Progress in IHEP

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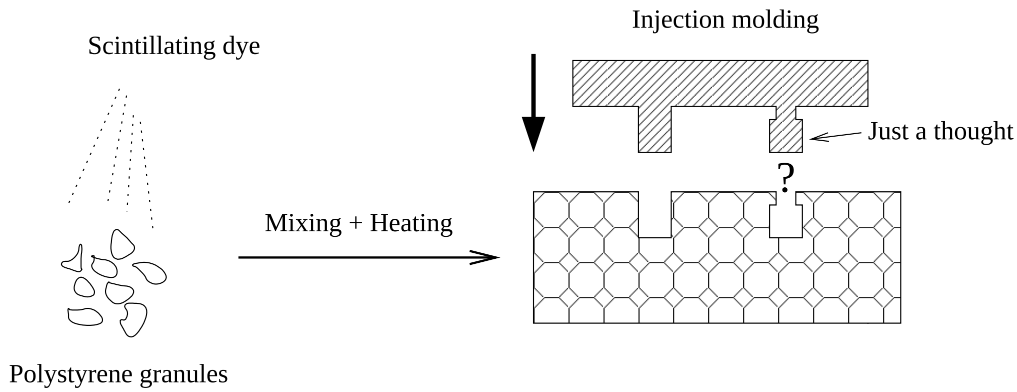
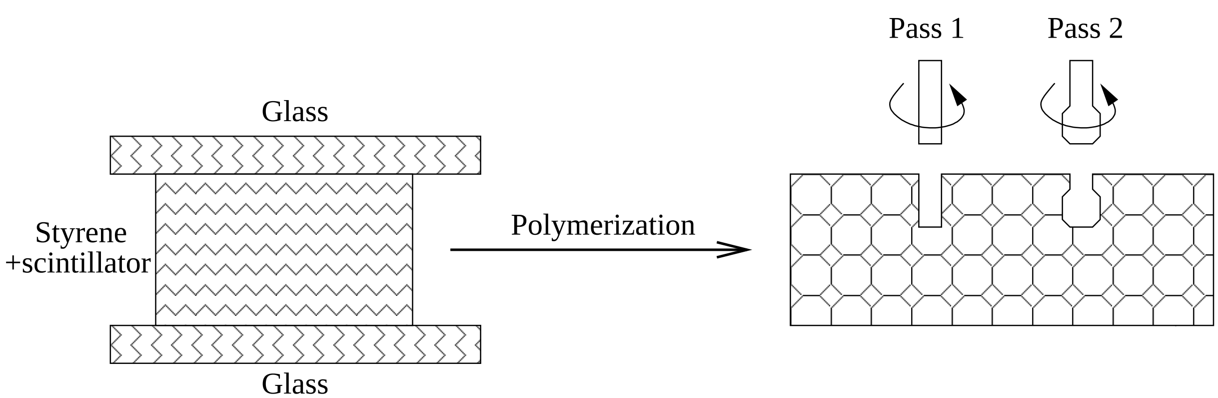
CKM simulation meeting, Fermilab.

Scintillator production technologies



It is possible to start from bulk scintillator which would give you higher quality, but it is more expensive.



Generally polymerization between glasses has higher light yields and attenuation (μ-veto?). But the price is generally higher compared to injection molding.

Production of scintillator in IHEP

IHEP is known for its molded scintillation production for many years. Recently two new molding machines were installed in IHEP allowing them to manufacture tiles up to 650g by weight. Major advantage of having facility in research institute is ability and will to do different R&D tests. Currently facility is using only one of the machines to build KOPIO calorimeter prototype modules. IHEP group are interested in experimental projects having large volumes of molded scintillators.

- Scintillator quality
  - Light yield about 55-57% compared to anthracene. For comparison BC-404 is about 68% (from Bicron catalogue). Note that scinitillator comparisons is not a straight-forward task and is always approximate.
  - Sample to sample differences for manufacturing in IHEP molded scintillators are about RMS<1% (based on KOPIO calorimeter tiles) The geometrical deviation of tile size is about $\sim 50\ \mu m$

- ➥ Attenuation length about $\sim 0.5\ m$. It dependends on the type of covering: mylar, tyvek etc . . .

- ❍ Production capabilities are function of scintillator shape and size. For big and complicated shapes it would take $\sim 3\ min$ to produce one scintillator tile. CKM type scintillator tiles can be produced on large machine.

- ❍ IHEP can also produce mold for CKM-shape scintillators. Mold would have surface quality of 12-13 class which is adequate for plastics. Typical mold survives about 5×10^5 cycles.

  - ➥ IHEP needs few months to build the mold.
  - ➥ IHEP successfully designed and used mold for PHENIX experiment at BNL.

- ❍ Plan to install extrusion production line to produce $650 \times 5 - 10\ mm^2$ plates. Length up to 12 meters.

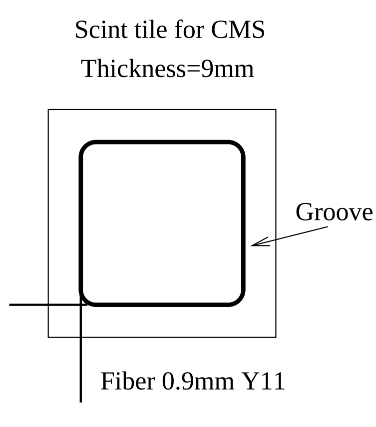
- ❍ IHEP group thinks that they can construct and ship the whole CKM VVS module. They express interest in perfoming all works connected with assemby, shipment, mounting etc. . . , provided that all the necessary documentation is worked out by the CKM-collaboration.

