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Activities concerning the PANDA and Prototype Target

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Overview

- Information from the 2nd PANDA cluster-jet target at COSY beam time (March 2019)
- Plans for the upcoming 3nd PANDA cluster-jet target at COSY beam time (August 2019)
- Vacuum studies and simulations using Monte Carlo techniques
- Activities concerning the PANDA prototype target

2nd PANDA Target Beam Time March 2019

- **Beam energy loss** data:
  - Thickness of ›2 x 10^{15} atoms/cm^2 at low nozzle temperatures and high pressures
    - Severe gas load problem in beam pipe at this conditions O(10^{-2} mbar l/s)
  - Different thicknesses between (5 - 7) x 10^{14} atoms/cm^2 at nozzle temperatures and pressures at the supercritical/liquid hydrogen regime
    - Gas load in beam pipe at this conditions O(10^{-3} mbar l/s)

➢ Correlation of target thickness and residual gas load must be studied in more detail at next beam times

2nd PANDA Target Beam Time March 2019

- **Tests with barrier bucket and stochastic cooling:**
  - Target thicknesses ›2 x 10^{15} atoms/cm^2 and 3 GeV/c beam momentum
  - 35 % cosy beam losses at 300 s cycle length
    - Defect connections found at stochastic cooling cavity after beam time
    - ➢ Similar measurements will be repeated next beam time

2nd PANDA Target Beam Time March 2019

- **Beam quality studies** with reduced thicknesses between (5 - 7) x 10^{14} atoms/cm^2
  - After a power failure in Jülich → no stable beam conditions at higher thicknesses/lower temperatures
  - Measurements done with barrier bucket and stochastic cooling
  - ‹ 5 % beam losses at 300 s cycle length
  - ‹ 50 % beam losses at 60 minutes cycle
  - ✓ Long cycle times for PANDA achieved
  - ✓ HESR will have more stochastic cooling power than COSY
  - ➢ During next COSY beam time improved cooling performance expected → less beam loss

2nd ANDA Target Beam Time March 2019

- **Vacuum conditions due to cluster evaporation:**
  - Measurement procedure:
    - Moving COSY beam over jet target
    - Measure pressure increase profile at WASA IP due to COSY beam heating jet beam
  - ➢ No direct visible effect → Fluctuations of target are dominating
  - ➢ Gas load due to evaporating clusters much less than current residual gas effects of target
  - ➢ Redo measurement with different scan time and target parameters next time
    - ➢ Finding better S/B (thickness/residual gas) ratio to give a limit of evaporation effects

3rd PANDA Target Beam Time June 2019

- Investigation concerning:
  - **Beam quality**
    - Highest thicknesses
    - Optimal running stochastic cooling
  - **Vacuum conditions due to cluster evaporation**
    - Redo measurement with different scan times and target parameters (small/big clusters)
  - **Effect of target settings on physical data taking ($pp \rightarrow pp\pi^0$)**

