PS/LP Note 94-09
2/03/94

CTF RUN N° 1 - 1994

An update on the installation and the programme for the beam tests

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1. Modifications to the CTF beam layout, in brief (see fig. 1).

- The gun used during last run is now at a larger distance from LAS : its pc is at 3201.5 mm from the axis of the input coupler of LAS.
- New solenoid at gun outlet : SNF350.
- A 'Gun-Booster'(G-B), a four cells structure for accelerating the beam from the gun to 10MeV/c
- A spectrometer between G-B and LAS : BHZ385, MTV386
- TCM390 in front of LAS and TCM452 behind TRS. (TCM630 removed)
- The straight line behind TRS is prolonged : the BPM line. At the entrance of this line : a diaphragm, W , l = 22mm and the diameter of the hole on axis is 1mm.

2. Modifications to the RF power distribution network (see fig. 2)

A first 3dB splitter divides the power to the LAS and the networks feeding the gun and the G-B. The second 3dB splitter for the gun and the G-B. The new isolator in the line to the G-B avoids any reflected power to the klystron.

The waveguides have been re-routed.

Note that we need to run the klystron at 30MW to get the nominal 100 MV/m in the gun.

3. Laser and PTG

At 262 nm and pulse length 8 ps FWHH.

For the single bunch measurement we need in one pulse 20 µJ on the pc (with QE = 1%, charge from pc about 40 nC, enough to check saturation in the gun/G-B ensemble). Implies that the first pulse of the train of 8 pulses can be used for single bunch measurements.

A train of 8 , 12 and of 24 pulses as during last run.

Newly announced: train of 24 pulses on 3 beam lines and of 48 pulses on 6 lines. Wanted for pushing the 30 GHz power generation.

For studies we like to dispose of two equal laser pulses at a distance adjustable from 0 ps to 90 ps.

4. Photocathode

Cs_2Te

To begin with, produced as for the last run. Later we may profit from possible improvements found in the photoemission lab. Life time and the 'memory 'effect in the train are the main issues.

5. Objectives of the run

- Test the gun / G-B ensemble and compare with computations.
- Study the lack of charge in bunch trains ('memory 'effect in the train). In the first instance this implies a comparison between the UMA and the FC.
- Study the discrepancy between the measured 30 GHz from TRS and the computed one using UMA readings.
- Make a suitable beam for the BPM's tests.
- Increase power from TRS and find a stable high-power regime.
- Measure beam characteristics as bunch length, transverse emittance.

6. Possible chronological order of the tests

6.1 Gun performance

Even with the attenuator in the rf line to the G-B at its max: -23dB we have to take into account the contribution of the G-B to the beam momentum. For an optimum phase this contribution is 0.385MeV/c. We can also open the line feeding the G-B during the gun tests.

With single bunch

Beam momentum as f ('laser phase') with BHZ385 and MTV386 (screen close to exit window BHZ385 as the beam is divergent at the outlet)

For small and large laser spot on the pc : bunch charge as f (laser energy on the pc) with UMA375/395 and FC387 (FC put close to exit window of BHZ385).

Bunch length as f (charge, phase) with TCM390

As a pilot measurement : the bunch emittance with TCM390

With train of 8 bunches

Study, for different charges per bunch, the contribution of each bunch to the total charge of the train; see how bunch 1 and 2, 1 and 3, 1 and 4, etc. are adding-up. Compare UMA375/395 with FC387. Measure beam loading in the gun.

Observe train with TCM390.

Try other pc's if 'memory' effect is confirmed

6.2 Performance of the gun / G-B ensemble

We operate the gun at 100MV/m and the G-B, hopefully, at 60MV/m.

Single bunch.

For a typical high and low charge gun setting found previously, scan the phase between gun and G-B. Measure energy, bunch length and transverse profile.

Train of 8 bunches

For different charges analyse train with TCM390.

6.3 Optimise the beam from LAS for 30GHz generation

Single bunch.

So far, the highest charge passing TRS is 7.5 nC. We shall find out what can be gained by increasing the beam momentum at the LAS entry.

SNL set at 200 A and 400 A to be tried.

Bunch length and transverse profiles with TCM390/445 and 452.

Compare measured with computed 30 GHz power.

Run bunch into the BPM line and make a performance assessment. Proposed to do the optimisation and prolonged running later on (see 6.4).

Two bunches with adjustable spacing in one 3GHz bucket.

Study behaviour of long bunch by overlaying the laser pulses. Compare transit time pc to gun outlet with simulations. Wakefields in LAS as function of bunch spacing.

The double pulse generator should be tried out before beam start up.

Train of 8 bunches

Results of the last run showed a big difference between measured and computed power. The TCM452 behind the TRS will show how the bunches pass and this may give a clue. Each measurement should be completed with running the probe beam.

Furthermore, as the charges used in the computations are average values, we should have an equivalent average power value.

At least a complete measurement for two train charges: one without transmission losses in TRS and one giving high power.

Train of 12 and 24 bunches

Note that I propose to skip the 2 x 8 bunch train. Repeat work done on the 8 bunch train case.

