Mid-linac and Two-beam Test-stand Testing Plans

Magnus Johnson

Uppsala University CTF/CLIC group

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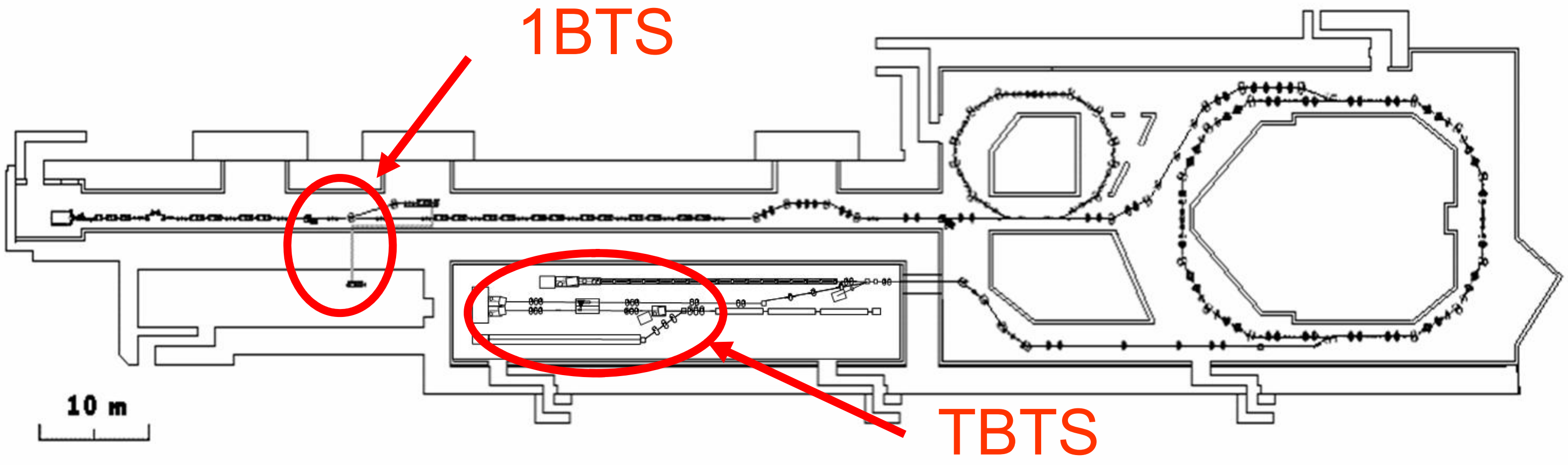
The CTF3 Test-stands



Mid-linac Test-stand (1BTS)

- Accelerating structure tests

CLEX Two-beam Test-stand (TBTS)

- PETS and accelerating structure (ACS) tests
- Test with probe beam!

