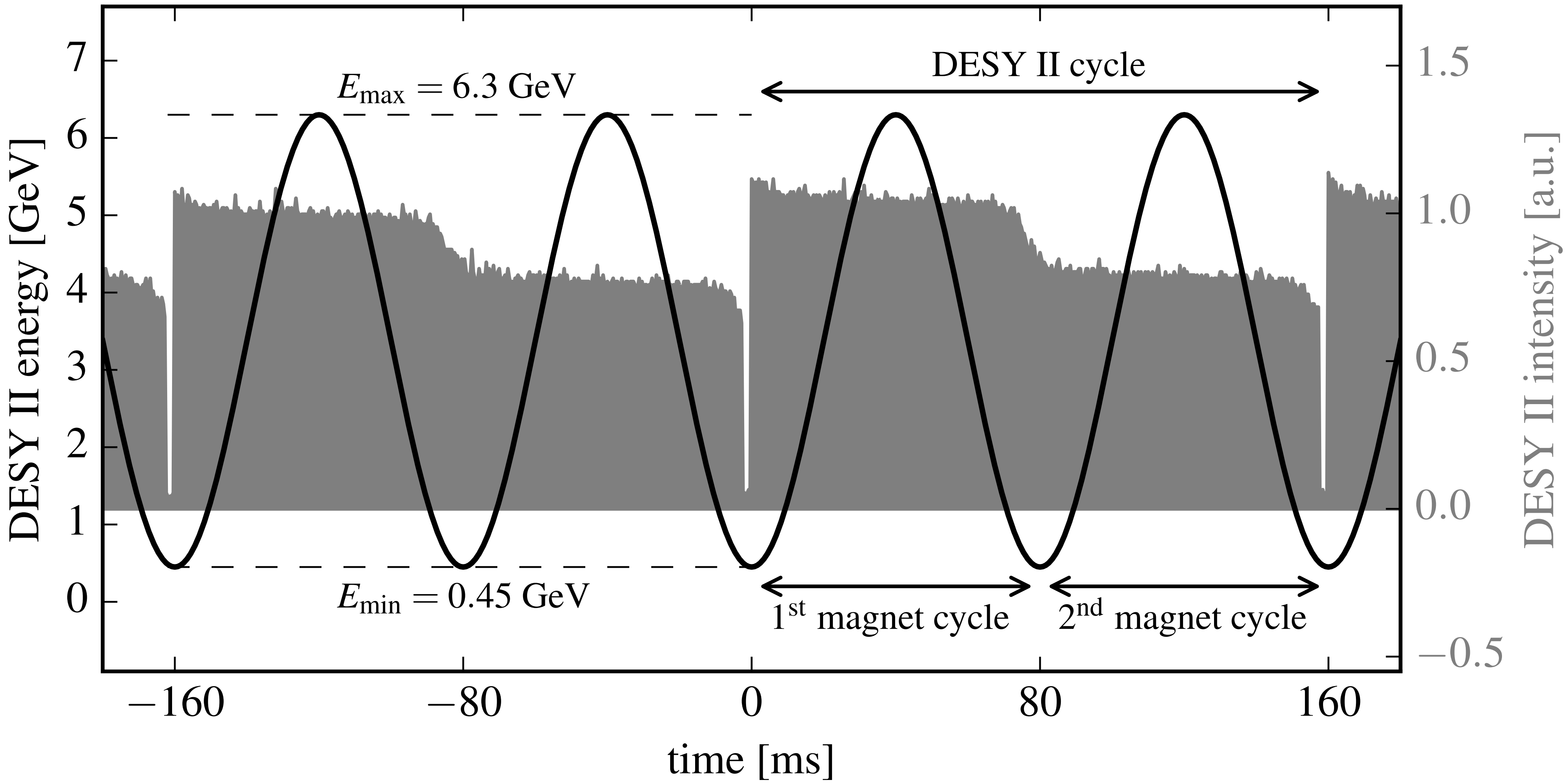
Some DESY testbeamT24 parameters

and

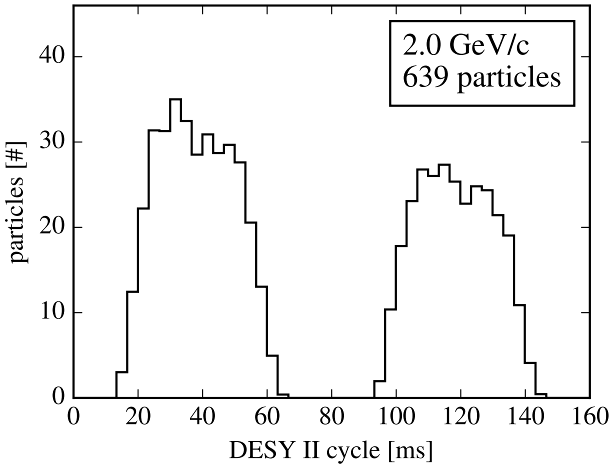
Preliminary measurements plan

Goals of our testbeam

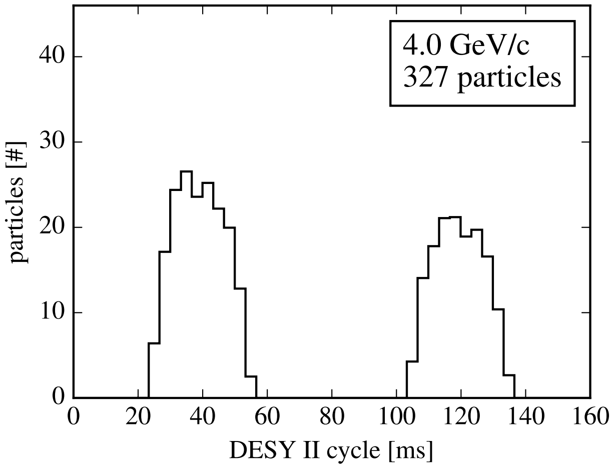
- Overall performance of ‘large’ system of 32 TPX3 GridPixes
- NEW: with B-field of 1 T ->
  transverse diffusion 300 um -> 100 um/cm$^{1/2}$
- NEW: momentum up to 5 GeV -> less mult. Scattering
