Simulation from ion source to RFQ

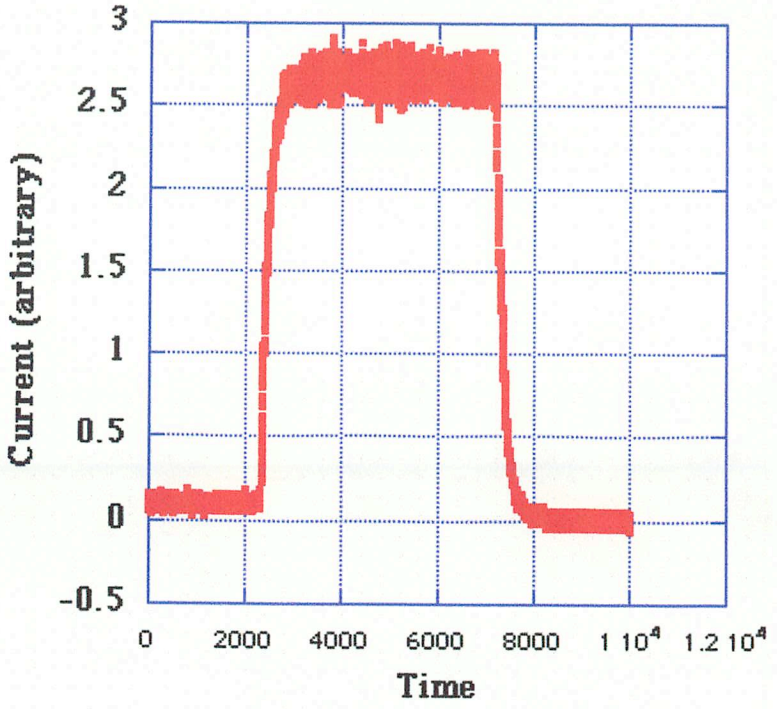
- No reliable code for IS - LEBT part (pre-injector group)
- RFQ beam was used in 1999 simulation
- Similar-level code should be used for pre-injector part, otherwise, there is no consistency
- Now, pre-injector group add additional unrealistic artificial distribution at the RFQ entrance in order to create a halo-part of the RFQ output emittance.
  - It is one of invention of data.
  - We did not confirm such properties in the MEBT beam during MEBT beam experiment.

MEBT issues

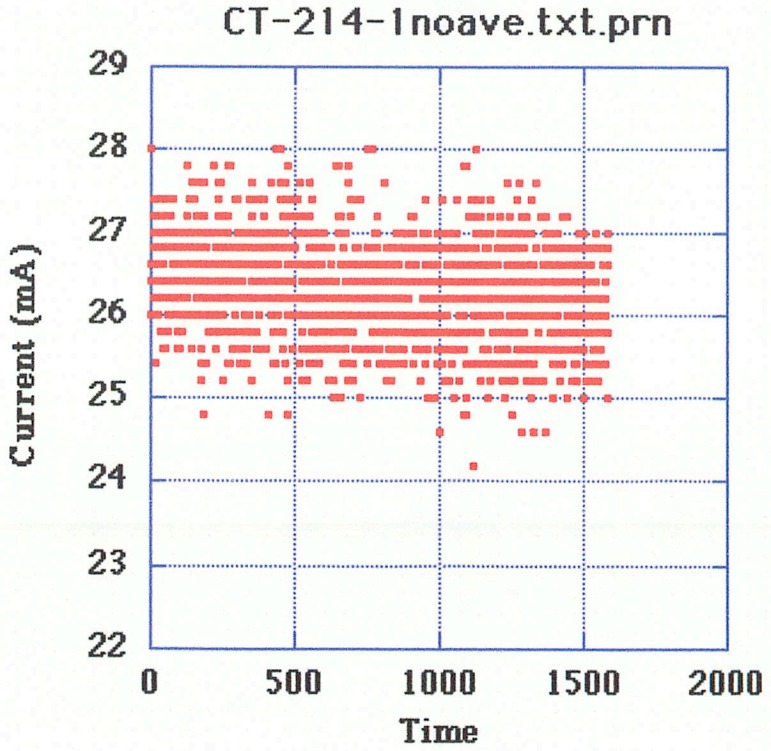
- **In PARMILA simulation**
  - **It suggests an issue that what matching method is best for our target.**
  - **RFQ beam of having large halo parts was already used**
    - **No problem, however, demanding more severe linac operation requirement**
- **In LINSAC simulation**
  - **Emittance growth in the MEBT is tolerable according to the LINSAC results**

