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CERN - PS DIVISION

PS/ PA/ Note 96-28

EHNL_5

Proposal for the Beam Lines & Areas for Tests and Experiments in the East Hall

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This note reports the modifications relative to the previous version. The drawing of the proposed layout is supplied in appendix C. It also contains a reissue of the information collected since EHNL_1 (see list of references) and is the result of fruitful discussions with most of the people quoted in the list of distribution.

I - THROUGH THE LIST OF BEAM LINES AND AREAS

FT61 + BEAM_DUMP + E17_s + E17_n

This transfer line connects to the PS ring and transports the extracted beam to either the Test Beam Dump line which operates while an access is required into the primary zone or to the splitter which feeds both the E17_s and E17_n lines. Those lines will remain as they are today (Ref.5). It is worth mentioning that to deliver the whole beam to one of the south (E17_s) or neutral (E17_n) lines, requires a quadrupolar and splitter setting which differs from the setting used for a production of secondary particles on the targets. Such a change of configuration is not available in "pulse to pulse modulation" mode. Therefore, this change cannot be applied within a PS super cycle, but only for a period of several days.

T7/T8_SWITCHING REGION

Apart from using this region for irradiation of items of small volume ($\approx$ 0.2x0.2x0.2 m^3), its main purpose is to supply a:

- beam of primary particles from PS (up to 24 GeV/c) to T8 line
- beam of secondary or primary particles (up to 10 GeV/c) to T7 line

A revolving target/monitor system will be located just upstream the switching magnet (E17S_Y) and will permit to :

1- supply a beam position and envelope measurement device (such as luminescent screen)

2- position a target for secondary particle beam production. The brilliance of production of secondary particles (at an angle of about 10 degrees) is high enough to supply an intensity of more than 1E5 secondary protons in the range of momenta from 1 to 10 GeV/c. In this configuration, 50% of the primary particles have not interacted with the target and remain in the acceptance of the T8 transfer line.

3- retract the beam monitor and targets to let the primary beam travel to one of the two lines with no interaction except with the air. Such a system standing outside the vacuum is cheap.

Depending on the setting of E17S_Y magnet and revolving the target in or out of beam will offer 4 possible configurations:

E17S_Y ...	OFF	OFF	*ON*	ON
Target ...	IN beam	OUT of beam	*IN Beam*	OUT of Beam
T7 ...	**secondary beam**	**none**	**secondary beam**	**100% of primaries**
	50% of primaries	**100% of primaries**	**secondary beam**	**none**

In the above table:
Column 4 is not of great interest today, but nevertheless will remain available.

Column 3 and 5 may be applied one PS super cycle on different B cycles provided the magnet is fed by a pulsed power supply. A laminated magnet (MCB type) is at present in operation on the T9 line but is fed by a static DC power supply. For this scheme, two different specific B cycles are to be programmed within one PS super cycle and their associated triggers delivered to the power hall and EBCR (East Beam Control Room).

T7_ALICE

No change since EHNL_1.

Surface of 10 x 4 m^2 - Upper momentum of 10 GeV/c - Primary or secondary beam.

No beam can be delivered simultaneously to T7_ALICE and T8 when T8_DIRAC line imposes the retraction of the target out of beam in the T7/T8 switching region. This configuration might be required to avoid increasing the beam halo induced by the target being in the beam.

T8_DIRAC

A considerable amount of work is still to be made on the design of the beam optics for the T8 line. Nevertheless, the drift space from the T7/T8 switching magnet down to the DIRAC spectrometer should be long enough to locate the :

- beam stopper
- bending magnets to connect T8_a to T8_b
- 4 quadrupoles
- 2 to 4 correctors
- 1 to 2 monitors
- vacuum equipment (valve + pump)

T8_IRRAD

The appendix A supplies the configuration of the space devoted to irradiation.
One should note that :

