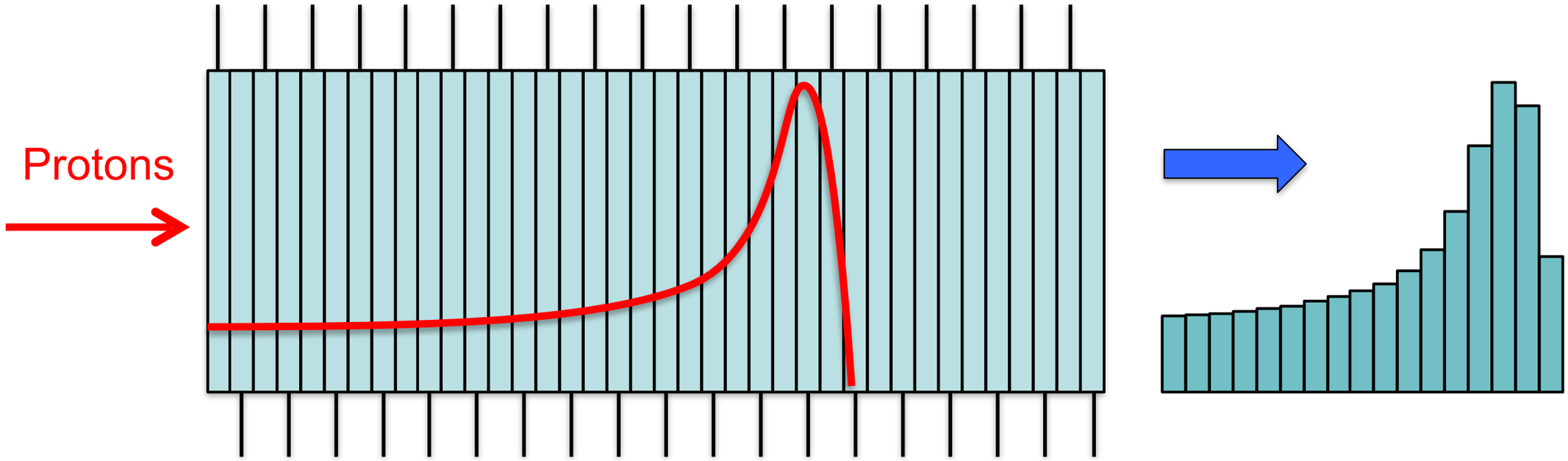
UCL Proton Therapy Quality Assurance Range Detector Commercialisation

Proposed QA Range Detector



- **Segmented Plastic Range Detector:**
  - Segment block into slices and read out light from each slice individually.
  - Integrate signal from many protons: intensity for each sheet.
  - Fit quenched Bragg curve to this data.
  - Reconstruct actual Bragg peak and Water Equivalent Path Length (WEPL)

