

## Introduction to the use of the H8 beam

### updated version for 2000:

1) A new collimator, C7<sub>v</sub>, has been installed to double-up C9<sub>v</sub> - this is used to separate hadrons from electrons/positrons at high energies: closing C7 together with C9 should e.g. reduce the hadron contamination in the +180 GeV positron beam as well as the -200 and -300 GeV electron beams.

2) A second Threshold Cerenkov counter (XCET) has been installed in zone 158, i.e. just upstream of ATLAS. This is a standard beam instrument (see DETECTOR / THRESHOLD) and replaces the counter so far provided by ATLAS-Tiles. This counter is used with two TRIG scintillation counters, TRIG5+TRIG6.

3) A new lead-glass calorimeter (XEMC), allowing to study the beam composition, is installed just after the second Cerenkov counter. This instrument is used by experts only, e.g. by the CRN operators on request of the users. The XEMC is operated in coincidence with a small TRIG counter (2x2 cm<sup>2</sup>, called TRIG7). Use the option TUNE / MEAS / CALO to use the XEMC.

4) Following the installation of new material (see above), the TRIG counters had to be re-numbered. On this occasion, also the TRIM magnets are being re-numbered. The list of changes is given in Appendix-2, the new situation is shown in the layout /optics drawing attached.

### REVIEW of your past runs:

In order to allow users to find their way back to what was done to their beamline in the past, the LOG files are now available on the web:

<http://nicewww.cern.ch/sl/eagroup/eaframe.html> -- choose Logfiles and choose H8. For the information from previous years, go to the end of the page ("Older Logfiles"), then make your choice.

The H8 beam is a secondary particle beam that provides hadrons, electrons or muons of energies between 10 and 400 GeV/c, as well as 450 GeV/c (primary) protons and up to 400 GeV/c per charge (32.8 TeV) primary Pb ions. The H8 beam is a part of the SPS North Area (EHN1, building 887). This note gives a short introduction to the basic elements of the H8 beam. For more detailed information the users are referred to one of the SL-EA liaison physicists.

# 1. The Layout of the H8 beam

(see also the drawing attached)

A 450 GeV/c primary proton beam is extracted from the SPS towards the North Areas, split into three beams of which one is directed onto the T4 primary target. Typical intensities of this primary beam are a few  $10^{12}$  protons per burst. *For proper operation of the beams the symmetry on the T4 target should be at least 65%, with a small "a" indicating that the angular asymmetry is included in the value displayed.* This number as well as the T4 intensity can be read from the so-called 'PAGE-1' TV screens in the electronics huts and control rooms. From the T4 target, three secondary beams are derived: the P0 beam to ECN3, the H8 and the H6 beams. The momenta and polarities of the three beams are strongly correlated. For example, if the P0 beam runs at 450 GeV/c (the standard condition), the H8 beam can run at any negative polarity (-10 to -400 GeV/c) or at positive polarities up to 180 GeV. The H6 beam always runs at the polarity of the H8 beam and typically up to 50% of the momentum chosen in H8. Any of these "front-end" changes of the beams should be done by an SL-EA liaison physicist or a CRN operator and **only during working hours**.

## a) different modes of H8 operation

There are five distinct modes of operating the H8 beam:

- 1) as a 450 GeV proton micro-beam (see appendix 1)
- 2) in the high resolution mode
- 3) in the high transmission mode
- 4) in the "**filter**" mode (testbeam mode, also used to produce tertiary beams)
- 5) as a heavy ion beam (not discussed in this note)

For a user asking for different particles/energies, the "filter" mode is the optics used to calculate the beam files - it provides a large range in energies from 10 to 300 GeV/c and several possibilities to create tertiary beams (see below).

For a (low intensity!) 400 GeV/c hadron beam, the high resolution mode has to be used because of lack of magnet strength in some relevant quadrupoles (Q7). Note that at positive polarity, the 400 GeV/c beam consists mainly of protons, whereas at negative polarity, it contains mainly pions. **Information on beam composition in secondary beams can be found in the following reports:** (1) H.A. Atherton et al., CERN Yellow Report No. 80-07, (2) G. Ambrosini et al., CERN-EP-99-019, Europhys. Journal C).

## b) beams available in H8

If the P0 beam is off, the H8 beam can run in the 450 GeV/c "micro-beam" mode (see below). This mode implies significant hardware changes to the beamline and switching to and from the micro-beam requires time and a stop of the whole North Area for several hours.

