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Status of pellet tracking activities

The pellet tracking system for PANDA is based on line-scan CCD cameras and diode lasers configured in several measurement positions.

It is designed to provide*:

- pellet positions ($\sigma \approx 0.1$ mm accuracy) at a hadronic event

- useful information for ≈ 90 % of the hadronic events

*) see the **PhD** thesis of **Andrzej Pyszniak**:
Development and Applications of Tracking of Pellet Streams (January 2015)

The tracking system is separated (geometrically, mechanically, electronically etc.) from target generator and target dump.
In principle it can be used together with any target generator, but only

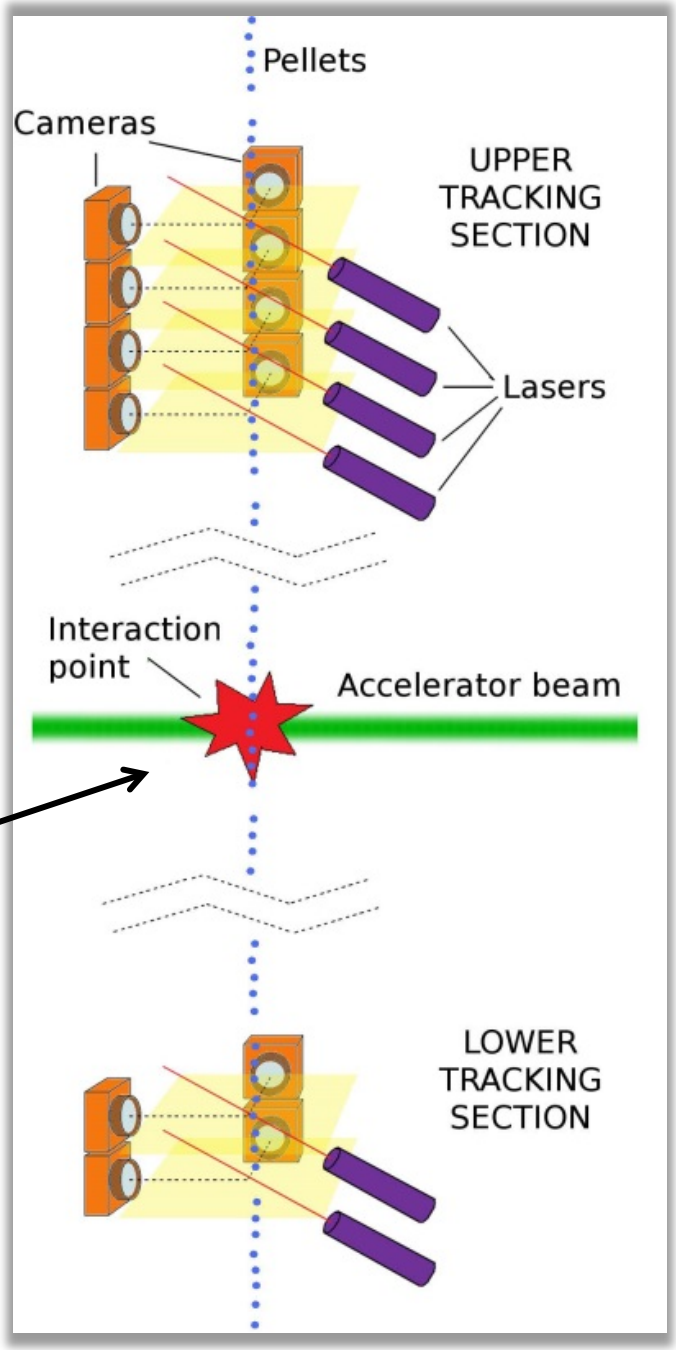
in "Pellet TRacking mode" operation it provides useful tracking info.

For pellet "Pellet High Luminosity mode" and for Cluster-Jet, it mainly could provide only stream (jet) position, shape and time structure info.