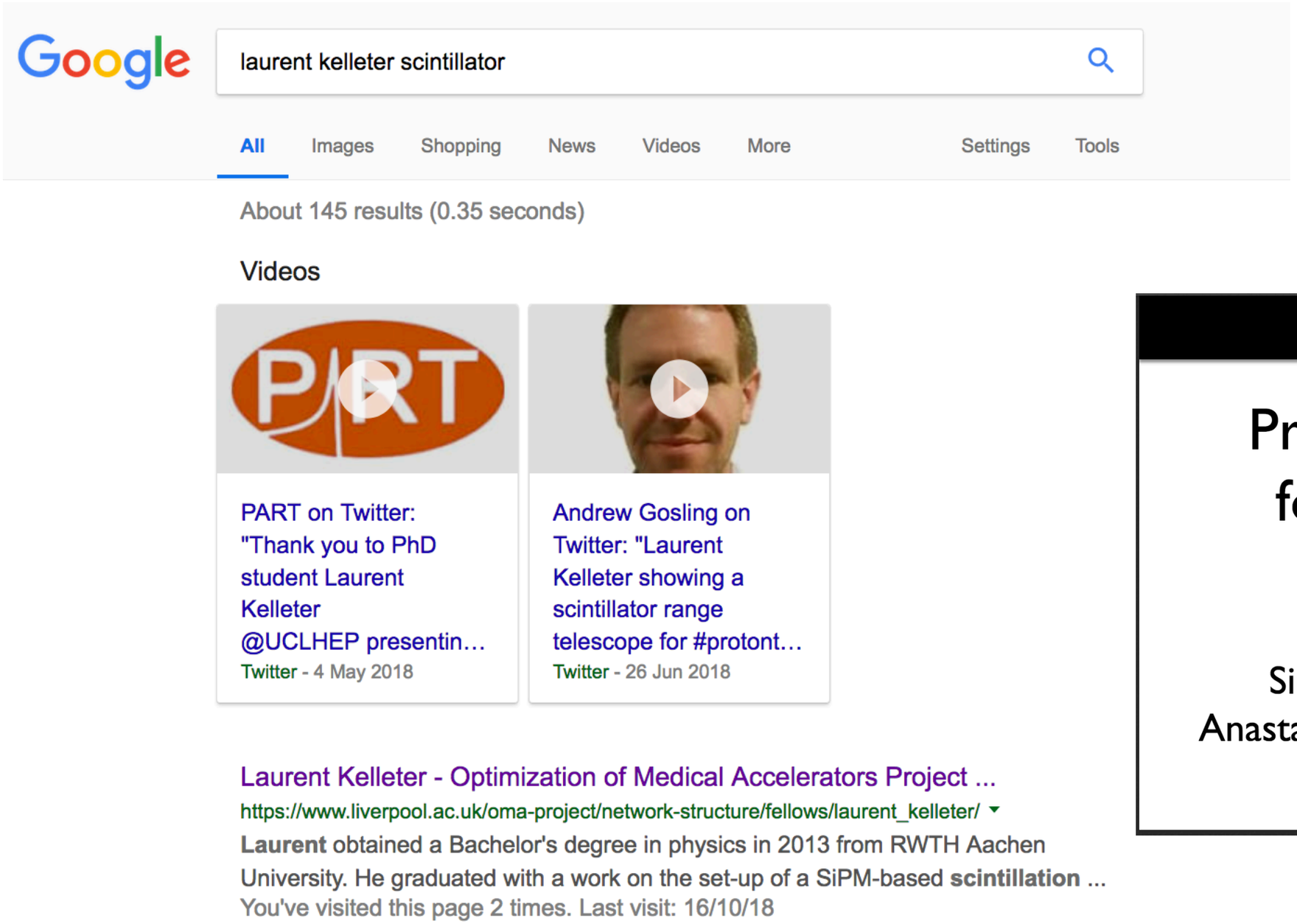
Conditions of patentability

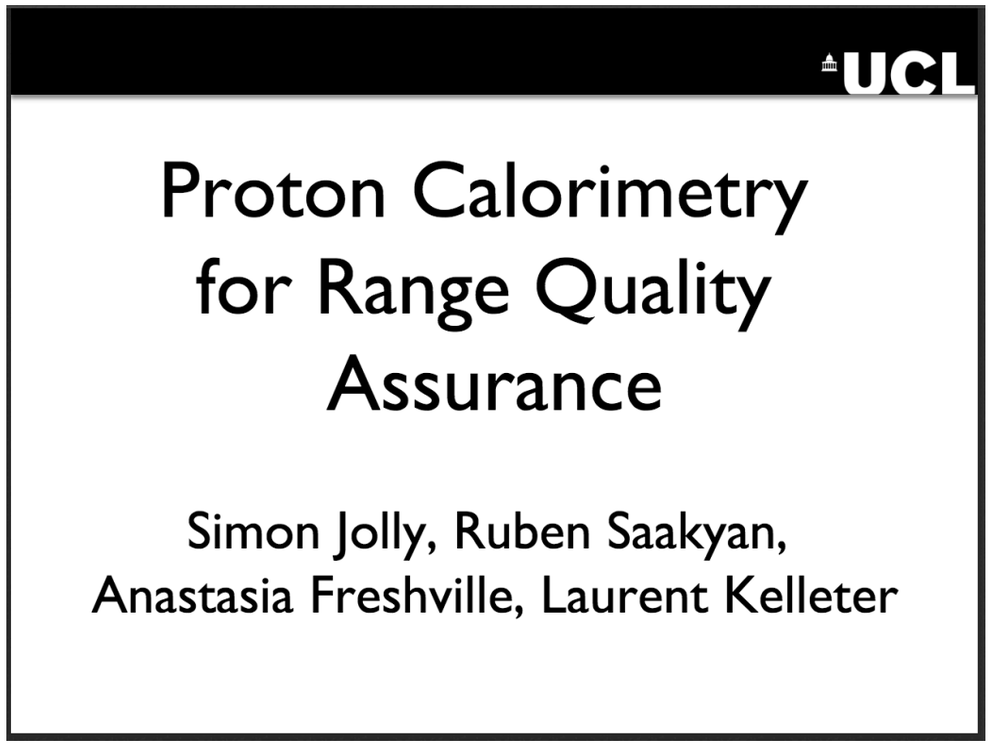
- An invention must meet several criteria if it is to be eligible for patent protection.
  - the invention must be **industrially applicable (useful)**,
  - it **must be new (novel)**,
  - it must exhibit a **sufficient "inventive step" (be non-obvious)**,
- the **disclosure of the invention in the patent application** must meet certain standards.

