Beam diagnostics at TBL in CTF3

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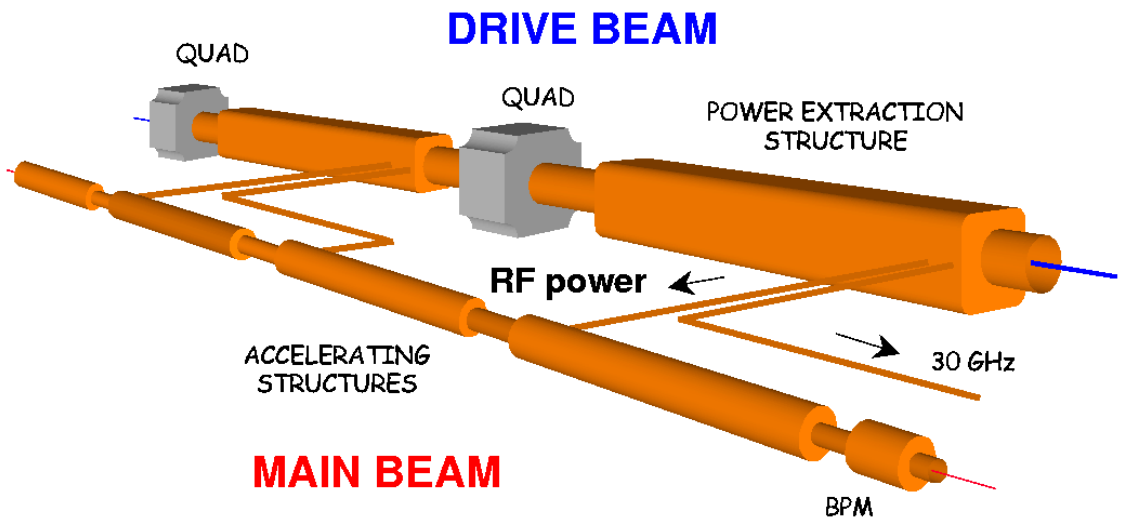
Beam diagnostics at TBL in CTF3

- Brief overview of CLIC and CTF3
- TBL – the beam line and need for profile measurements
- Two techniques to measure beam emittance/transverse profile and energy and energy spread
- Status and outlook of my work

CLIC – Compact Linear Collider

- Beyond the LHC: a lepton collider for precision measurements.
- An electron-positron collider based on a two-beam system:
  - A high intensity drive beam is decelerated to provide RF power for the colliding main beam.



High intensity low energy e^- beam (100 A, 2.4 GeV)