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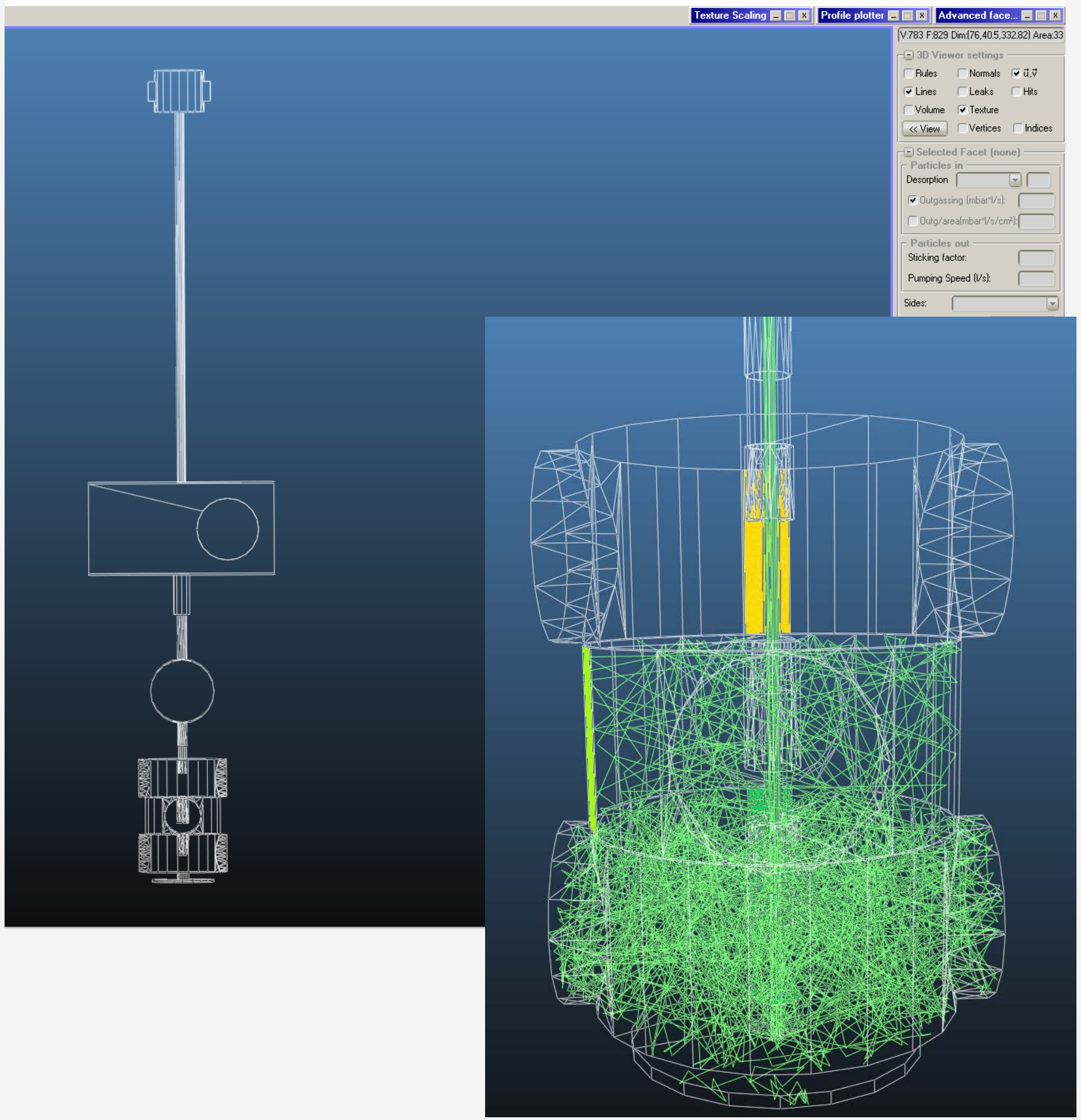
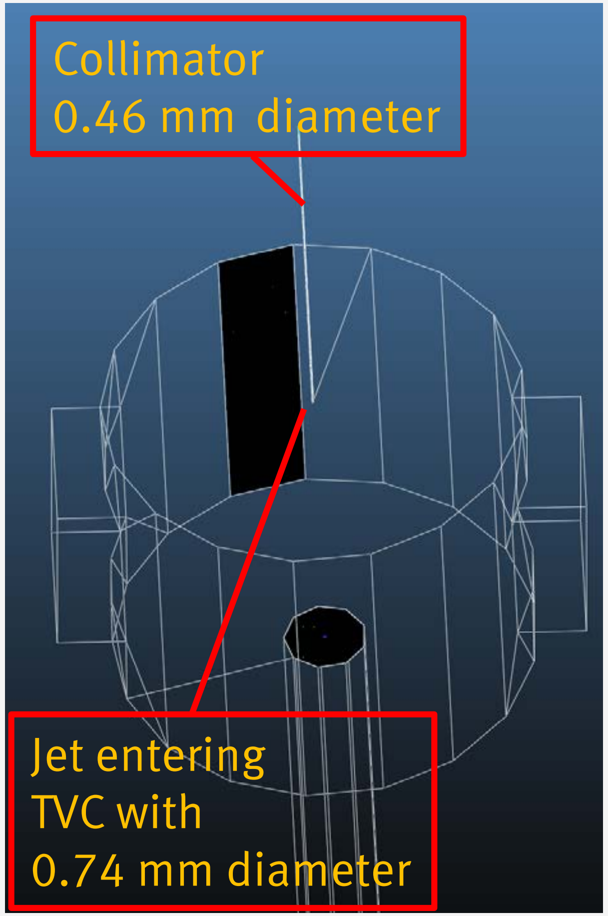
MolFlow+ Vacuum Studies

