How Can One Support Scientists to Optimise Their Work With Industrial Partners

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What are the main conditrions for successful cooperation with industry?

- Distinct differences exist between the academic institutions and industry:
- Usually academic istitutions are well-off with research capabilities, finances, time, well-equipped special laboratories and instrumentation
- In contrary, a typical Industrial partner can afford only very few researchers and rather inferior instrumentation (it is expensive to keep non-producing people)
- Sometimes a person/group from an academic institution thinks that he/she/they have a good idea and wonder why the possible industrial partners do not „jump“ on it?

How to achieve a good cooperation with industry?

- The explanation is simple: the industrial partners „jump“ on a new idea(s) (are motivated) either if
  - They see a commercial potential or, in the case of doubt,
  - The cost for the tries should be supplied from outside (limiting their own investment „losses“)
- About photo sensors: the academic institutions make only

  3-5% effect in the total sells of companies; we are not in their mainstream.

  It is true that the big projects from time to time put large orders but these are happening only occasionally
- For photo sensors the center of gravity are the medical applications (PET, Gamma cameras, +life-sciences,...)

The best way of cooperating with industrial partners

- Start a specific development program that has some financial support (or at least some promise)
- Look for proper industrial partners who think they may want (are interested) to launch a novel product
- Do some work sharing: the R&D part can usually be initiated and in part carried out by the academic institutions
- The industrial partner starts recommended/agreed upon tests
- Try to see if there is a room for organizing a (friendly) competition among different industrial partners
- On the next slides I want to show a few examples