If the H8 beam runs as a secondary hadron or electron beam in the "filter" mode, a further "TARGET" can be introduced into the beam to produce tertiary beams of lower energy. Typically, this is done when H8 runs at e.g. -200 GeV/c, and tertiary beams then range from -10 to -150 GeV/c (for pions, 10 and 20 GeV/c tertiary beams are marginal).

This mode of operation allows an easy change of beam momentum, which can be done by the H8 users from their beam control terminal simply by loading a different file.

### c) experimental areas in H8

**NOTE:** Like all other beams in EHN1, we distinguish experimental areas (at present only NA45 in H8) and test zones. Since 1997, the zone H8A is used by ATLAS inner detectors and TileCal (hadronic calorimeter), H8B by ATLAS EMB (liquid argon electromagnetic barrel calorimeter) and ATLAS muon detectors. There are two beam control terminals for ATLAS: the H8A terminal in the common ATLAS control room on the ground floor, and the H8B terminal in the control room of the barrel em. calorimeter upstairs (HNA468). From the point of view of emergency stops, intercom, beam index etc., the two zones H8A+B are treated as a single one. From time to time, some test beam activities with bent crystals take place in an area near door 128 (not a formal test zone).

## 2. The Control Tree

The user wants to select the energy and polarity of the particles in his beam, to steer the particles into a selected part of the detector and to adjust the spot size (focussing). He needs to choose the type of beam particles, control the beam intensity and eventually to stop the beam and get access to his experimental zone. He will use the beam instrumentation to check certain properties of the beam. Finally he needs to monitor that all the equipment in the beam is functioning correctly.

All these tasks can be performed from the beam terminal (an X-terminal), connected to a cluster of HP UNIX computers running the NODAL system. From this terminal the user controls the beam and related equipment through the so-called TREE program, invoked by the command 'RUN TREE', or if necessary 'RUN <index> TREE', where the 'index' is 217 for NA45 and 205 for the ATLAS test zones. From then onward the user just follows the menus offered by the control tree.

Note that the NODAL system traditionally only accepted upper case! In case you get lost or stuck, you can leave the control tree by typing CTRL\_C. You can then enter the tree again by 'RUN TREE'. In case of mis-typing, you should use '**backspace**'. In emergency cases only, switch terminal OFF/ON.

Additional windows can be obtained to work (or count) in parallel by selecting (in the dark area of your screen) **local X-terminal** with the mouse. The window will open in unix mode with the 'prompt' *eanorth*: - you have to type NODAL to continue.

## 3. Beam Files

Normally each user has a number of different beam energies and corresponding beam intensities at which he wants to run his experiment. These sets of conditions are described by Beam Files. In each index (205 or 217) there are 10 read-only beam files, and up to 99 beam files, for use by the experiments. The EA files are called H8.A to H8.J and

the user files are numbered H8.1 to H8.99. These files contain all magnet and collimator settings. A list of available files is obtained by

### **FILES / LIST**

Usually beam files are prepared by or after discussion with the responsible EA liaison physicist, although experienced users will sometimes change files themselves.

The actual conditions in use at any given time are described by another beam file, called "the BIM.0 file".

The user can select new conditions by loading a file from the tree:

### **FILES / LOAD / H8.nn**

and then answering the questions. In particular one has the option to change only magnets, only collimators or both. Magnet current changes are fast, collimator changes may be much slower. This command copies the values of file H8.nn into BIM.0 and sets the proper magnet currents and/or collimator positions. NOTE that the target and absorber are NOT changed when loading a file!

**WARNING:** Changing from a tertiary beam (typically with wide open collimator settings) to a secondary beam, one should first load only the collimators, then the magnets. Otherwise, during some bursts very high intensities might be present in your beam-line.

It is wise to check that the equipment has responded correctly to the requested changes by typing

### **STATUS / CHECK or STATUS / MAGNETS and STATUS / COLL**

thus verifying that the currents (positions) read correspond within tolerances to the currents (positions) in BIM.0. Tolerable deviations are 0.2-0.3 Amps for BENDS and QUADS, 0.5 Amps for TRIMS, 0.2 mm for collimators. In case of problems, try once more to load the file. If the problem still persists, call the CRN operator (using the intercom - CRN - or phone 75566, NATEL 160137). The EA liaison physicist can do nothing for you in this case!

