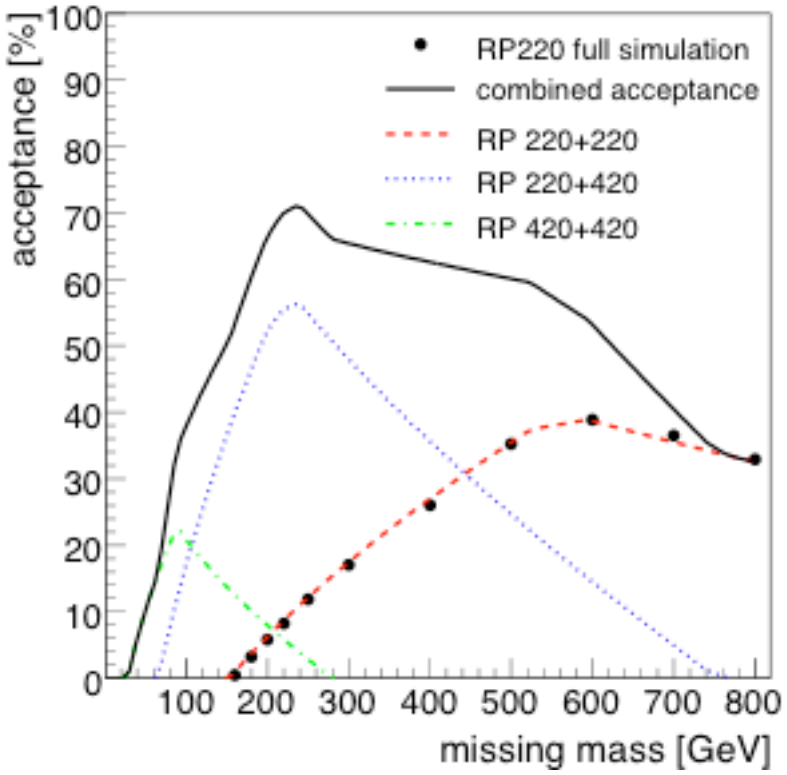
Diffractive Physics at LHC

- Project of installing roman pot detectors at 220m from the ATLAS IP.
- Collaboration between
  - Prague, Cracow, Saclay, Stony Brook, Giessen, Paris 6,MSU
  - Chair : Christophe Royon (DAPNIA CEA Saclay)

Physics process

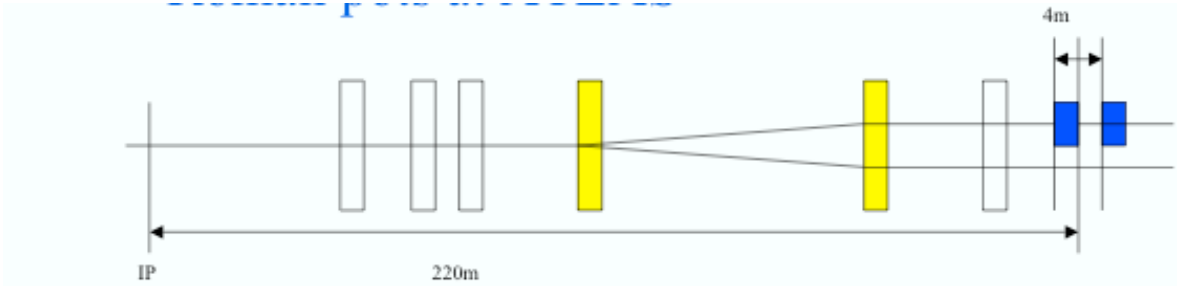
- Study of inclusive events (the only events which are existing for sure)
  - determination of gluon at high β , search for SUSY events (or any resonance) when dijet background is known
- Exclusive Higgs:
  - Signal over background: ~ 1 if one gets a very good resolution using roman pots (better than 1 GeV), enhanced by a factor up to 50 for SUSY Higgs at high tanβ
- QED WW pair production
  - cross section known precisely, allow to calibrate prescisely the roman pot detectors
- Diffractive top, stop pair production
  - possibility to measure top and stop masses by performing a threshold scan with a precision better than 1 GeV if cross section high enough (same idea as linear collider, without ISR problem)