Power Extraction and Transfer Structures

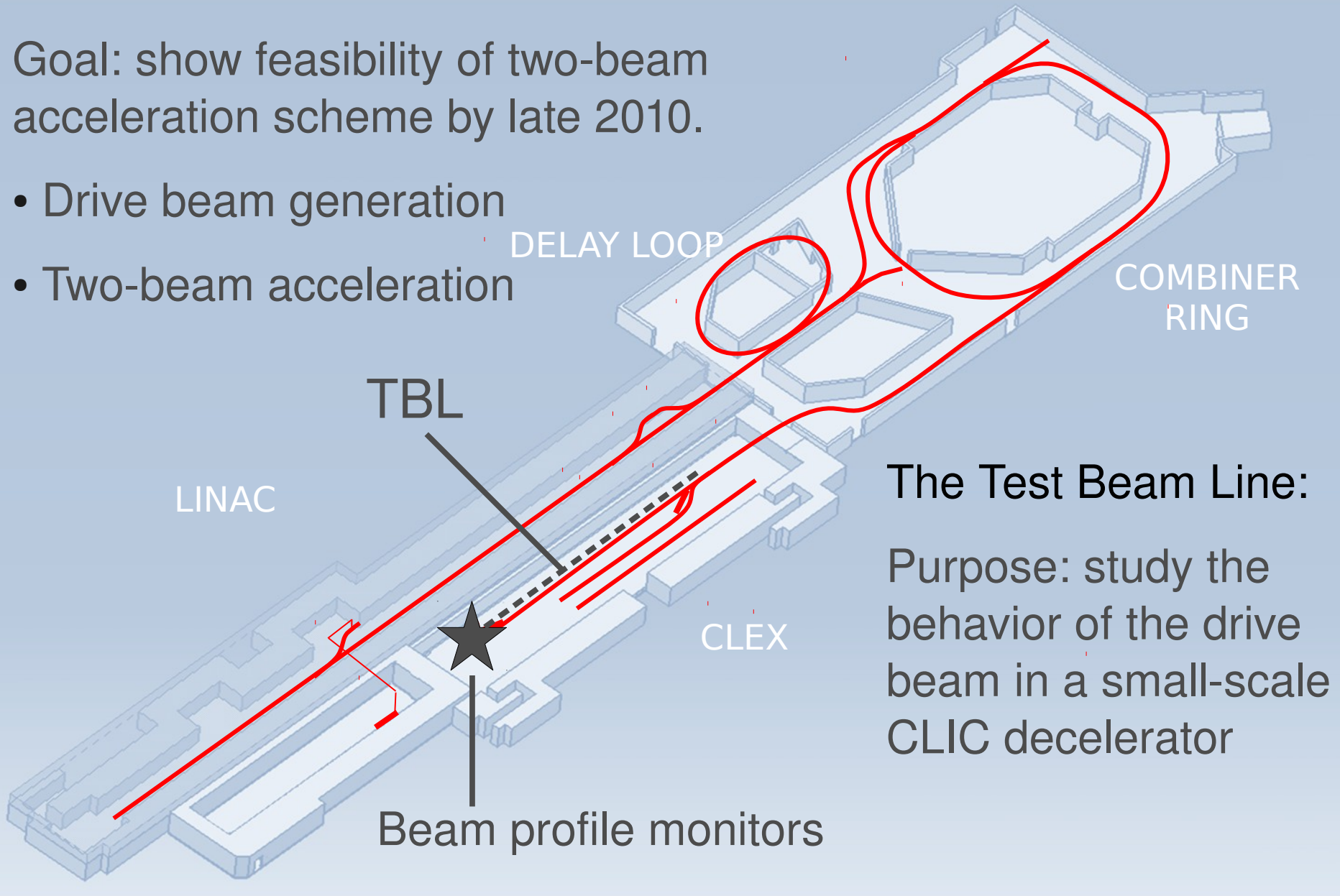
Power

High energy e^-/e^+ beam (1.5 TeV)

CTF3 – The CLIC Test Facility

Goal: show feasibility of two-beam acceleration scheme by late 2010.

