

# The M2 beam line for COMPASS

The M2 is a 1.13 km long beam line that serves the COMPASS experiment. It is produced from the T6 primary target, of which it is the only user.

It can be operated in three basic modes:

1. As a high-intensity **muon beam** in the momentum range 60 to 190 GeV/c

*Typically  $2.3 \cdot 10^8$  muons per pulse from  $1.4 \cdot 10^{13}$  ppp on T6*

The beam was designed with mainly this operation mode in mind

2. As a high-intensity, high energy **hadron beam**, typically  $\pm 190$  GeV/c

*Typically  $2 - 5 \cdot 10^7$  hadrons per spill, from  $5 \cdot 10^{12}$  ppp on T6 (tbc)*

3. As a low-intensity low-energy low-quality tertiary **electron calibration beam**

*Typically few  $10^3$  electrons per pulse of up to 40 GeV/c*

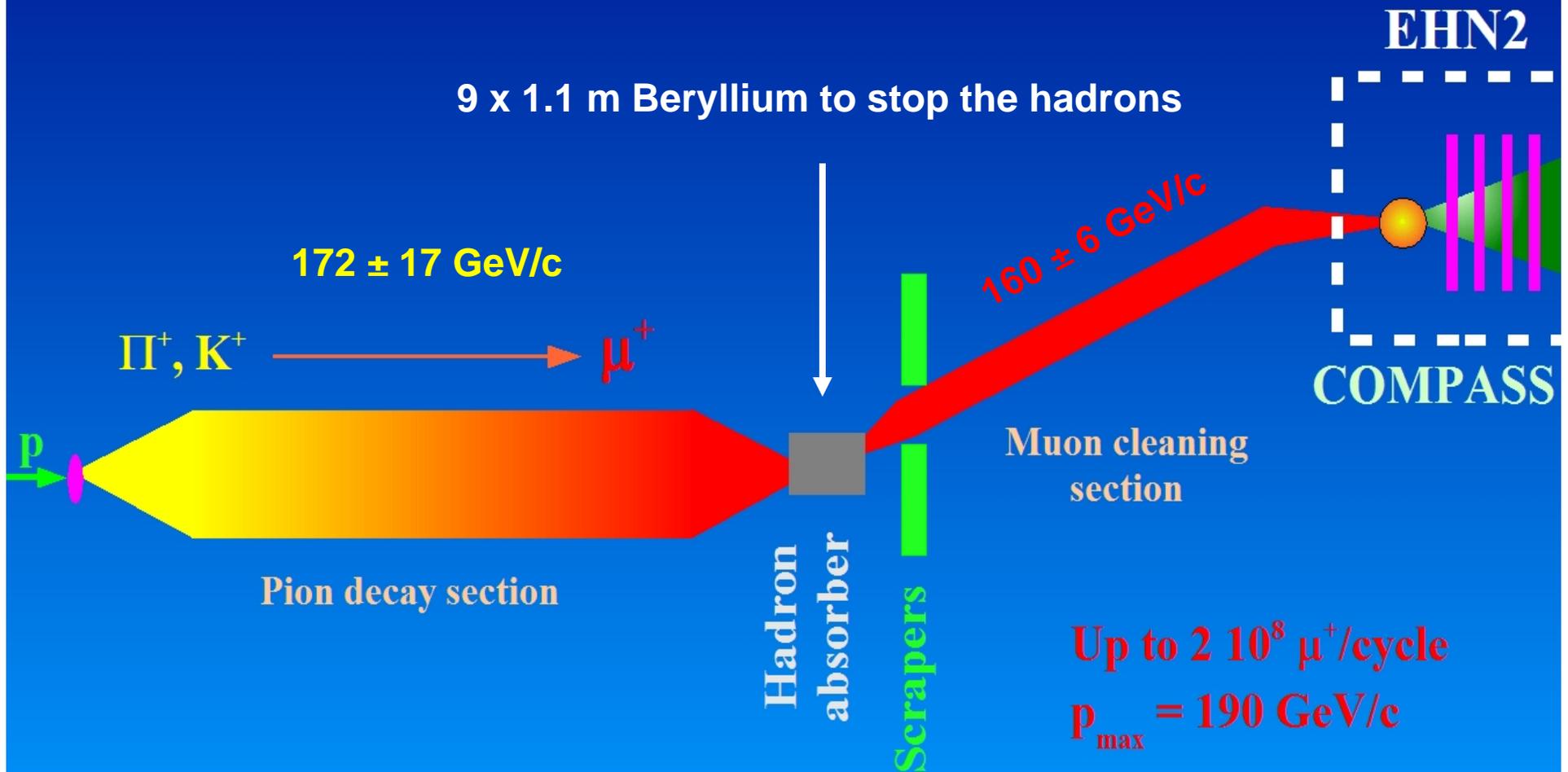
So far the main mode of operation was as a muon beam.