In case of doubts about your beam particles or to check other parts of your beam, please check

### **STATUS / GENERAL**

which will give you a full account on your TARGET, ABSORBER, file loaded, collimator and TRIG status etc. - this will allow you to judge whether you are in a "strange" mode or not. A more complete picture can be obtained by using

### **STATUS / MODE .**

## 4. Fine Steering and Focussing of the Beam

- BENDs** Steering of a beam is done by BENDING magnets (dipoles). Normally the currents in the dipole magnets are defined correctly in the beam files and the user should not modify them without discussing with the EA physicists.
- QUADs** Quadrupoles are like lenses in conventional optics, they are used to (de-)focus the beam and thus change the spot size of the beam. The spot size of the beam is controlled by the last QUADs in front of each experiment. Which quad controls what projection depends on the beam file used. In the beam files these quads are usually defined to minimise the spot size at the main experiment locations.  
**Note: different users may choose a different beam spot size - the quadrupole values saved in the files are therefore not always the ones you like - in H8A/H8B, this concerns mostly the values of Q17 and Q18 (cf. Appendix 3).**
- TRIMs** Trim magnet are correction dipoles, used for fine steering of the beam. Normally the last TRIMs upstream of each experiment should only be used for steering. Typical values for TRIM10 (vertical) and TRIM9 (horizontal) steering to ATLAS Tiles are 23 mm for a 100 A change at 100 GeV/c beam momentum (proportional to  $p$  and inversely proportional to the distance from the TRIM). **When starting a run with a given beam file, a TRIM scan should be made to make sure you have the correct steering.**

The currents in these magnets can be set using e.g.

**TUNE / SET/ TRIM / 8 / current**

These changes are **not** saved in the files (except the BIM.0 file for the present status)!

## 5. Beam Intensity and Momentum Spread

The beam intensity for a secondary beam is normally controlled by three collimators, namely:

C3 Momentum defining collimator (vertical),  
C5 and C6 X and Y acceptance collimators

The momentum defining collimator C3 defines the momentum of the particles transported to your detector. The momentum byte  $\Delta p/p$  is proportional to the opening of the collimator. A gap of 3 mm gives a  $\Delta p/p$  of approximately 0.1%.

More accurately, the general expression to calculate the **full width** momentum spread is

$$\Delta p/p = (C3^2 + C9^2)^{1/2} / 27 [\%]$$

where C3 and C9 are the **full width** opening of these collimators **in mm**, 27 mm/% is the vertical momentum dispersion of the beam at C3 compared to C9. This expression holds for a tertiary beam in all cases, while for a secondary beam C9 is often more open than the beam image and should be replaced by 2 mm (the T4 target thickness, i.e. the "source size" of a high energy secondary beam), in which case C3 usually dominates the resulting  $\Delta p/p$ .

Decreasing the opening of C5 and C6 results in a (non-linear) reduction of rate. It is not related to the momentum band of the beam. The collimators are controlled by (e.g.)

**TUNE / SET / COLL / 3 / JAWS / -5 / 5**

or

**TUNE / SET / COLL / 5 / SLIT / 24**

Note that depending on momentum bite requirements it may be more advantageous to close C3 than C5,6, or conversely, to open C5,6 rather than C3.

Sometimes it turns out not to be possible to reduce the rate sufficiently by closing C5 and C6. Other collimators have to be closed in those cases, material can be put in the beam, and if necessary the first 3 quadrupoles can be set to zero.

## 6. The type of particles in your beam

### Overview of your present beam:

In order to get rapid information on the beam you are currently using, you may type

----->>>> **STATUS / MODE**

You will get the status of TARGET, ABSORBER, relevant collimators etc..

Several options exist for the type of particles in your beam (**ions not treated here**):

450 GeV protons      These are selected at 0 degrees from the production target and transported to a set of micro-collimators (C12 and C13) between the two main vertical BENDs. At these microcollimators, a new "source" of the beam is defined (intensity reduced by orders of magnitude). Setting up and most of the operations of the micro-beam are done by the SL-EA physicist - see the Appendix.

'Pure' electrons      **(1) secondary beams:** These are obtained by loading the appropriate file and by assuring that the dangerous material (target, absorber and TRIG counters, beam dump, etc.) are removed from the beam. Separation of electrons from hadrons is achieved by the synchrotron radiation energy loss in the big BENDs followed by collimation of the hadrons. The effect is very strongly energy dependent. Example: separation of pions and electrons at 200 GeV is 16 mm at collimator C9 in H8.

