



BIW 2012

Highlights & History

Hosted by
Jefferson Lab
Kevin Jordan, Program Chair



Where was it?

- Central East Coast, USA
- Newport News, Virginia
 - Hosted by Jefferson Lab
- Venue
 - Marriott City Center
- Banquet
 - Virginia Living Museum





Thanks to You!

BIW12

- 134 attendees from 27 countries
 - 2 Tutorials
 - 11 Invited talks
 - 19 Contributed talks
 - 69 posters
- 50 institutions represented from 14 countries
- 17 vendors + 3 sponsors
- Proceeding published on JACoW
 - Preliminary proceedings available at:
<http://www.jlab.org/conferences/biw12/>

Origins of BIW

The Beam Instrumentation Workshop (BIW) was started to provide a forum for in depth discussions of techniques for measuring charged particle beams produced in high energy accelerators. The large US and European Particle Accelerator Conferences dedicated a few sessions to instrumentation, making it difficult to have significant interaction among those in the field. It became apparent to Dick Witkover at BNL that a conference or workshop dedicated to instrumentation was needed.

After meetings with representatives from the other National Labs across the US the first Accelerator Instrumentation Workshop was held at Brookhaven National Laboratory in 1989.

Total of 15 BIW Meetings

- 1989 BNL; Co-Chairs Gerry Bennett, Richard Witkover, Ed Beadle
- 1990 FNAL; Elliot McCrory
- 1991 CEBAF (JLab); Walter Barry
- 1992 LBNL; Co-chairs Jim Hinkson, Greg Stover
- 1993 LANL; Co-chairs Robert Shafer, Mike Plum
- 1994 TRIUMF; Co-chairs George Mackenzie, Bill Rawnsley
- 1996 APS-ANL; Alex Lumpkin
- 1998 SSRL/SLAC; Co-chairs Robert Hettel, Steve Smith
- 2000 MIT-Bates; Co-chairs Ken Jacobs, Coles Sibley
- 2002 BNL; Co-chairs Gary A. Smith, Thomas Russo
- 2004 ORNL/SNS; Co-chairs Tom Shea, Coles Sibley
- 2006 FNAL; Co-chairs Jim Zagel, Robert Webber
- 2008 LBNL; Co-chairs Fernando Sannibale, Walter Barry
- 2010 LANCE/LANL; J. Doug Gilpatrick
- 2012 Jefferson Lab; Kevin Jordan



BIW12

There was food...



BIW12

And Drink...



Enthusiastic Vendors



Please thank our vendors they are part of our community
& their support is greatly appreciated!

BIW12

Plenty of Time for Good Interactions!



Posters Were Up Entire Conference

BIW12

- Venue large enough to have posters, vendors & breaks in common area
 - No need for ‘Poster Police’
- ‘Refreshments’ & food followed poster sessions promoting extended discussions into the evening
- Generous vendor support enabled this!

BIW 2012 draft agenda: 2 Tutorials, 11 Invited, 19 contributed, and 2 poster sessions (March 28, 2012)					
Time	Themes of the day:	New results & Faraday Cup	Optical measurements & Synchronization realization	IPMs, data processing, DPPS techniques	Longitudinal properties & Beam Losses
7:00	Sunday 08:00	Wanda Simek Gordon Smith, UK Opening remarks by chair	600 MHz Laser system Synchronization	IPMs Data processing DPPS techniques	Conference Goals 08:00 - 10:00
8:00		Mike Tschirhart Jeff 12 Self Diagnostic Challenge 30 - 70 nm	Cyrille Thomas, CERN As a fully functional camera with a large acceptance aperture	Daniel Mark O'Connor, BNL Concurrent electron cooling First of its kind, integrated with beam transport	Open Beam Beam Test of TEC 10:00 - 12:00
9:00		Invited talk 1 Mike Tschirhart Jeff 12 Self Diagnostic Challenge 30 - 70 nm	Tutorial #1 Neutron Measurement Sukhwinder Singh Balwani Sukhwinder Singh Balwani Balwani Balwani	Invited talk #2 Herman Klapwijk DPPS implementation of the current algorithms	Stephen Westfall Fast Beam Profile Monitoring with the Implementation of Correlation on GPUs 12:00 - 14:00
10:00		Invited talk #3 Faraday Cup Award Talk 30 - 70 nm	Invited talk #4 Discussions & Questions	Invited talk #5 Discussions & Questions	Invited talk #6 Herman Klapwijk Implementation of Correlation on GPU 14:00 - 15:00
11:00			Coffee Break	Coffee Break	Coffee Break
12:00			Invited talk #6 Kanadei Saito Photon Beam Diagnostics for ATLAS, XENON 30 - 70 nm	Invited talk #7 Anne Pfeiffer Electron 300 MeV 30 - 70 nm	Peter Knutson, SLAC Anisotropy Beam Diagnostics and Beam Position Monitors for an Electron Linear Collider Study 15:00 - 16:00
13:00			Invited talk #8 Alessio Cipolletta Imaging systems & considerations of issues 30 - 70 nm	Invited talk #9 Wei Xianzhe Present 3D Beam Energy Losses 30 - 70 nm	Marco Riccioli, INFN Gauge length characterization of stored beam profiles/fields 16:00 - 17:00
14:00			Invited talk #10 Michael Wiedner Status of the Multi-Layered Beam Position Monitor for the Future Electron-Ion Collider Discussions & Questions	Invited talk #11 Discussions & Questions	Stephen L. Krane, BNL Characterization of Beam Position Monitors 17:00 - 18:00
15:00					30 Minutes for IBCD, RIC & SIS14 Announcements and Closing Remarks 18:00 - 19:00
16:00					Discussions & Questions 19:00 - 20:00
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Student Fellowships