**In 2008 the beam will mainly be operated as a hadron beam.**

Some short (~1 week) runs with electrons and muons are foreseen as well.

# THE M2 MUON BEAM

FOR COMPASS / NA58



## The hadron mode

The hadron mode is a 'simple' secondary hadron beam

The beam has never been fine-tuned so far in this mode.

A new, hopefully improved version of the optics has been prepared and will be commissioned in the course of the year.

Once commissioned, the hope is that the operating conditions will be rather stable.

This condition will be documented on the Wiki page, eLogbook and beam files.

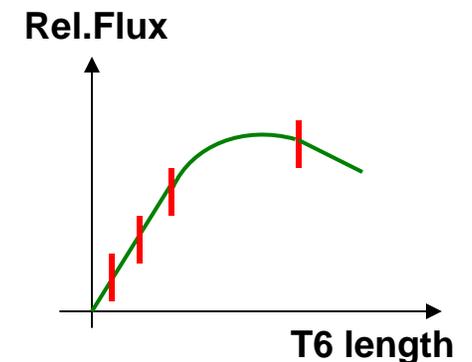
The request is for                    +190 GeV/c hadrons @  $5 \cdot 10^7$  ppp  
   -190 GeV/c hadrons @  $2.5 \cdot 10^7$  ppp