**Note:** Limited purity of this beam has been observed, in particular in positive polarity. The electrons are however focussed in the centre of the beam, while pions and muons occupy a larger phase space. It has been found that the best purity in the experiment is obtained if the secondary pion beam is used first for steering onto the experimental counters, then copying the TRIM values found for the electron case. An increased purity is expected as of 2000 due to the addition of C7, which precedes C9 and should always the same jaw positions as it.

**(2) tertiary beams:** Are obtained by loading the appropriate file and choosing **Pb** as a TARGET (see below). Downstream of this target, all other Pb sheets and TRIGs should be out of the beam. Momentum selection of the tertiary beam in second main BEND, separation from hadrons due to production mechanism in the Pb foil TARGET (degrading electrons, by bremsstrahlung, much more the hadrons).

'Pure' hadrons **(1) secondary beams:** Choose the appropriate beam file and put in the **Pb** TARGET to remove electrons. In addition, further purification can be obtained by entering an **ABSORBER (4, 8 or 18 mm of Pb)** into the beam.

**(2) tertiary beams:** Choose the appropriate file and use **POLY or Cu** as a TARGET. Momentum selection as above, use the **ABSORBER** to "kill" the electrons in the tertiary beam. Note that the Cu target generally gives less intense but more clean tertiary hadron beams.

Mixed beam Do you really want it? You get it by not applying the prescriptions above, i.e. choose a tertiary hadron beam and do not remove electrons by lead sheets.

Muons Choose a secondary hadron beam file and close collimator **C9 and C10** asymmetrically (i.e. setting the jaws to +45 and +46 mm respectively). The muon momentum is selected by BEND5 and BEND6. For higher muon fluxes, open all collimators upstream of C9.

The TARGET can be changed by

**TUNE / SPECIAL / MODE / TARGET /**

and the ABSORBER by

**TUNE / SPECIAL / MODE / ABSORBER /**

and the situation of the TRIG counters and MWPCs can be observed or changed by

**TUNE / MEAS / TRIG /  
TUNE / MEAS / MWPC / MOVE**

Note however that in general a TRIG counter is always mounted on one support with a MWPC, e.g. TRIG1 with MWPC1+2.

## 7. Access to your zone

Frequently you will need access to your zone in order to modify, adjust, move or repair your apparatus. This is done through the command

**ACCESS / DOOR / 138 / OPEN** (for the NA45 zone)  
or  
**ACCESS / DOOR / 158 / OPEN** (for the H8A test zone)  
or  
**ACCESS / DOOR / 168 / OPEN** (for the H8B test zone)

Type in your name when the program asks for it. Wait until you get the message which confirms that you have access, "ACCESS GRANTED"! Then go to the door (e.g. marked PPE158), make sure the lights 'ACCESS WITH KEY' are flashing, push the button with a key on it, take the key for which the red diode lights up and use it to open the door and enter the zone (**PRESS THE DOOR HANDLE SLOWLY!!!**). **Every person entering the zone has to take a key and keep it with him** - your safety depends on this action!!! When you come out of the zone you should put back the key and turn it into its normal position. When the last person has finished, check that nobody is left in the zone, put back the last key, push the red button marked 'END OF ACCESS' (do not forget - otherwise you will not get beam and have to walk back to the door later...!) and go back to your barrack.

At your beam terminal, type e.g.

**ACCESS / DOOR / 158 / BEAM ON,**

type in your name (you are responsible for persons left in the zone!) and wait till beam comes back.

### **New since 1997:**

**The SL Radiation Safety Officer M. Jonker has issued a memorandum describing the rules for access. The main change is that**

- a) when more than 8 persons need to enter the experimental area, the experimental team should change the zone to FREE access mode**
- b) only the CRN operators can change from FREE to KEY access mode. Such a change can only be made if the zone is being searched following a prescribed search procedure. The search is made by the CRN operator or by an authorised person of the experiment (whose name will be noted by the CRN operator).**
- c) Search authorisation is granted by the RSO of SL and/or the RSO of PPE to a limited number of persons from the experiment which are designated by their GLIMOS.**

### **New in 1998:**

**All experimental areas have been equipped with a timer. If a door on key access stays open for longer than 1 minute, the zone is automatically set on FREE access. FREE access can also be requested from your beam terminal via**

## ACCESS / DOOR / 158 / FREE

In both cases, a search of the area is needed to go from FREE access to access WITH KEY (see above, "new in 1997").