Tracking Pellets

- **Laser beams with a horizontal beam line profile of 3 mm width and 50 μm height.**
- **Line-Scan CCD cameras taking one line of 512 pixels, size 35x35 μm^2, at 100 kHz frequency.**
- **The camera line of sight and the beam line profile of the laser must coincide within 10 μm.**
- **A pellet measurement accuracy of 20 μm.**

Position of a pellet in the interaction region can be reconstructed with a precision of 0.1 mm



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The tracking sections consist of measurement levels.

Equipment and procedures have been developed* so that the complete measurement level system can be (fine) tuned offline and then be securely installed at the tracking section of the target pipe.

It then maintains its performance during the experimental conditions without need for further manipulation (access).

It was tested successfully at UPTS under real conditions with pellets in August 2016.

*) see the **Master** thesis of **Jenny Regina**:
A measurement level module for a pellet tracking system (February 2017)

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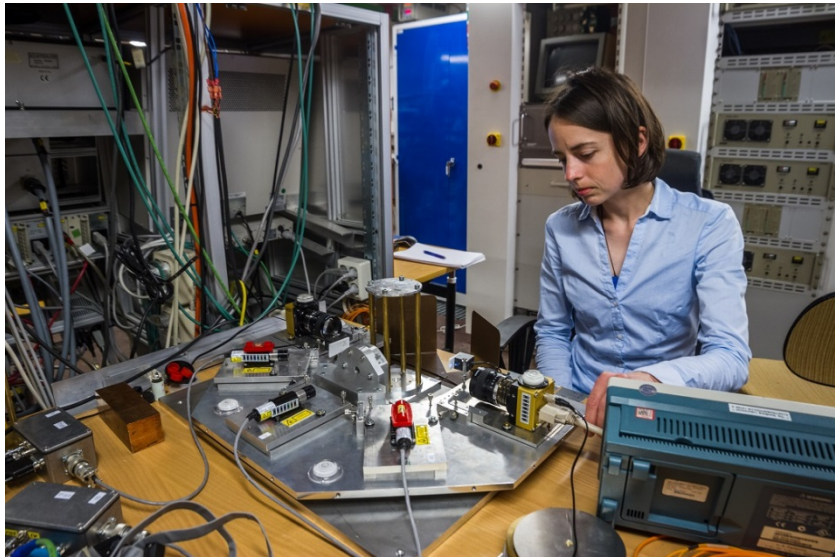
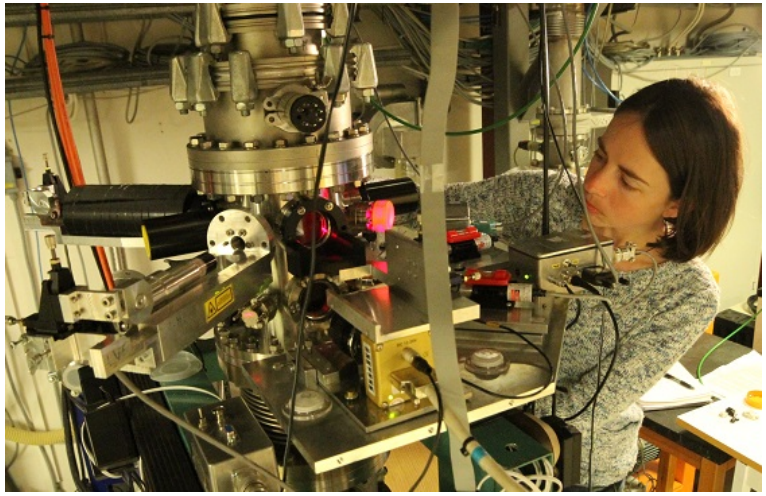
Testing and tuning of the measurement module proto-type in the table top setup.

Internal alignment of cameras and lasers is done by using fishing lines as targets.



Installation of the measurement module at the PTR chamber.

Fixation by 4 screws onto a sight glass flange.



Jenny Regina (master degree project worker 2016**)**

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Project planning and status (August 2017)

Ongoing: Multi-camera r/o and control. Monitoring and analysis s-w is being developed.

Fabrication of a "generator" tracking chamber (that can house four measurement levels).

Time line: Tests of a measurement level module prototype were done 2016.