Variation of peak current

- ± 9% amplitude change during macro pulse



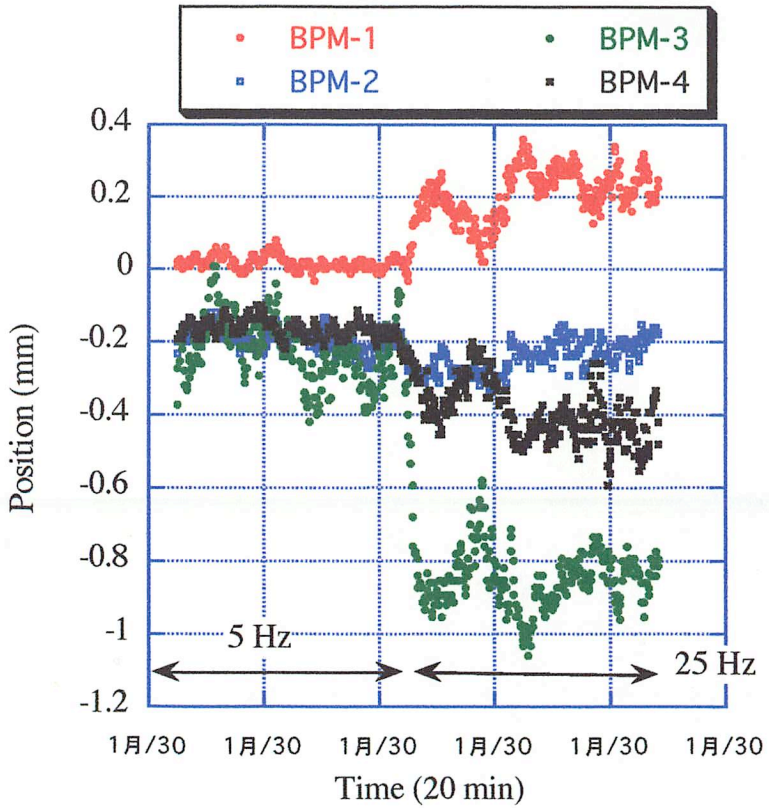
100 μsec



15 min.

Effects of repetition frequency

- **Change in repetition frequency from 5 to 25 Hz**



MEBT BPM output
Large changes were observed:
1. Position
2. fluctuation

RFQ

- **First priority issue**
  - **Test more intense beam by using the existing RFQ**
    - **Now, a 30-mA beam was accelerated with good performance**
    - **How is a simulation result with a 50-mA beam?**
    - **Is it acceptable or not?**
- **NEW RFQ is a second choice**
  - **High cost**
  - **Design issue**
    - **The problem of longitudinal-halo design has been solved or not?**

Ion source further development

- **RF type had a 10 % amplitude modulation of rf frequency. It is close to the chopped frequency.**
  - **This is a serious problem.**
- **Detailed study and estimation of amplitude modulation are necessary at first.**
- **Improvement of the used type is more desirable than developing other type IS.**

