ICFA mini-Workshop on “Electromagnetic wake fields and impedances in particle accelerators”

- Chairmen: V. Vaccaro (Naples) and E. Métral
- 52 participants

https://indico.cern.ch/event/287930/

ICFA mini-Workshop on “Electromagnetic wake fields and impedances in particle accelerators” to be held in Erice, Sicily, in 2014 from April 24th to April 28th. The Workshop will be hosted by “ETTORE MAJORANA FOUNDATION AND CENTRE FOR SCIENTIFIC CULTURE”.

Overview
Motivation
Scientific programme and timeline
International Advisory Committee (IAC)
List of items to be discussed
Contacts
List of participants
Timetable
Erice - Get there
Excursions
Application form
Application Form
Flyer
Picture of the workshop

Support

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Wednesday 23/04/2014: Arrival
21:00 - 23:00: Get-Together-Party

Thursday 24/04/2014:
Session 1: Impedance theory and related effects
Session 2: Impedance numerical simulations
Session 3: Impedance bench and beam-based measurement

Friday 25/04/2014:
Session 4: Extensions of the impedance concept
Session 5: Impedance challenges for new projects
Session 6: Building the impedance model of a machine
Banquet in the evening

Saturday 26/04/2014:
Session 7: Space charge and resistive-wall impedances
Session 8: Geometrical impedance
Session 9: Impedance of diagnostics structures
Poster session at the end of the afternoon

Sunday 27/04/2014: Full-day excursion

Monday 28/04/2014:
Session 10: Impedance of collimators and kickers
Session 11: Summaries

Tuesday 29/04/2014: Departure
(“Known => For instance in Chao’s book”) 1st introduction of the impedance concept for particle accelerators => A. Sessler and V. Vaccaro (1967)

\[ U = Z I \]

Ohm’s law in electricity

\[ Z = - \frac{E_z}{2 \pi R} \]

Longitudinal impedance (frequency domain)
A. Sessler passed away just before the workshop (17/04/2014)

[Link to obituary]

...There was another paper in 1966...which could not be known...

Distribution: (closed) AR and ISR Scientific Staff.

1. Generalities

We assume that the electrical action on an ion beam, of a discontinuity in a tank is that of an impedance. We still consider the

\[ E_d = -\frac{Z I}{d}, \]

where \( d \) is the magnitude of the discontinuity, and \( Z \) is the impedance of the discontinuity.

REFERENCES

1) Y.K. Heil and A.H. Sessler
   Longitudinal Resistive Instabilities of Intense Coasting Beams in Particle Accelerator

2) I.H. Sessler and V.G. Vecce
   Longitudinal Instabilities of Axially Uniform Beams in Circular Vacuum Chambers of Arbitrary Electrical Properties
   (in preparation).
Wake field (wake function) = concept in space / time domain (came few years later => 1969)

=> The 2 are linked by Fourier transforms
2 fundamental approximations behind the “conventional impedances / wakes”

- Rigid-beam approximation => $z = s_{\text{witness}} - s_{\text{source}} = \text{Constant}$

- Impulse approximation => $
\nu \Delta p = \int_0^L F \, ds$

Several properties

- No wake in front for $\beta = 1$
- Etc.
- Sessler-Vaccaro formalism works very well for longitudinal impedance

\[ \int_{0}^{L} F_l \, ds = - e^2 W_l (z) \]

- Transverse case is more complicated

  - Conventional definition
    \[ \int_{0}^{L} F_r \, ds = - e^2 r_{source} W_r (z) \]

  - ... but several terms need to be added to correctly describe the beam dynamics
    \[ \int_{0}^{L} F_r \, ds = - e^2 r_{source} W_r (z) - e^2 r'_{source} A_r (z) - e^2 r_{witness} D_r (z) + ... \]

- Driving (or dipolar) wake
- Angular wake => Fast damping in VEPP-2 and BEP
- Detuning (or quadrupolar) wake => Effect on tune shift, TMCI, etc.
Importance of the detuning (quadrupolar) impedance

G. Rumolo et al.