- the passage from room A to room B is only 0.4m high and 1m wide at the altitude of the beam line (1.28 m)
- the room B supplies a free volume of 4.5 m x 4.0 m x 2.4 m (length x width x height)
- the roof of room B is 4m thick and will be dismantled to bring voluminous apparatus (such as a liquid argon calorimeter) into the beam
- in room B, using a shuttle ("convoyeur à rail"), small items (such as silicon strip detectors) can be put in the beam with no human access from outside. This shuttle tunnel of 0.4 m x 0.2 m cross section will also be used to pull cables and gas lines
- the lateral walls are thick enough (4 m) to place a tungsten or lead block for secondary neutron production at a position just downstream the separation wall between room A and B

T9/T10_Switch_yard

Its purpose is to put in close contact the two bending magnets just downstream the iron wall which separates the primary zone from the secondary zone. This option permits to raise up the momentum range of T10 line. The switch yard can only be accessed from the T9_ATLAS/CMS area. Obviously, any human intervention in this zone will trigger the beam stoppers to operate on both T9 and T10 lines.

T9_ATLAS/CMS

In this version, both experiments will share the area. The available surface is of 11 m (transverse) x 14 m (along the beam axis). Adjacent to this zone is the transit zone to let heavy equipment such as modules of calorimeters to be moved in or out of the T9 zone. A part of the wall will be dismantled to permit such maneuvers.

T10_LHC-B

The available surface for tests is 6 x 13 m^2 . The higher momentum available of the line in operation today is 5 GeV/c (Ref.5). A beam optics and feasibility study will supply the maximum rise. A very preliminary value, 7 GeV/c seems obtainable. An accurate value will be published by September this year.

T11_Others

This line will remain in the configuration already set up today (Ref. 5).

II - MAIN PARAMETERS

a) Beam Lines (momentum, particles, extraction type, height)

	max momentum	beam	extraction	beam height
	GeV/c	primary/secondary	slow/fast	m
FT61	24	p	slow/fast	1.26
E17n	24	p	slow	1.26
E17s	24	p	slow/fast	1.28
T7	10	p/s	slow/fast	1.28
T8	24	p/s	slow/fast	1.28
T9	15	s	slow	2.29
T10	7	s	slow	2.50
T11	3.5	s	slow	2.50

Beams/ primary:
- ♦ proton as today (3.57 and 24 GeV/c, other momenta on request)
- ♦ positron and lead ion beams might be available in the EAST hall of PS after further investigations.

secondary:
- ♦ any from conversion of primary proton in the targets.

Extraction slow: ♦ ~ 400 ms duration once or twice every 14.4 or 19.2 s

fast: ♦ ~ 2 μs " " " " " " "

b) Estimated Electrical Power required for EHNL_3 configuration:

	max momentum	H deflection	V deflection	power
	GeV/c	mrad	mrad	MW
FT61	24	337	0	0.370
E17n	24	0	0	0.250
E17s	24	61	0	0.540
T7	10	200	0	1.000
T8	24	88	0	1.000
DIRAC spectro	24			1.430
T9	15	194	60	0.974
T10	7	325	76.48	0.630
T11	3.5	540	92.12	0.430
			Total =	**6.624**

The above power consumption includes all the elements needed for beam transport (bending magnets, quadrupoles, correctors) and for the spectrometer of the DIRAC experiment.

c) Lifting weight parameters for the 2 cranes:

Maximum load (Tons)	ground clearance (meters)
20	8.5
40	8.9

d) Maximum load on the ground floor in the hall : 20 Tons.m $^{-2}$

III - BEAM OPTICS

T7 :	is to be studied
T8 :	as mentioned above, it will be a considerable work
T9, T10 :	are to be studied
T11 :	will remain as it is today (Ref. 5)

IV - TIME TABLE

The major milestones quoted in EHNL_4 (see appendix B) still remain valid as far as duration is concerned, provided the specifications are not drastically upgraded. But, the start date of the installation of the primary zone (ID_4 in appendix B) is still under discussion and might be postponed.

V - SUMMARY

EHNL_5 version does not freeze all the parameters and leaves some open for more accurate computations. This version allows to house all potential users. An assembly area of 15 x 20 m^2 is kept at the disposal of the users. The only weak point of this proposal stands in the upper momentum limit on T10 of 7 GeV/c, while 10 GeV/c would have pleased LHC_B. Further computations are required to put a value on the exact limit.