Novelty

- Undisputed condition of patentability
- **An invention is new if it is not anticipated by the prior art**
  - prior art is all the knowledge that existed **prior to the relevant filing or priority date** of a patent application, whether it existed by way of written or oral disclosure
  - The **disclosure of an invention** so that it becomes part of the prior art may take place:
    - by a description of the invention **in a published writing**
    - by a description of the invention **in spoken words** uttered in public (oral disclosure)
    - by the **use of the invention in public**

Oral disclosure ?





Googling: Simon Jolly scintillator

- http://www.pprig.co.uk/pprig/meetings/docs/20161201-02_pprig_workshop/6-jolly.pdf
- https://stfc.ukri.org/files/accelerators-in-the-uk-proton-therapy-centres/
- https://indico.cern.ch/event/654712/contributions/2666034/attachments/1531773/2397743/SJ_STFCDetectors_ProCal_25-09-17.pdf

Novelty

- A document will only destroy the novelty if the patent subject matter is explicitly contained in the document
- **Lack of novelty if the publication by itself contains all the characteristics of the patent claims**

Is the novelty condition addressed in our case?

Inventive Step

- **Whether or not the invention would have been obvious to a person having ordinary skill in the art**
- "inventive step" conveys the idea that it is not enough that the claimed invention is different from the state of the art (new) but that:
  - it must be inventive, **result of a creative idea**
  - there must be a clearly identifiable difference between the state of the art and the claimed invention (**advance or progress**)