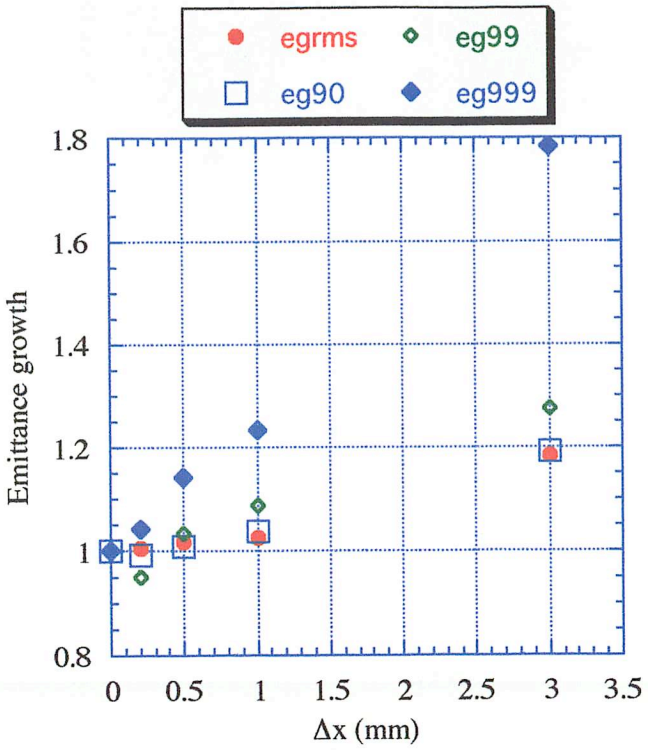
Required LEBT functions

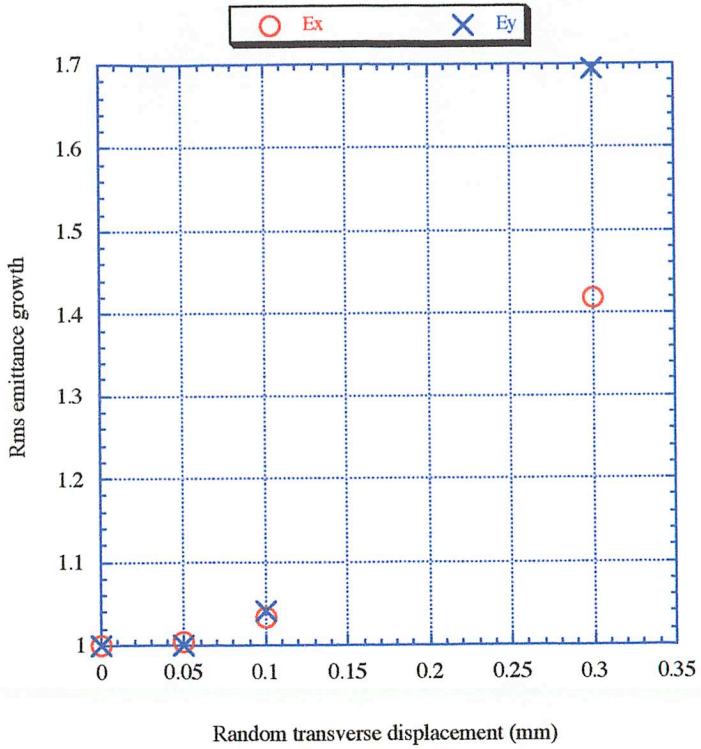
- **Knobs for adjusting injection errors by a set of steering magnets**
  - **Frequent replacement are expected in the normal operation. No additional tuning after MEBT part should be avoided for achieving fast tuning of the linac system**
  - **Injection errors usually cause serious problems in acceleration of the beam**
    - **There is no exception**
- **Electro-static chopper for changing a repetition rate of the beam pulse**
  - **A change in number of arc-pulses causes a change in the beam qualities. Thus, frequent tuning becomes very difficult and takes much time: it should be avoided during the normal operation period.**

Summary of IS, LEBT & RFQ

- **Status**
  - **A stable 30-mA RFQ beam has been delivered.**
- **ION SOURCE**
  - **Large amplitude noise ~ 10%**
    - **Improvement is required**
  - **Longer life is required**
  - **RF type has a serious problem**
  - **Further work should be devoted to improvements of the non-RF type.**
- **LEBT**
  - **Modify steering magnets**
  - **Install electrostatic deflecting chopper**