References

1 - J-Y. Hémery - "EHNL_1 - East Hall New Look" - *PS/PA/Note* **95-12**

2 - L. Danloy, L. Durieu, B. Williams - "EHNL_2 - East Hall New Look" - *PS/PA/Note* **95-16**

3 - L. Durieu and J-Y. Hémery - "EHNL_3 - Proposal for the Beam Lines & Areas for Tests and Experiments in the EAST HALL" - *PS/PA/Note* **96-10**

4 - L. Durieu, M. Giovannozzi, J-Y. Hémery, B. Williams - "EHNL_4 - Proposal for the Beam Lines & Areas for Tests and Experiments in the EAST HALL" - *PS/PA/Note* **96-25**

5 - L. Durieu and D.J. Simon - "Secondary Beams for Tests in the EAST EXPERIMENTAL AREA" - *PS/PA/Note* **93-21**

TIS–CFM/MT/96–033 19.06.1996

MEMORANDUM

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Sujet : **Possibilités d'irradiation avec le futur faisceau T8 du PS (Hall Est).**

Suite aux diverses réunions et discussions à propos de la possibilité d'installer des zones d'irradiation utilisant le futur faisceau T8 dans le Hall Est du PS, il apparaît que de telles zones pourraient être utiles tant pour les physiciens que pour les ingénieurs machine.

Les diverses zones possibles sont décrites ci dessous:

(Les lettres A, B, C, D et E apparaissent sur la Figure 1 (copiée de PS/ PA/ Note 96-10))

A - Irradiation de petits composants avec le **faisceau primaire de protons** :

Cette position d'irradiation se situera dans la zone de DIRAC, entre les derniers éléments de l'expérience et l'entrée du "beam catcher". Elle utilisera directement le faisceau primaire de protons à 24 GeV. Elle devra être réservée aux petits composants légers (principalement des détecteurs au silicium) pour minimiser la production de particules secondaires (tant d'un point de vue de radioprotection que du point de vue de DIRAC).

Cette position d'irradiation ne devrait pas nécessiter de modifications importantes: les composants seront mis en place par l'opérateur accédant à la zone par la porte; les câbles passeront sur un chemin de câbles via une chicane minimum à faire dans le blindage existant (chemin de câbles à installer vers le local E). Une table mobile sera éventuellement utilisée pour un meilleur positionnement et pour pouvoir choisir des temps d'irradiation indépendamment du fonctionnement de DIRAC.

B - Irradiation de grands volumes, **à l'intérieur du "beam catcher"** :

Le volume du "beam catcher" a volontairement été surdimensionné pour permettre l'irradiation d'éléments très volumineux, tel un cryostat simulant le calorimètre à argon liquide de ATLAS.

Le champ de radiation sera constitué de gammas et de neutrons secondaires rétrodiffusés. Le flux de neutrons à 1 m du dump devrait être de l'ordre de 3e7 n.cm^{-2} par spill de 1e11 protons primaires, avec un spectre tel que à peu près 10% de ce flux total devrait être d'énergie supérieur à 100 keV. Selon la position d'irradiation choisie, il sera aussi éventuellement possible d'utiliser les protons primaires.

Les éléments à irradier devront être mis en place par le toit démontable du blindage. Les alimentations cryogéniques passeront au travers du blindage supérieur via une chicane, les câbles passeront via une chicane au niveau du sol. Ces chicanes seront donc à prévoir, et des chemins de câbles devront être installés vers le local E.

C - Irradiation de petits composants dans une **fente réservée dans le dump** :

Pour l'irradiation de petits composants dans un champ mixte comprenant des neutrons rapides, une fente pourrait être réservée dans le dump (Fig. 2); les premiers centimètres du blindage servant de cible de production de neutrons. Selon G. Stevenson, le maximum de fluence serait atteinte après 20 cm d'acier (TIS-RP/93-2/pp). Pour un flux secondaire maximum, la position d'irradiation serait idéalement dans l'axe du faisceau. Mais cette configuration risquerait de produire un flux de fuite trop important; il est plus vraisemblable que l'espace réservé doive rester sous le niveau du faisceau; dans ce cas, le flux de hadrons secondaires pourraient être de l'ordre de 5e8 cm^{-2} par spill de 1e11 protons. Si on voulait augmenter la proportion de neutrons dans ce flux secondaire, la fente pourrait être positionnée à 40 cm de profondeur; le flux total de hadrons serait alors diminué.