- Drive beam generation
- Two-beam acceleration



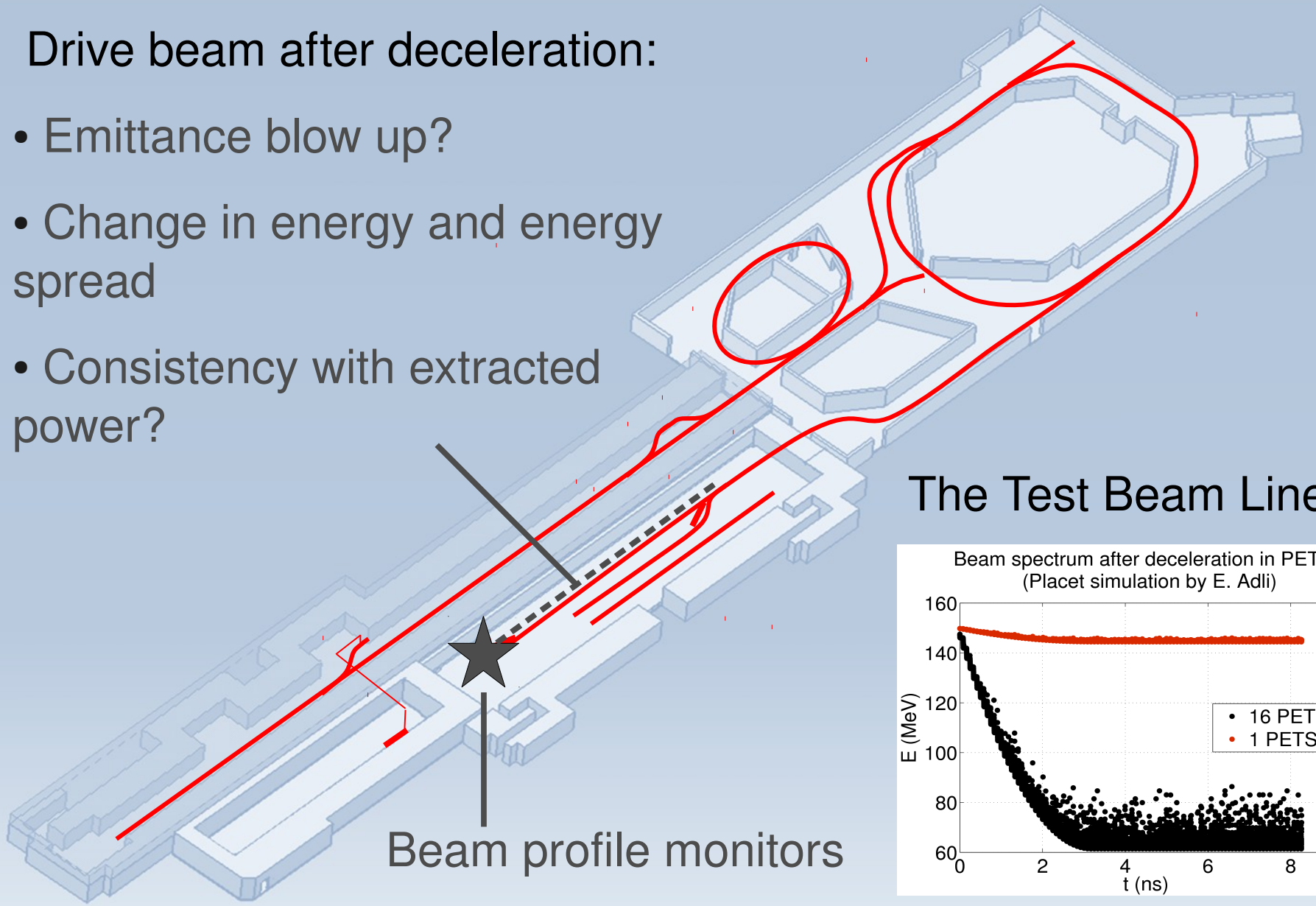
The Test Beam Line:

Purpose: study the behavior of the drive beam in a small-scale CLIC decelerator

TBL at CTF3

Drive beam after deceleration:

- Emittance blow up?
- Change in energy and energy spread
- Consistency with extracted power?