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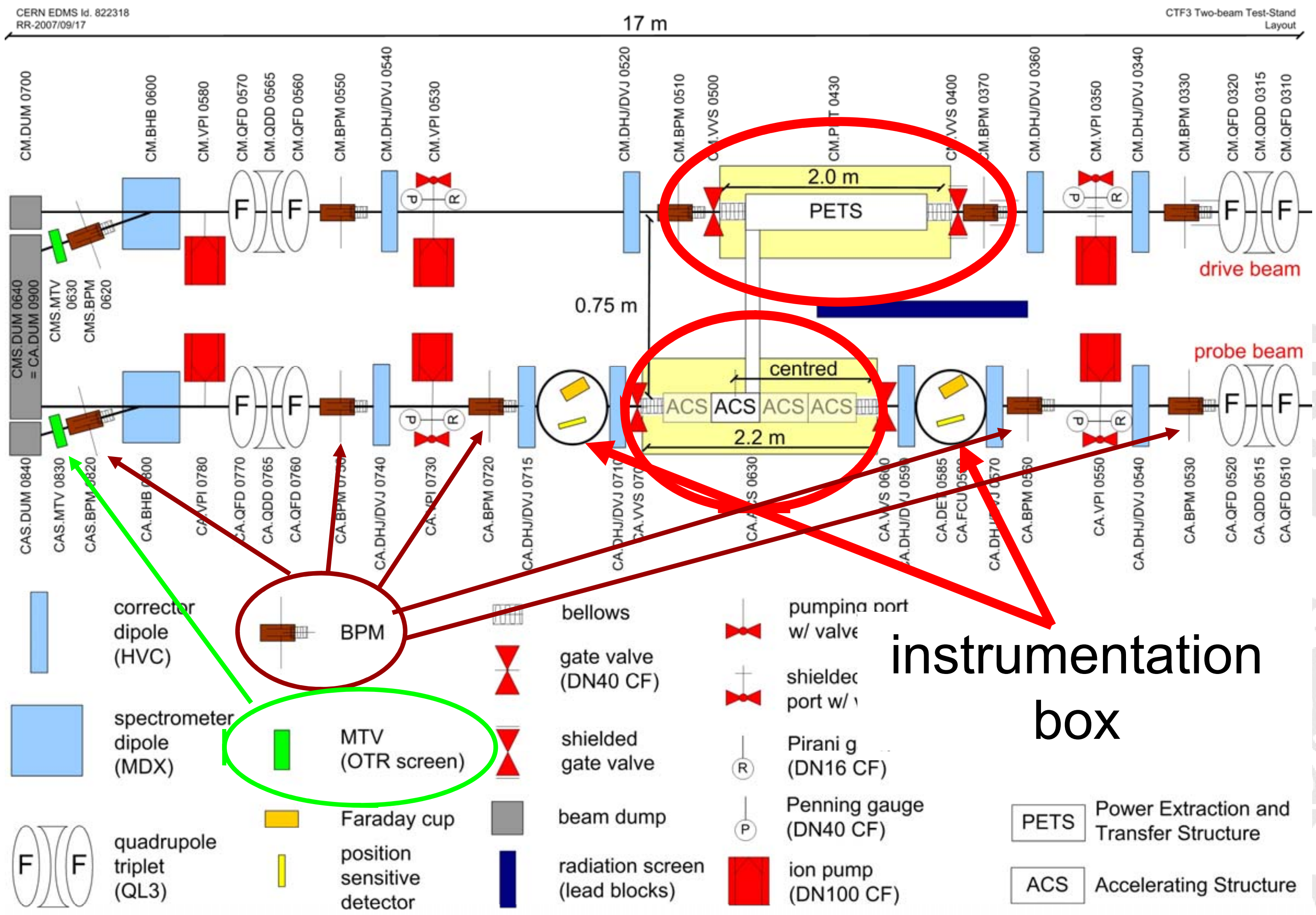
Two-beam Test-stand Layout



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Possibilities of the TBTS

Many unique features:

•ACS and PETS with beam

- **Energy gain/loss (ACS/PETS)**
- **RF Breakdown studies – Does beam change the breakdowns?**
  - **RF power signals (incoming, transmitted, reflected)**
  - **Transverse kick measurements**
  - **Breakdown rate**

•Full CLIC module

- **Alignment studies**
- **Which parameters change when 'everything is bunched together',**
  correlation between PETS / waveguide / ACS