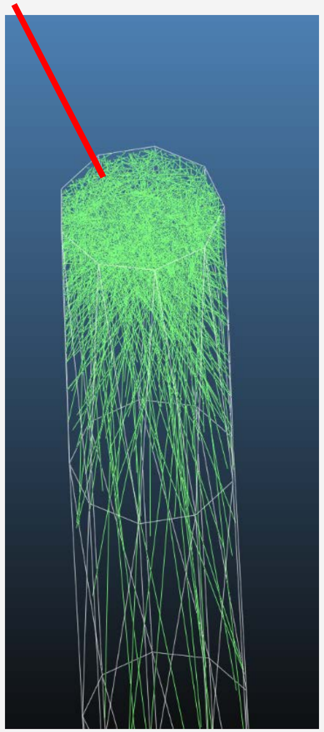
- Ongoing master's thesis of D. Klostermann
- Calculate pressure profiles and conductance with test particle Monte Carlo method
- For particle generation and rebounds at facets Knudsen's cosines law is applied
- Particle speed is chosen by a pdf of particles colliding with a wall, based on Maxwell-Boltzmann distribution
- Pumps are defined by a sticking factor (probability of absorption), read pumping speed:
  - Assuming equilibrium both can be converted to each other by:

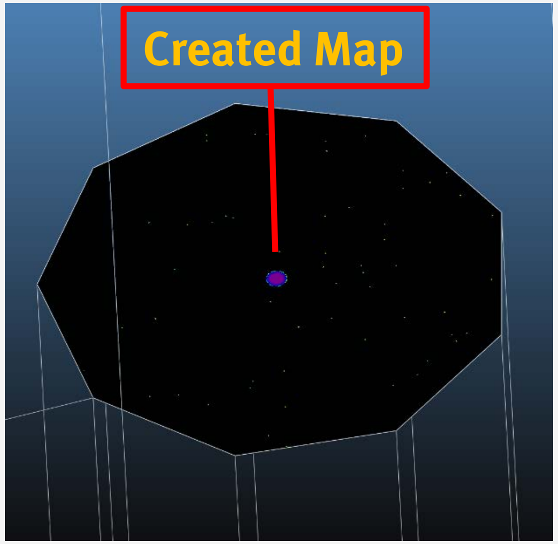
$$S[\frac{m^3}{s}] = sticking \times \frac{1}{4}\tilde{v}[\frac{m}{s}] \times A[m^2]$$



