On the feasibility of using an extracted polarized antiproton beam of the HESR with a solid polarized target

(continue)

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PSTP2015, Bohum, Germany

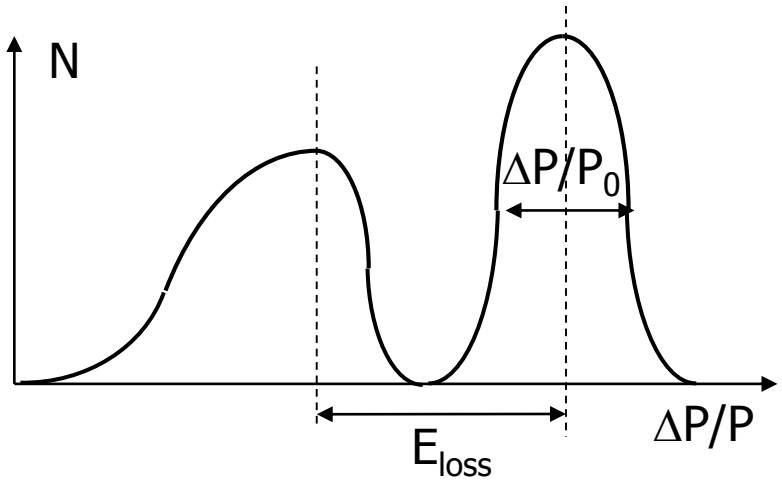
Urban model of beam energy loss

$$\Delta E = n_1 I_1 + n_2 I_2 + \sum_{i=1}^{n_3} \frac{I}{1 - g\xi_i} \qquad g = \frac{E_{\max}}{E_{\max} + I}$$

