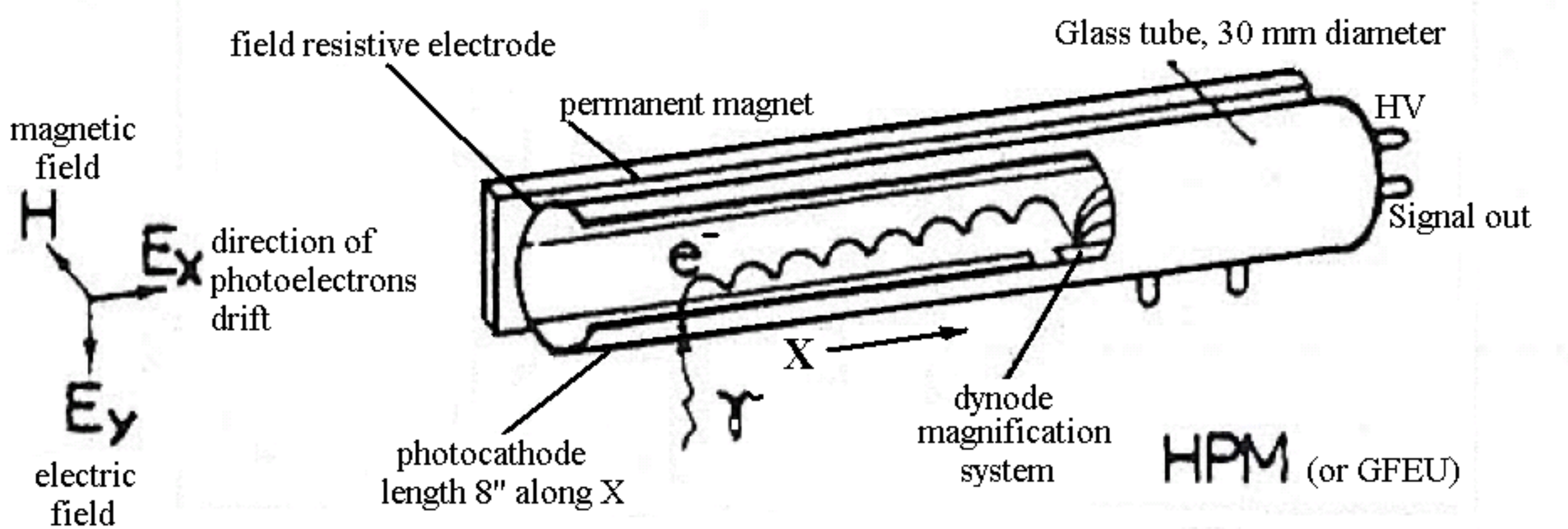
Spot Welder, from Argonne as backup

Few approaches to PC production

- We have a few approaches to make a PCs, (perfect Sommer's experience, also Ozzi, Klaus, Burle (Zikri, Jun) and e.g. GFEU, IHEP, Russia (8'' long PC for position sensitive PMT).
- For the GFEU we have well defined procedure and experience to produce PC. The main steps are cleaning of all components, outgassing, evaporation of Sb, Cs, K and measuring their thicknesses of the thin films, thermal cycles, control and monitoring QE during production, procedure of gettering, level of vacuum we need to keep, etc. The main controlled parameters are: coming out gasses (by RGA), temperature during different phases of PC production, vacuum level, photo current and dark current.
- Zikri and Jun made bialkaly photocathodes at Argonne using Burle equipment, we can repeat, for example, the PC exercises with chalice by using the same equipment/procedure.
- Ed working on DAQ for the PC production in chalice.

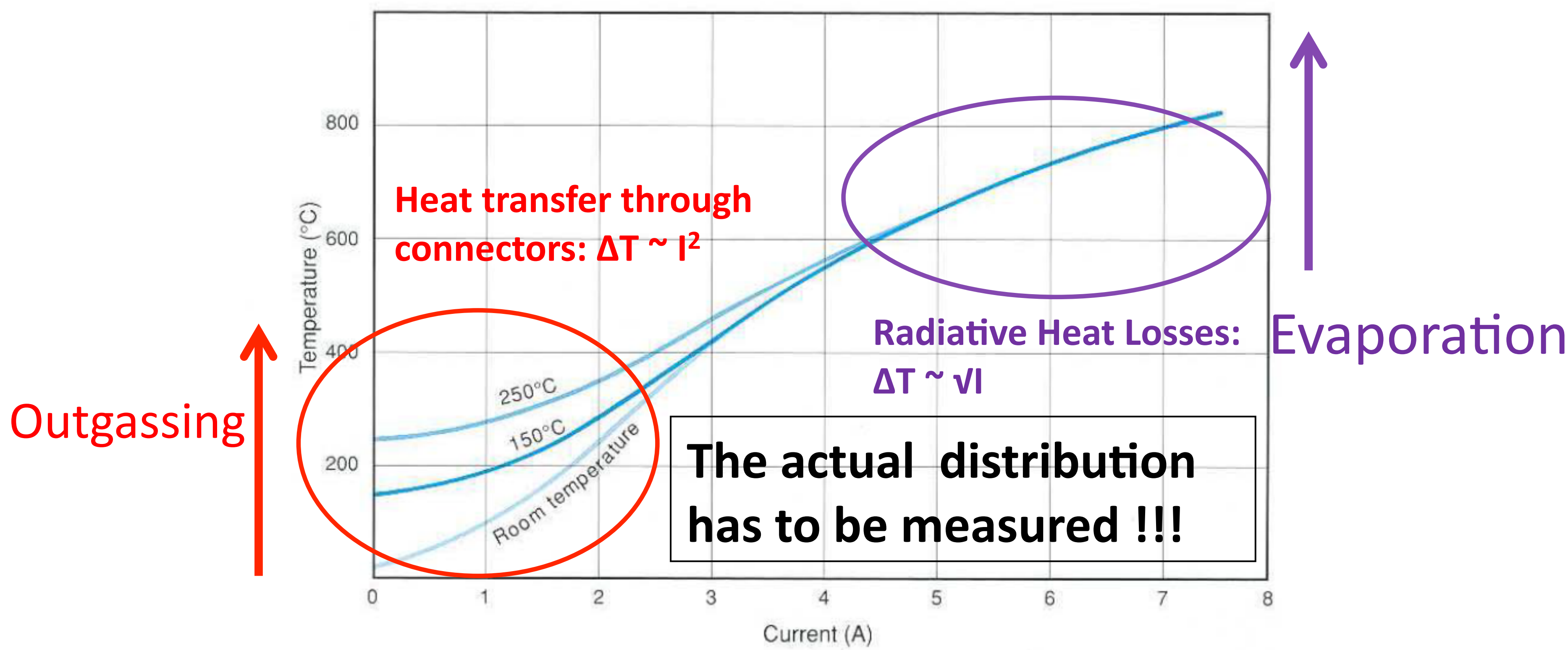
We produced the HPM (PC length is 200 mm) at IHEP, Protvino, Russia in about 15 years, we did bialkaly (KCsSb) photocathodes