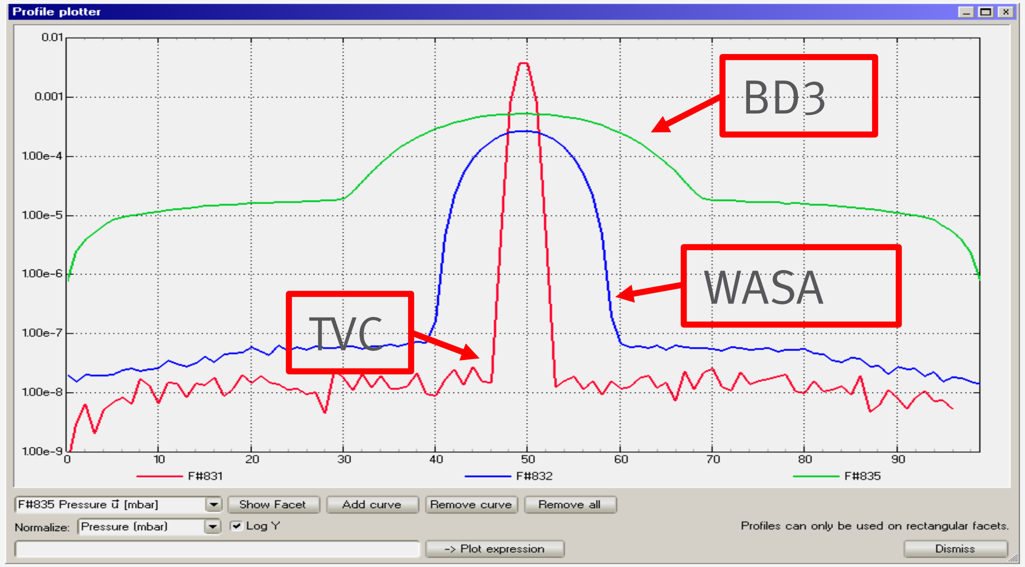
Generating a „Cluster“-Jet





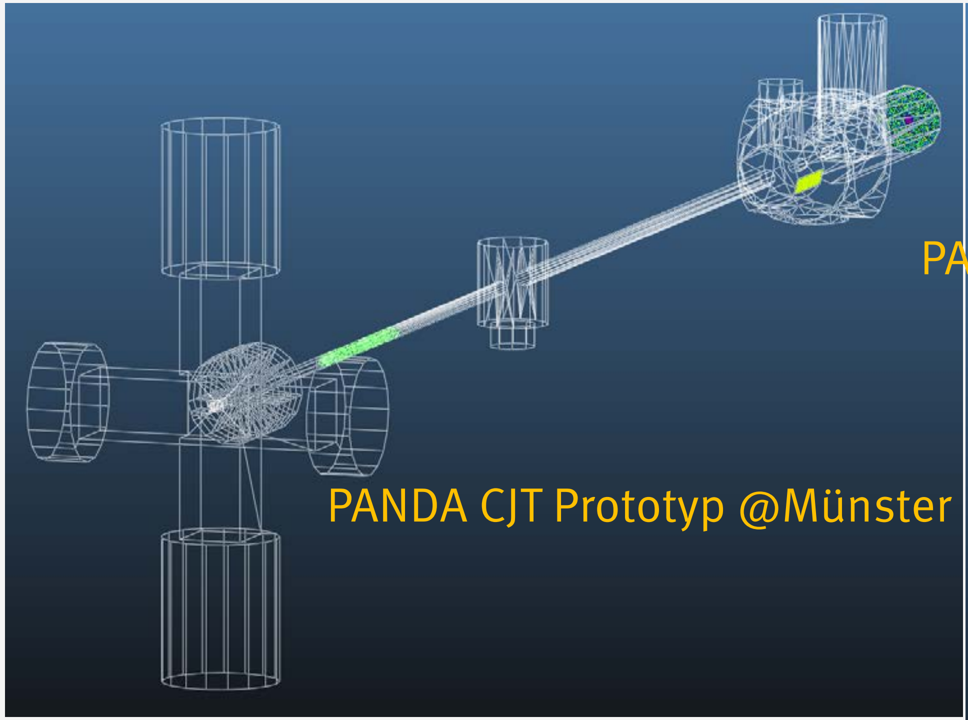


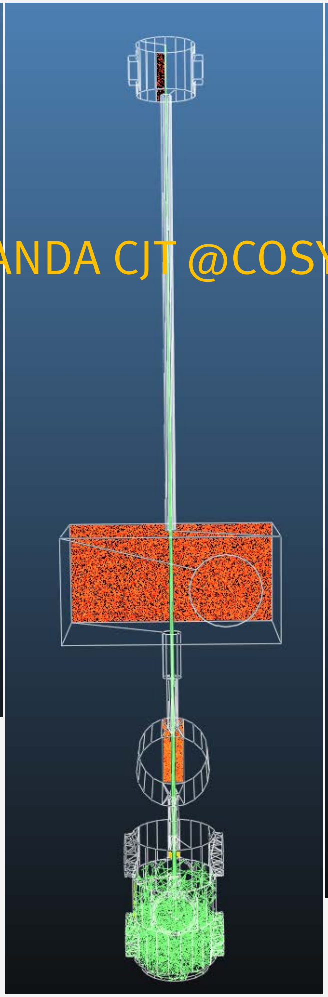
- The jet beam is simulated by creating an angular map using a simulated flight path from the collimator into the TVC
- Using this map a directed, continuous gas beam of the desired thickness is created at the TVC entry