- Study possible distortions with and without B field
- Investigate rate possibilities using the Concentrators



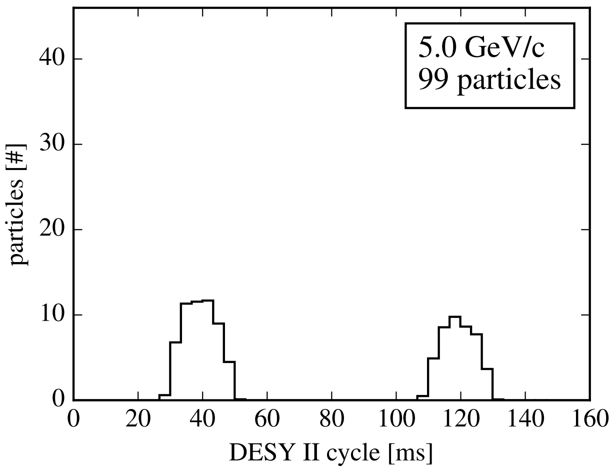
- Single bunch during 2 magnet cycles of 80 ms (12.5 Hz) = 160 ms ; then new bunch
- Circinference ring = 292.8 m (average radius 46.6m)
- Time of roundtrip of bunch = 0.976 us
- Duty cycle @ 5 GeV is 26.7/80 = ~33%
- Duty cycle @ 1 GeV is 64.8/80 = ~ 81%