Make a prolonged operation with settings giving high power in order to assess medium term stability and become better aware of the difference : peak/ average power.

Train of 48 bunches: will require setting-up time not readily available during the beam experiments. Thus its use depends on the extent the system is tried beforehand.

6.4 Beam for the BPM tests

The diaphragm in front of the line is fixed. The alignment should put the axis of the hole parallel to the beam axis. A misalignment will limit the charge into the BPM's. If we run into troubles then we can consider to equip the device with remote position controls.

If the stability of the bunch-charge-center is not good enough then we shall try to identify the source(s). The laser is a likely candidate and by varying the spot size and its operating conditions we may find out about it. As these investigations may turn out to become time consuming I propose to schedule them at the end of the run.

6.5 Beam emittance measurements

To be measured before and after LAS with TCM390 and TCM445 resp. As these measurements need to be done for a number of beam conditions we intend to first develop an automated procedure. We aim to make some tests with such a procedure.

7. Time schedule

We want to bake-out the gun / G-B ensemble during wk12, do the rf conditioning wk13 and start with beam tests after Easter. Unfortunately, we are behind schedule and due to the present lack of staff we can't catch up. Beam start up will likely come two weeks later.

The duration of this run depends on a number of factors and I mention a few :

- for our contribution to EPAC we like to clear up the 'memory' effect in the train and the discrepancy between the measured and computed power,
- finding out if the BPM line is or can become suitable for testing the monitors,
- KLY98 will be tested in may and as its use can boost the CTF performance we prefer to install the associated wave guide system in June.