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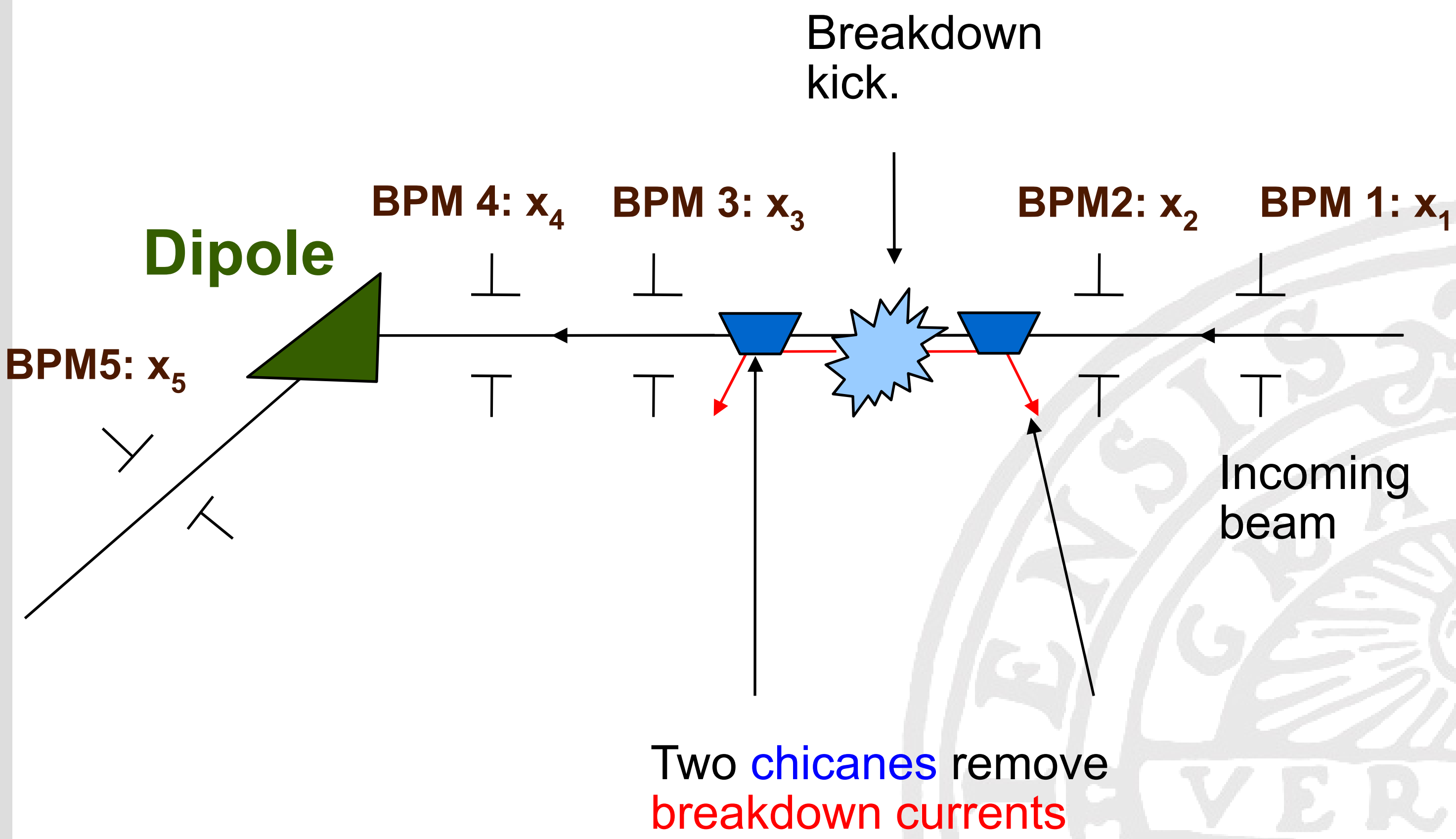
Uppsala measurement plan at the TBTS

- **Breakdown kick measurements**
  - Measure the transverse kick on beam due to breakdown, using BPMs
  - Essential for determining maximum breakdown rate at CLIC
- **Ion current/breakdown current measurements**
  - Understanding the physics of RF breakdown
  - Possible to use as RF conditioning figure of merit?

Kick measurements

- What happens to beam during breakdown?
  - 2 BPM before ACS/PETS allow measuring incoming beam angle/offset
  - 3 BPM after ACS/PETS allow measuring kick change in angle
  - Dipole before last BPM allow measuring breakdown induced energy spread
- CLIC linacs 20 km each, important to determine magnitude of transverse kick in order to determining tolerable breakdown limits!
- Estimations done of accuracy of this method (CLIC-Note-710 2007)

