



Paul Scherrer Institut PSI



AAT offices / PARK INNOVAARE DeliveryLAB

## About AAT

Advanced Accelerator Technologies AG (AAT) has been founded on an initiative of the Paul Scherrer Institute (PSI) in 2015 in order to intensify the commercialisation of its experience and know-how in accelerators and large scientific infrastructure development and operation as well as the broad spectrum of their applications. As part of the national initiative Switzer-

land Innovation, AAT is located in PARK INNOVAARE at PSI in Villigen, Switzerland. AAT is set up as a joint venture of industry leaders in the large science and high-tech enterprises supply markets, injecting their specific industrial skills, experience and strengths in order to create higher customer value by combining with PSI's vast R&D expertise.

**AMPEGON**

**XILON**

**HB**  
Heinz Baumgartner AG  
Innovation in Mechanics

**COSYLAB**

**VDL**  
VDL Enabling Technologies Group

Based on a broad cooperation and license agreement with PSI AAT commercialises innovative and custom designed high end instrumentation and systems for research institutions and high-tech industries. AAT is member of Switzerland Innovation PARK INNOVAARE.

## About PSI

PAUL SCHERRER INSTITUT  
**FEI**

PSI is the largest national research institute in Switzerland with excellence in a wide spectrum of scientific fields and frontier technology developments. PSI has pioneered in building and operating worldwide outstanding accelerators and other large science infrastructure for numerous scientific experiments. Fur-

thermore, it has generated applications with social and economic impact, such as cancer therapy, energy solutions, industrial processes among others. Technology developed for the Proton Therapy Facility and at other accelerator installations at PSI are key for AAT's diagnostic components.

PSI PROSCAN beamline



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Center for Proton Therapy CPT ©Scanderbeg Sauer Photography

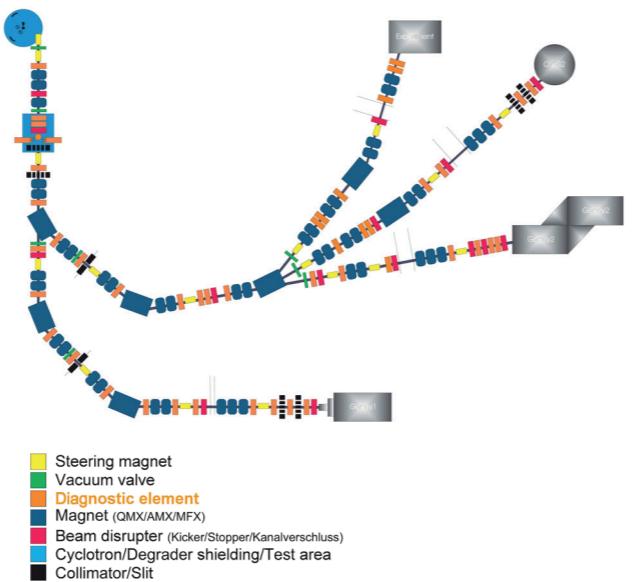
# Beamline Diagnostics for Proton Facilities

## Multi-Channel Ionization Chambers

Paul Scherrer Institute technology  
adapted to your needs

# Beam diagnostic elements

Proton beam diagnostic monitors, designed by PSI, have been in continuous operation ever since the start of the PROSCAN proton therapy facility in 2007. The Swiss company AAT has upgraded the monitors into commercially available licensed products based on the original PSI detectors and incorporating experience gained from many years of PROSCAN operation. State-of-the-art instrumentation development and engineering has optimized the production, performance and control system compatibility. The new monitors and control and readout electronics allow seamless integration into the beamline and beamline controls. Beam monitors are used throughout the beamline till just before the gantry to measure and monitor the beam profile, current and position. The monitors operate in a beam energy range of 50 to 250 MeV and current from 1 to 500 nA..