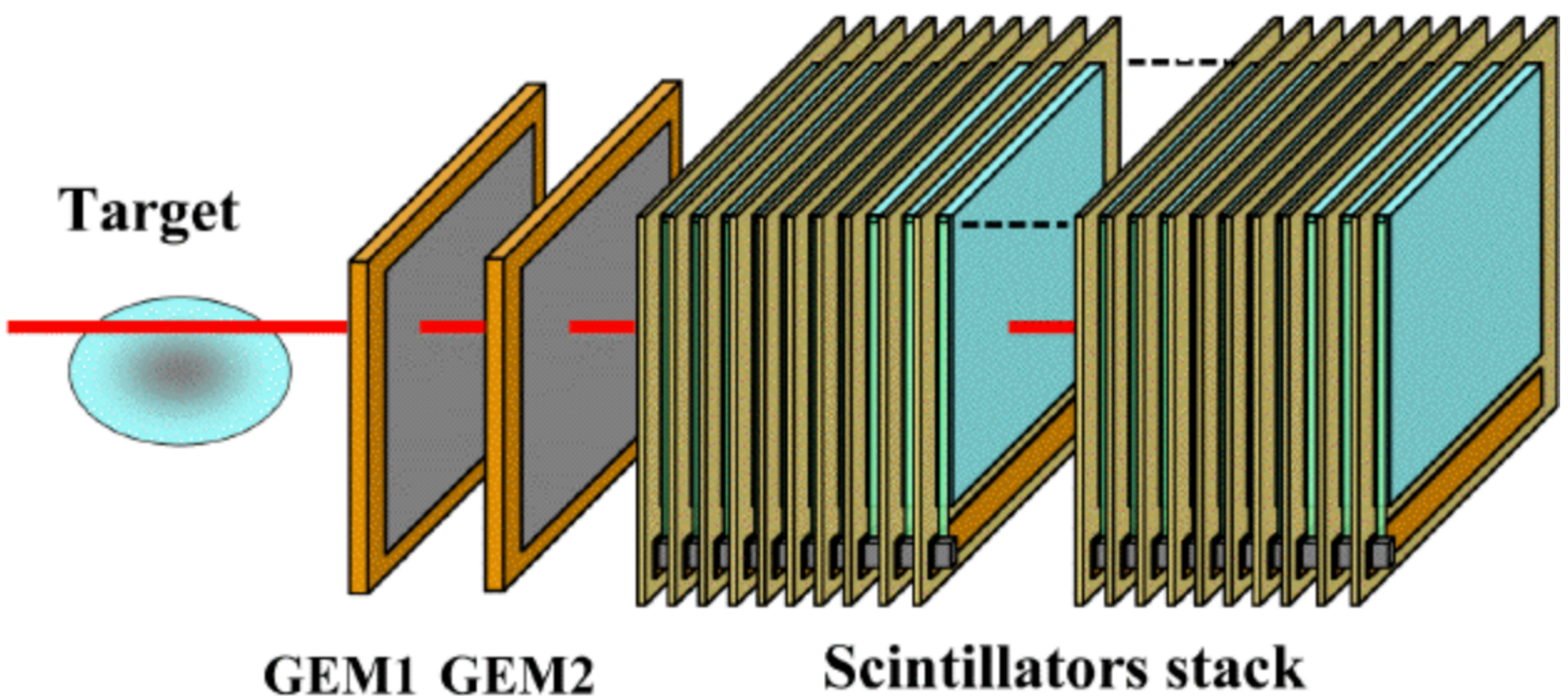
State of the art

Proton Range Radiography

Range/Energy loss measured by plastic scintillator stack and silicon photomultipliers readout

References:

- TERA foundation page: https://project-aqua.web.cern.ch/project-aqua/prr.html
- PhD Thesis: https://ddd.uab.cat/pub/tesis/2014/hdl_10803_133354/daw1de1.pdf
- https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5402303