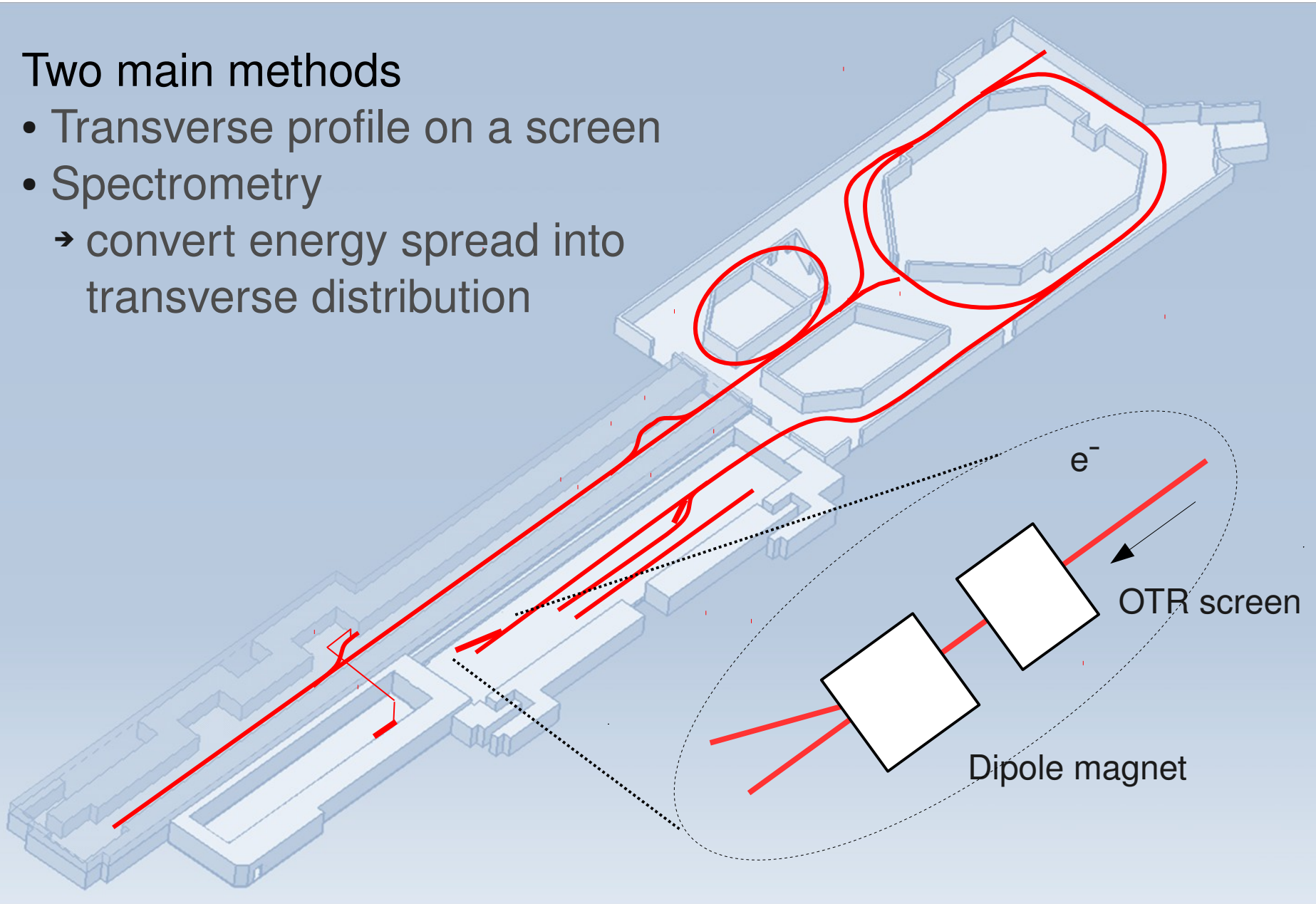


The Test Beam Line:

Beam profile monitors in TBL

Two main methods

- Transverse profile on a screen
- Spectrometry
  - ➔ convert energy spread into transverse distribution