La fente aurait une hauteur de 40 cm et une largeur de 20 cm.
Un convoyeur à rail et à câble serait utilisé pour amener les composants dans la position d'irradiation depuis le local E. Ce type de convoyeur peut être acheté dans le commerce et coûterait moins de 4 kCHF, installation non comprise. Il devrait être installé pendant la construction du dump et du blindage. Il serait prudent de construire le dump de façon telle que la face avant soit démontable sans devoir tout démonter depuis le haut.
L'influence de la fente et de la chicane doit être étudiée d'un point de vue radioprotection; il est fort probable que le blindage latéral doive être renforcé (Fig. 3).

D - Irradiation dans un **faisceau de muons**

En aval du dump en acier est prévue une zone où des irradiations de volumes relativement importants sont possibles. A cet endroit, le champ de radiation sera essentiellement constitué de muons.

Remarque

Tout le matériel irradié dans cette différentes positions sera rendu radioactif. Il sera donc important que toutes les futures irradiations se fassent sous le stricte contrôle de personnes agrées par le service de radioprotection.

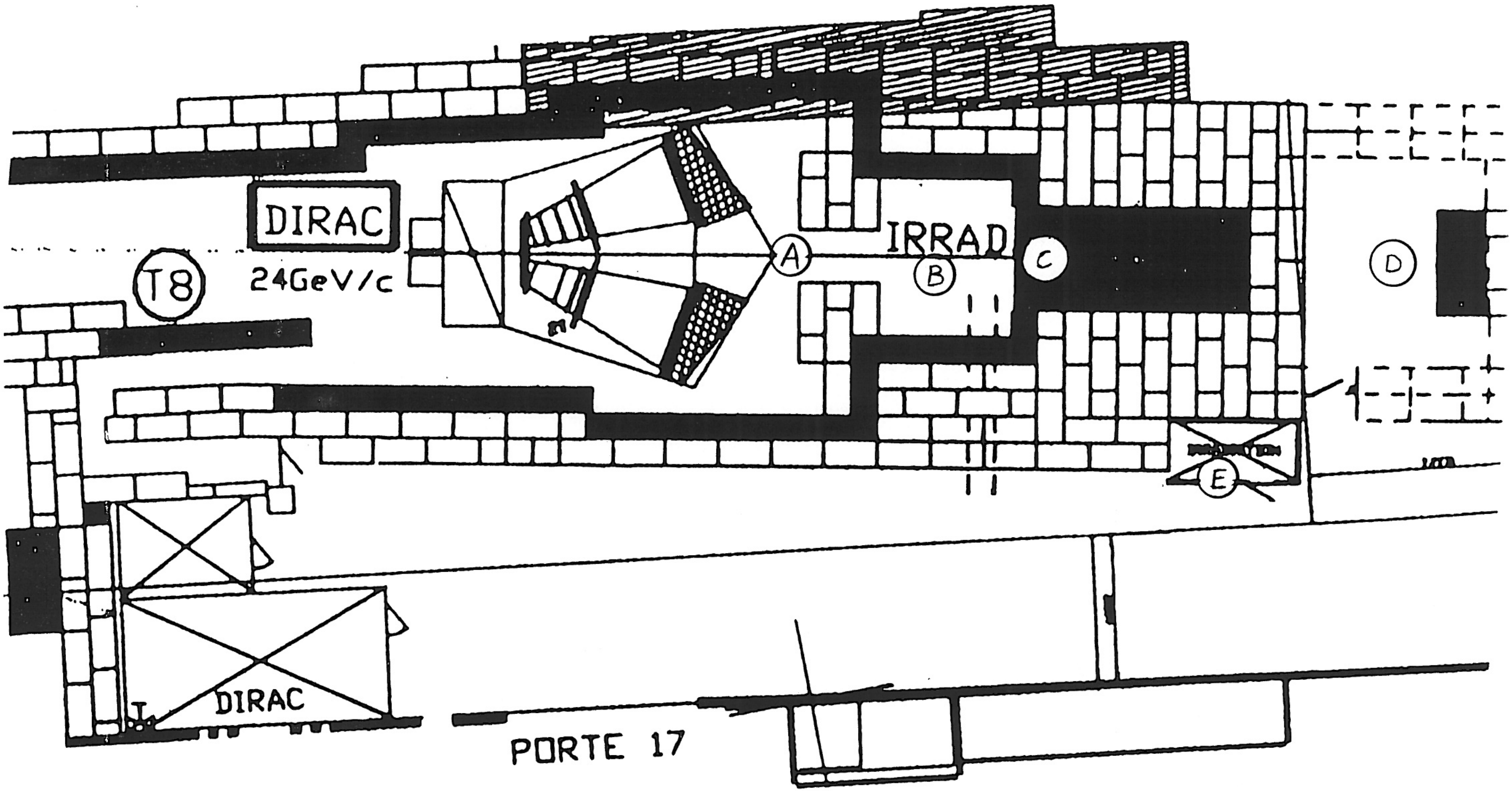


Fig. 1.