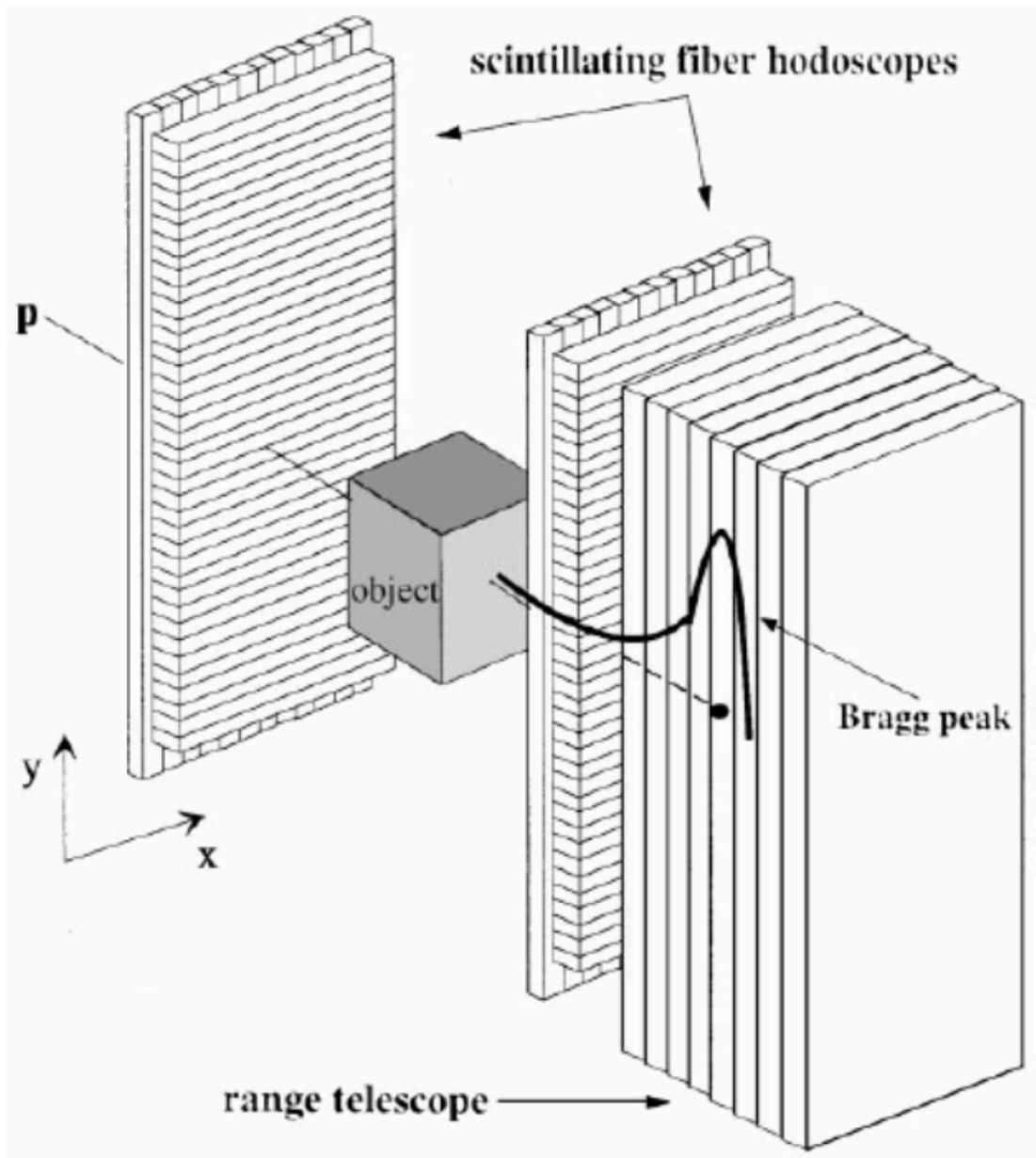


State of the art

Proton Range Radiography

Range/Energy loss measured by plastic scintillator stack

- P. Pemler et al, Nucl Instr. and Meth A432(1999)483



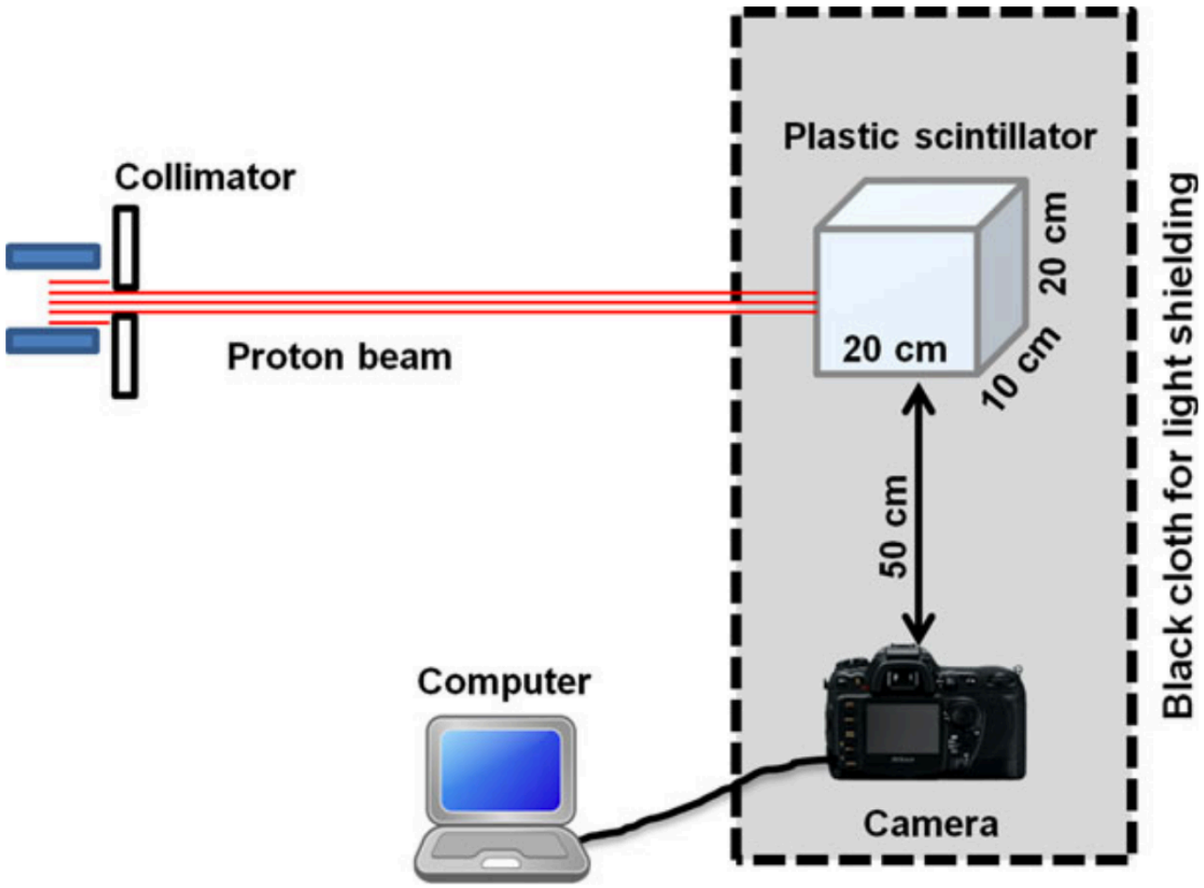
State of the art

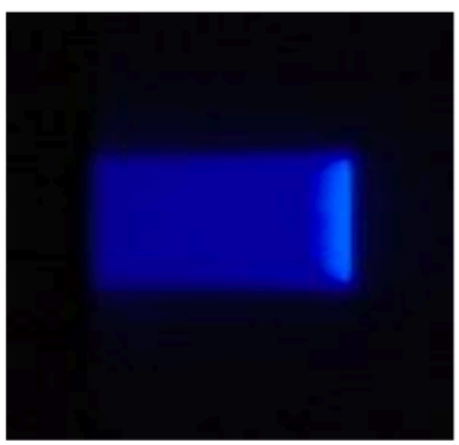
Proton Range Radiography

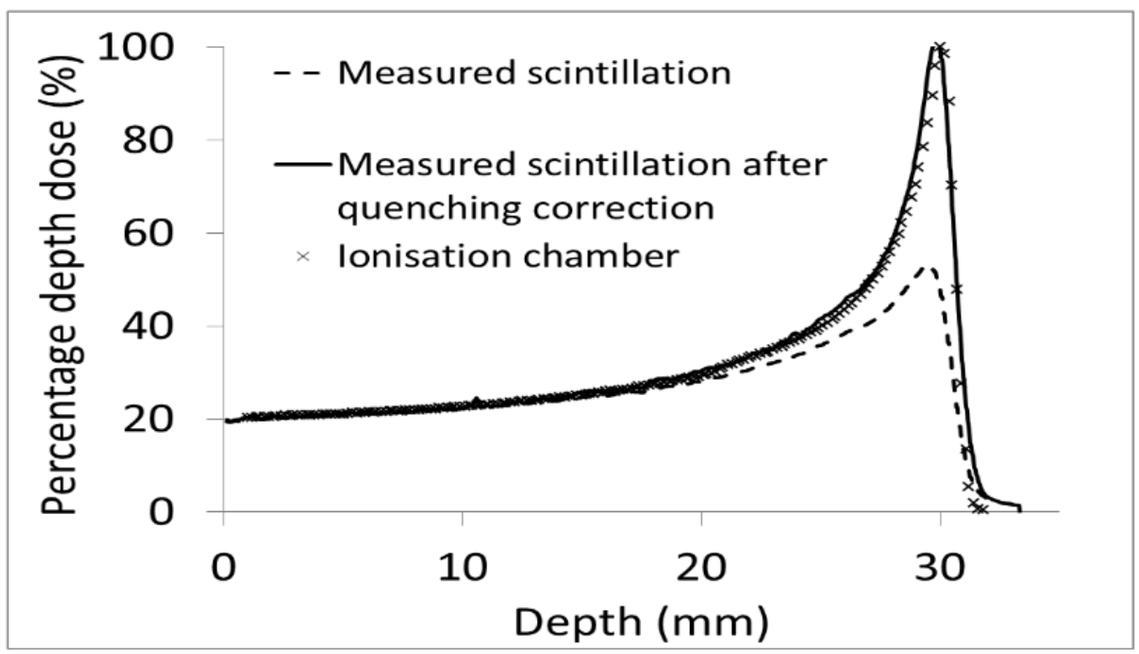
- No quenching correction mentioned
- Single proton measurement
- Different read-out w.r.t. the final proposal for the UCL PT QA Range Detector
- Different principle of operation

State of the art

Volumetric scintillation dosimetry







State of the art

Volumetric scintillation dosimetry

References:

- D. Robertson et al: “Proton beam ruler - a fast proton range measurement tool using a scintillator block and camera” @PTCOG57
- D. Robertson et al: “3D plastic Scintillator detector for a fast verification of ocular proton beam” https://www.thegreenjournal.com/article/S0167-8140(17)30505-4/pdf
- M. Almurayshid et al (UCL authors): “Quality assurance in proton beam therapy using a plastic scintillator and a commercially available digital camera”
  - http://discovery.ucl.ac.uk/1570219/1/Almurayshid_et_al-2017-Journal_of_Applied_Clinical_Medical_Physics.pdf
  - https://smps.org.sa/en/wp-content/uploads/2017/11/Almurayshid_Plastic-Scintillator.pdf

