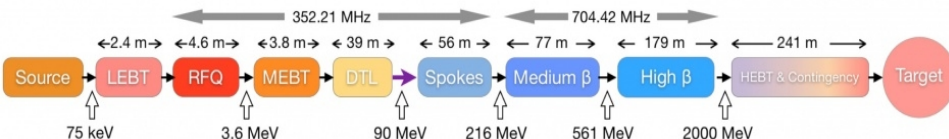
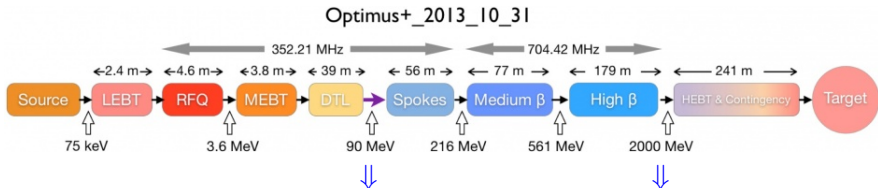


Cold NPM: Short PDR review and WIP design

Optimus+



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Ionization Profile Monitors
(1 in Spokes, 3 in Medium β , 1 in High β)

MOTIVATIONS:

Provide a transverse profile measurement to:

- ▶ support the tuning of high power beam
- ▶ Monitor the high-power protons beam in production

REQUIREMENTS:

- ▶ Operates at pulse longer than 50s and nominal peak current
- ▶ Provide a measurement per pulse
- ▶ High reliability and lifetime
- ▶ Have minimum impact on beam

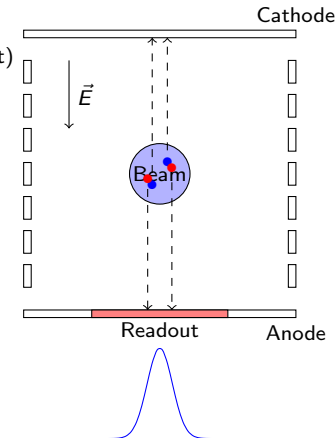
Two types of NPM at ESS:
Fluorescence Profile Monitor (in Warn Linac & Transport)
or

Ionization Profile Monitor (in Cold Linac)

1. Beam protons ionize the residual gas
2. An electrical field extracts ionized charges
3. A segmented readout collects charges
4. The profile is reconstructed in one direction

↓

X and Y profiles = 2 IPM = 1 NPM

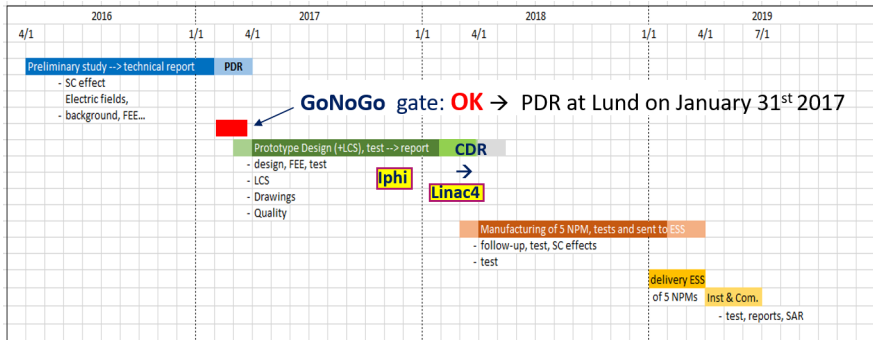


We have passed the PDR, on January 31st 2017

- ▶ Go/No Go → **Go**

Next step: CDR in one year → Short frame time

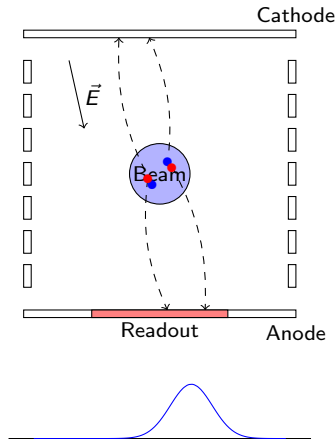
- ▶ Focus on design and manufacturing



PDR with a Go/No Go gate ...

Because of many critical points:

- ▶ Signal estimation
- ▶ Profile distortions, including:
 - ▶ Space charge effect
 - ▶ Initial momentum of particle
 - ▶ Non-uniformity of electrical field
- ▶ Readout systems
- ▶ Integrated Control System
- ▶ Testing Phase
- ▶ ...



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- ▶ ...

Conclusion for the PDR:

Use ions instead electrons



More details in second part of the presentation.

During the PDR we underlined that:

- ▶ A correct uniformity can be achieved in the ESS LWU chamber.
- ▶ Even if the IPM are close each other
- ▶ By using degraders improve uniformity

Comments from the PDR committee:

- ▶ Uniformity in beam direction to optimize readout length
- ▶ Simulations on engineering design
- ▶ Interaction with other systems in LWU
- ▶ Inquire about curved electrodes

Since the PDR:

- ▶ Engineering design has started (see next slides)
- ▶ We are using it for simulations
- ▶ Define realistic degraders
- ▶ Uniformity stills quite good (on $\pm 6 \cdot \sigma_{beam}$ for 3cm readout length)

We proposed to test several readout:

- ▶ Strip with and without MCP
- ▶ MCP with Scintillator screen
- ▶ Silicon Detectors

Comments from the PDR committee:

- ▶ Focus on one readout
- ▶ Especially MCP+Scintillator since it's a COTS solution
- ▶ Investigate more on MCP lifetime
- ▶ Taking care of ICS

Since the PDR,

We put less priority on silicon readout to focus on others

We are in contact with Hamamatsu for MCP based solutions:

- ▶ How to integrate MCP in our design
- ▶ Inquire more data about lifetime

For ICS we are working with CEA Engineering Service to find EPICS compatible solutions:

- ▶ For Voltage Control
→Should be OK
- ▶ For FEE of readout
→More difficult, may need development

We proposed to test our IPM at IPHI:

- ▶ 3 MeV Proton 100mA
- ▶ Accelerator inside CEA Saclay

Comments from the PDR committee:

- ▶ IPHI may be a good choice
- ▶ If possible test background at Linac4 or SNS

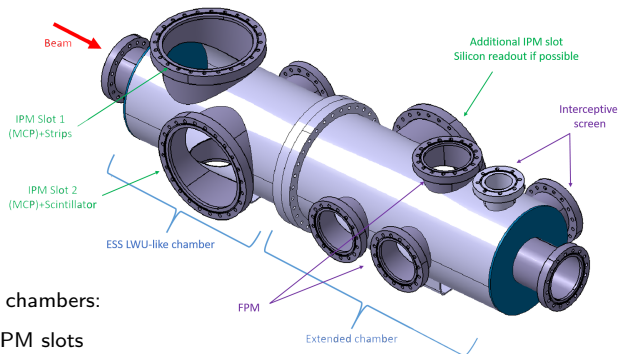
Since the PDR,

We met IPHI Team:

- ▶ Must be possible at the end of 2017
- ▶ Taking care of IPHI requirements (vacuum, ICS, ...)

We met Linac4 Team,

- ▶ May be possible outside the beam line for testing radiative background
- ▶ After IPHI tests



Test Bench = two separated chambers:

- ▶ ESS LWU-like with 2 IPM slots
 - ▶ Electrical field
 - ▶ Sparking
- ▶ + extended chamber, one more IPM slot and two reference measurements

Total length: $\approx 1200\text{mm}$

Versatile IPM design in order to:

- ▶ Change the readout easily
- ▶ Change axis profile measurement on the same port