The layout of the PROSCAN facility at PSI

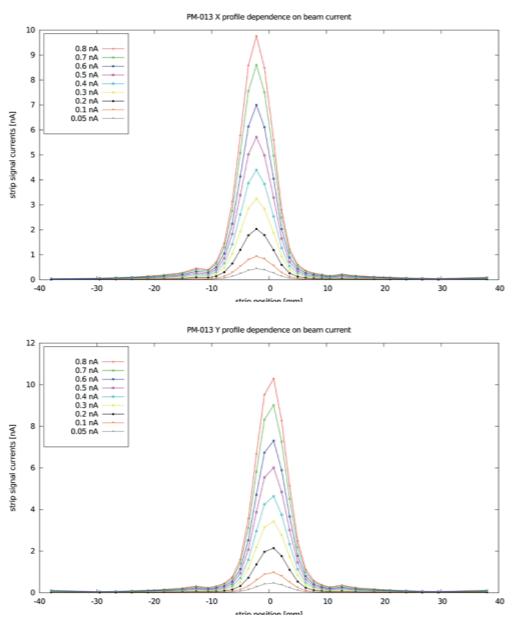
## Profile Monitor

The profile monitor is a retractable multi-strip ionisation chamber. A metallized ceramic board with horizontal and vertical stripe patterns, together with outer HV boards, form the detector of the profile monitor. Both vertical and horizontal beam profiles are simultaneously obtained. The detector is positioned in a housing, filled with ambient air, which can be pneumatically driven in and out of the beam. The housing moves inside a vacuum chamber which can be integrated to the UHV beamline. The monitor exists in three variants: standard version, thin version for higher currents in front of the degrader, and a stand-alone control point version typically positioned just upstream of the gantry. The profile monitors are designed to deliver spatial resolution down to 0.5 mm.



Stand-alone profile monitor (left) and control point assembly of profile, position and current monitors (right).

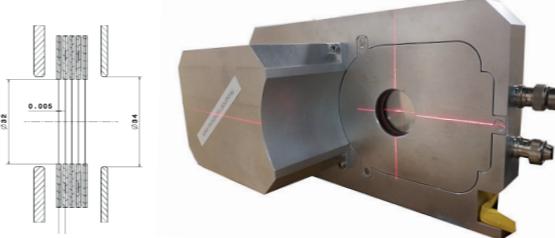
parameter	value
beam aperture size	65 mm standard/thin 90 mm control point
profile orientation	horizontal and vertical
no. of stripes	64H + 64V
no. of current signals	32V + 32 H (default)
bias HV	600/900 V
actuator stroke	105 mm
typ vac pressure	$1 \times 10^{-6}$ mbar



X and Y beam profiles for current range 0.05 to 0.8 nA

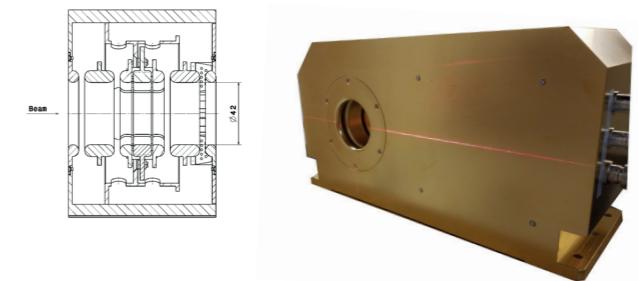
## Current Monitor

The current monitor is an ionisation chamber formed of a stack of five 5  $\mu\text{m}$  Titanium foils which can be permanently inserted into the beam. The outer and the central foils are connected to HV supply. The other two Ti foils deliver two independent and redundant current signals proportional to the beam current. One of signals is intended for beam diagnostics, the other signal for integration into e.g. the patient treatment, machine or safety systems. The current monitor also has two redundant HV read back signals, which ensure that a constant HV is always supplied to the monitor.



Geometry (left) of the current monitor (right)

parameter	value
beam aperture size	32 mm dia
bias HV	2 kV
air gap	4.9 mm
signals	1 + 1 current 1 + 1 HV read back
signal current level	1 nA – 2 $\mu\text{A}$



Geometry (left) of the position and halo monitor (right)

parameter	value
beam aperture size	40 mm dia
bias HV	2 kV
position resolution	<0.1 mm
signals	4x position (CoM) 4x halo
signal current level	1 nA – 2 $\mu\text{A}$

## Multichannel variable-gain readout (CDC064)

The CDC064 readout uses two independent 32-channel A/D converters combining both I/V and A/D conversion so that 1 to 32 low-level current signals can be directly input and digitized. The CDC064 can be used for the profile monitor signals as well as position/halo and current monitor signals. Currents from pA to  $\mu\text{A}$  can be continuously measured with high precision. The rack-mount unit can house upto 9 read out modules.

- Adjustable Full-Scale Range
- Adjustable Speed
- Data Rate up to 6kSPS
- Integration Times as low as 166.5 $\mu\text{s}$
- USB interface with 1Mbps
- LAN interface 10-100 Mbps
- 2 x 32 galvanic isolated input channels split to X and Y
- Remote Module-Diagnostics : Temperature, Humidity, Supply-Voltage, Supply-Current, Power-ON/OFF, Reset
- Power-Consumption per module 3W



## Pneumatic control and high voltage

A 19" rack mount device which provides the control and position status readback of up to 7 profile monitors. It also houses two HV modules to supply several monitors used for beam diagnostics in the beamline.