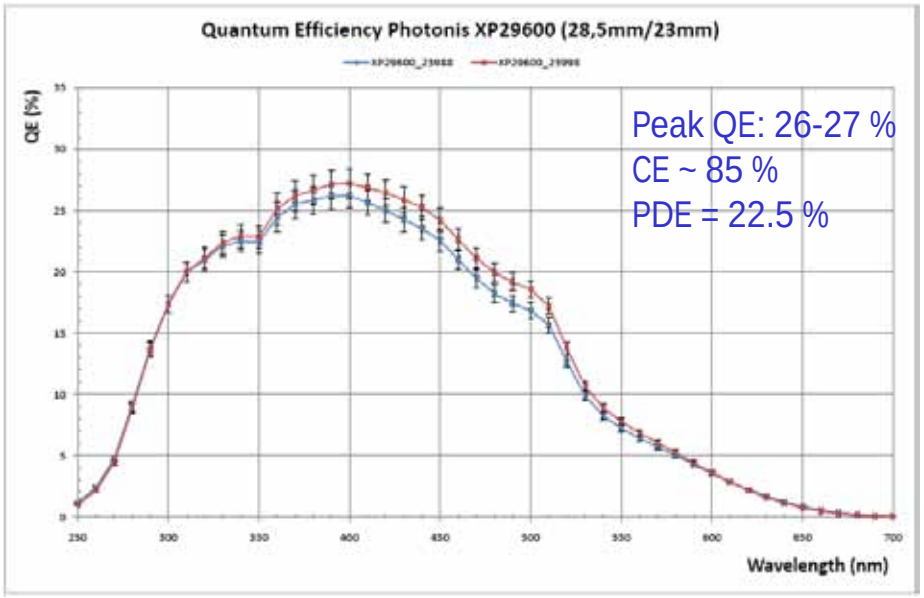
Development of PMTs for CTA

Hamamatsu 4 years ago

Hamamatsu-recent

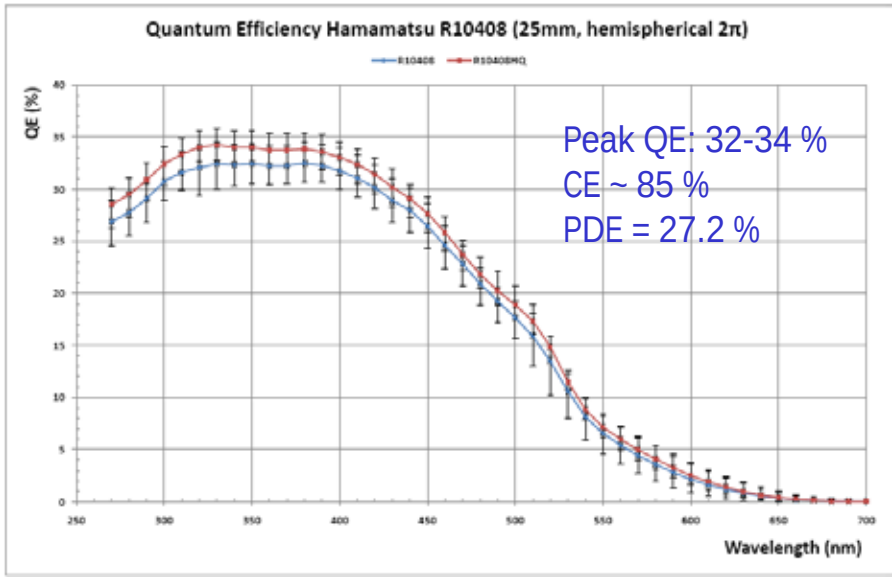
Electron Tubes Enterprises test PMT

Some background information



- On the left one can see the typical quantum efficiency (QE) of PMTs (from Photonis) used in the H.E.S.S. project
- The peak QE is in the range of 25-27%, CE ~85%
- This was the QE level of PMTs since 1960‘s

Some background information



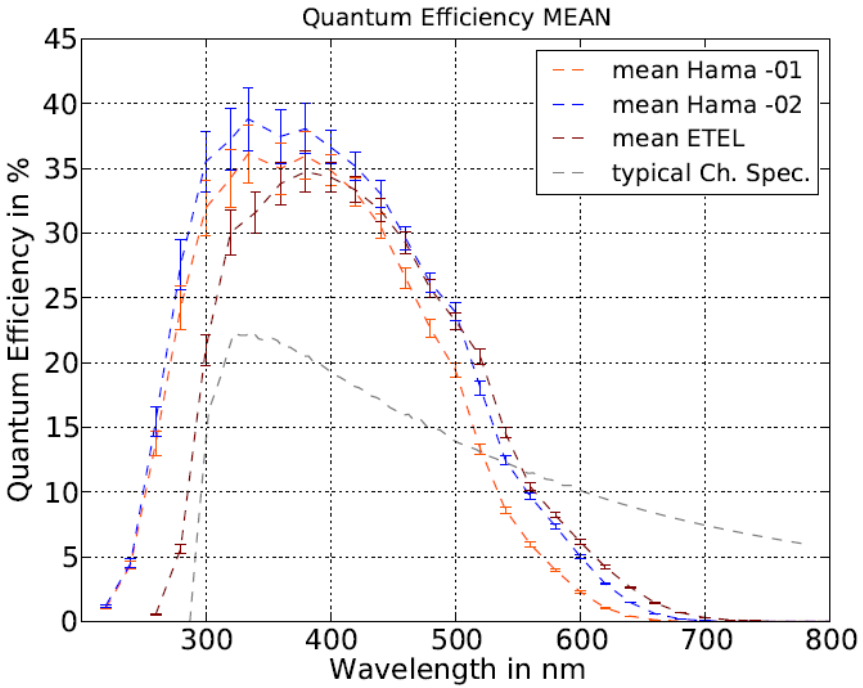
Later on these PMTs have got the name “Superbialkali”

- In 2004-2008 we have developed a program for enhanicing the QE, primarily for using in the MAGIC IACTs
- Working with industrial partners *Photonis*, *Electron Tubes* and *Hamamatsu* the QE of bialkali PMTs was enhanced towards 32-34%
- Note that the collection efficiency of ph.e. was still only ~85%

Photosensors for CTA

- When the CTA project started the Focal Plane Instrumentation working group asked the consortium for some funds for further development of PMTs
- A very modest level funding became available through the Preparatory Phase funding of CTA
- About four years ago we launched a new program for further improving the PMTs
- Today we face an improvement of
  - ph.e. collection efficiency from 85% à 95%, as well as
  - the QE has further increased towards ~40%
  - Afterpulsing level has been reduced from a typical 0.3% à 0.02%

PMT candidates for the CTA



- Both *Electron Tubes Enterprises* (England) and *Hamamatsu* (Japan) have made a big progress.
- The average QE level moved towards 40%
- The ph.e. CE moved towards 95-98%
- Compared to H.E.S.S. already with these tubes one gets +50% enhancement

Recent strong boost of QE à 45 %

(See how the company met our request of a minimum 32% peak QE)

Peak Q.E.