n_1, n_2 – number of excitation events to different atomic energy levels

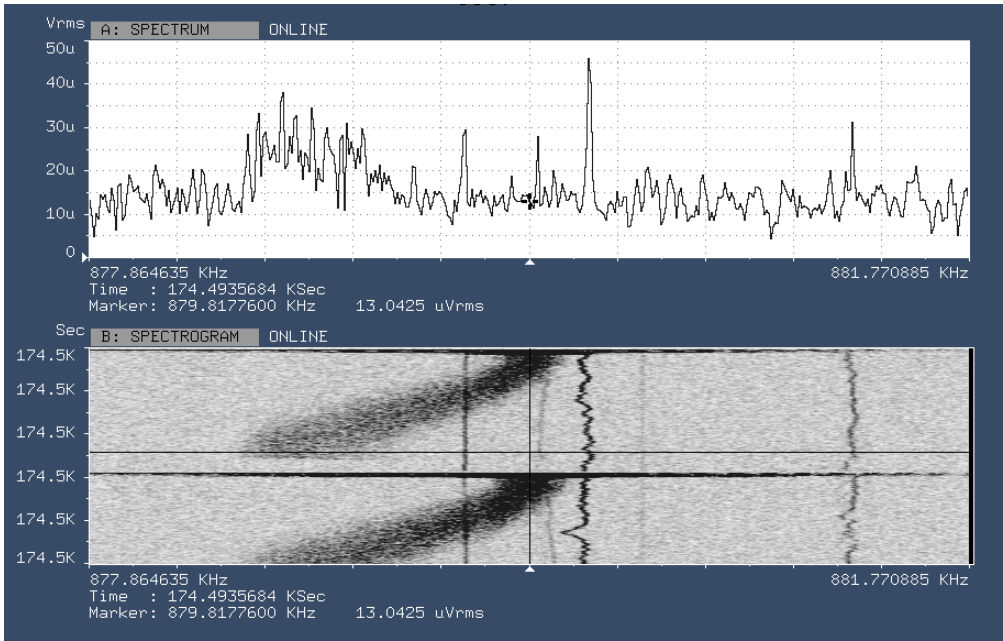
n_3 – number of ionization events

ξ – uniform random number

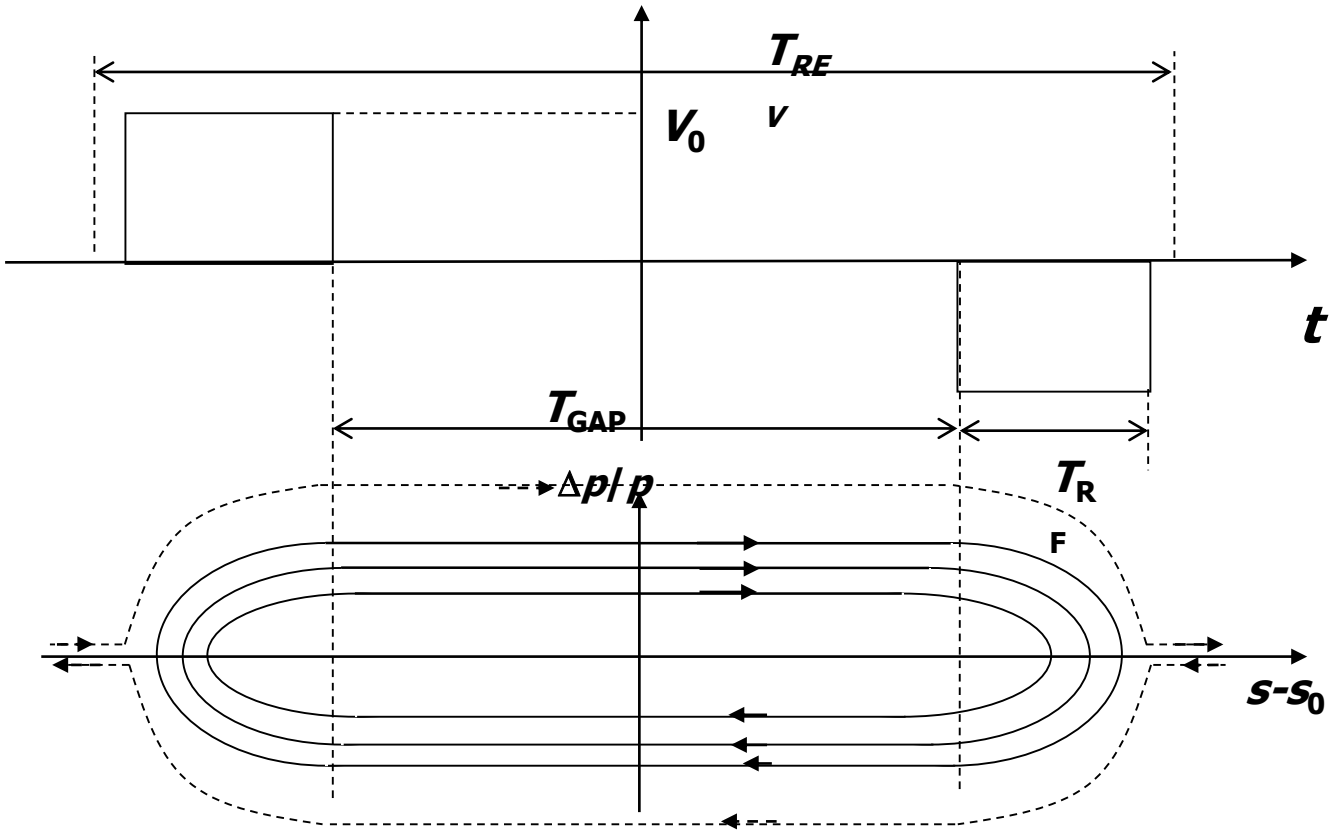


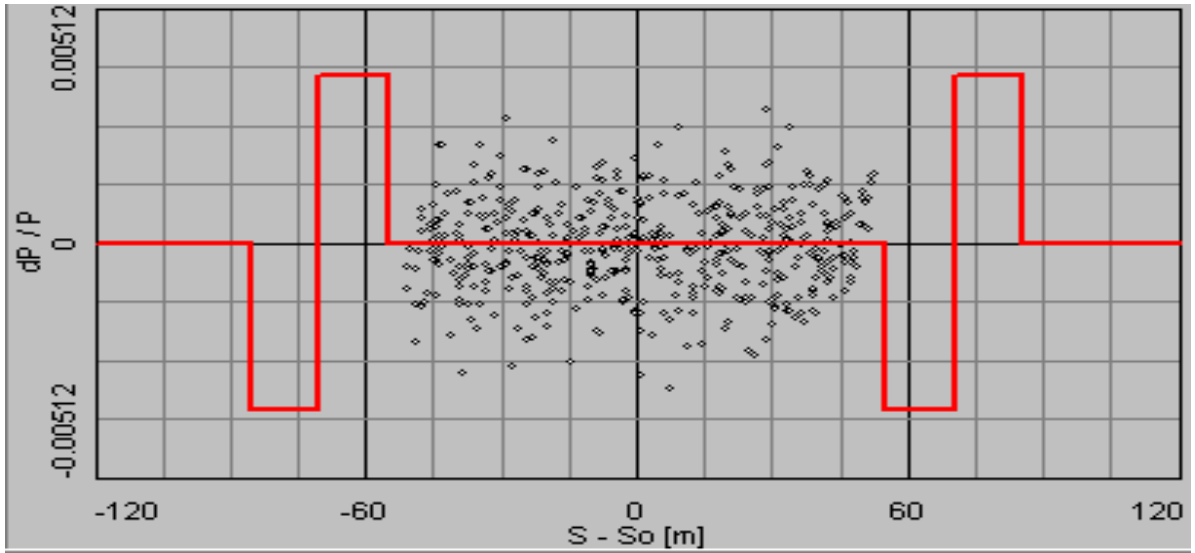
WASA@COSY experiment

(momentum on time – no barriers)



