

# **FETS-FFA Beam Diagnostics Instruments**

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# Required Beam Diagnostics Instruments (1)

Commissioning Phase1: Diagnostics for characterisation of the beams (emittance, momentum spread, bunch structure)		
Comissioning Goal	1. Acceleration to the top energy and extract in low current beam without painting.	
FETS-FFA Ring Diagnostics		
	<i>Qty</i>	<i>Property</i>
<b><i>Motorised Wire Scanner (H&amp;V)</i></b>	1	<ol style="list-style-type: none"> <li>1. After Foil, beam position, beam size and bump orbit measurements.</li> <li>2. Intermediate energy beam profile and beam position measurement.</li> </ol>
<b><i>Motorised Faraday Cup + Scintillating Screen</i></b>	1	<ol style="list-style-type: none"> <li>1. After Foil: injected beam current, transmission efficiency to design orbit.</li> <li>2. Intermediate energy: accelerrated beam current measurement.</li> <li>3. Faraday Cup can be replaced with screen to measure beam size at extraction orbit.</li> </ol>
<b><i>BPM</i></b>	1 or 2 per cell	<ol style="list-style-type: none"> <li>1. Beam position, tune and lifetime measurement from injection to extraction orbit.</li> <li>2. Bunch structure measurement when multi turn injection without painting.</li> <li>3. Beam position and gradient to reconstruct Poincare map and orbit correction.</li> </ol>
<b><i>Beam Loss Monitor</i></b>	1 or more per cell	<ol style="list-style-type: none"> <li>1. Monitor beam losses to identify beam loss locations.</li> <li>2. Develop into machine and personnel protection systems.</li> </ol>

# Required Beam Diagnostics Instruments (2)

## Commissioning Phase2: Diagnostics for injection painting and matching in longitudinal and transverse directions to mitigate beam loss

<b>Comissioning Goal</b>	<ol style="list-style-type: none"> <li>1. Ideal matching in longitudinal and transverse directions</li> <li>2. Achive injection painting to mitigate intensity effects.</li> <li>3. Accurate beam current and size measurements.</li> </ol>	
	<i>Qty</i>	<i>Property</i>
<i>Wall Current Monitor (WCM)</i>	1	Measurement of bunch structure and current during acceleration
<i>DC Current Transformer (DCCT)</i>	1	Measurement of casting and stacked beam current
<i>Motorised Beam Scraper</i>	1	Beam size measurement (if possible, read-out from scraper can be used to calibrate DCCT).
<i>Additional uses of phase 1 monitors</i>	N/A	<ol style="list-style-type: none"> <li>1. Intermediate: Beam size, position and profile measurement using motorised wire (H only).</li> <li>2. BPM tomography.</li> <li>3. Possible beam halo measurements with wire monitors or scraper.</li> </ol>

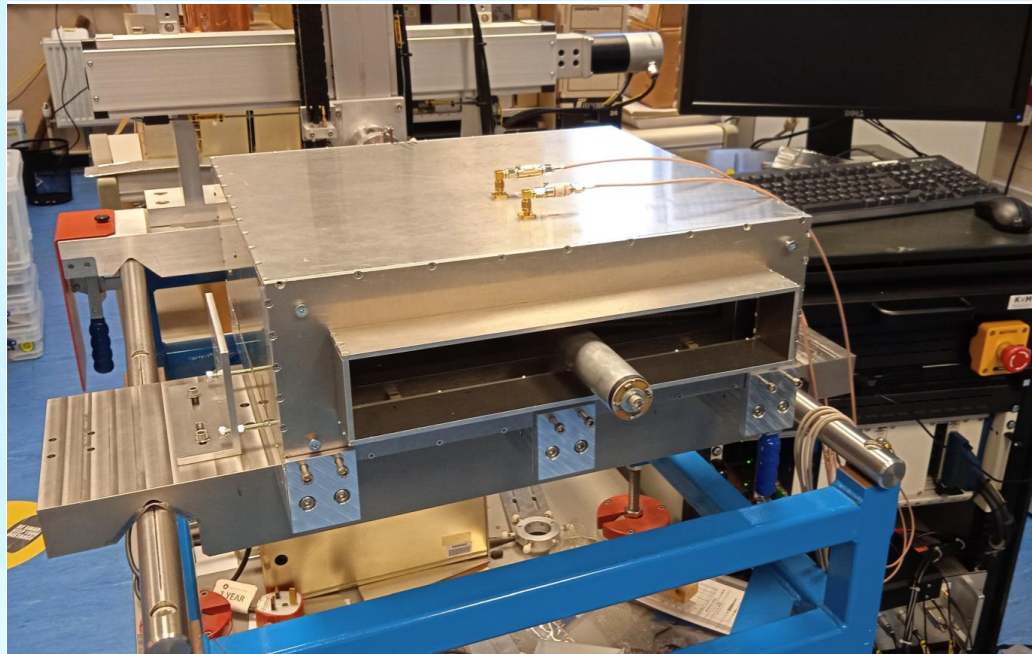
## Commissioning Phase3: Diagnostics for advanced beam commissioning