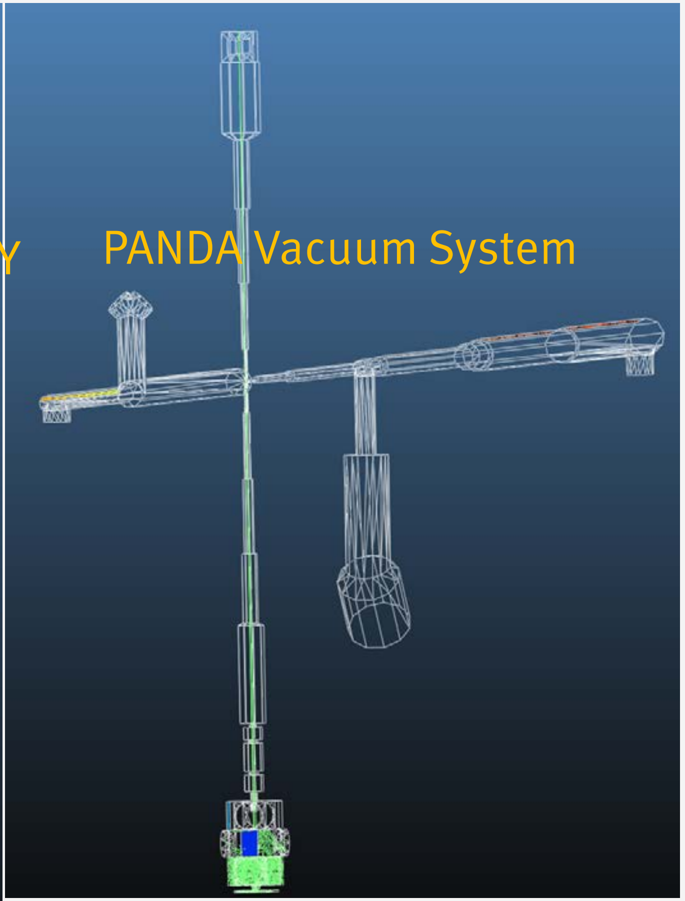


Simulated jet profiles
(Abscissa scale is given in facets/different scales)

Simulation of Different Target Geometries



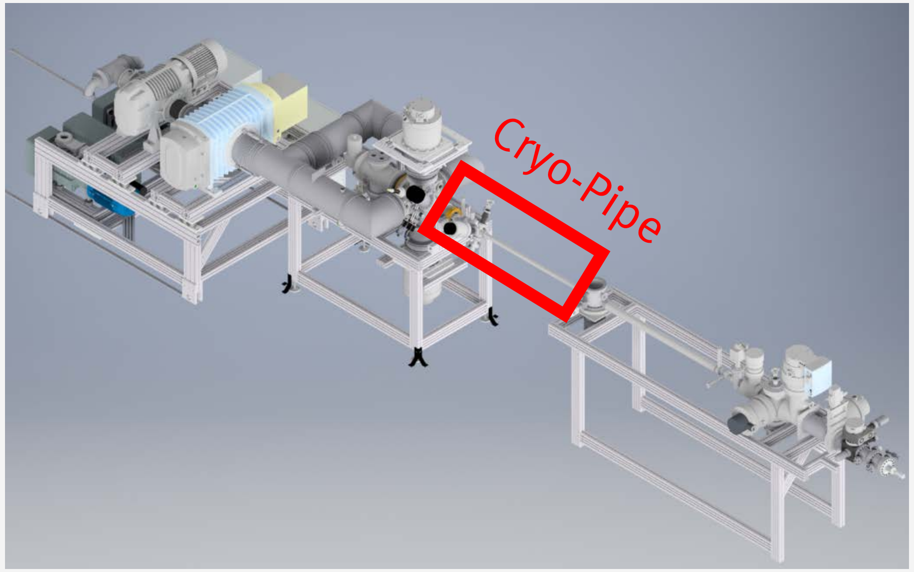




- Simulation of final target beam at COSY and at PANDA
- Trying to understand gas load at IP:
  - Flows from other chambers to IP
  - Simulation of evaporating clusters passing through the beam line
    - ➢ **Promising Ansatz:** First simulations reproduce measured COSY vacuum by a factor of ~2 in presence of a target beam
- Measurements & simulations of flows with the PANDA prototype in Münster will be performed