RP220 vs. other projects

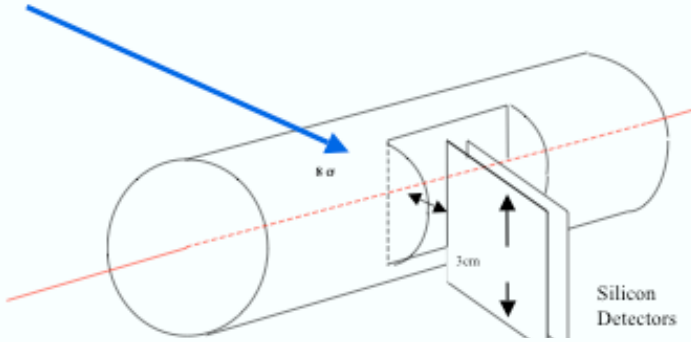


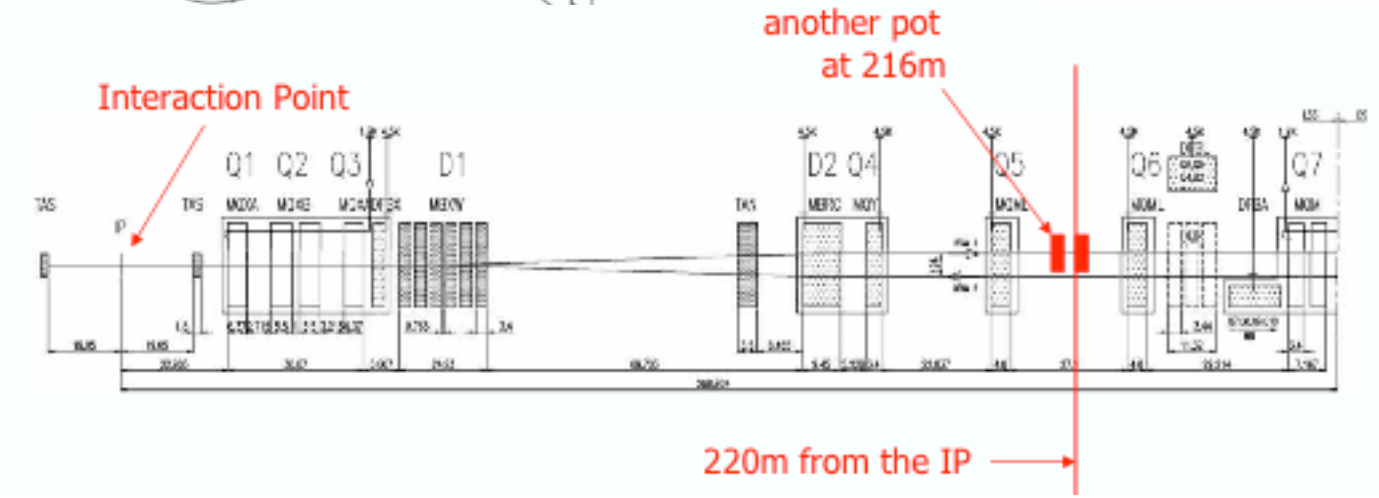
- High Luminosity
- Additional signal and flag at the L1 ATLAS Trigger
- Natural follow-up of the ATLAS luminosity project at 240 m to measure total cross section
- Complementary to the RP420