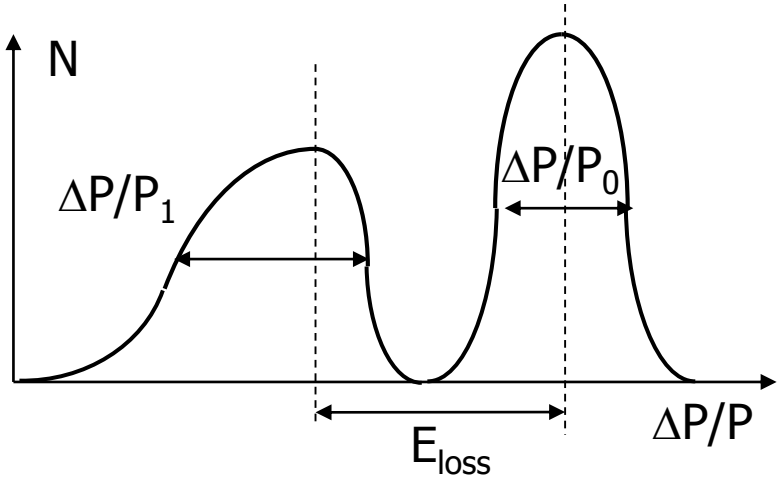
Burrier buckets reflect particles and keep inside barriers while momentum spread less than barrier height





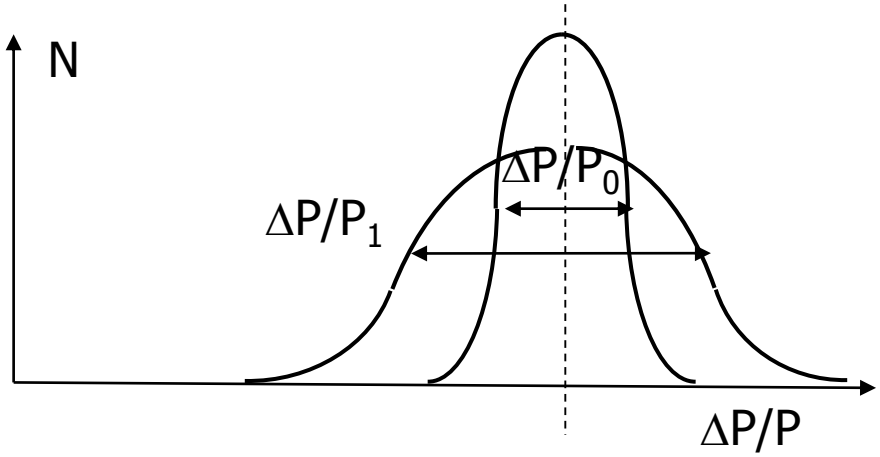
Example of moving barrier buckets

Burrier buckets compensate the effect of beam energy loss



no barriers:

fast negative energy loss

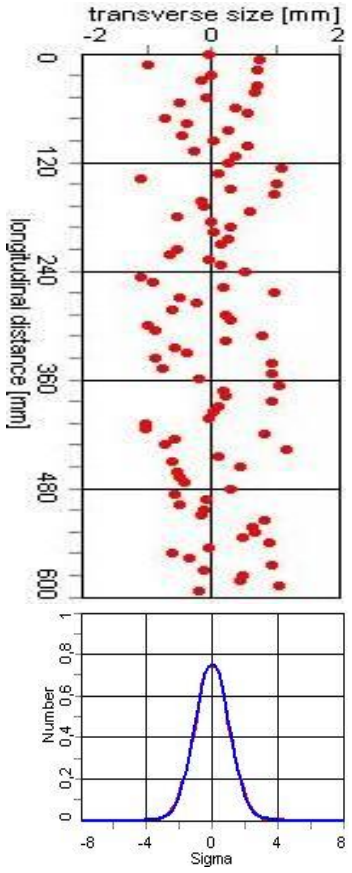


barrier buckets

momentum spread growths due to scattering process which is much slower than energy loss

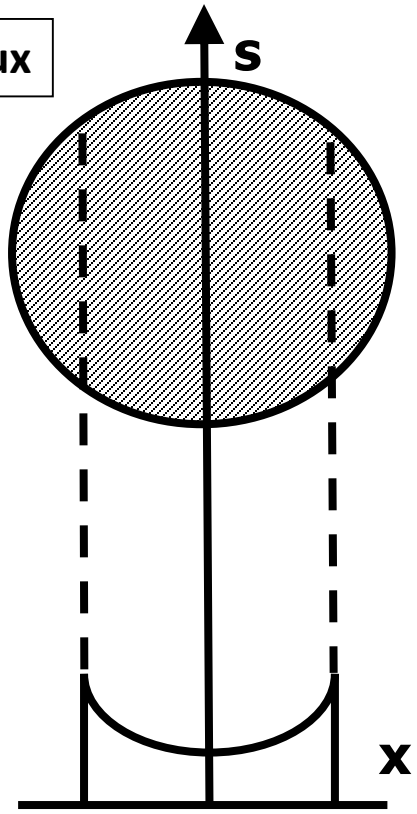
Simulation of particle interaction with pellets using BEATCOOL code

http://betacool.jinr.ru



Ion beam profile

Pellet flux



Particle probability distribution over betatron oscillation

For each particle

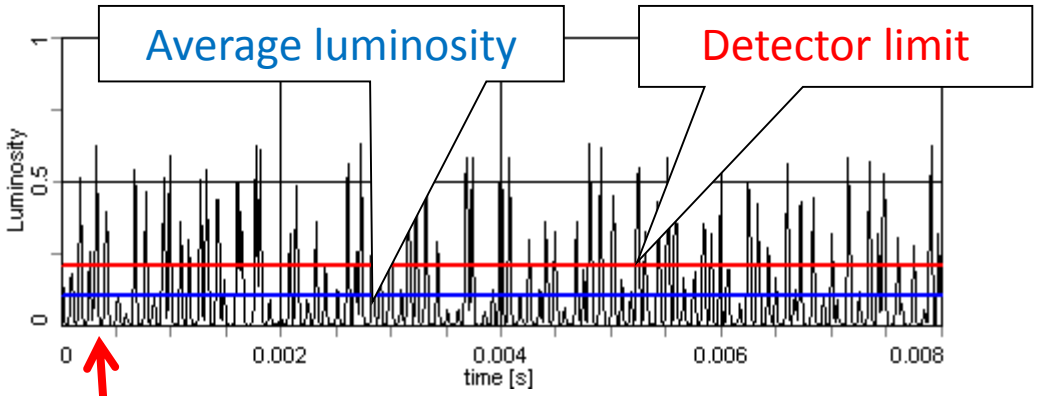
Find number of interaction events:
1) Integration over betatron oscillation
2) Integration over pellet flux
3) Number of turns per integration step