Emittance growth vs. alignment errors

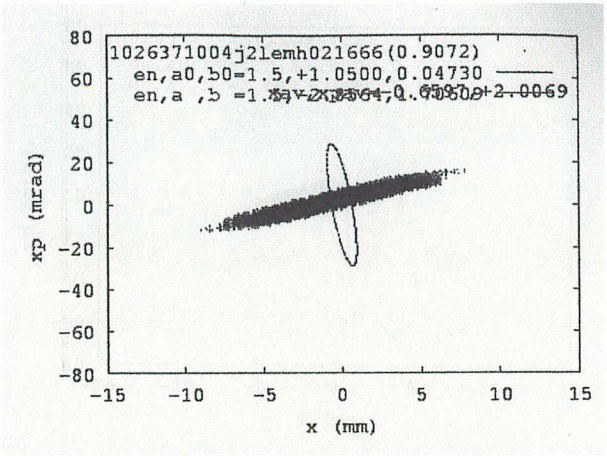


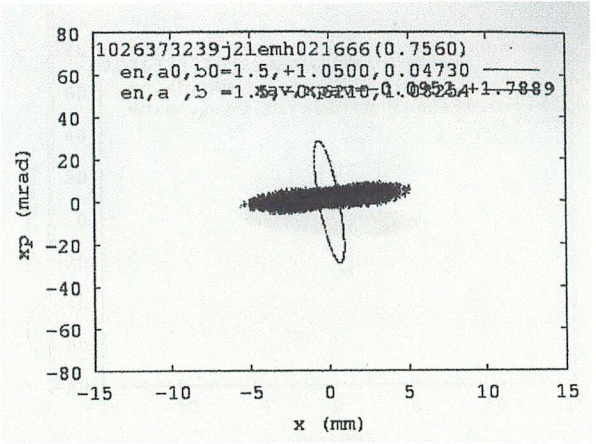


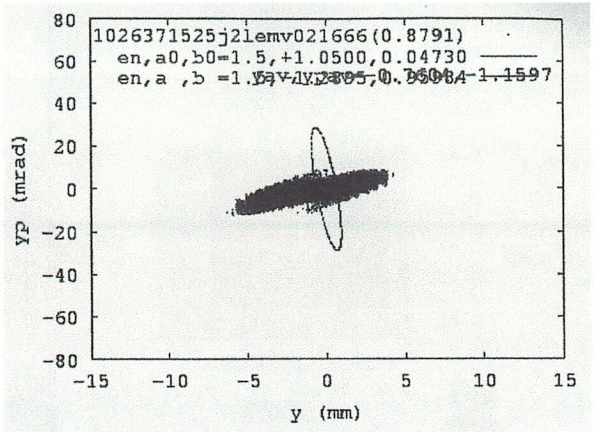
ΔX= deviation of SDTL rf center from Q-magnet center

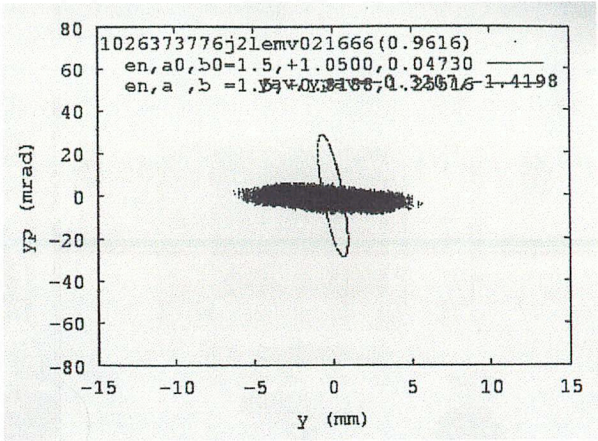
ACS: Q-magnet position random errors

MEBT measured emittance









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Eddy current of Q-magnet

$$A_2^0 r^2 \cos 2\phi \sin \omega t \longrightarrow A_2^0 r^2 \cos 2\phi (\sin \omega t - \varepsilon \cos \omega t)$$

σ=conductivity=1/ρ, ρ=72x10 $^{-8}$ Ωm,
R=radius of bore tube (center value),
δ=thickness of bore tube,
Rg=aperture radius of magnet pole

$$\varepsilon = \frac{\mu_0 \sigma \delta R \omega}{4} \left(1 + \frac{3}{4} \left(\frac{R}{R_g} \right)^4 \right)$$

1. Delay
2. Change in amplitude

	δ mm	R mm	μδR/4 μsec	1+.75(R/Rg)^4	μsec	ε	ε
3 MeV	**1**	**7**	**3.05**	**1.44**	**4.39**	**0.0013**	**0.011**
50 MeV	**1**	**13.5**	**5.89**	**1.56**	**9.21**	**0.0026**	**0.022**
ps 20	**0.8**	**10.4**	**3.63**	**1.60**	**5.80**	**0.0017**	**0.014**
						T=11 ms f=45 Hz	**T=1.3 ms f=385 Hz**