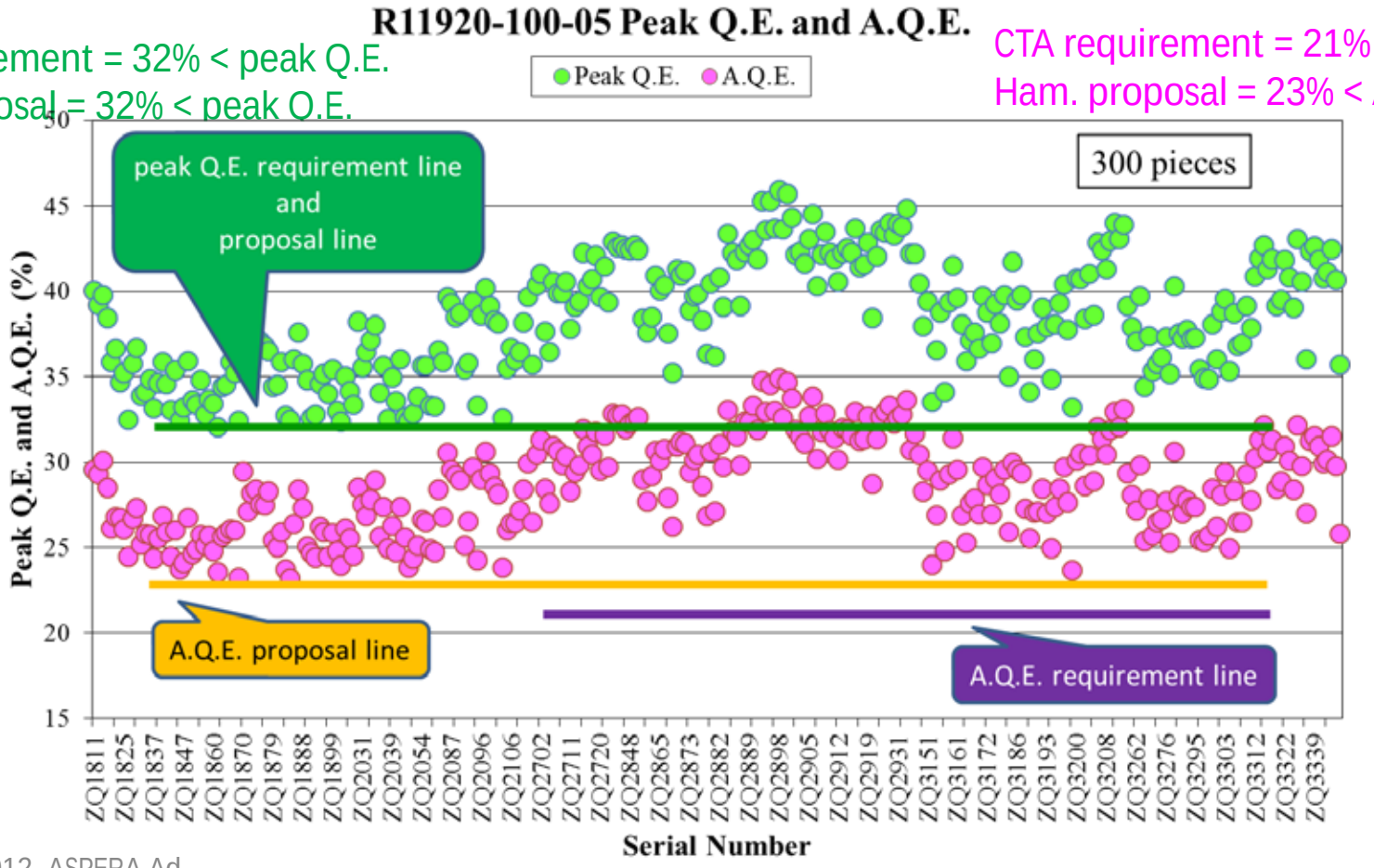
Average QE over Cherenkov spectrum (290nm-600nm)

CTA requirement = 32% < peak Q.E.

Ham. proposal = 32% < peak Q.E.

CTA requirement = 21% < A.Q.E.

Ham. proposal = 23% < A.Q.E.



After Pulsing for threshold 4 p.e. (Light Emission) MPI measurement result

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2.3.1 Set-Up

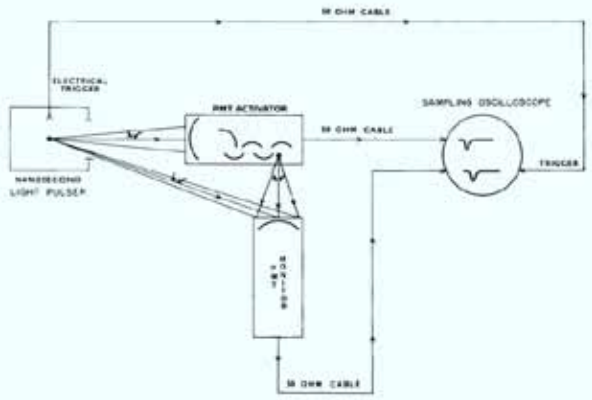
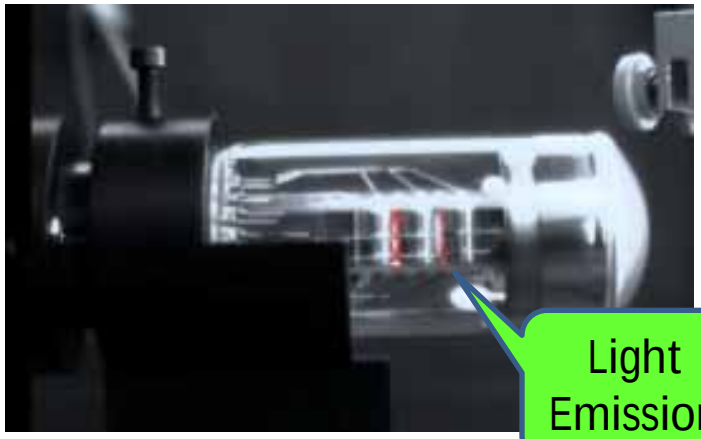