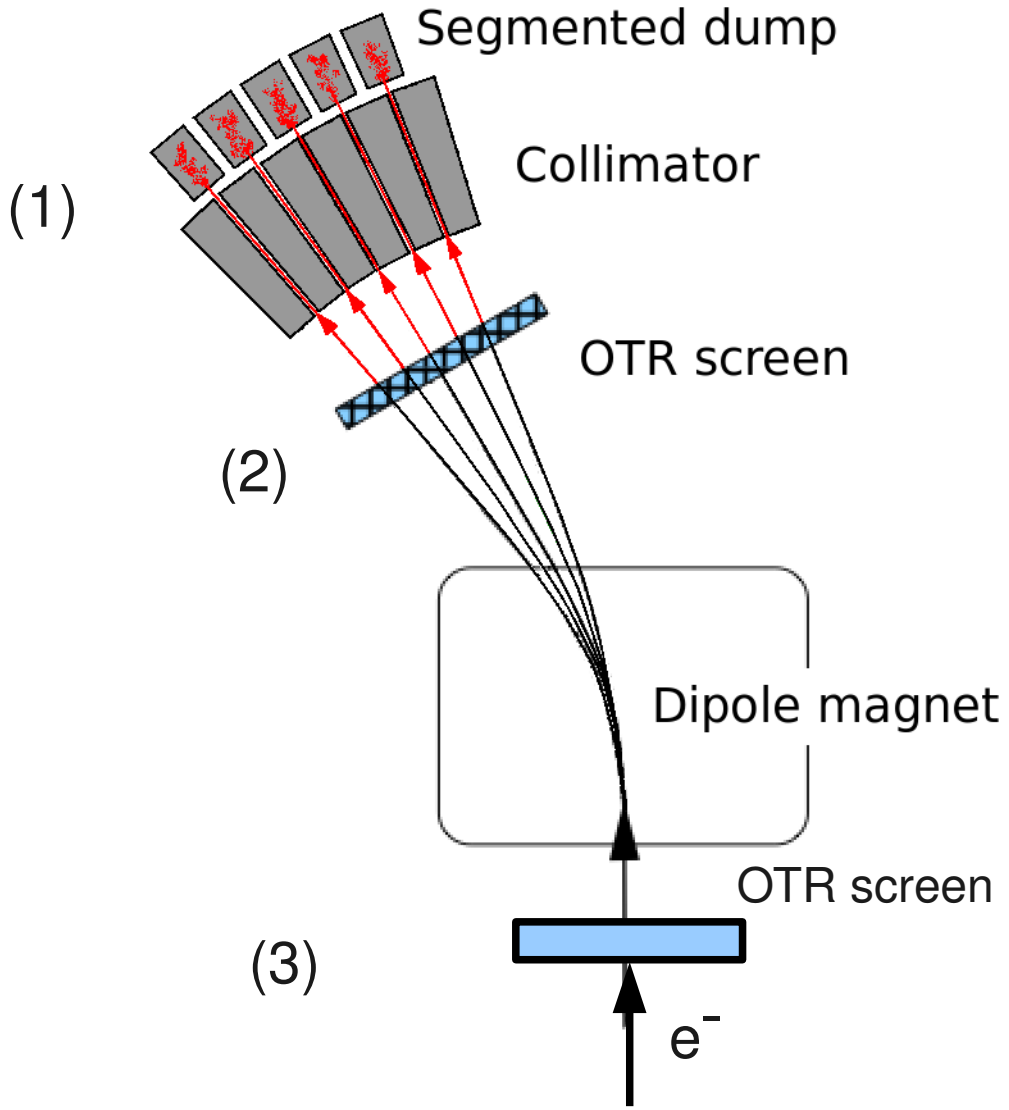


Beam profile monitors in TBL

(1) Segmented Beam Dump for time resolved spectrometry

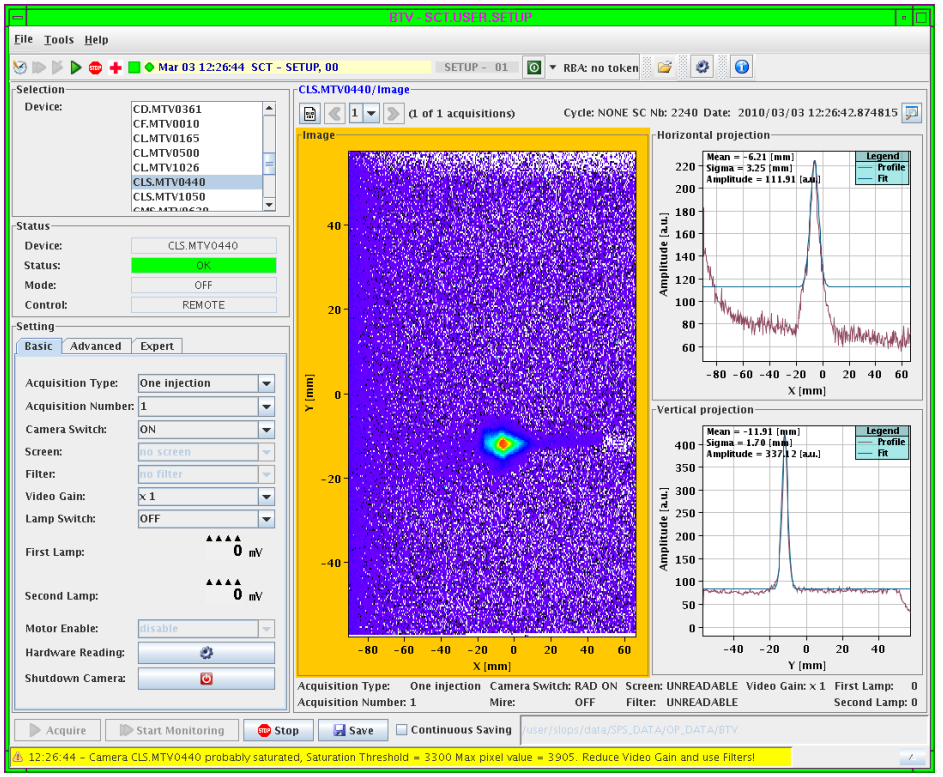
(2) OTR screen for spectrometry with high spatial resolution