Layout



As close as possible
to the beam:
10 σ = 1mm





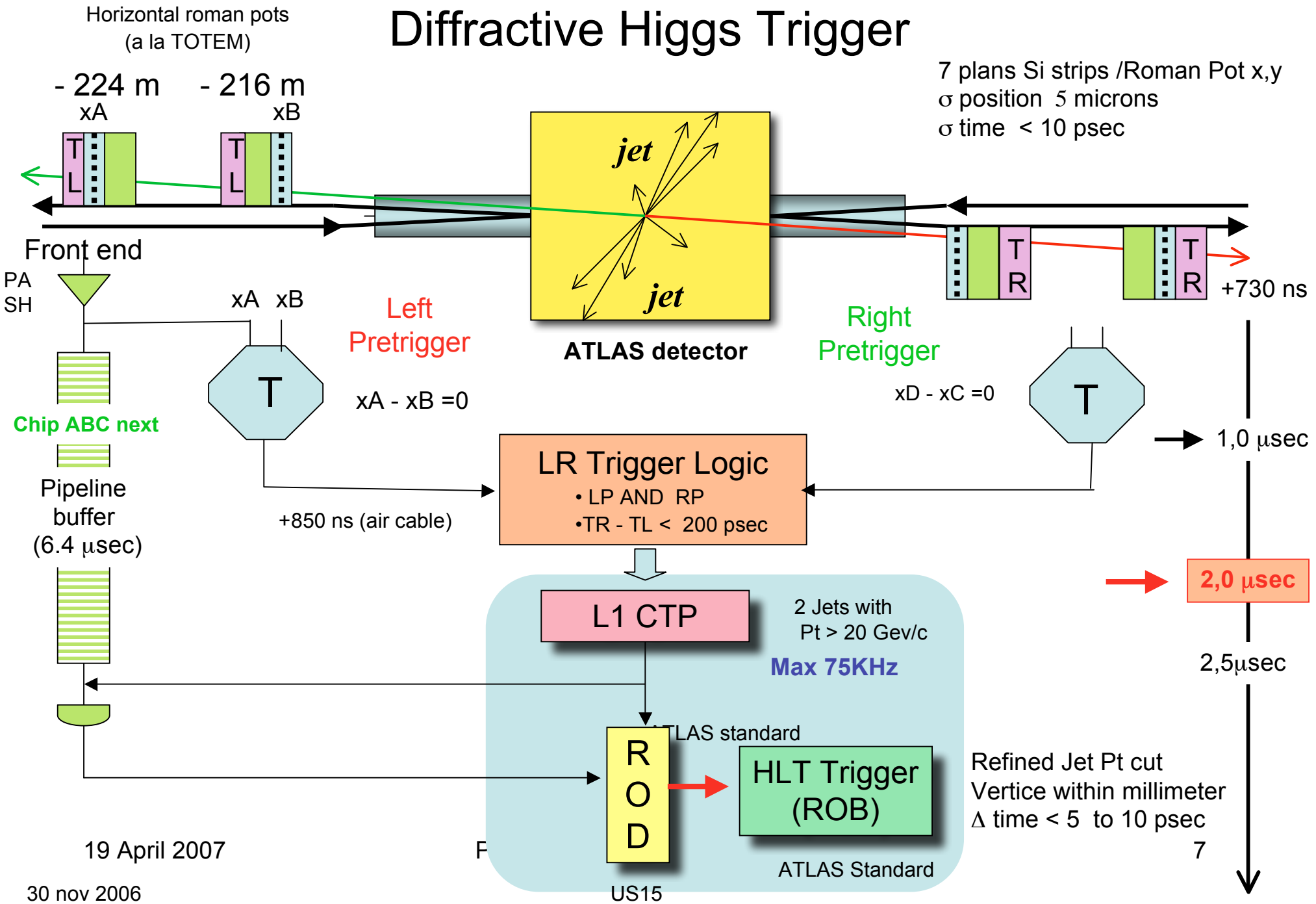
Si Strip detectors specifications

- Size: 2,5cm × 2,5 cm
- Spatial resolution of the order of 10-15 µm
- Si strip detectors of 50 µm, as a first proposal: 9 layers, 3 vertical, 2 horizontal, 2 U, 2 V (45 degrees)·
- Edgeless detectors: Between 30 to 60 µm·
- First prototype of detector to be sent by CANBERRA soon
- Test-stand (laser and radioactive source) to be installed in Saclay following the Paris 6, Prague, Cracow, CERN experience
- Readout: ABCD chip for test, ABCNext chip for final detectors (needs longer latency since needs as an input L1 ATLAS trigger and distance to be covered: 2 × 220 = 440 m)·
- 2 layers used for the trigger
- Strip detectors of 100-200 µm (to be optimised given the fact that we have 1 µs to send the trigger to ATLAS)·
- Timing from the Si strip detector: 5-10 ns required to identify from which bunch crossing the event is coming, implies a fast shaping time of 20-30 ns

