Pellet Target Development for PANDA

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Where to use it?

pellet generation

beam

interaction point

PANDA
Requirements on a Target for PANDA

• design luminosity: \(2 \times 10^{32} \text{ /cm}^2 \text{s}\)
  - average density: \(3.8 \times 10^{15} \text{ atoms/cm}^2\)

• reconstruction of short lived reaction products
  - define primary vertex

• leave space for detectors
  - few mm pipe diameter for a length of 3.7 m

• good vacuum in the ring
  - low out-gassing (pumping is restricted)

• small beam size (few mm)
  - special requirements on inhomogeneous targets
Pellet Generation Principle

- droplet formation
- capillary vacuum injection
- nozzle
- H₂
WASA Pellet Target

- in regular operation for production experiments with hydrogen and deuterium since 2000!
Currently achieved at CELSIUS/WASA

- design luminosity: $2 \times 10^{32}$/cm$^2$s
  - average density: $3.8 \times 10^{15}$ atoms/cm$^2$
- currently: $1.7 \times 10^{15}$ atoms/cm$^2$ √

- reconstruction of short lived reaction products
  - define primary vertex
- $25 \mu$m pellets can be tracked √

- leave space for detectors
  - few mm pipe for 3.7 m length
- currently: 3.2 m √

- good vacuum in the ring
  - low out-gassing (pumping is restricted)
- currently under study at Uppsala !

- small beam size (few mm)
  - special requirements on inhomogeneous targets
- currently: $\sigma_h \times \sigma_v = 1 \times 3$ mm$^2$ !
A Pellet Test Station at Uppsala

- new and completely independent system
- full access for observation and modifications
- independent on CELSIUS beam times...
- improvement keeping compatibility with the WASA system
Improved Cold-Head

- lower vibrations
- faster pumping
- vacuum monitoring in all stages
- individual heating
- temperature measurements
Pellet Production

- nozzle + capillary interchangeable with WASA
- good access for mounting
- fast exchange of parts
Lower Vacuum System

- simulating PANDA vacuum-wise
- vacuum monitoring at six points
- optical observation of the pellets
- flexible design
- ongoing developments: pellet tracking, ...
Results on the Vacuum in the Test Set-up

- agreement of experiment and calculations
- measurements with a stable pellet train
- calculations using VACLOOP
- agreement of experiment and calculations
Vacuum at PANDA
Vacuum at PANDA
Conclusions

- pellet targets - solution for internal targets with
  - space for detectors around the interaction point
  - high luminosities
  - vertex definition
  - but: beam size has to be matched (or larger)

- developments at Uppsala:
  - further vacuum measurements
  - optimisation of the divergence and rate of pellets
  - automating the systems

- use at COSY, Lanzhou ...