both assuming a long flat top operation

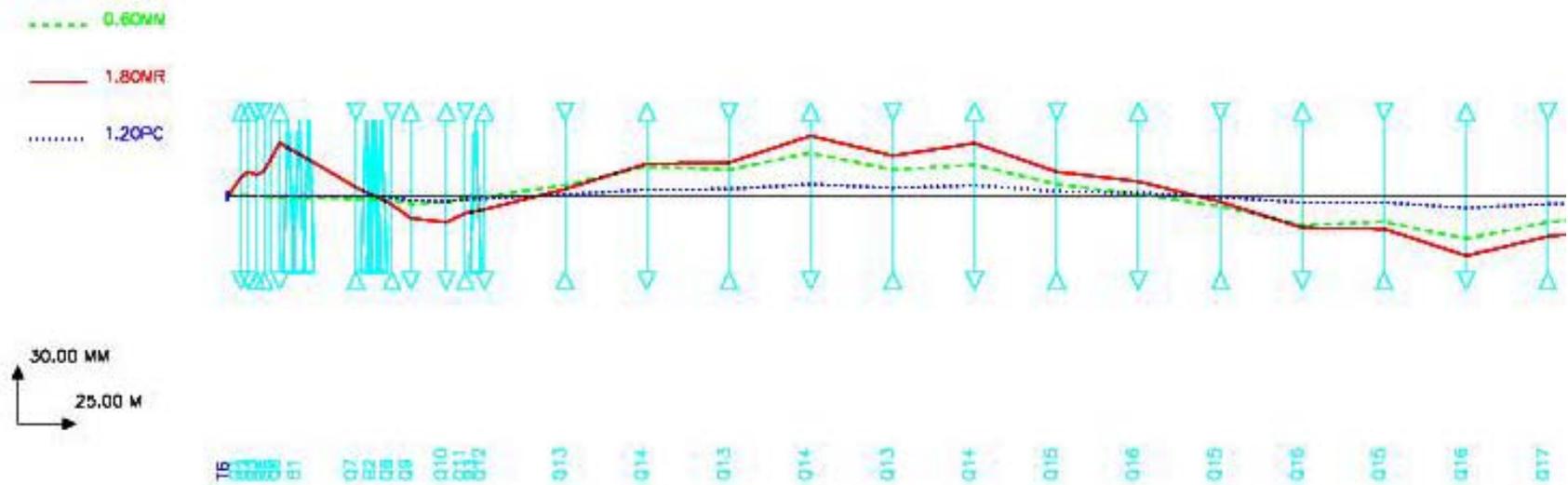
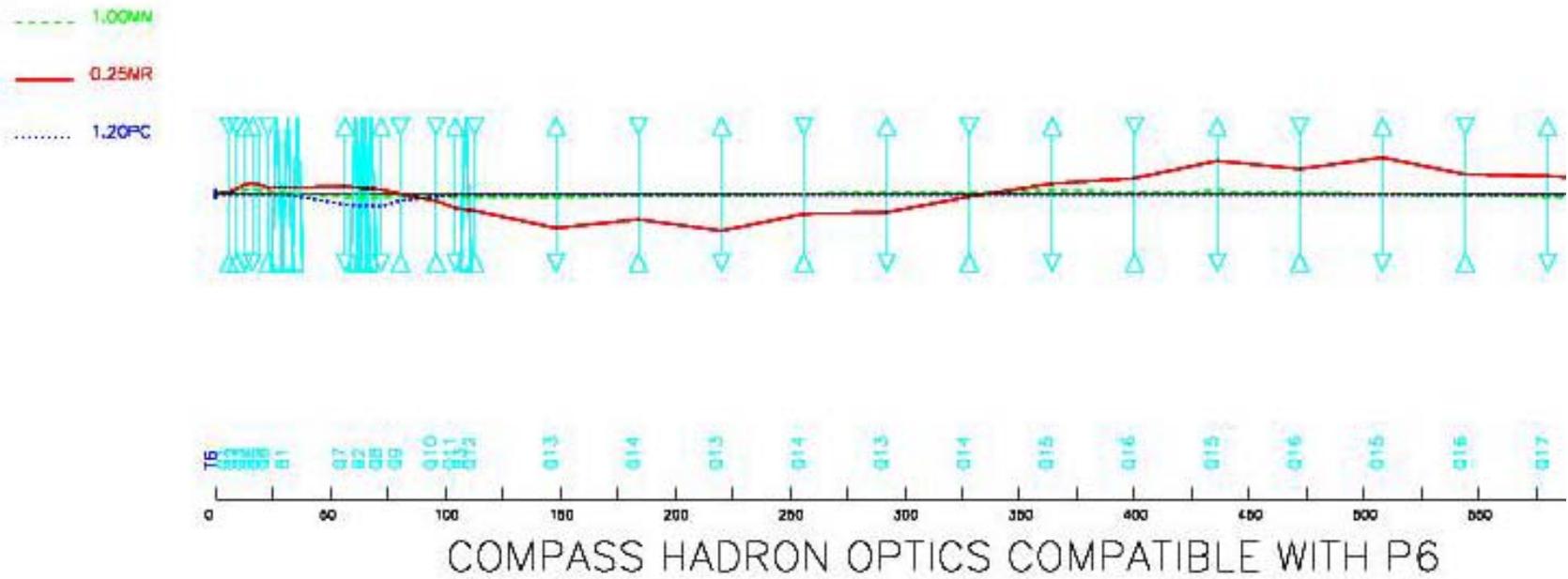
The intensity is controlled via:

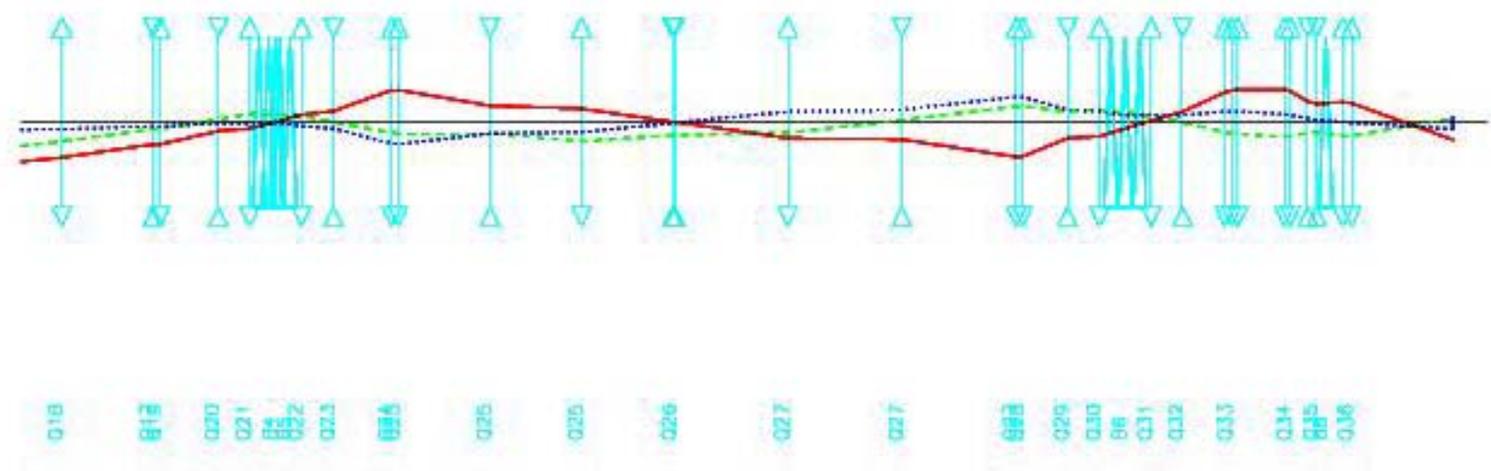
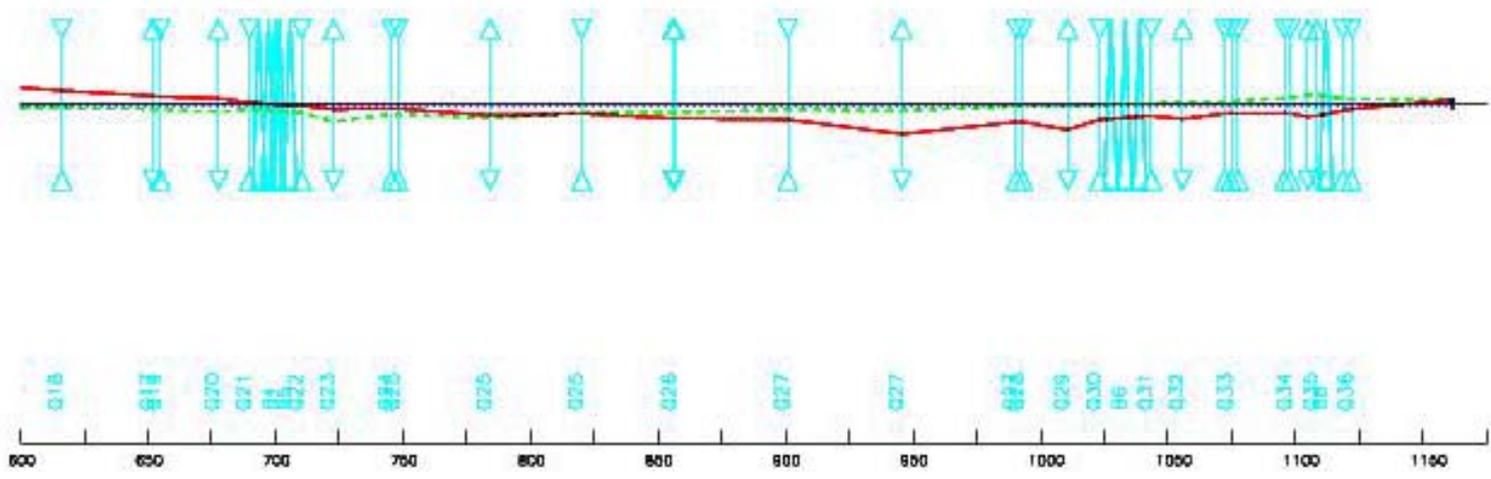
COLL-1 <sub>H</sub> = COLL-3 <sub>H</sub>	also momentum slit
COLL-2 <sub>V</sub> = COLL-4 <sub>V</sub>	vertical acceptance
T6 primary target head	0, 40, 100, 200, 500 mm

All absorbers are OUT



# The 'new' hadron optics:





## M2 Specials:

- ❑ BEND-6 is the momentum defining bend – never change its value!
- ❑ The T6 target head is under user control
- ❑ Bends 10 and 11 are the main spectrometers of COMPASS.