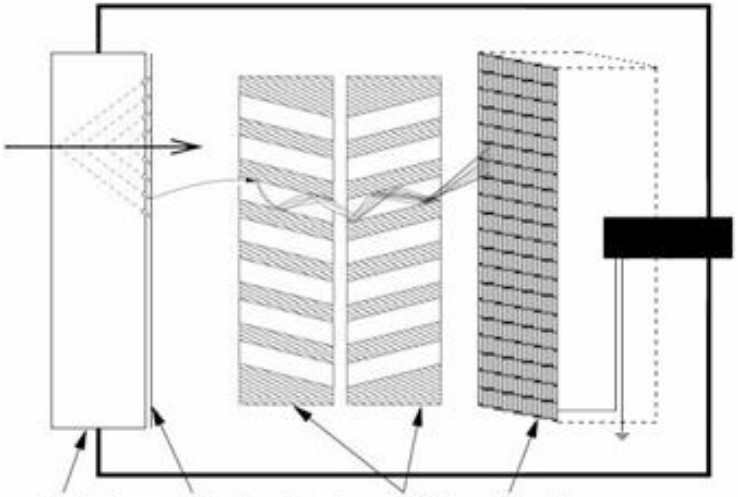
Trigger and timing principle

- Roman pot trigger to be transmitted to L1
- Compatibility of hit strips between 2 different planes and 2 different roman pots (local L1 roman pot trigger), and timing information
- L1 positive trigger sent back to the pots: starts the readout of the Si strip detector
- FP420 and 220 m pot trigger: In ATLAS, there is a large overlap between FP420 and 220 m pot kinematical domain (220 m pots sensitive down to MH ~ 130 GeV, allows FP420 trigger to be given by 220 m tags (offline, the 420 m information will be used)
- Timing with a precision of the order of 5 ps needed to identify from which vertex the protons are coming: 1 mm resolution, up to 25 interactions by bunch crossing

Diffractive Higgs Trigger



Ultra fast (psec) Timing



Use Cherenkov light ---> fast

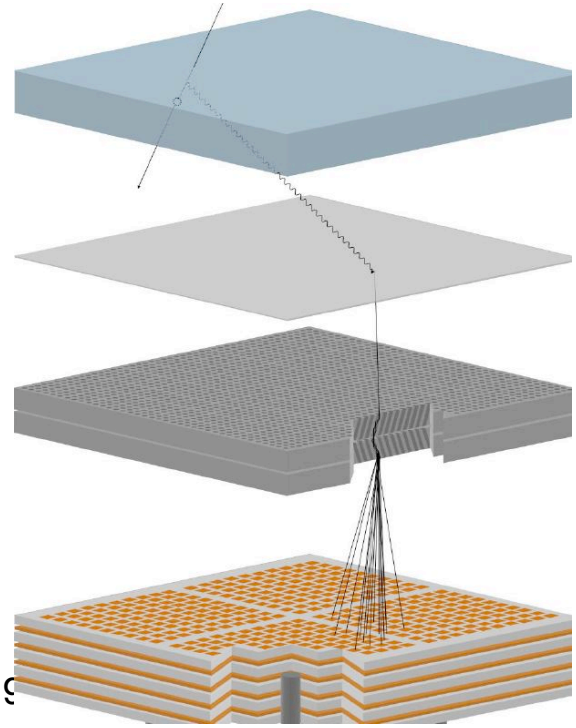
Use UC Chicago /ANL (Henry Frisch et al.) generic development