Method of phase detection system

- **Now, monitor group and RF group develop different methods for phase detection.**
- **Detailed comparison is necessary;**
  - **accuracy and total performance.**
- **Is it necessary for unifying them?**

Important work in construction

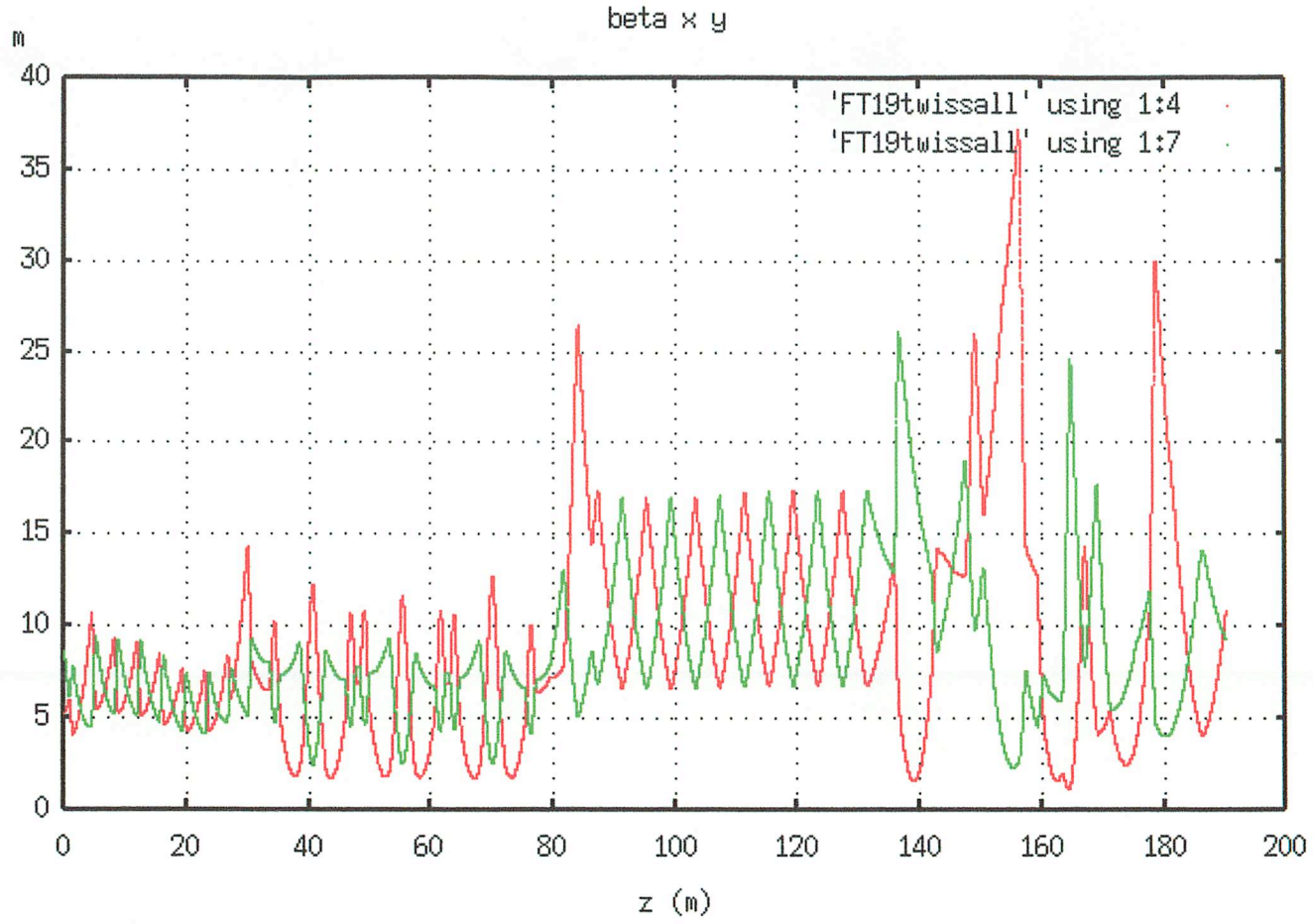
- **Pre-injector part improvements**
- **DTL assembly**
  - **If late, starting day of commissioning will be delayed.**
- **Total alignment**
  - **It determines final performance**