(3) OTR screen for emittance measurements using a quad scan technique

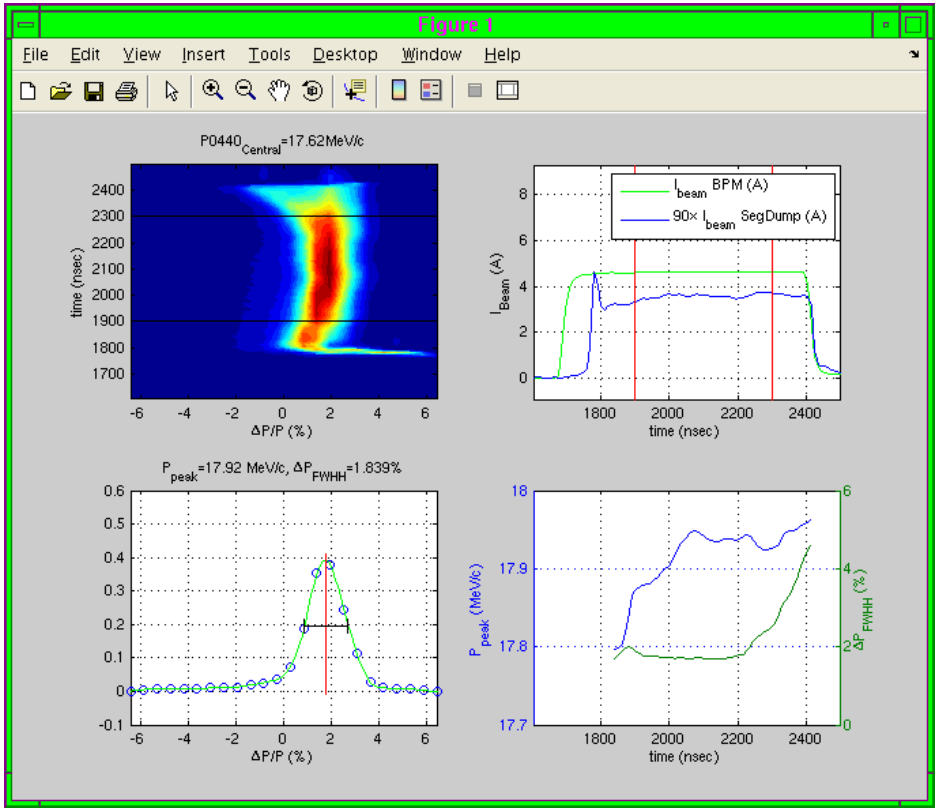


Optical Transition Radiation

- Light is emitted when a charged particle passes through a boundary between two materials of different electric properties.
- The intensity of the light reveals the intensity of the particle beam
- The shape of the light cone reveals the shape of the beam (almost...)



Segmented Beam Dumps



- The principle is a Faraday cup: The particle is stopped in a material and the deposited charge is read as an electrical signal
- From the spatial distribution of the deposited charge the energy distribution of the beam can be reconstructed.
- The method is fast and provides time resolved spectrometry.

Status and Outlook

- OTR screen and optics system for energy measurements is functional
- Vacuum tank with OTR screen and optical line for acquisition under installation
- Design of a new segmented beam dump ready for implementation (mechanical drawings, manufacturing, installation)
- Once all installation work has been completed: start taking data!