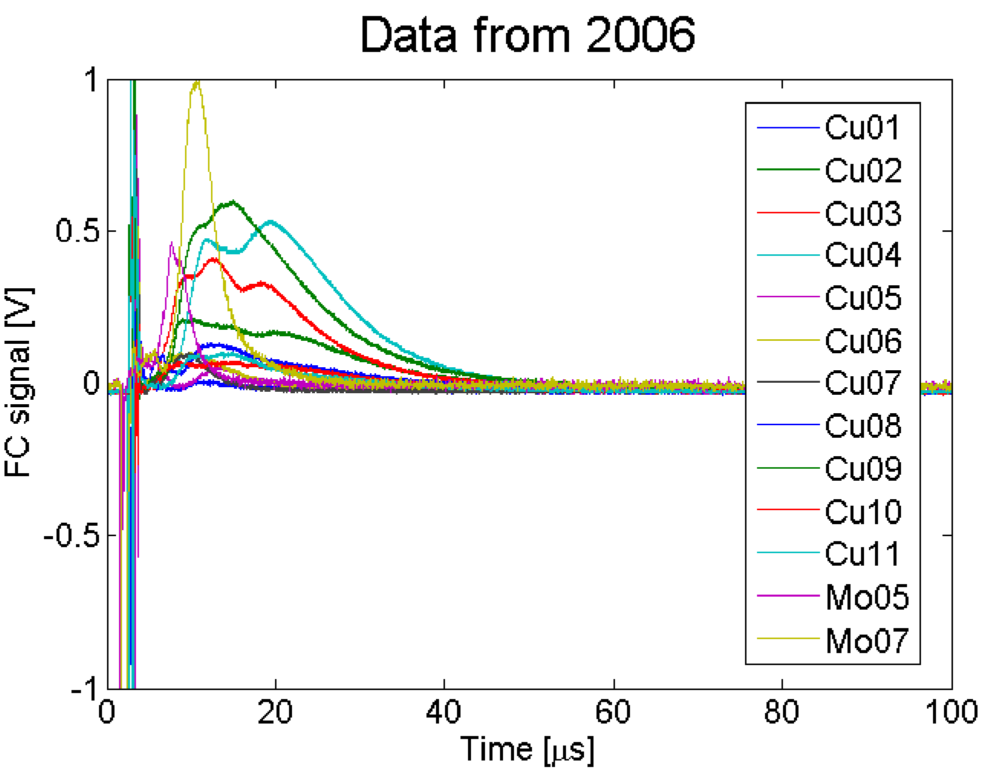
Set-up of kick measurements



Ion current measurements

Following a RF breakdown:

- (Fast) burst of electrons at ns scale (**breakdown current**)
- Sometimes (slow) burst of positive ions at μs scale (**ion current)**



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Analytical calculations

One possibility: Ion originates from **Coulomb explosion** of **spherical**, **homogeneous** distribution of ions.

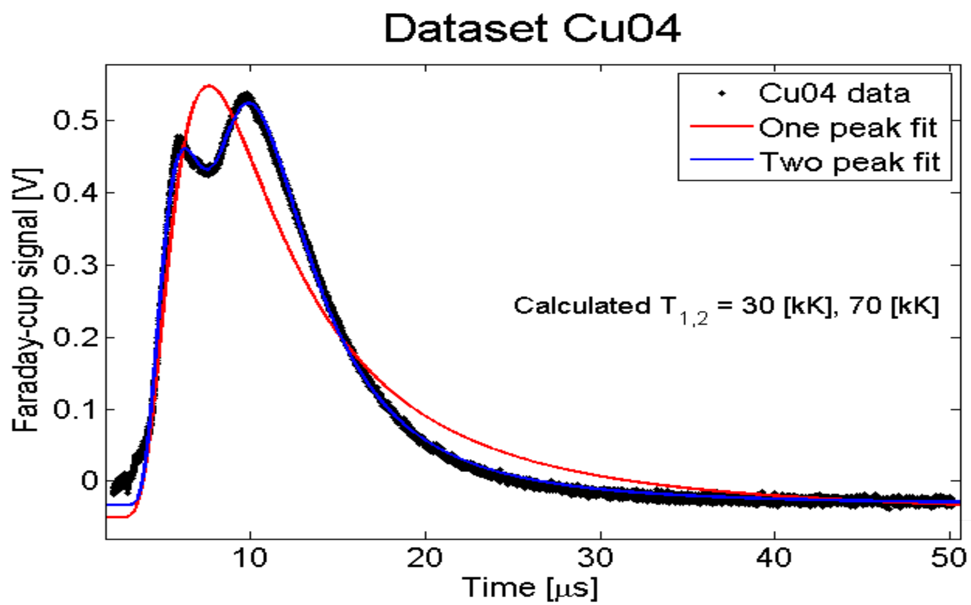
Last & Jortner, Phys. Rev. A 71 (2005): **dN/dE, not including** motion due to temperature **T**.

Ziemann, NIM. A 575 (2007): **dN/dt, including** motion due to temperature **T**.

dN/dt = f (N_0, α, t_s)

- $\mathbf{N_0}$ = number of particles in sphere
- **α** = RMS width of velocity distribution due to thermal motion (**T**)
- $\mathbf{t_s}$ = arrival time of fastest ions from cold distribution.