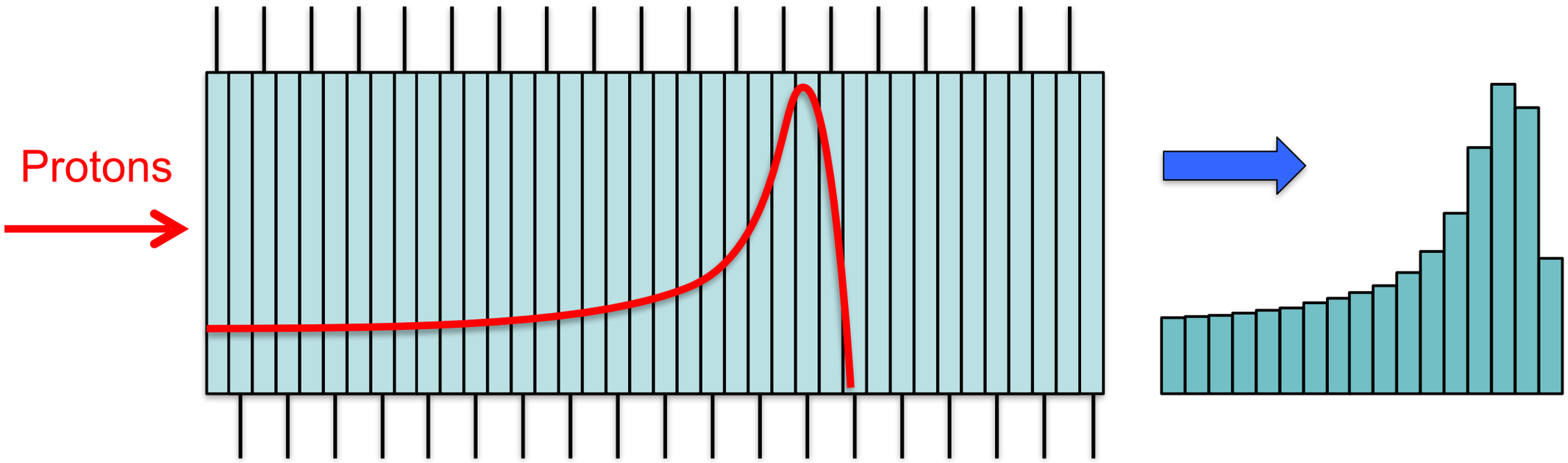
State of the art

Volumetric scintillation dosimetry

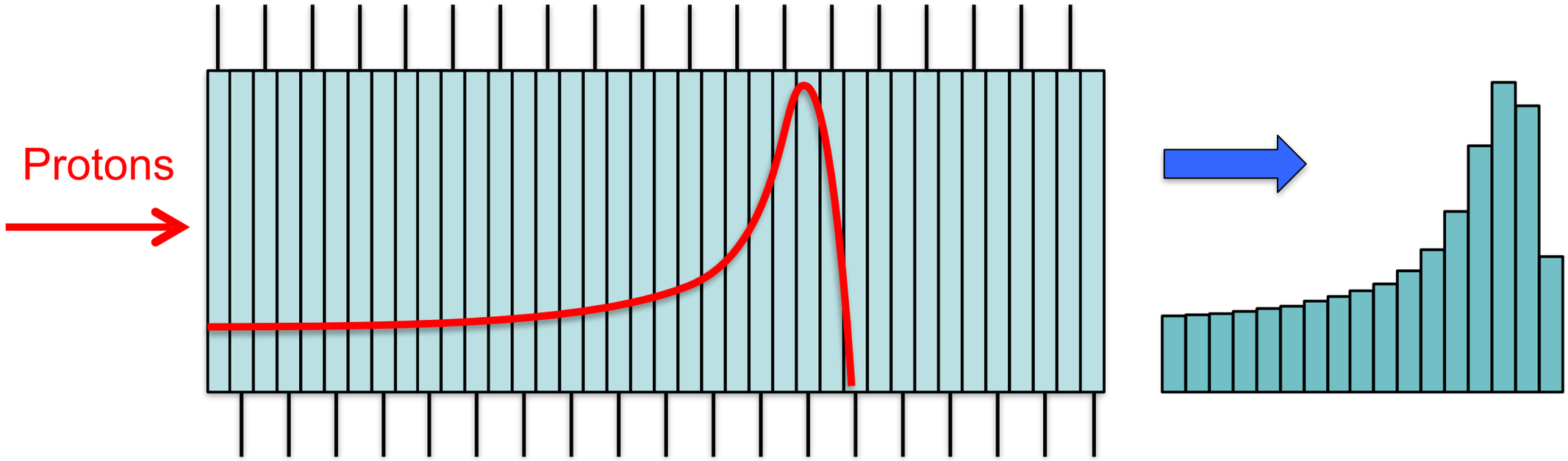
- 3D picture of the beam: complete Bragg peak measured in 3 dimensions and calculate the range from it.
- complex setup
- quenching discussed

Inventive Steps for our proposal

- Dose deposition as a function of depth from a stack of scintillator sheets
- Range extracted directly from the quenched light output of the scintillator
  - New mathematics: Bortfeld analysis for scintillator intensity (not dE/dx)



Proposed QA Range Detector



- **Are the conditions of patentability fulfilled?**
- **If not, how do we protect our intellectual properties?**
  - (PhD student needs to publish his work within ~ one year)