**New in 2000:**

**SEARCH done by 1 CRN operator + 1 Physicist of the experiment!**

After an access, it is wise to check that all magnet currents are OK by typing

**STATUS / MAGNETS.**

If the magnets do not switch on properly, then try "ACCESS / BEAM ON" again or try to set them to their BIM.0 value by TUNE / SET. If the problem persists, call the CRN operators.

**Important :** In the door itself, next to the handle, there is a round 'pastille' with a dim red light in it, which should be pushed **in emergency cases only !** Whenever this button is pushed, it requires an operator to come over and reset the emergency stop manually. This may cause significant loss of beam time, in particular because the operators are often working on another problem elsewhere!

### **SPECIAL features in zone 168:**

- 1) The motorized beam dump separating 158 from 168 allows access to the 168 (H8B) area at any time without stopping the beam in zone 158 (H8A). **Exception: High Intensity running of H8 - the zone 168 will be fully interlocked and the beam stopped in the tunnel when access is requested on 168.**
- 2) The garage of H8B, for the preparation/modification of the Lar endcap modules and cryostat, can be opened by opening door **PPG168 using a normal key** taken with the standard access procedure at door PPE168. However, opening this large door (which potentially allows a lot of people to enter the area in a short time) will create a **special FREE** condition in zone 168, requiring a **search including a special search box** located in the far corner (Jura side) of the H8B zone.
- 3) The timer of zone PPE168 has been set to 5 minutes to allow the search.

## 8. Using the detectors / beam-tuning

The H8 beam is equipped with various detectors:

- CALO** For experts only - a lead-glass block with a PM can be moved into the beam upstream of ATLAS/H8A. A pulse-height spectrum of this detector allows a rough estimation of the beam composition (in particular electrons vs. hadrons) in one burst.
- CET** Two Threshold Cerenkov counters- see the description on the EA pages on <http://nicewww.cern.ch/sl/eagroup/eahome.html>  
Control via branch **DETECTORS / THRESH /...**
- XWCA (MWPC)** Wire chambers that allow to make beam profiles. They only perform reasonably for beam rates above 1000 particles per burst. These profiles are obtained by typing **TUNE / MEAS / MWPC / PROFILE / ...**  
Often, the first profiles look strange - repeat profiles, because HV adjustment in the chambers is done automatically with every profile.
- FISC** Scintillation counter filaments of 0.2 mm widths, moving through the beam at 1 step per burst, which provide horizontal and vertical profiles, in particular in secondary beams. To use a FISC, type **TUNE / MEAS / FISC / PROFILE / fisc number / norm=2 / start mm / end mm / stepsize mm/**  
----- >>> FISCs 1+2 and 5 to 10 are **FASTFiscs**, i.e. the beam profile can be obtained in one spill. In order to normalise the profile to the beam intensity during the spill, a so-called **NORMFisc** is automatically placed in the beam (in H8, this is FISC4). To use a FISC in this mode, type **TUNE / MEAS / FISC / PROFILE / fisc number / NEW / return / / start mm / end mm / stepsize mm /**  
(NOTE that the max. number of points in a spill is 80).
- TRIG** Scintillation counters. Trig-1 counts the rate between the two main BENDs. Trig-2 is located before the last horizontal BENDs 5+6. Trig-3 and Trig-4 are used as trigger counters for the XCET-1 threshold Cerenkov counter (see below), Trig-5 and Trig-6 are used as trigger counters for the XCET-2 threshold Cerenkov counter. TRIG6 also counts the rate just upstream of the H8A experiments and TRIG8 at the entrance to the H8B zone. Their rates can be measured by **TUNE/ MEAS/ TRIG/ 5/ USE/ Norm=2/nr of bursts**  
Note that the scintillator can be moved in to and out of the beam with **TUNE/ MEAS /.../ USE** or **TUNE / MEAS /.../OUT**.
- EXPT** Experimental scalars do not count any of **our** detectors but rather **yours**. In your barrack there is a panel with four plugs. In each of

the four you can provide a standard NIM-signal that is counted over each burst and read into the SPS computer system. These counts are displayed by

**TUNE/ MEAS/ EXPT/ *scaler* / norm=2 / *nr bursts***

where the scaler number depends on the barrack (ask your EA physicist).