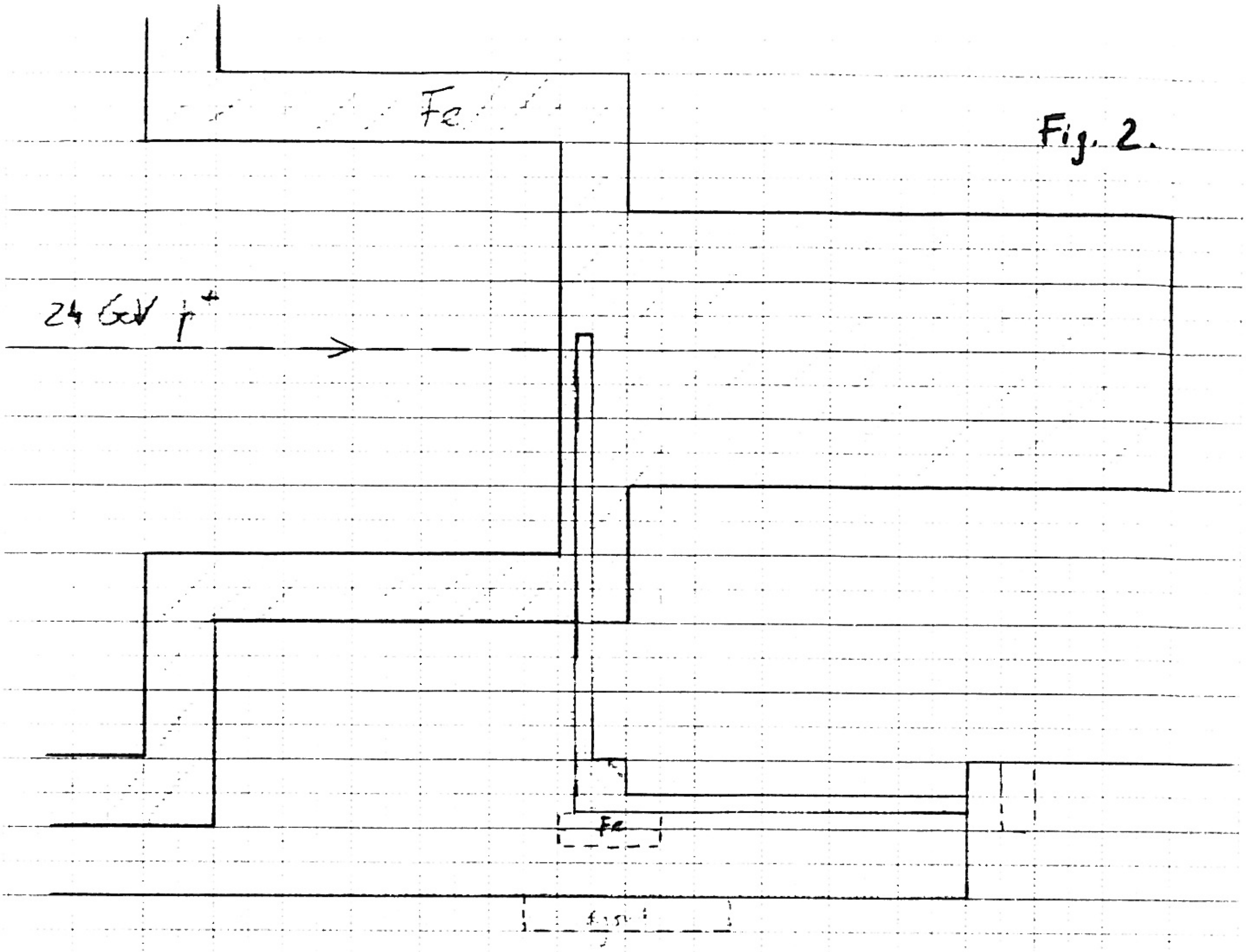
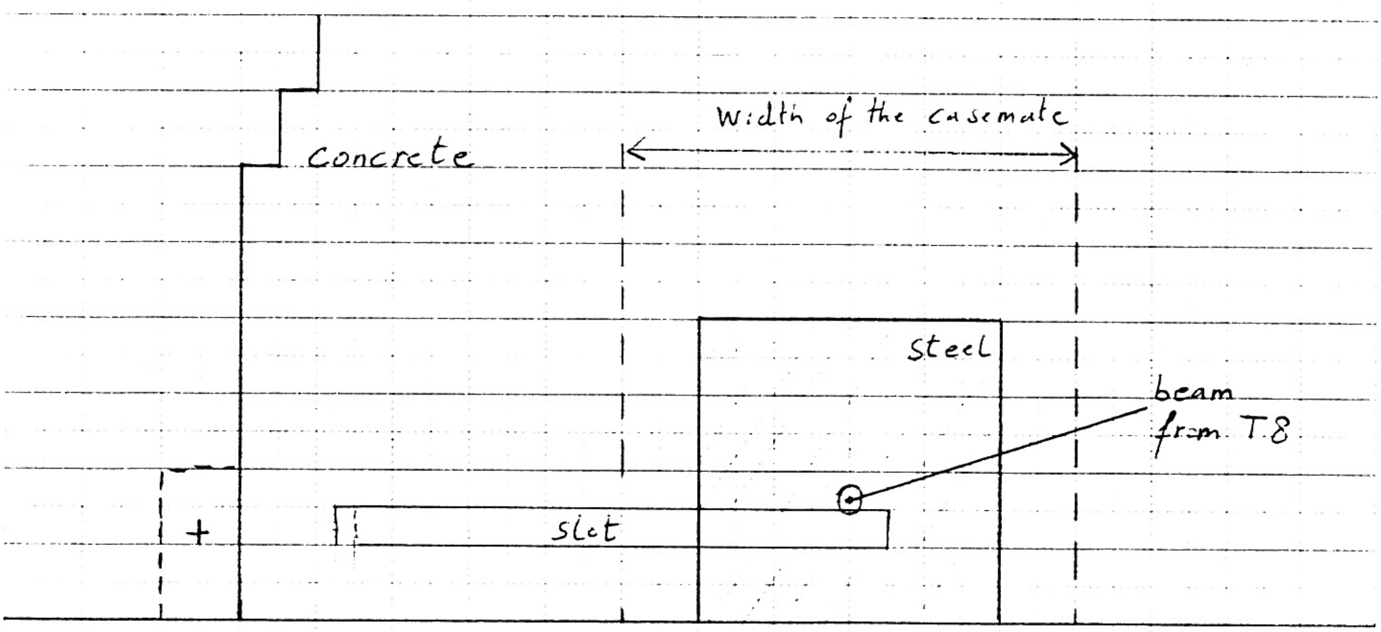


Fig. 2.

Front view (1 cm = 30 cm)

Fig. 3.