A few interactions of each particle per integration step (about 0.1 - 1 sec) with realistic interaction models (Urban + plural scattering)

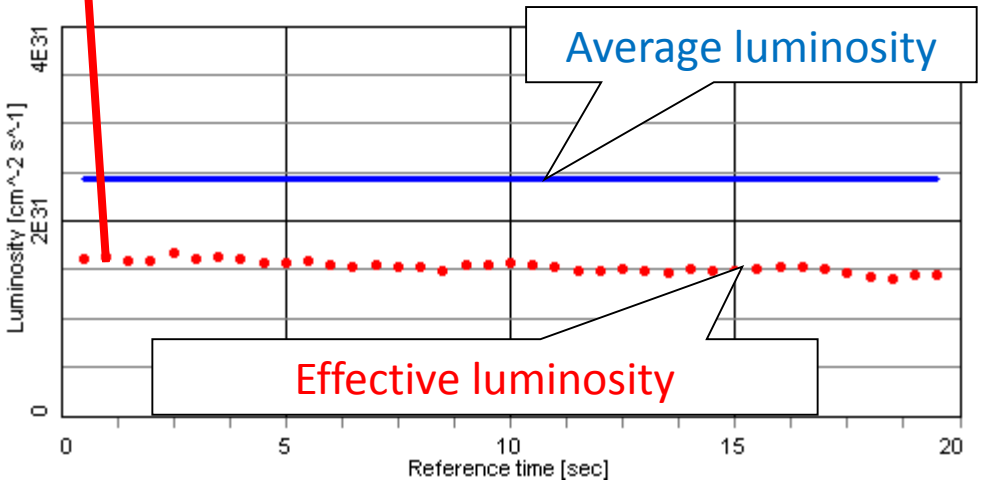
Designed parameters for PANDA (high-luminosity mode)

Momentum, GeV/c	**9**
RMS momentum spread	**$1 \cdot 10^{-4}$**
Transverse emittance (RMS normalized)	**0,4**
Average luminosity, $cm^{-2}\ s^{-1}$	**$2 \cdot 10^{32}$**
Detector limit, $cm^{-2}\ s^{-1}$	**$3 \cdot 10^{32}$**
Effective target density, cm^{-2}	**$4 \cdot 10^{15}$**
Pellet velocity, m/s	**60**
Pellet flux radius, mm	**1,25**
Pellet size (diameter), μm	**28**
Distance between pellets, mm	**5**

Effective luminosity simulation for different variants of detector limit

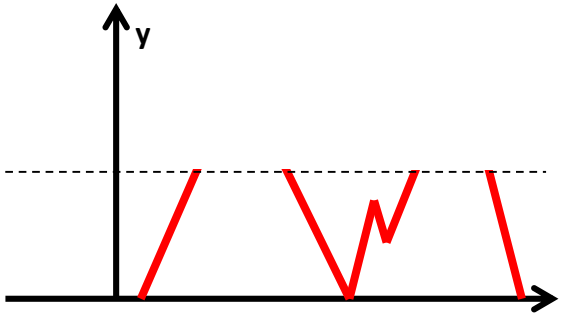


Microstructure of luminosity on time

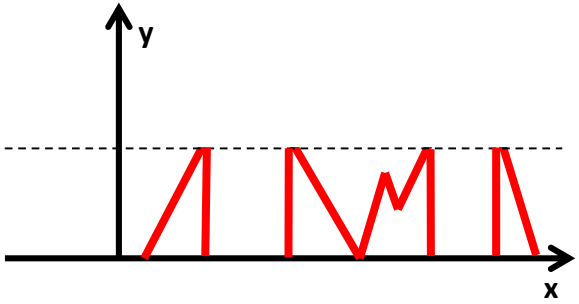


Luminosity on time

Detector can not count more than limit



Full overload of detector



Conclusion

- BETACOOL simulations show that the pellet size should be much less than 28 μm which was accepted by PANDA community
- Algorithms in BETACOOL code were especially elaborated for PANDA experiment and can be effectively used for the optimization of the beam extraction with the scattering on the different types of internal targets