The TRIG and EXPT counters are very useful in beam tuning. Steering can be somewhat helped by the SCAN procedure - for example,

**TUNE / SCAN / EXPT / 3 / norm=2 / TRIM / 8 / -50 / 50 / 20**

varies the Trim-8 current from -50 to +50 Amps in steps of 20 Amps (one step per burst), measure the count in EXPT-3 (**you** know what that count means!), normalise it to NORM-2 and display the ratio of EXPT-3 and NORM-2 versus the TRIM-4 current at the end. This technique of using a normalisation counter helps to be less sensitive to fluctuations in the SPS itself. The SCAN procedure allows to choose the optimum current for e.g. TRIM-8. You can set this current by

**TUNE / SET / TRIM / 8 / *current***

and eventually save it into the beam file by

**FILES / WRITE / H8.nn / *comment* / TRIM / 8 / *current***

where the comment is a text of up to 30 characters ('return' leaves the old comment). Alternatively the whole BIM.0 (present setting) can be saved with the

**FILES / SAVE / H8.nn**

command.

#### **Explanation of NORM's:**

Two (or more) normalisation counters are available:

- Norm-0 : simply the time for normalisation.
- Norm-1 : Interaction rate in primary target T4,
- Norm-2 : Incident rate on primary target T4,

Usually, it is recommended to use Norm-2.

## 9. Further problems

1. The HELP command gives you a general list of questions and suggestions on what to do - even though it might not be specific to your beamline only, it could still be of use... .

A general check of magnets and collimators is obtained by

**STATUS / CHECK**

which indicates wrong values in these beamline elements.

Use also

**STATUS / GENERAL**

to make sure that you are in a correct beam mode (secondary, tertiary, muons, etc.).

2. Under INFO / LOGBOOK you find the last changes to magnet currents and collimator settings and traces of other action related to your beam. You may find hints to what went wrong.
3. Run the STATUS /CHECK and STATUS/MODE to assure that no magnet nor collimator has failed and verify the precise status of the beam. In particular, this could help to see why you don't get electrons, etc... .
4. **Note that there is a manual vacuum valve in the NA45 zone (door 138).** If you are not happy with the quality of your beam, in particular electrons, make sure that valve is open! (Check in particular after MD's or technical stops).
5. Call the CRN operators (Intercom, Tel. 75566 or NATEL 160137) if all this fails.

Experimental scalers in the H8 barracks + tree

EXPT	1	HNA262	ATLAS H8A	1
	2			2
	3			3
	4			4
EXPT	5	HNA480	<b>reserve</b>	
	6			
	7			
	8			
EXPT	9	HNA468	ATLAS H8B	1
	10			2
	11			3
	12			4
EXPT	13	reserved for SL-EA crystal tests		
	14			
	15			
	16			
EXPT	17	HNA443	NA45	1
	18			2
	19			3
	20			4

## H8 operation as 450 GeV "microbeam"

The H8 beam can be operated with 450 GeV protons from T4, in the so-called "microbeam" mode. Historically, the microbeam was developed by H. Atherton to satisfy a request for a very small beam spot at the NA34 experiment - it was used in its original version with two sets of vertical/horizontal micro-collimators (called C12/C13 and C14/C15).

In recent years, a simpler version of the microbeam was used: only the first set of micro-collimators (C12/C13) is operational, and the beam spots are larger - however, the users of the 450 GeV beam (typically NA12, NA45 and RD21) seemed to be happy with it. For the bent crystal experiments, which are done at the place of the former second micro-collimator station (i.e. at a position 414 m from T4), the beam optics is modified such as to have a horizontally parallel/vertically focussed beam at the crystal.

### 1) Interlock conditions

The different options of the H8 beam (normal secondary beam, microbeam, ion beam) have different interlock conditions, which can be found in Fig. 1 (obtained on DICO from the tree via EA/BEAM/SETUP). It is important to note that for the microbeam mode of H8 only the condition TAX-6 RANGE = SMALL is an interlock condition: TAX6 = +20 mm (approx.) corresponds to a 2 mm hole.

In addition to this TAX RANGE condition, the following conditions have to be fulfilled for microbeam operation:

- >> collimator XCIO200 has to be IN  
(this is a 3 mm collimator with fixed openings just upstream of the microcollimator)
- >> microcollimator table has to be IN  
(this is a manual operation, needs vacuum intervention, and the status is obtained from a switch)
- >> microcollimator openings have to be smaller than 1 mm

Under these conditions, the main bending magnets (R22D-14 and R22D-15) can be allowed to go to maximum current ("unlimited") and H8 is considered to be in a "legal" status.