Activities concerning the PANDA prototype target

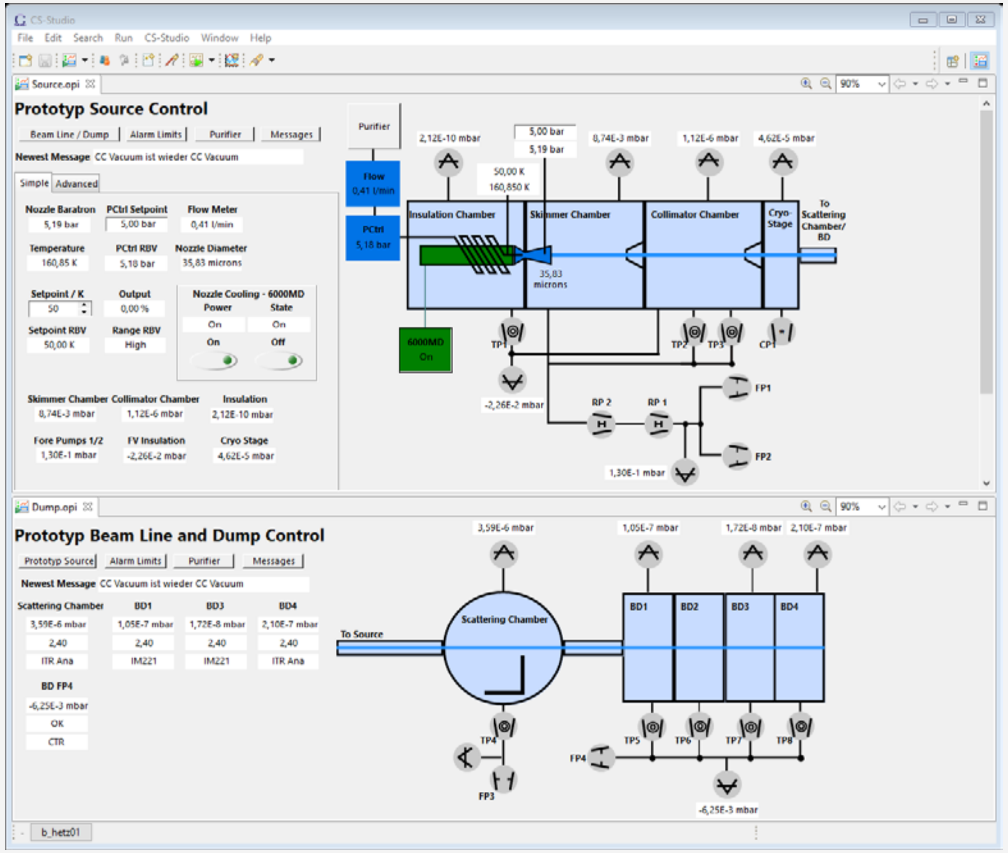
- Measurements concerning the shown gas flow simulations
  - Matching of simulation parameters with real measurements in everyday operation at Münster
  - Trying to supress/influence cluster evaporation using new produced cryogenic vacuum pipe for part of jet beam line



- Replaced coldhead for nozzle cooling installed
- Characterization of new produced nozzle series

Activities concerning the PANDA prototype target

- New computer hardware and DAQ equipment
- Completely new written slow control software for prototype
  - Based on EPICS
  - OPI/GUI using CSS
  - Central EPICS archiver “Archiver Appliance“
    - Same as used in Jülich



Summary

- Shown data taken at 2nd PANDA target beam time
- Preparing 3rd PANDA target beam time, continuing the investigation of beam quality, vacuum, and data taking effects introduced by the target
- Vacuum studies and simulations using Monte Carlo techniques
  - Comparison with real data from PANDA target at COSY and Münster prototype
  - Cooled beam pipe at prototype to suppress cluster evaporation effects
- New hard- and software at installed/integrated at prototype (coldhead, slow control, DAQ)