Question of energy recovery strategy: linac part

- **Basic condition**
  - **High performance in acceleration at an energy of 180 MeV is indispensable.**
  - **The first priority is:**
  - **To construct an accelerator complex of high performance up to 180 MeV.**
- **How can we increase beam intensity by extending poor machine's energy?**
- **Cutting the cost for constructing 180-MeV linac, and using it for shortening the required periods for the recovery. Is it a good strategy?**
- **For example, cutting the alignment cost costs very much in the operation performance.**

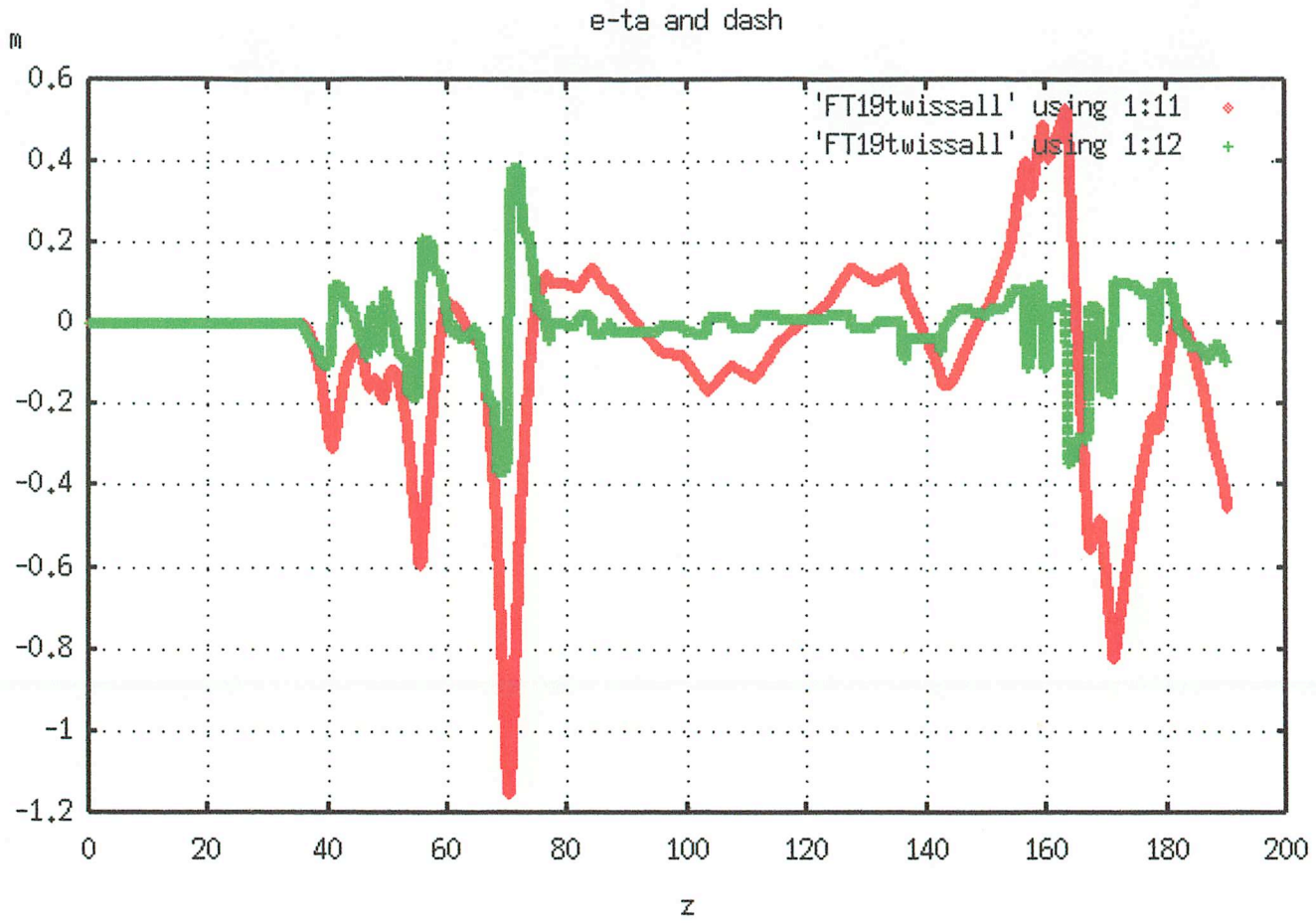
JPL-sup **Everyone know that!!**