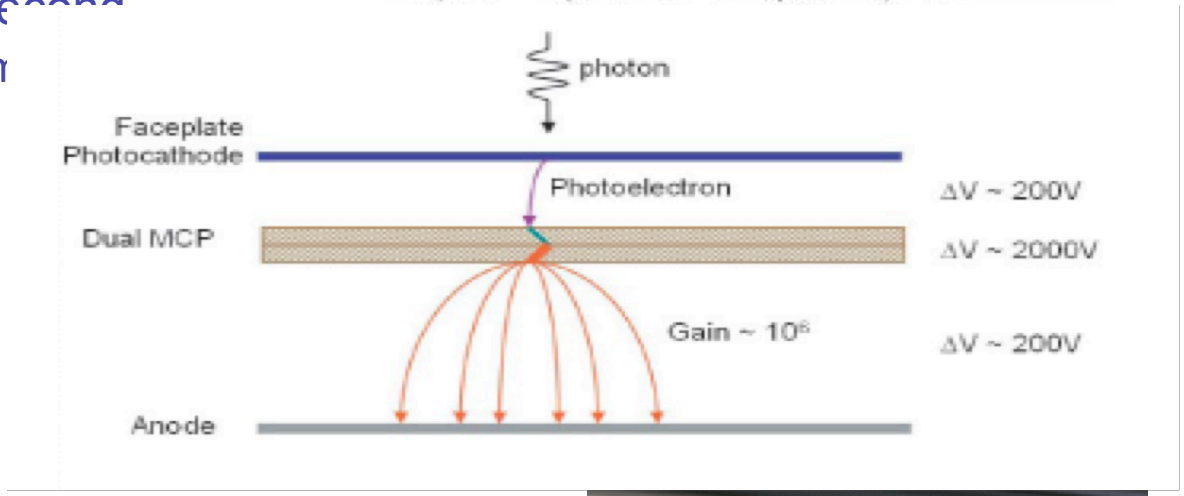
New MCP 2x2 inches tubes developed Burle/Photonis

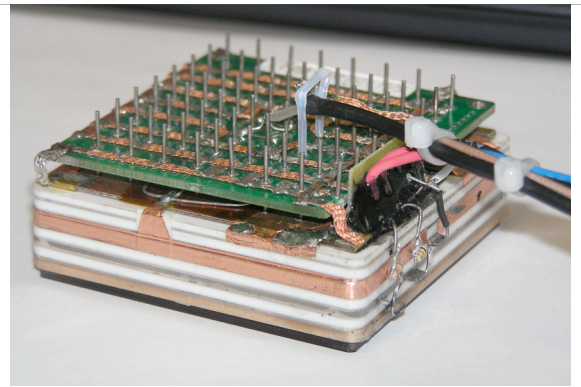
Apllications for ultra fast Timing for future detectors (SLHC,ILC,CLIC) and medical imaging (PET)