## 2) TAX5 - two options for the microbeam

There are in fact two options for TAX5:

TAX5 = +20 mm    12 mm hole filled with a 80 cm long Be rod:  
"medium intensity" microbeam (up to about  
 $5 \cdot 10^6$  protons per burst)

TAX5 = - 140 mm    80 mm hole  
"high intensity" microbeam (more than  
 $10^7$  protons per burst)

(TAX5 and TAX6 = +140 mm is the condition for access).

## 3) Tuning the microbeam

a) Intensity: use the opening of the microcollimators C12/C13  
**(WARNING:** might cause interlock problem because of the                      limit to 1 mm  
aperture - if so, close to 0.2 mm, wait for                      interlock conditions to be  
o.k., and start opening C12/C13 in                      small steps)

b) beam position at NA45:                      use TRIM5 (hor.) + TRIM6 (vert.)  
    beam position at RD21                      use TRIM9 (hor.) + TRIM8 (vert.)

c) beam focussing at NA45                      use Q14 and Q15  
    beam focussing at RD21                      use Q17(=Q21) and Q18

(Note that in order to transport the microbeam from a focus at NA45 to a focus at ATLAS, Q17 had to be strengthened: a third quadrupole was added, acting as a third Q17; this quad is **called Q21**, and is used only in microbeam mode).

## Appendix 2:

### New names for H8 TRIG detectors, as of 2000

BEATCH name	"old" name (until 1999)	new name	comment
XTRI042198	TRIG1	TRIG1	before COLL5/6
XTRI042410	TRIG2	TRIG2	after COLL8/9
XTRI042463 XTRI042475	TRIG3 TRIG4	TRIG3 TRIG4	pair of TRIG around XCET042474 (upstream of NA45)
<b>XTRI042532</b> XTRI442543	--- TRIG5	<b>TRIG5</b> <b>TRIG6</b>	pair of TRIG around <b>new XCET042539</b> (upstream of ATLAS-H8A)
<b>XTRI042544</b>	---	<b>TRIG7</b>	<b>small XTRI for use with XEMC</b>
XTRI042574	TRIG6	<b>TRIG8</b>	upstream of ATLAS-H8B

### New names for H8 TRIM magnets, as of 2000

BEATCH name	"old" name (until 1999)	new name	H/V	comment
MDXH042133 MDXV042134	TRIM1 TRIM2	TRIM1 TRIM2	<b>H</b> <b>V</b>	steer onto COLL5+6 (and onto microcollimator)
MDXH042203	TRIM3	TRIM3	<b>H</b>	steer onto COLL8
MDXH042318	TRIM7	<b>TRIM5</b>	<b>H</b>	do.
MDXV042407	TRIM4	<b>TRIM6</b>	<b>V</b>	steer onto COLL9
MDXH042462 MDXV042463	TRIM5 TRIM6	<b>TRIM7</b> <b>TRIM8</b>	<b>H</b> <b>V</b>	steer onto NA45
MDSV042529 MDSH042530	TRIM8 TRIM9	<b>TRIM10</b> TRIM9	<b>V</b> <b>H</b>	steer onto ATLAS

### Appendix 3:

**For information of ATLAS H8 testbeam users:**  
**focussing with Q16, Q17 and Q18**

In the new "1997" filter mode optics of H8, the following current settings allow to change the focussing in the ATLAS region (H8A and H8B zones). The values given are for a +300 GeV/c beam - scale the current values with momentum for any other momenta, including the sign.

<b><u>condition</u></b>	<b><u>Q16 [A]</u></b>	<b><u>Q17 [A]</u></b>	<b><u>Q18 [A]</u></b>
focus at MWPC 5+6	-265.2	-294.2	+265.2
parallel in ATLAS areas	-263.6	-149.2	0
focus 5.5 m upstream of MSP	-236.0	-281.0	+236.0
focus 5 m downstream of MSP	-305.8	-2128.	0
focus 10 m downstream of MSP	-302.6	-207.0	0
focus 20 m downstream of MSP	-297.4	-198.2	0
focus 30 m downstream of MSP	-293.6	-191.8	0
focus 40 m downstream of MSP	-290.4	-186.8	0
focus at MNP17 (MUONMAGNET)	-288.4	-183.4	0

