



Exercise on Bunch Shape Monitor:

- The RF frequency of the RFQ is 352 MHz and the designers of the Bunch Shape Monitor promise a phase resolution of 1 degree. What time resolution does this correspond to?
- Some years ago a BLVD (Bunch Length and Velocity Detector) was in operation at CERN. The device worked like the BSM (Bunch Shape Monitor) described in the lectures. However it was movable along the axis of beam movement. If the detector is moved along this axis, then the movement corresponds to a phase shift. If you move the detector far enough (360 degrees of phase advance) then the bunch shape measured will coincide with the one measured in the first position. Like this the beam velocity (and energy) can be measured. By how much do you have to move the detector if your expected particle energy is 3 MeV and 160MeV (same RF and phase resolution as above).

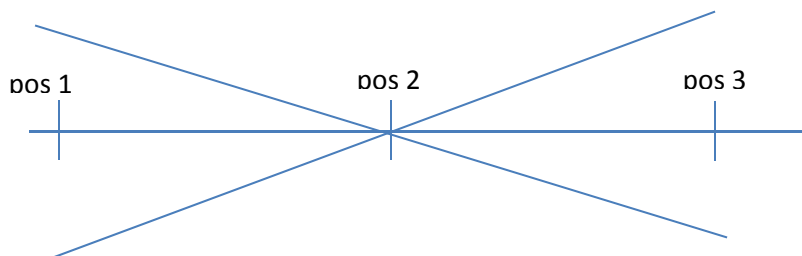
The relationship between kinetic particle energy and $\beta=v/c$ is $T = \left(\frac{1}{\sqrt{1-\beta^2}} - 1 \right) * E_0$

where E_0 is the proton rest mass.

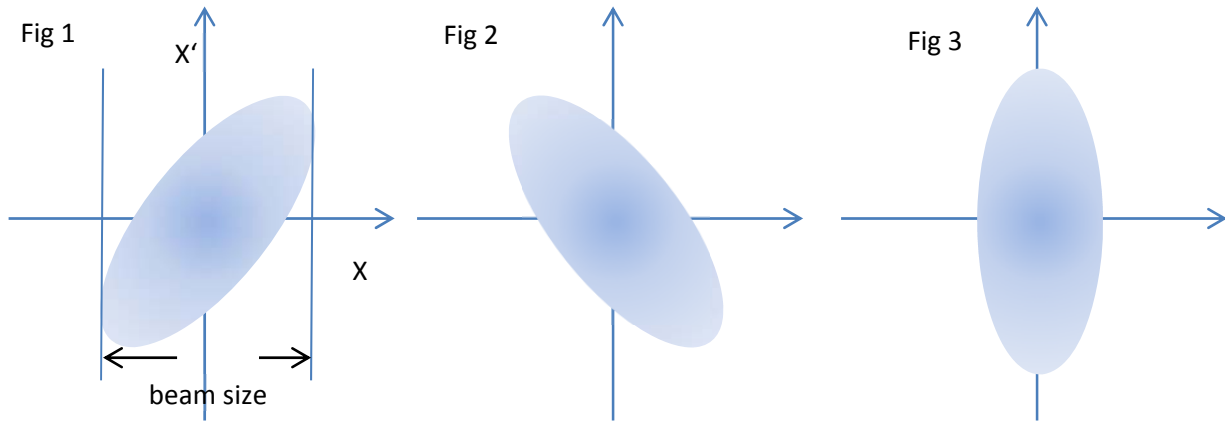
Exercise of transverse emittance measurement:

3 profile measurement

During the lecture on the phase space scan has been presented. There are however other ways to measure emittance as well. One method is to measure 3 beam profiles around a waist:

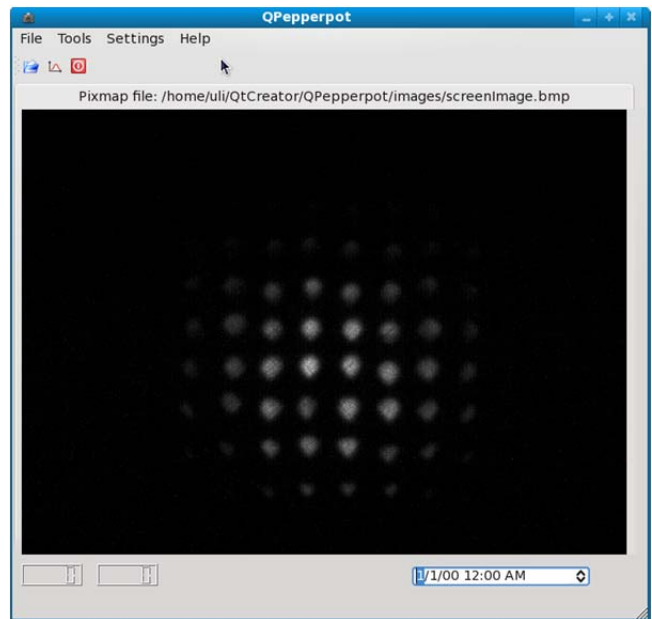
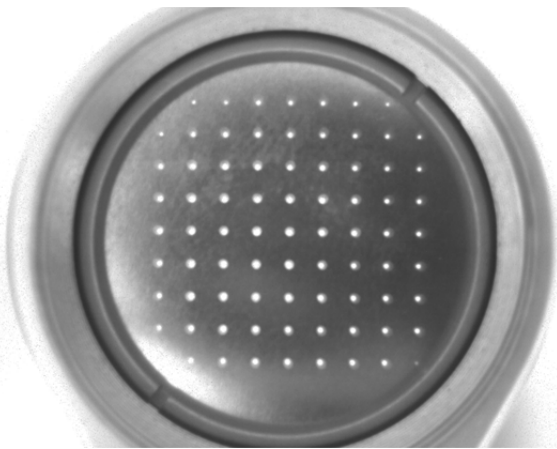


The following figure shows 3 phase space ellipses as calculated for the 3 positions above. Which ellipse corresponds to which position?



Pepperpot measurement

In order to measure beam emittance in a single beam pulse a plate with a matrix of holes is placed into the beam and, after a drift space, the image of the holes is observed with a TV camera.



What are the steps you need to transform a pepperpot image into a phase space plot?