# Tuning procedure for H8 Microbeam setting of the beam optics

29th of April 2019

## 1. BEAM FILE SETUP

- Set TAX1 (XTAX.042.018) position to -140 mm (80 mm opening)
- Set TAX2 (XTAX.042.020) position to -40 mm (2 mm opening)
- Load beam file H8Z.SBA.001 (date: 08.04.2018). The AppLE.py graphical output for the optics for this beam file is displayed at the end of the procedure.
  The optics file is called h8micro07.

- Check that the collimator settings are as follows:
  - COLL01 (XCSH.042.064) = ± 1 mm
  - COLL02 (XCSH.042.128) = -1.1 mm; +0.1 mm
  - COLL03 (XCSV.042.132) = ± 1 mm
  - COLL04 (XCSV.042.185) = -1.8 mm; -0.6 mm
  - Microcollimator overall gap size: 0.8 mm
  - COLL07 (XCSV.042.404) = ± 2.5mm
  - COLL08 (XCHV.042.406) = ± 2.0 mm
  - COLL09 (XCHV.042.407) = ± 2.5 mm
  - COLL10 (XCSH.042.424) = ± 6.0 mm

## 2. 400 GeV/c PROTON BEAM TO T4

- Switch on the T4 wobbling by loading e.g. the file T4A.SBA.035 with properties
  - P0 beam is off
  - H8 beam is primary (400 GeV/c, 0 mrad)
  - H6 beam is secondary (120 GeV/c, -0.20 mrad)

  Alternative wobbling settings can be considered (e.g. different H6 momentum or secondary beam in P42)
- Set T4 target head to position 1 (500 mm Be).
- Beam intensity at T4: 30 units.
- Combined symmetry (position and angle) of proton beam incident onto T4 ≥ 90 % (SPS Page 1). Ask CCC to re-steer if necessary.
- Ask CCC to scan the T4 spot on BBST-H,-V 241.150 (TBIU (T4)) from +7 to +13 mm in steps of 0.2 mm (miniscan).

3. STEER PROTON BEAM TO THE MICROCOLLIMATOR

- If necessary, make a 'manual' horizontal scan of B3T bend (check with the operators that WOBSU is disabled for T4 during the scan)
    - Scan between -547 A and -527 A in 11 steps, counting on SCINT01, using normalisation 2 (T4-TBIU)
    - Set B3T to the value providing maximal beam intensity at SCINT01
    - Ask the operators to re-enable WOBSU
    - Note: This procedure perturbs the data taking on H6 beamline and P42 beamline (experiment NA62, if running). Inform the users about the starting time and the duration of the procedure!
- TAX2 scan
    - Set TAX2 to position -40 mm, i.e. ∅ = 2 mm
    - Open TAX1 to position -140 mm
    - Scan TAX2 in 1mm steps from -44 mm to -36 mm, counting on SCINT01
      Set TAX2 to the position that gives the largest rate on SCINT01

- Horizontal Steering through COLL01 and COLL02
    - Scan COLL01 collimator
        - Scan COLL1 from -3 to +2 mm onto SCINT01 with slit 1 mm and 11 steps
        - Set COLL01 center to the value providing maximal beam intensity at SCINT01
        - Open COLL01 gap to ± 1 mm around this center
    - Scan TRIM11 (TRIM.042.094) through collimator COLL02 onto SCINT01
        - Set COLL02 collimator jaws to ± 0.6 mm
        - Scan TRIM11 from -30 A to +0 A in steps of 2 A
        - Set COLL02 collimator jaws ± 0.6 mm

- Vertical Steering through COLL03
    - Set COLL03 collimator jaws to ± 0.5 mm
    - Double scan BEND01 (BEND.042.049) and BEND01 (BEND.042.061) from -1305 A to -1285 A in 11 steps of 2 Amps with factor 1.0, counting on SCINT01
      (Sensitivity: 1.0 mm position change at COLL03 per Ampere of bend current change)
    - Set COLL03 collimator jaws back to ± 1.0 mm
- Vertical parallel displacement
    - In case no sufficient (~$10^7$ ppp) beam intensity can be achieved by the vertical steering above:
    - Set COLL03 collimator jaws to ± 0.5 mm
    - Double scan BEND01 (BEND.042.049) and BEND02 (BEND.042.061) from - 1395 A to - 1195 A in 11 steps of 20 Amps with factor -1.0, counting on SCINT01
      (Sensitivity: 0.01 mm position change at COLL03 per Ampere of bend current change)

- Set COLL03 collimator jaws back to ± 1.0 mm

4. SCAN OF MICROCOLLIMATOR POSITION AND ANGLE

- Horizontally:
  - Keep microcollimator overall gap size to 0.8 mm
  - Scan microcollimator position (TABLE_X_042.201) from -3.5 to +2.5 mm in 13 steps with slit 0.8 mm
  - Select the setting, at which the count rate on scintillators XSCI.042.403, XSCI.042.410 and XSCI.042.463 is maximal. Compromise if necessary. In case the maxima at these scintillators differ a lot, contact BI for scintillator alignment or calibration.
- Vertically:
  - Scan microcollimator position (TABLE_Y_042.201) from -2 to +4 mm in 13 steps with slit 0.8 mm
  - Select the setting, at which the counts on scintillators XSCI.042.403, XSCI.042.410 and XSCI.042.463 are maximal. Compromise if necessary. In case the maxima at these scintillators differ a lot, contact BI for scintillator alignment or calibration.

5. STEERING TO THE EXPERIMENT

- Open COLL09 (XCHV.042.407), COLL10 (XCSH.042.424) and COLL11 (XCSH.042.442) to ± 40.0 mm
- Vertical steering
  - Set collimators COLL07 (XCSV.042.404) and COLL08 (XCHV.042.406) to ± 1.0 mm
  - Double scan BEND03 (BEND.042.325) and BEND04 (BEND.042.330) from -1315 A to - 1295 A in 11 steps of 2 Amps with factor 1.0, counting on SCINT05 (XSCI.042.463) (Sensitivity: 1.4 mm position change at COLL07 per Ampere of bend current change)

- Horizontal steering
  - Set collimator COLL10 (XCSH.042.424) to ± 1.0 mm
  - Double scan BEND05 (BEND.042.412) and BEND06 (BEND.042.416) from -830 A to – 1030 A in 11 steps of 20 Amps with factor 1.0, counting on SCINT05 (XSCI.042.463) (Sensitivity: 1 mm position change at COLL10 per 50 Amperes of bend current change)
- Set COLL09 (XCHV.042.407) back to ± 2.5 mm

6. CLEAN THE BEAM AND SET THE REQUIRED SIZE

- Vertical beam size
  - Scan collimators COLL07 (XCSV.042.404) and COLL08 (XCHV.042.406)
    - Open collimator COLL08 to ± 10.0mm
    - Scan COLL07 jaws symmetrically from ± 1.0 mm to ± 5.0 mm in 9 steps

        - Set COLL07 jaws to the values approximately providing desired vertical beam size at the profile monitor XWCA.042.404
        - Scan COLL08 jaws symmetrically from ± 1.0 mm to ± 5.0 mm in 9 steps
        - Set COLL08 jaws to the values providing desired vertical beam size at the profile monitor XDWC.042.476 and removing the beam halo to a sufficient degree

- Horizontal beam size
    - Scan collimator COLL10 (XCSH.042.424)
        - Start with following jaw settings: left: ± 1.0 mm
        - Scan until following jaw settings: left: ± 10.0 mm
        - Number of steps: 10
    - Set COLL10 to the values providing desired horizontal beam size at the profile monitor XDWC.042.475