List of distribution :

Lemeilleur F.	/ECP-MIC
Grandclément L.	/EST-SU
Lasseur C.	/EST-SU
Brouet M.	/LHC-VA
Gröbner O.	/LHC-VA
Bosser J.	/PS-BD
Bovigny J-P.	/PS-BD
Chohan N.	/PS-BD
Koziol H.	/PS-BD
Daems G.	/PS-CO
Frammery B.	/PS-CO
Allardyce B.	/PS-DI
Bouthéon M.	/PS-DI
Simon D.J.	/PS-DI
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Bonzano R.	/ST-MC
Carlod M.	/ST-HM
Cornuet D.	/SL-MS
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Doser M.	/PPE-XB
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Henriques A.M.	/PPE-ATO
Kourochkine I.	/PPE
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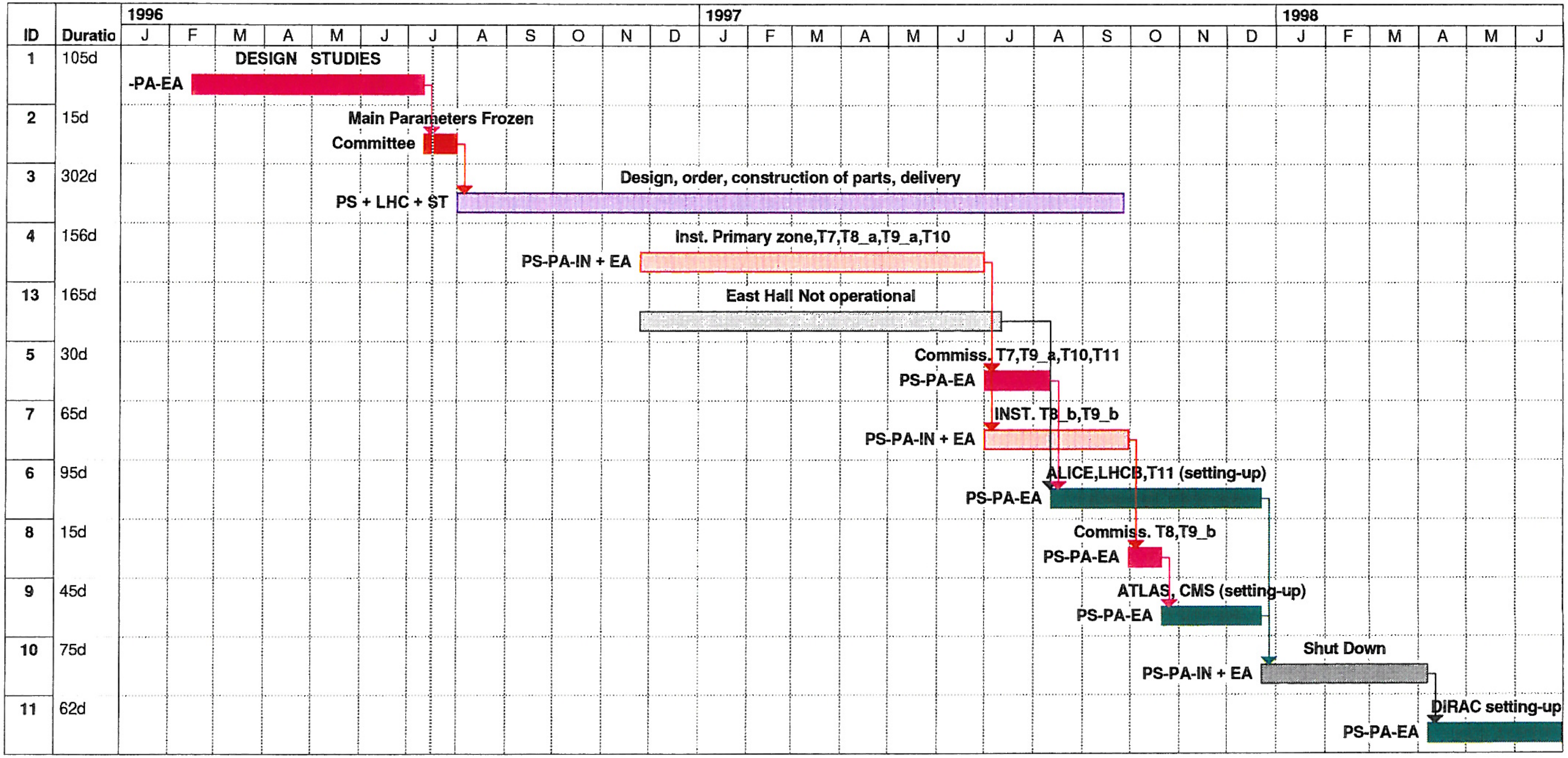
May J.	/PPE-ALD
Piuz F.	/PPE-ALI