Preparation of some parts for one (upper) tracking section 2017-18 …. (Continued support from CTS made this possible!)

Design of the dump tracking section. It depends on mechanical design of the target dump area and on experience from cluster-jet tests at COSY.

To be able to prepare the complete system with two tracking sections, additional funding is needed. Then it may take only 1-2 years if some of our expert personnel is still available.

Risks: Evaluation done (Autumn 2013 (TDR), Feb 2015 (SG)).

Funding: Consumables: Almost zero ...

SRC application for 2015-18 rejected Nov2014. No new try !
HPH2020 application rejected Aug2016 ….

Equipment: CTS grant (20k€) 2017-18.

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Connections between the Pellet tracking system and other systems (sub-projects):

System	Item	Status (August 2017)
Cluster-Jet generator	Pumps and valves in upper yoke-pit. Space for 4-layer PTR section and possibility for pumping below a second skimmer.	Not clear if PTR (pellet target) requests are met. They should be considered in the final design.
Vacuum	Piping & pumping at upper yoke-pit.	Not clear.
Vacuum, Physics, Accelerator	Vacuum at IP region. Need for more pumps at target dump.	Reduces pressure at least with 50% (Report by J.Löfgren, Apr 14)
Target dump, Vacuum	Pumps and piping in lower yoke-pit. Space for 3-layer PTR section. Access.	No draft design available?
Accelerator	Beam size vertically ≈ 5 mm for PTR mode.	Not clear. (Simple?)
Pellet target generator	PTR mode operation ($\Phi_{stream} \approx 3$ mm, $\Phi_{pellet} \approx 25$ μm, v ≈ 70 m/s, f ≈ 15 k/s, ...)	Parameters well known. (Std pellet target operation so far).
Pellet target	Valves, pumps, skimmers, access space etc. just below the target generator.	No draft design available yet. Approximate space requirement for the PTR section itself is well known.
Control, monitoring	Eventual usage of PTR info	Not started.
Physics analysis	Merging of PTR data and hadronic event data	Not started. (Example from WASA-at-COSY exists (A.Pyszniak PhD thesis)).

For more details see the talk at the Target session, CM December 2015 in Wien.

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Test of “Pellet Tracking” with PANDA **Cluster-jet** at COSY

The PTR system could provide jet position, shape and time variations.

Some differences between cluster-jet and pellet-stream that the system has to be adapted for:

1) size at accelerator pipe about 13 mm compared to 3 mm

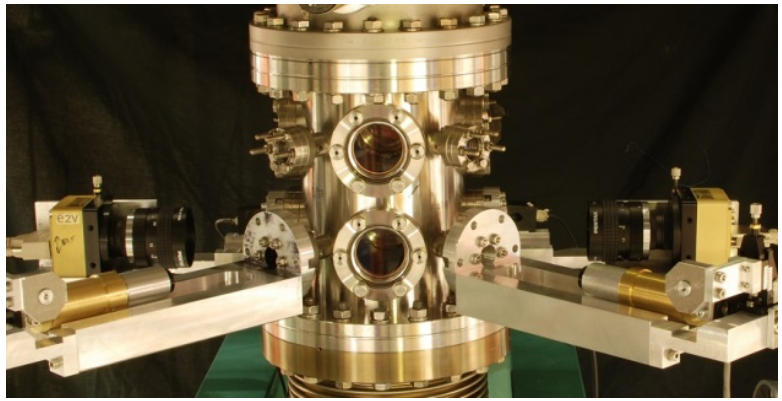
2) time structure continuous on the scale of microseconds

3) optical properties i.e. light reflection and transmission

It is also a matter of how to treat the camera image information

The present UPTS tracking chamber with two measurement levels could be used.

Two DMs each be equipped with one LS-camera and one STR-laser at 90 degrees, both with modified optics to cover the jet completely.



Time plan: **Autumn 2017** – **prepare the setup in Uppsala.**

New year service period – **install the tracking chamber at COSY.**

Spring 2018 ... – **install the DMs and carry out the run.**