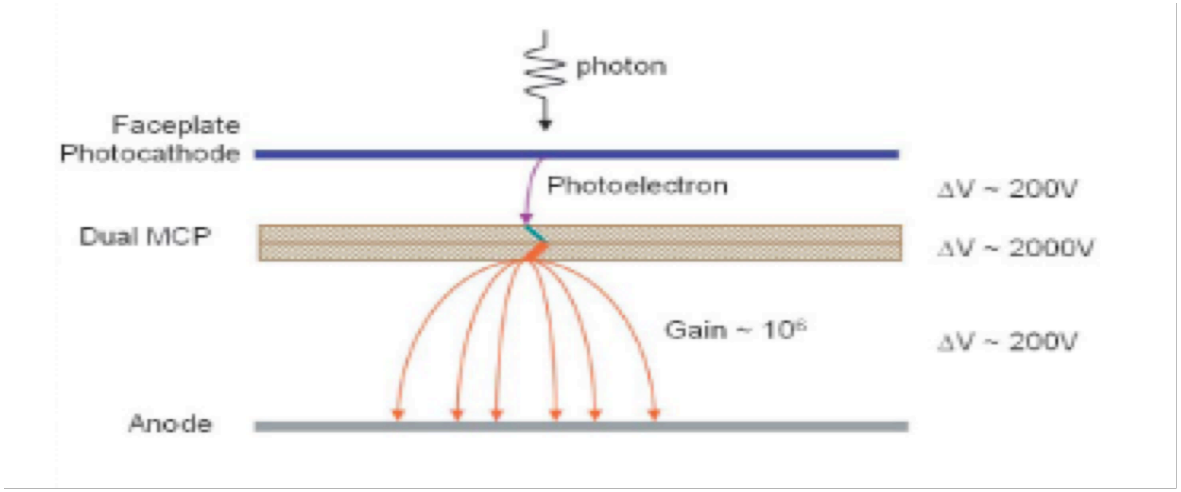
Target performance : The Picosecond

TOF with precision of 0.3 m

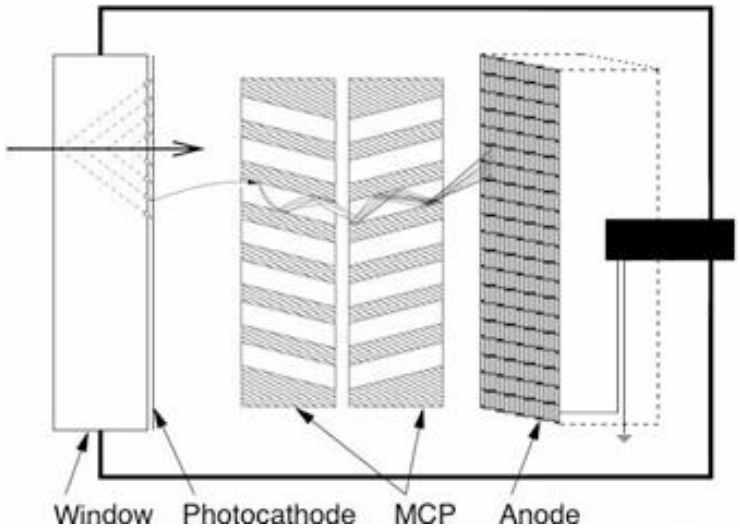


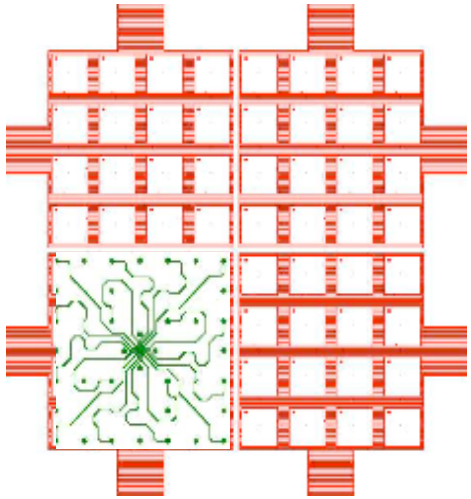




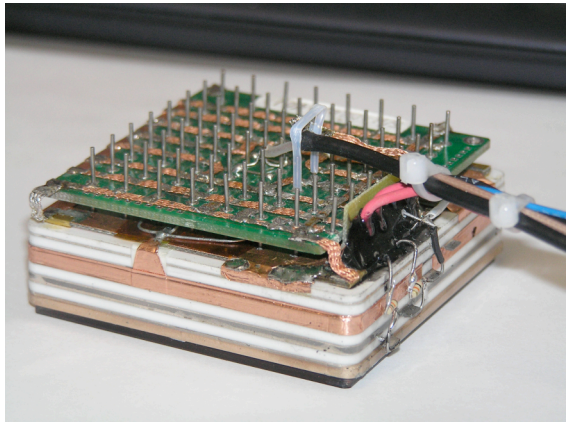


MCP Principle





Anode pads and equal read out design



Photonis Prototype