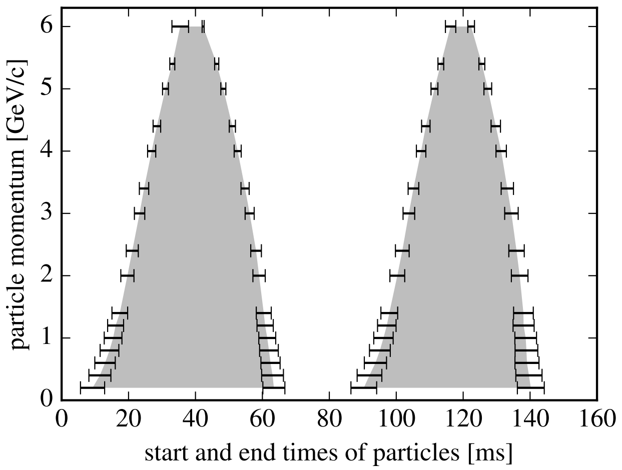
(a) at 2 GeV/c



(b) at 4 GeV/c

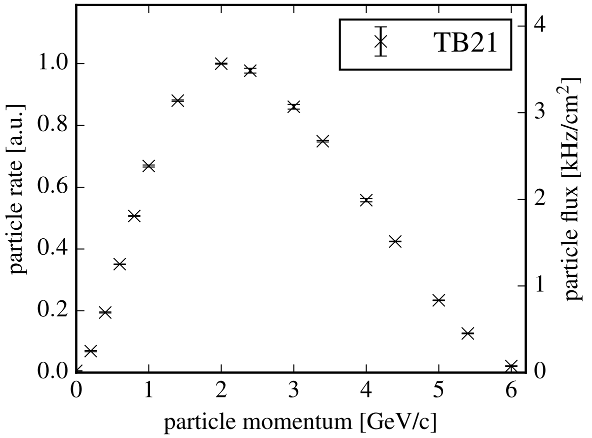


(c) at 5 GeV/c

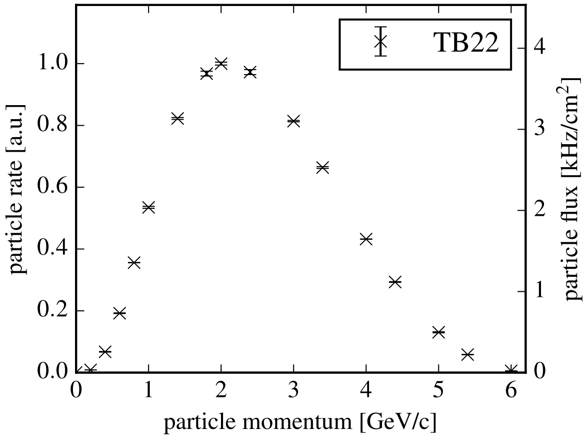


(d) momentum vs. time

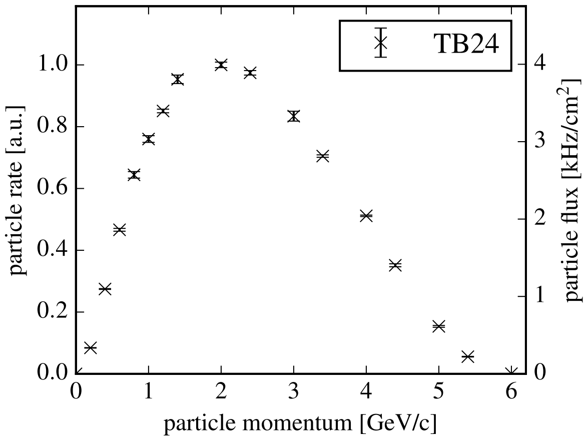
Particle flux per cm2 (measured in T24 etc)



(a) at TB21



(b) at TB22



(c) at TB24

- At 1 GeV: 2.5-3 kHz
- At 2 GeV: 4 kHz
- At 5 GeV: ~ 400 Hz

- Probably lower in T24/1

Detector and beam telescope

- 4 TPX3 chips perpendicular to beam; 8 TPX3 along beam direction
- Total length including gaps inside the quad: ~158 mm; width = 56 mm
- Sagitta at B=1 T: R [m] = p [GeV]/(0.3 B[T])
  - P=5 GeV: R = 16.67 m -> sagitta = 0.187 mm (3 pixels); will be hard to measure with diffusion between ~100 um to ~ 200 um at full drift
  - P=1 GeV: R = 3.333 m -> sagitta = 0.934 mm (17 pixels!)
- Beam telescope: 2 x 3 planes of MAPS CMOS pixel chip:
  - Pixel pitch 18.4 x 18.4 um; 1152 columns x 576 rows -> 21.2 mm x 10.6 mm
  - Point reconstruction resolution of ~3-5 um! Will give much better sagitta precision
  - Zero-suppressed data stream w. intergration time of 115.2 us (rolling shutter) = 118 bunchXs
- Common trigger via TLU to TPX3 data streams and telescope stream

How much data do we hope to take?

- T2K gas gives about 100 hits/cm tracklength

  -> 1 track = 8 chips x 14 mm x 100 hits = ~1120 hits/track
- @5 GeV: ~100 Hz -> 112 khits/s
  - For 1 M tracks takes 10^4 secs = 2.8 hours -> 10^4 x 112 khits x 8 bytes = 9 GB

    so ~100 runs on 1 TB tape/disc (i.e. 280 hours; one TB disc would be enough)

    Peter measured 100 MB of noise data in 1000s => 1 GB in run of 10^4 s (10%)
- @2 GeV: ~4 kHz -> 1000 s run gives 4 M tracks = 36 GB (noise 0.1 GB)

  so ~27 runs/tape (i.e. 1 tape per shift of 8 hours)

Measurement plan (1)

1. Initially without B field:
   a) Search alignment with beam of beam-telescope and measure beam profile. We might need TWO positions of beam w.r.t. telescope; can be done by displacement of whole magnet setup
   b) Define optimal position of detector w.r.t. telescope given limited movement of QUADs detector w.r.t. telescope (40 mm??)
   c) Take few runs at different x and 1-2 z positions to allow fast pre-analysis to check things

Measurement plan (2); precision measurements

- With magnetic field 1 T at p = 5 GeV:
  1. How many x points needed at (probably 2 positions inside telescope)?
  2. How many z points (we need several if we want to distinguish “our own” E-field distortions and the extra magnetic field distortions)?
  3. Measurements at slight angle in x-y plane w.r.t. beam to scan the chip borders (both outside borders and inner borders)
  4. Few (at least one!) measurement(s) with whole setup rotated in hor. Plane (gives tracks with hits at different drift distance; pedagogical seeing effect of diffusion; at high rate e.g. at p = 2 GeV would be nice to see if any difference in daq rate capability with hits arriving at (slightly different times)
- Without magnetic field at p = 5 GeV:
  - (part of same) program as above

Measurement plan (3); high rate measurements at ~ 2 GeV