**Appendix 4: H8 operation for “very low” beam energies**  
 (see also the following page for a sketch)

In order to allow the operation of the beam at energies lower than achieved before, the 6 main vertical bending magnets (MBN's) BEND1, 2, 3 and 4 have been recabled during the 1996/97 shutdown, in the following way (see also the figure attached):

previously	now (as of 1997)
B1 A	B1 A
B1 B	B2 A
B1 C	B2 B
B2 A	B1 B
B2 B	B1 C
B2 C	B2 C
B3 A	B3 A
B3 B	B4 A
B3 C	B4 B
B4 A	B3 B
B4 B	B3 C
B4 C	B4 C

This allows to run the beam with currents  $I(B1)=0$ ,  $I(B3)=0$  and  $I(B2)= 2I_0$ ,  $I(B4)=2I_0$  while previously all currents were set to  $I_0$ .

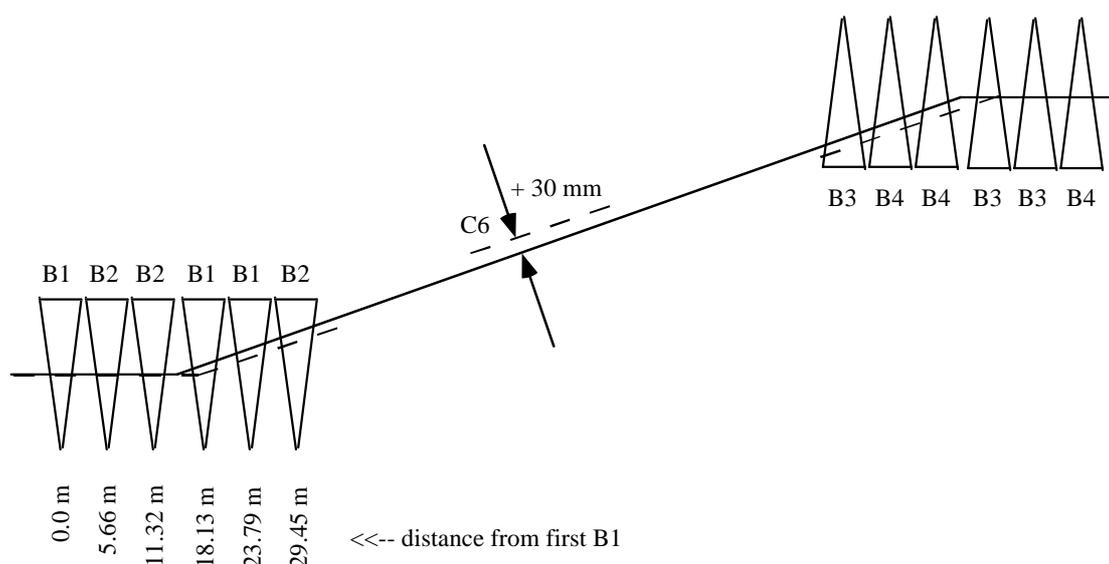
As a result, the “point of deflection” is no longer in the centre of the 6 large bending magnets is no longer in the middle of them but slightly offset. This has as a consequence that the beam **is vertically offset, e.g. by about + 30 mm in collimator C6** and is back on axis again only in collimator C9.

The beamfiles for this very low energy running are specially marked in the comment line and should not be changed without “additional thinking”.

## The “low energy wiggle” in H8

The main vertical bending magnets in H8 are B1/B2 (+41 mr, 6 MBN magnets) near the end of TCC2 (target area) and B3/B4 (-41 mr) at the top of TT82.

A general problem at low energy is the stability and precision of low currents in the rectifiers. At high energy, two rectifiers are needed for B1/B2 as well as B3/B4. At low energy, higher stability and precision is obtained if one works only with one out of the two rectifiers, i.e. with double the currents. In order to obtain a good beam transfer, the bending magnets have been recabled and the new layout is as follows.



In the low energy “wiggling” mode,  $B1=B3=0$  and B2, B4 are used at twice the current. This implies that the effective bending point is moved 0.75 meters downstream. As the total bending angle is 41 mr, we get a vertical offset of the beam of  $-0.75 \cdot 41 = -30$  mm at the level of B1/B2. The magnification, i.e. the effect of the beam optics, being -1 at collimator C6 implies that **the vertical offset of the beam at C6 should be + 30 mm.**