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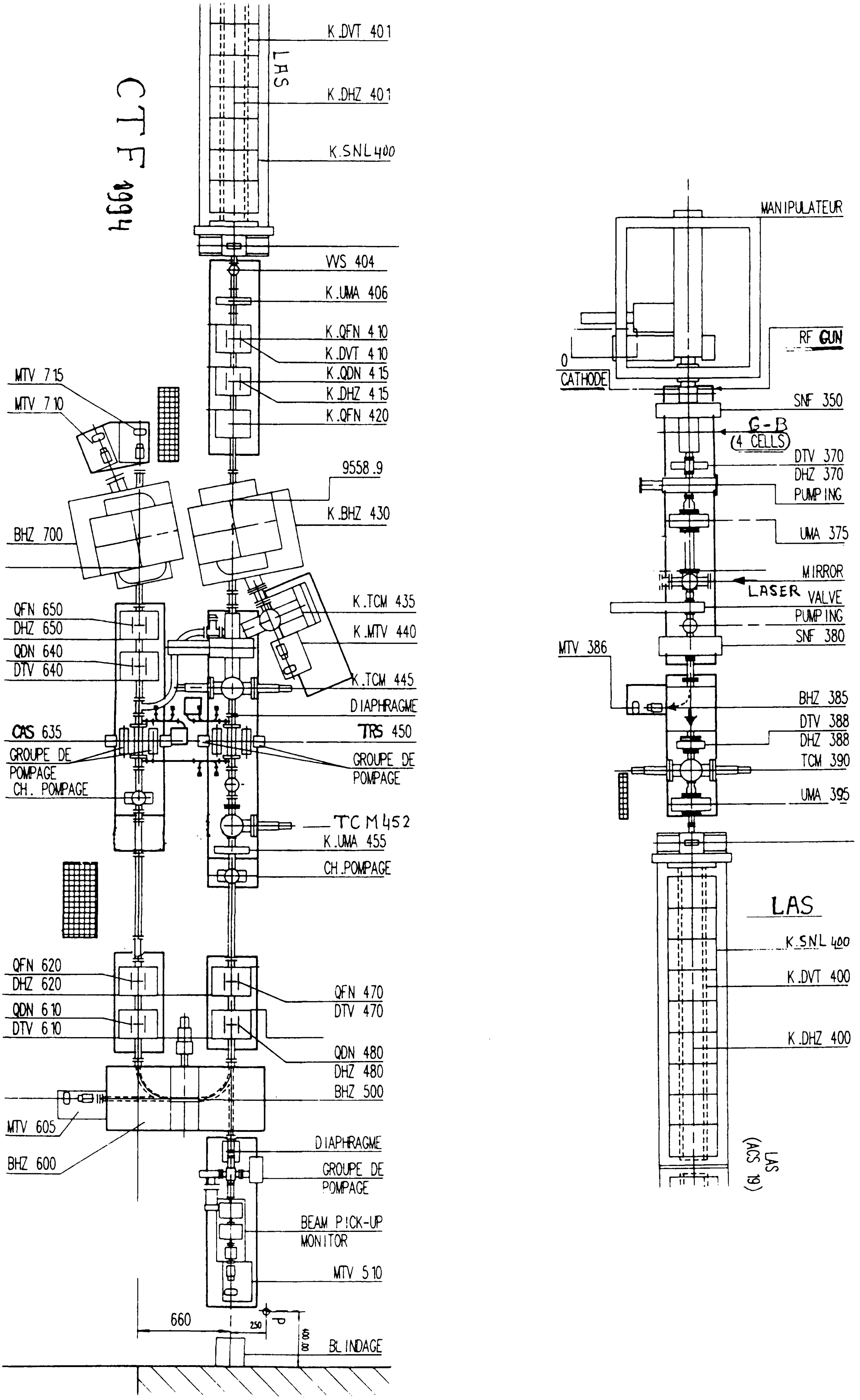
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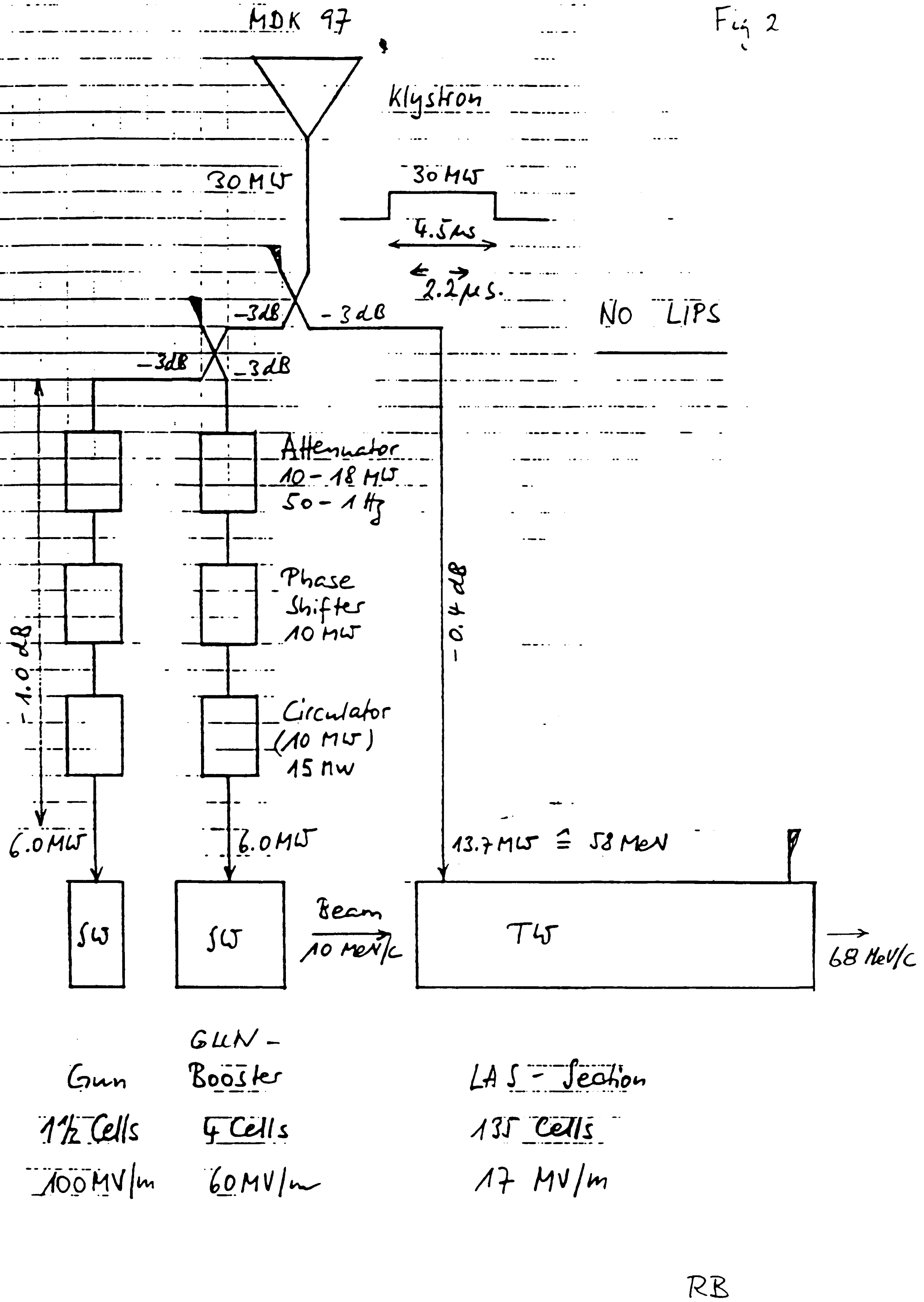

MDK 97
Fig 2
Klystron
30 MW
30 MW
4.5 µs
2.2 µs.
-3dB
- 3 dB
NO LIPS
-3dB
-3dB
Attenuator
10 - 18 MW
50 - 1 Hz
Phase
Shifter
10 MW
-0.4 dB
-1.0 dB
Circulator
(10 MW)
15 MW
6.0 MW
6.0 MW
13.7 MW ≙ 58 MeV
SW
SW
Beam
10 MeV/c
TW
68 MeV/c
GUN -
Gun
Booster
LAS - Section
1½ Cells
4 Cells
135 Cells
100 MV/m
60 MV/m
17 MV/m
RB