	<i>Qty</i>	<i>Property</i>
<i>Ionisation Profile Monitor</i>	1	Turn-by-turn, non-destructive horizontal beam profile measurement.
<i>Additional uses of phase 1 monitors</i>	N/A	DCCT measures 1% beam loss if any due to halo development.

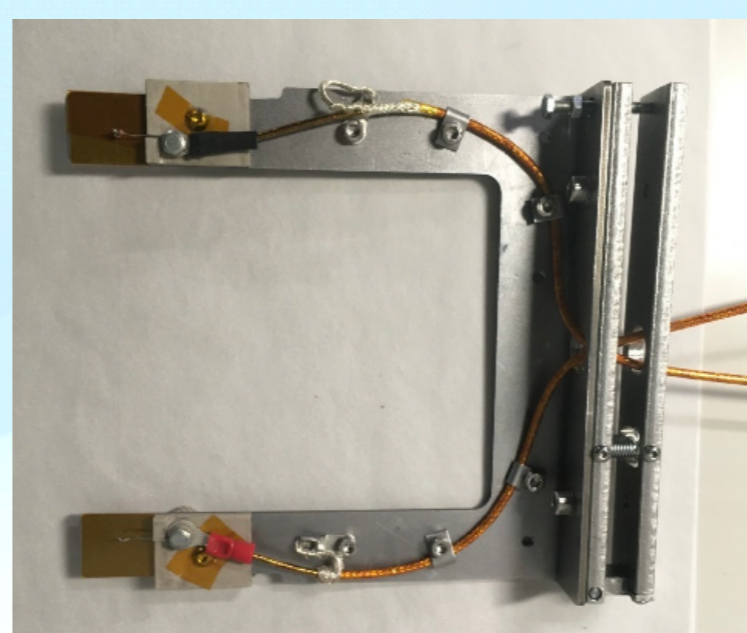
## Challenging for Diagnostics

Large structure of diagnostics for non-destructive turn-by-turn measurements, whilst still providing required measurement sensitivity and resolution.