- In IHEP large facilities and trained personnel are available.
- Prior experience: shipment of PHENIX supermodules to BNL by the sea: size $70 \times 70 \times 50\ cm^3$, weight $800\ kg$.
- Cost evaluation can be done.

- IHEP group expressed interest in building and testing of 1/8 of CKM VVS module. At the moment fraction of CKM VVS module is being assembled and the electron beam is being tuned for measurement of this module characteristics. For faster completion of the project several components are needed. The IHEP group is very interested in Fermilab reference scintillator with wavelength shifting fibers, PMT , etc

Production of scintillator in Kharkov

- Kharkov has a large facility "Monokristall" which has several technologies to produce scintillators:
  - Polymerization between glasses (was recommended)
  - Polymerization in blocks
  - Injection molding machines similar to IHEP
- Currently Kharkov is finishing project to build scintillator for CMS detector. 24000 tiles were produced and tested with 1.5 years. Two types of scintillator were used: SCSN81 (Kurarary Japan) and radiation hard scintillator produced in Kharkov. Kharkov scintillator turned out to be better (light yield, attenuation)



- Light yield from CMS tile (Kharkov) = 10-12 p.e. from 2 fibers for 9mm thick plastic.

- IHEP group (Zaychenko, Kryshkin and others) is actively collaborating with Kharkov and establishes R&D studies, scintillator testing and quality control for produced scintillators. IHEP group expressed interest in joining CKM.

- Kharkov + IHEP group expressed interest in building and testing of the module (20 layers of Pb/scintillator + mirrored fibers). They need design specs and would build it within few months. They say that they have all the necessary components to do that.

Fiber Time-stamp detector

Alexander Gorin and his group has built several detectors for CERN experiments

- Fibers: SCSF-78M $\phi = 0.58\ mm$, SCSF-38M $\phi = 0.5\ mm$. Light yields are about $2 - 3\ p.e.$ per fiber. Mirroring can increase the light yield but degrade time resolution.

- Readout: 16 channel photomultiplier. 64-channel PM are not there yet: higher price per channel, small pads, big cross talk, generally harder to work with. Comments about VLPC
  - Need fast amplifier about 10^3. Not a trivial task for high-rate experiments even in liquid helium environment.
  - Avalanche from each photoelectron creates dead region about $\phi \simeq 6\mu m$ which is insensitive for several ms. (Here BobT noted that CDF studies showed that VLPC can survive high rates)

- Performance:

- Time resolution 0.6 ns
- High rate tests: $200\ MHz$ μ-beam through $4 \times 4\, cm^2$ area or $13\ MHz/cm^2$. For comparison CKM $1\ MHz/cm^2$
- Deadtime is driven by electronic readout, not detector by itself. About $13\, ns$ given by discriminator. It is possible to go down to $5\, ns$.

- Problems:
  - Photocathod uniformity
  - similar to all PM: large pulses due to ion feedback. 1 pad can be dead. Rate is about $\sim 10 - 10^2 Hz$

Electron test beam

- There already are electron beams in IHEP. BTeV Ecal is studied by A.Vasiliev group. But their requirements are quite different from ours.

- Special test beam area to study $1 - 5\ GeV$ $e^-\ e^+$beams. Production inside U-70 main ring, and special channel to guide electrons out. Chrenkov, PWC and sintillators are going to be used to tag electrons.

- Test beam is about to be started (December 20)
  - Beam composition
  - Sources of noises
  - Electron tagging efficiency

- In March this beam is going to be used to study 20 layers of Pb/Scint *"supertile"*. All pieces with CKM design sizes are already in place.

OKA experiment progress

- OKA experiment goal is to measure CP-assymetries in K^+, K^- , search for non-SM formfactors in kaon decays and study different *"mid-rare"* charged kaon decays.
  - Kaon beam is produced with 2 SCRF cavities built in CERN that are currently undergoing studies in IHEP.
  - This experiment has many similarities to CKM and could be a perfect testing groung to check CKM designs.
  - Also many people who work on OKA has joined CKM
- SCRF test is planned on end of January
  - Test RF quality.
  - Test superconductor stability
  - No beam test yet.
- OKA proposal is due to January
- Possible cooperation on front-end electronics

Kaon physics results from IHEP

Preliminary result on semileptonic K^- decays was announced by ISTRA experiment. About 100000 events were tested to look for non-standard model contributions to decay form-factor. No scalar or tensor contributions were found. They establish the best limit (contributions $< 1\%$) in charged kaon decays.

Administrative efforts for Fermilab-IHEP collaboration

Currently more serious studies are required for TDR to establish design specs of the CKM. IHEP provided big help in writing CKM proposal and is eager to continue this effort. Many studies would require transportation of certain apparatus from/to IHEP. Also financial transactions will be required to buy certain things. All of that requires formal document that declares collaboration on CKM experiment between IHEP and Protvino.

Vladimir Obraztsov has form for such an agreement and needs a letter from Peter and Bob to start this process. It would take about a month to prepare and sign the agreement.

Many people expressed concerns that active and well-organized work on CKM proposal switched to almost zero activities since CKM was approved.