Backup

Patentable Subject Matter

Reference: WIPO Intellectual Property Handbook
http://www.wipo.int/about-ip/en/iprm/

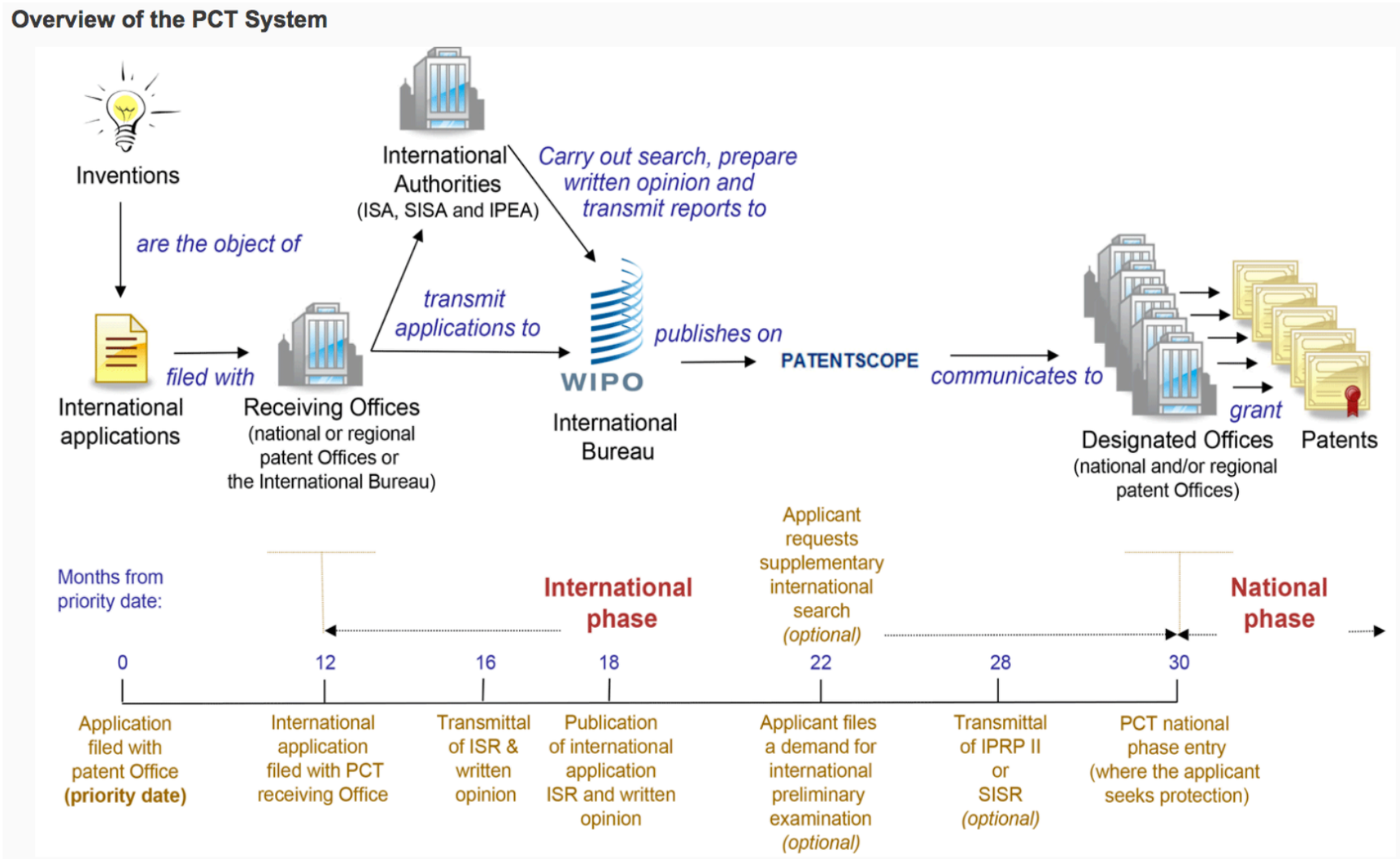
- Excluded from patentability:
  - scientific theories or mathematical methods
  - methods of treatment for humans, or diagnostic methods practiced on humans (but not products for use in such methods)

Industrial Applicability - Utility

- invention applied for practical purposes with the possibility of making and manufacturing in practice

No objections for our Range Calorimeter/Telescope, in my opinion

Examination of a Patent Application



- The application is checked to accord a filing date
- The filing date determines the **priority date** and is **relevant to the evaluation of novelty and inventive step**

We don't need to wait the patent to be granted to publish

According a filing date can take several months / 1 year