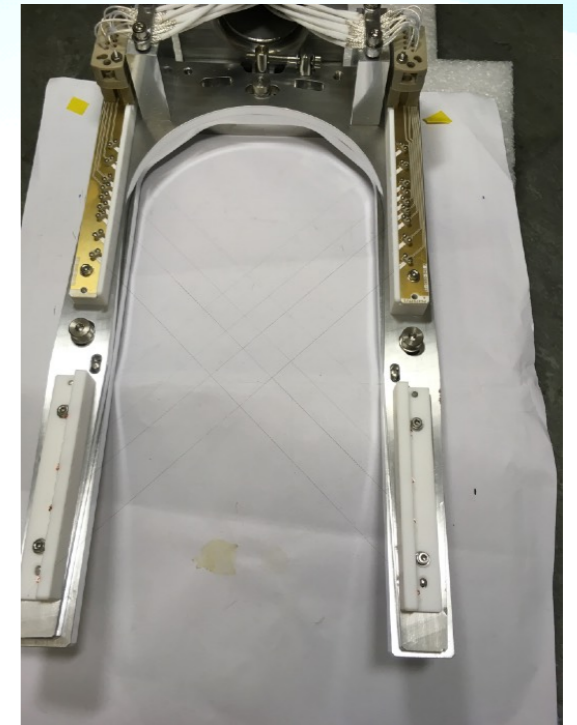
# Several Diagnostics Developments



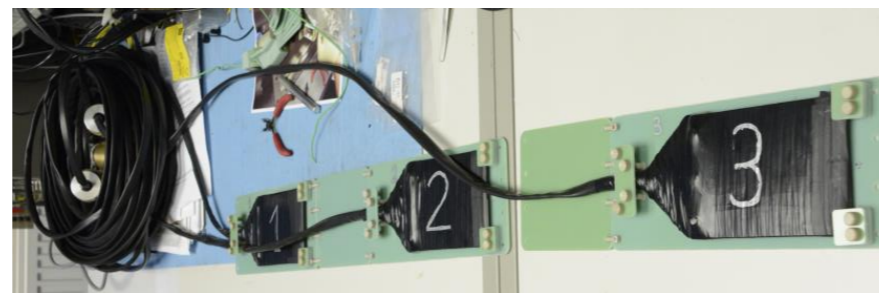
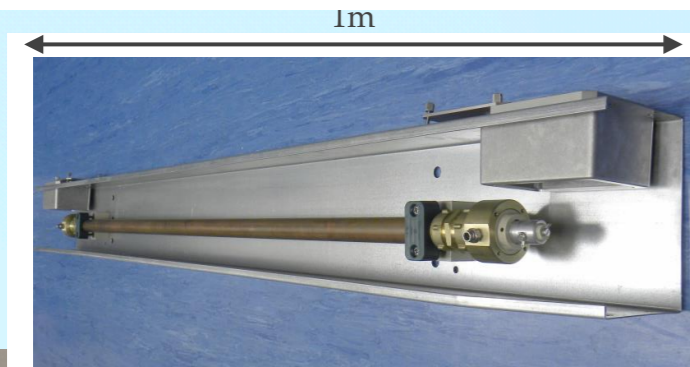
FFA BPM prototype being tested at the Diagnostics lab test rig.



WSM (CNT:  $\phi 10\mu\text{m}$ ) to measure a profile of circulating beam



$\phi 10\text{-}50\mu\text{m}$  CNTs on FETS beam line.



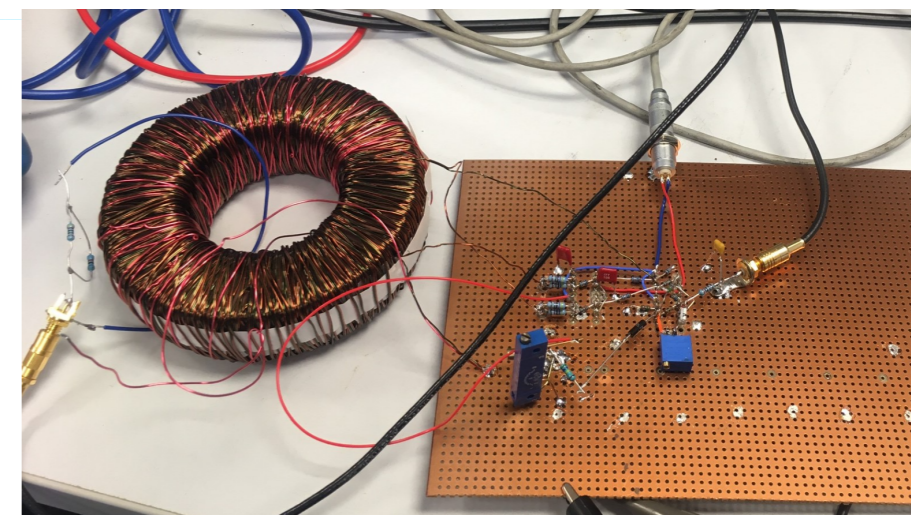
Scintillation plates and optical fibres for BLM



Shorter ISIS Ionisation chamber (1m long) on FETS.



Scintillation plates for profile/position monitor



Demonstration of CT monitor for beam intensity monitor