Time of flight used for the HPM readout, start - trigger, stop - HPM signal, position resolution along X - 1 mm



Current –substitute of temperature

- Measurement of temperature may be avoided in mass production (chalice):
  - →The evaporation rate can be controlled solely via current
- T-I behavior is expected to be robust during evaporation



Temperature/current curves for alkali dispensers as a function of the tube temperature

Temperature – control parameter

- Temperature-dependent reactions
  - T<500 ^oC -- degassing
  - 550 < T < 850 ^oC – alkali evaporation: mildly exothermic reaction between Zr-Al alloy (St 101, getter) and Me_2Cr0_4 (Me = Cs, Na, K, Rb, and Li)
- The evaporation rate depends on the amount of reactive material (~linearly) and temperature (~exponentially)

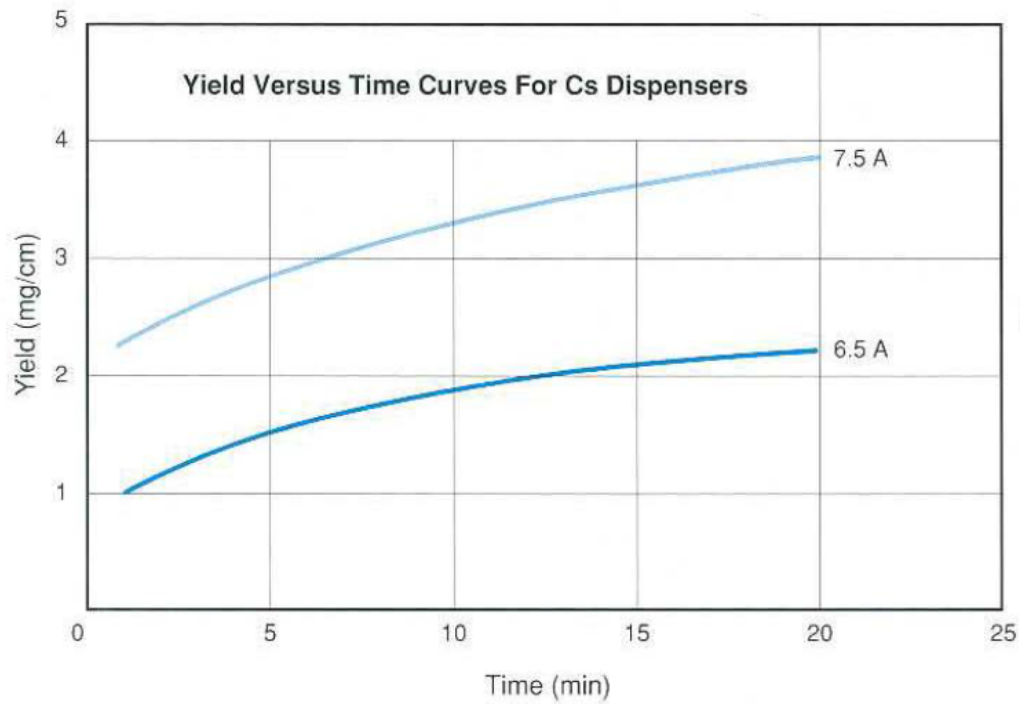


Fig. 2

What we can learn with chalice?

- specify all safety issues before the PC production.
- does the chalice and equipment allow us to make high quality PC, start with CsKSb.
- does used PEEK O-ring fit chalice temperature range.
- does the used DAQ allow to make QC of the PC.
- check different approaches to make PC, starting with standard Burle PC procedure.
- check achievable PC uniformity, define right number and location of evaporators.
- find optimal positions of the evaporators with respect to photocathode.
- define convenient and reliable evaporator‘s wiring/welding, check current design.
- check PC uniformity, define right number and location of evaporators.
- do we need additional layers between window and PC.
- understand the role of plasma discharge for PC production, oxidation?
- try to make different types of PCs (CsKSb, NaKCsSb? etc.?)
- establish temperatures for different phases of the PC production, time of ramping it up and down, optimize time for different phase, define required level of vacuum.
- establish when we must measure PC current and dark current during the production.
- probably upgrade the chalice with separate evaporators insertion from additional volume.

Backup slides