L3BT tuning



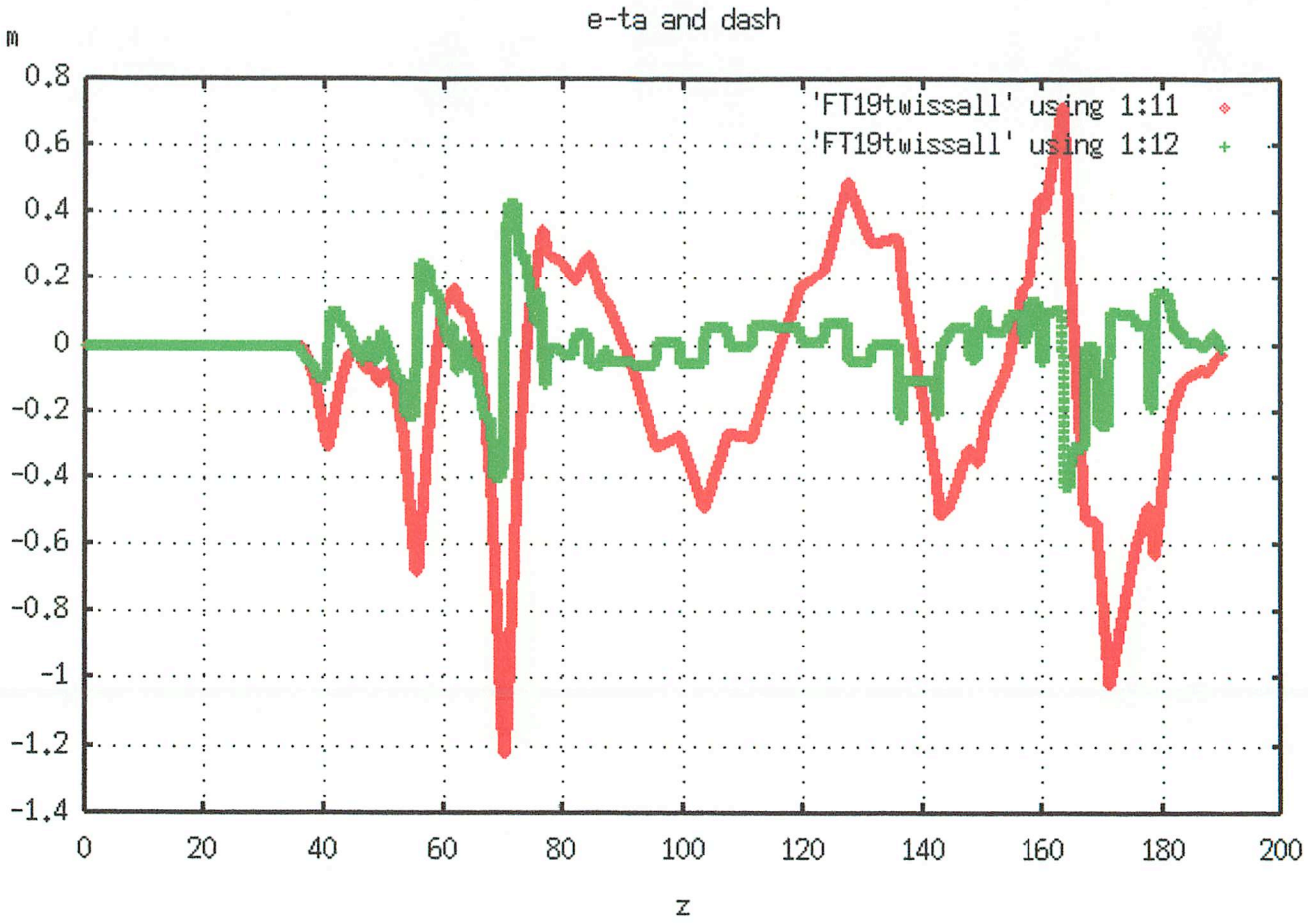
150 mA, no tuning of dispersion

L3BT tuning: no tuning



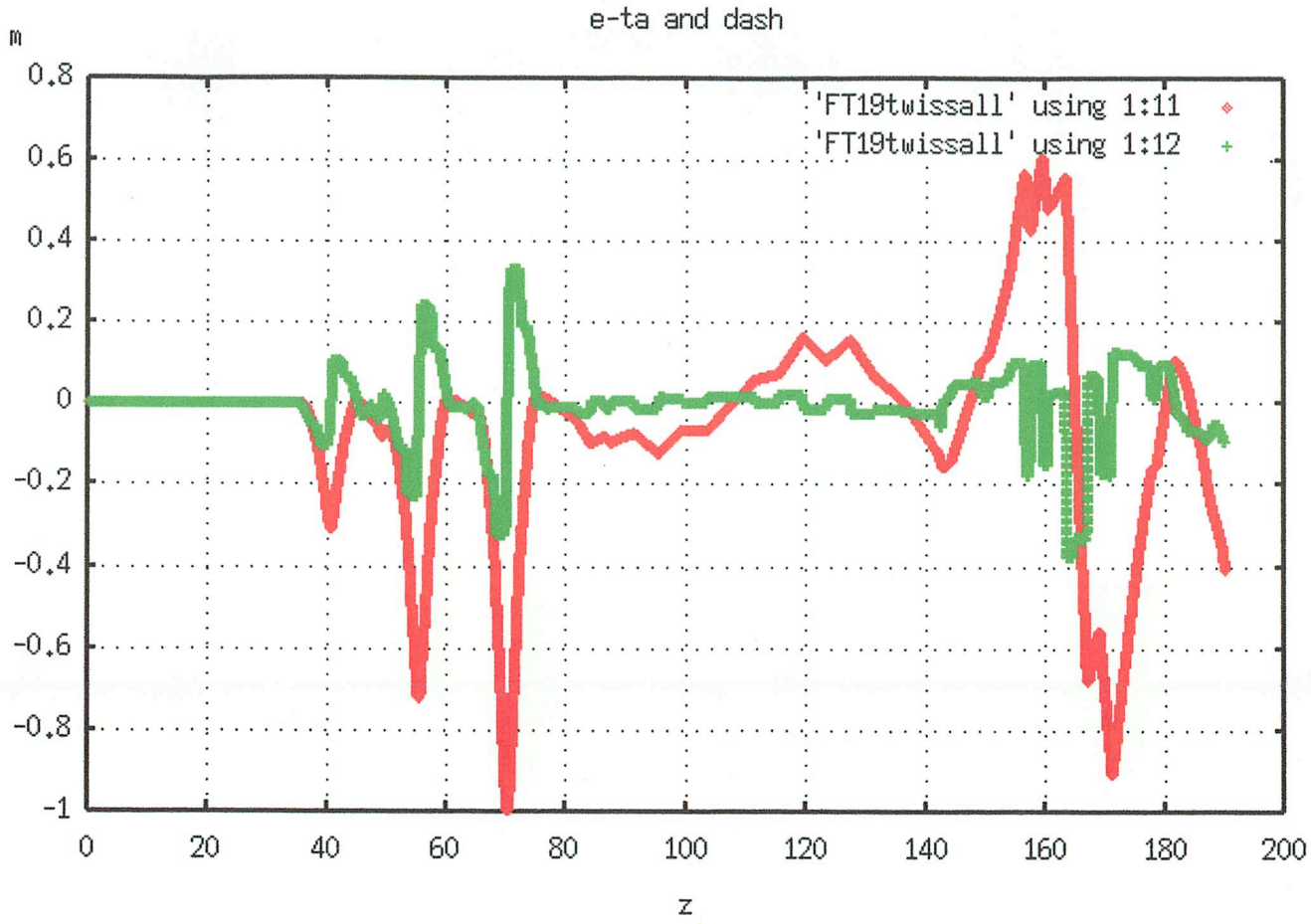
150 mA, no tuning of dispersion

L3BT tuning: dispersion~0



150 mA, tuning of dispersion at the exit

L3BT tuning: arc-1



150 mA, tuning of dispersion at arc-1