Figure 2.2: The photomultiplier dynode glow test apparatus, sketch adapted from [10]



2.3.3 Results

A screen capture of the oscilloscope with more than 200 million
Fig.2.3. The individual peaks on the activator photomultiplier ar

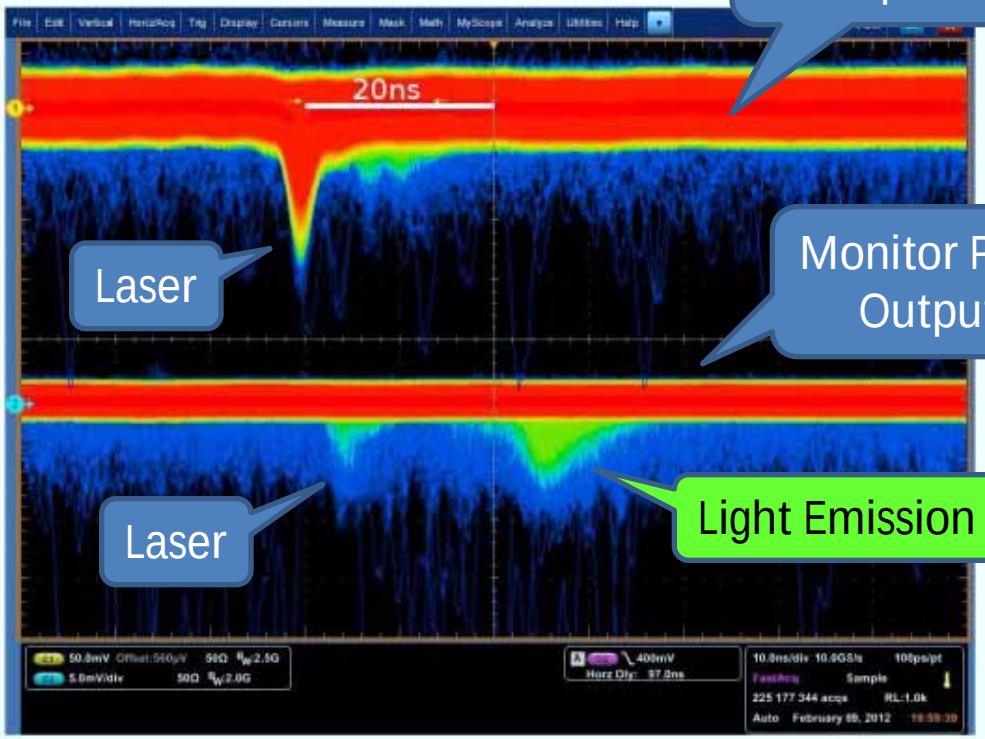


Figure 2.3: Measurement of the activator photomultiplier (top) and the monitor photomultiplier (bottom).

After Pulsing for threshold 4 p.e. (Light Emission) HAMAMATSU measurement result

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„The show must go on“

- The last word for the PMT QE is not yet said, we are moving towards the 50% peak QE
- Everybody will profit from this, also we as human beings, people undergoing nuclear medicine treatment;
  with better sensors they could be exposed to lower radiation doses and in shorter times, this is less risk for health
- Now we are planning to setup a similar improvement program with novel *SiPM*; they have a big potential to be used almost everywhere, also in CTA we are considering to use them
- Financial support for academic institutions for hardware developments can pay-off, can allow one to make big steps ↑
  In its absense the good ideas can simply be lost or the interested industries may license them, often with the goal of not using them but also not allowing nobody else to use them

ASPERA Photosensor Fora

- The ASPERA photo sensor fora were very useful, they have brought together and closer the academic institutions and the industrial partners
- This initiative should be continued until reliable mechanisms could be developed on how to launch optimal cooperation
- We will benefit a lot if a special review-panel will be created on national/international level(s) for evaluating financial applications for co-development work, just similar to how the scientific projects are evaluated
- This will make developments in scientific projects more transparent, straightforward and efficient, to the benefit of all