BIW 2012 was able to support 5 student fellowships



Renuka Krishnakumar
Technische Universität Darmstadt



Martin Espig & Christian Eckardt (unable to attend)
Technische Universität Darmstadt



Auralee Morin
Colorado State University



Ling-Ying Lin
Michigan State University

Tutorials

These are a key part of the IBIC series
Perhaps combine all on BIGnet?

- Synchrotron Radiation Monitor; Special Topics
 - Toshi Mitsuhashi
- FPGA Based Digital Signal Processing – Applications & Techniques
 - Nathan Eddy

2012 Faraday Cup Award Winner Marek Gasior (CERN)

BIW12

**Direct Diode Detection (3D);
High sensitivity tune measurements**

AN INSTRUMENT NOT JUST A MEASUREMENT!

Next Faraday Cup Award is 2014

www.faraday-cup.com



**FARADAY CUP
2012**

Beam Diagnostic Instrument:
A device to measure the properties of charged elementary particle, atomic or simple molecular beams during or after acceleration, or the properties of neutral particle beams produced in an intermediate stage of charged particle acceleration. The device may operate by detecting secondary beams of charged, neutral, massive or mass loss particles. But its purpose should be to diagnose the primary charged particle beam. The mass of primary beam particles shall be no greater than the order of 1000 atomic mass units.

Delivered Performance:
The performance of the device should have been evaluated using a charged particle beam, rather than in a "bench top" demonstration.

Publication:
A description of the device, its operating principle, and its performance should have been published in a journal or in the proceedings of a conference or workshop that is in the public domain. Laboratory design notes, internal technical notes, etc., do not qualify but may be submitted to support other publications. Full and open disclosure is necessary to the extent that a potential user could design a similar device. More than one article may be submitted (together) to satisfy this requirement; for example, an article describing the principle plus another article describing the performance.

Eligibility
Nominations are open to candidates of any nationality for work done at any geographical location. There are no restrictions for candidates, with the only exception that they cannot be members in charge of the BIW Program Committee. In the event of deciding between works of similar quality, preference will be given to candidates in an early stage of their beam instrumentation career. The award may be shared between persons contributing to the same accomplishment. Once accepted by the Award Committee a nomination shall remain eligible for two successive competitions unless withdrawn by a candidate.

Disclosure:
The Award Committee may release the names of entrants and a list of publications related to an entry if requested by a third party. Unpublished supporting material will not be disclosed nor will the names of persons supporting a nomination. Discussion regarding individual entries, scoring, etc., is regarded as confidential and will not be disclosed.

Nominations:
The nomination package shall include the name of the candidate, relevant publications, a statement outlining his/her personal contribution and that of others, letters from two professional accelerator physicist, engineers or laboratory administrative personnel who are familiar with the device and its development.

Winner selection criteria and rules, submission rules and deadline for submission are published on www.faraday-cup.com

Innovative Beam Instrumentation Award
Sponsored by Bergoz Instrumentation

A cartoon illustration of a man with a wide, toothy grin, wearing a brown jacket and white pants. He is holding a large, ornate sword in each hand, pointing it upwards. The background is yellow with some decorative patterns.