*Please do not switch them off without informing / consulting COMPASS  
(except of course in case of emergencies or ‘force majeure’)*

- ❑ The SM1+SM2 interlock:

*In case of a trip (or wrong current) in the spectrometer magnets SM1 and SM2, this interlock will put Bends 4 and 5 on ‘delestage’ to avoid that the beam hits sensitive parts of the detectors.  
This interlock can only be disabled by the experiment!*

- ❑ SCRAPERS and MIBs are special magnets that provide  $\sim 0$  field on axis and a toroidal field outside the beam aperture – to clean muon halo.

*Please do not touch scraper positions without good reason!*

See the M2 User Guide on the ATB-SBA web page for more details

- Two CEDAR counters will be commissioned and used.
- Special status and Scan GUIs have been developed:

The screenshot shows the CEDAR - XCED.021.465 GUI. The window title is "CEDAR - XCED.021.465". The status bar at the top displays "Beam: H2 / H2B-1", "File: H2A.010", "Momentum: +75 GeV/c", and "Comment: FM sec. hadrons @ 0.0 mrad". The date and time are "30.10.2007 11:44:01".

The main interface has four tabs: "Status", "Alignment", "PM Setup", and "Pressure Scan". The "Pressure Scan" tab is selected, as indicated by a red arrow. The "Pressure Scan" tab contains several sections of parameters, each with a corresponding input field:

- PRESS AND MASS:** Energy (GeV) 75, Pressure (bar) 1.81, Comp. Mass (Gev) 0.725.
- MOTORS POS.:** Diaphragm (mm) 1.213, Hor. X (mm) -2.081, Vert. Y (mm) -0.195.
- SCINT. POS.:** Scint. Pos. IN, Scint. HV ON.
- GAS TEMPS:** Head (Deg) 17.923, Mid (Deg) 18.107, Tail (Deg) 19.46, Temp Diff (Deg) 1.537, Transducer (Deg) 40.268, Room (Deg) 18.424.
- COMP. MASS-PRESS:** Electrons (Bar) 1.649, Muons (Bar) 1.653, Pions (Bar) 1.655, Kaons (Bar) 1.724, Protons (Bar) 1.919.
- PMS:** 6-Fold 45, 7-Fold 11, 8-Fold 3, 6-Fold/Trig. 0, 7-Fold/Trig. 0, 8-Fold/Trig. 0, Comp. Effic. n6 0.679, Comp. Effic. n7 0.367, Comp. Effic. n8 0.1, Triggers 229,294, Comp. NPE/PM 1.386, TBIU 6.59680e+12, PM HV OFF.

At the bottom left, there are radio buttons for "Run" (selected) and "Hold", along with a "Refre..." button. At the bottom center, there is a "Set Pressure" button, which is highlighted by a red arrow.

## The other modes of M2:

### ❑ Electron mode:

-100 GeV/c up to Q20, -40 GeV/c or lower after Q20 (→ special beam file)

A 5 mm lead converter (→ 'electron target' is IN) downgrades the energy of electrons in secondary beam, ~ without affecting the hadrons in the beam. Only the downgraded electrons are transported towards the experiment.

This requires a special optics with a focus at the lead converter.

### ❑ Muon mode:

The beam energy downstream of the hadron absorbers is ~8% lower than the energy upstream (→ special beam file).

At least 7 absorbers modules are IN the beam to stop all hadrons.

The scrapers and MIBS are of particular importance in this mode (halo)

Changes between different modes are done under ATB/SBA control or by instructed experts in the experiment. Documented in Wiki pages

The settings for the different beam modes are summarized in the table below:

Beam Mode	Typical momentum	Safety guarantee	T6 target head length	Hadron absorbers	Colls 1 to 5	Secondary Target
Muons	+177/160	Absorbers	any OK	-              -	Open	Out
Hadrons	+200 -100	T6 head Colls 1-5	max. 100 up to 500	- - - - -	Very closed	Out
Electrons	-100/40	Colls 1-5 $P_{EHN2}/P_{T6}$	<b>Must be 500</b>	- - - - -	Rather closed	In