B

EHNL Time Table 16/07/96 9:10



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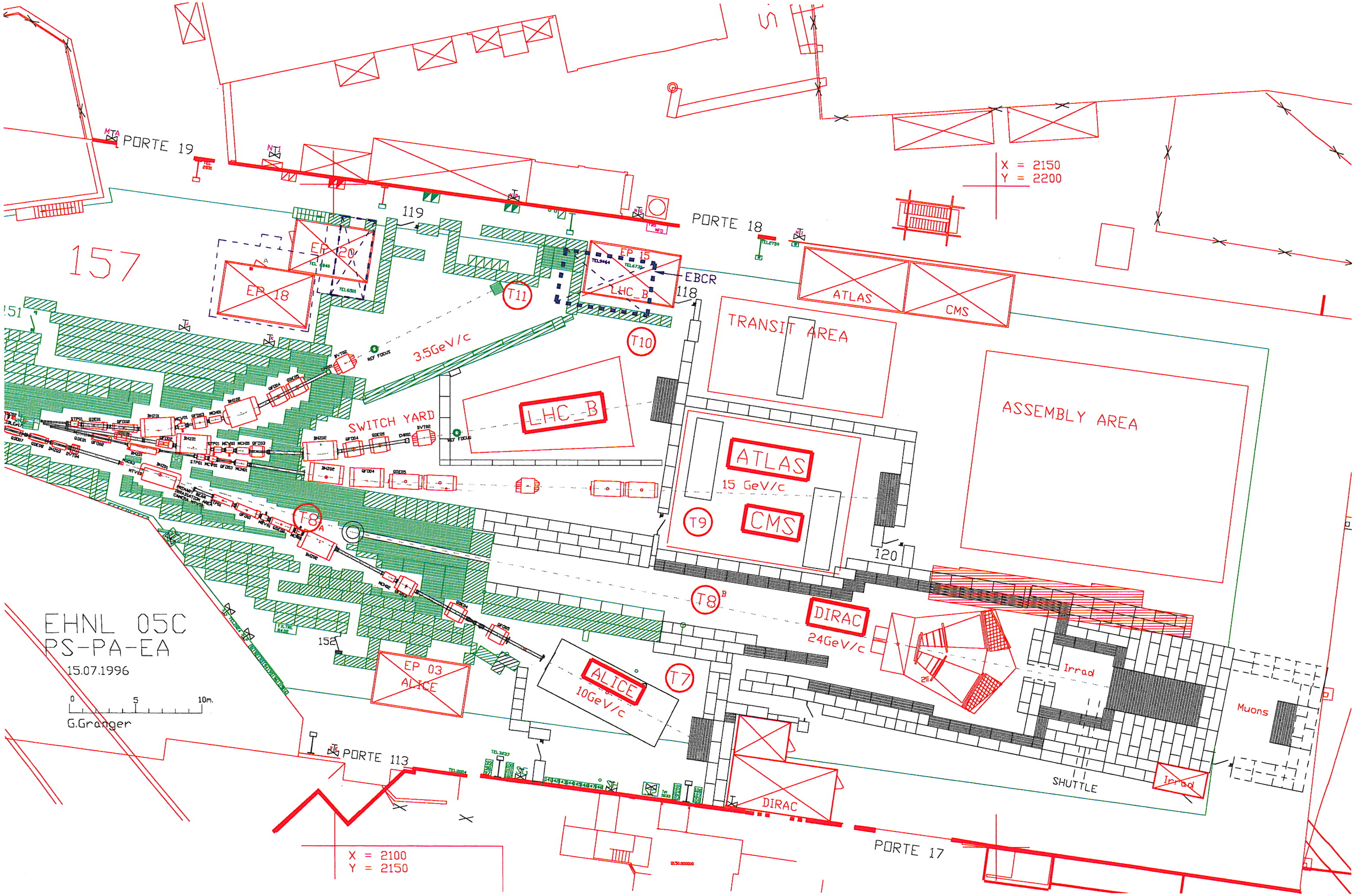
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