Measurement Data



- Fit allows to estimate
  - Temperature **(T)**
  - Number of particles **(N)** a bit harder....

FC is not a good ion detector! (secondary electron emission).

TBTS will use a dipole chicane to separated ions and electrons.

Silicon strip detector for ions, FC for electrons.

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Two-beam Test-stand Plans Summary

- Many unique features of TBTS
- Many interesting experiments possible
- Specialized RF breakdown experiments
  - Kick
  - Ion/breakdown current
- Important to correlate all measurements
  - RF signals and kick/currents

Goal: obtaining a clear picture of RF breakdown

Proposals are extremely welcome!

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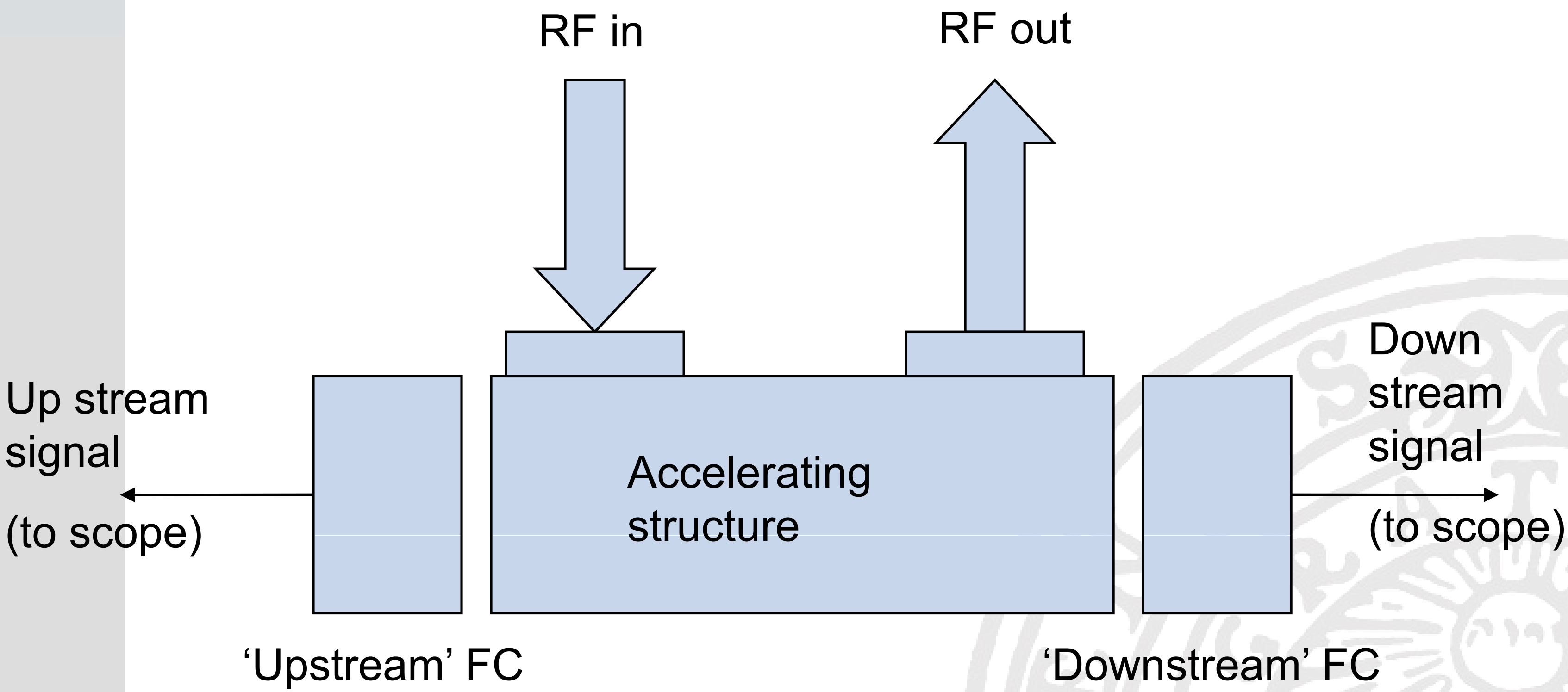
Set-up (Mid-linac Test-Stand)



Set-up (Two-Beam Test-Stand)