Please review his talk at:

<http://mgasior.web.cern.ch/mgasior/pro/BBQ/index.html>

High Sensitivity Tune Measurement using Direct Diode Detection

2012 Faraday Cup Talk

Marek Gasior

Beam Instrumentation Group, CERN

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High Sensitivity Tune Measurement using Direct Diode Detection

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Outline:

- Basics of tune measurement
- Challenges of the LHC tune measurement
- History of the development
- Principles of the direct diode detection (3D)
- Measurement examples
- Other development triggered by the diode detection project

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High Sensitivity Tune Measurement using Direct Diode Detection

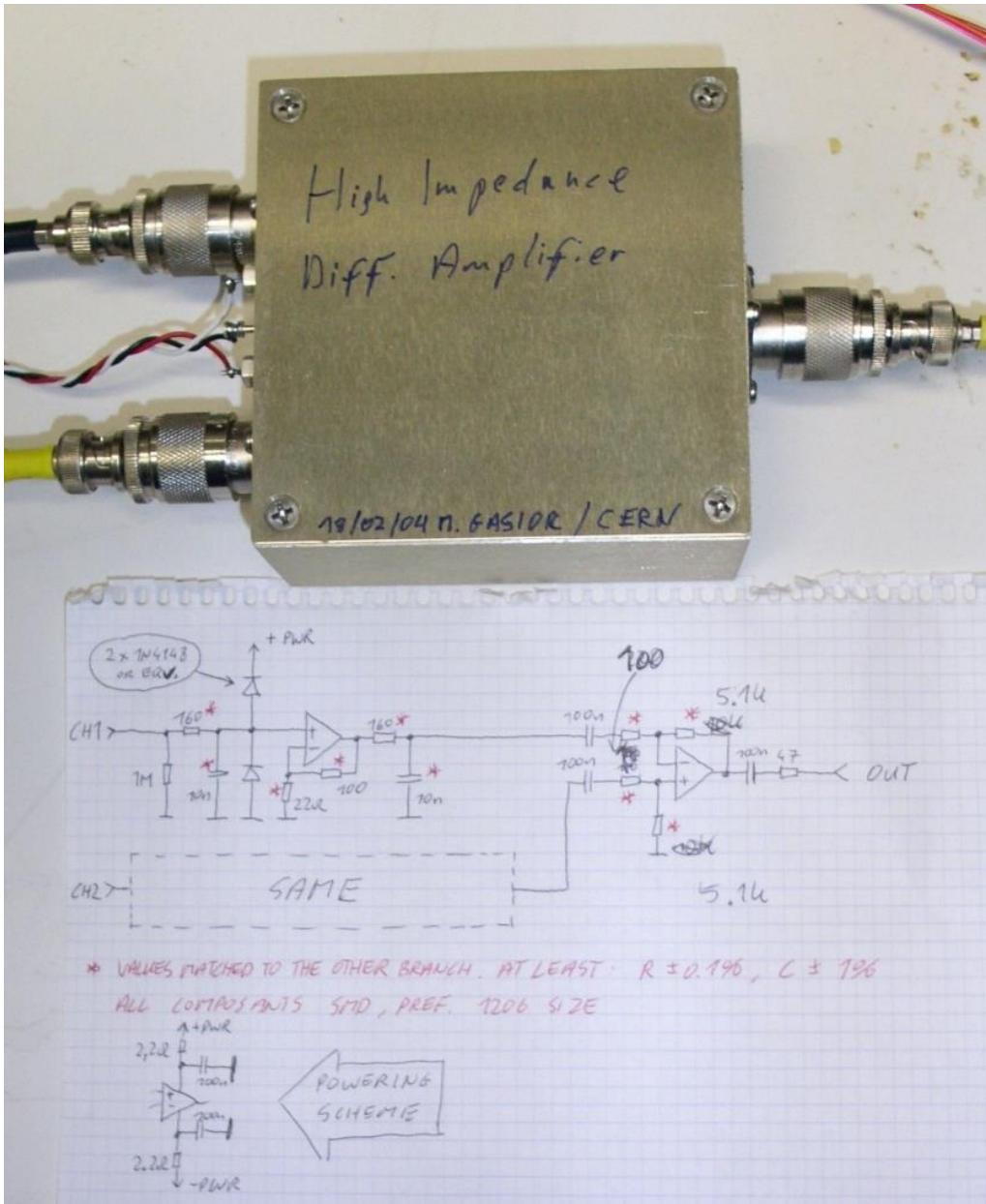
2012 Faraday Cup Talk

Marek Gasior

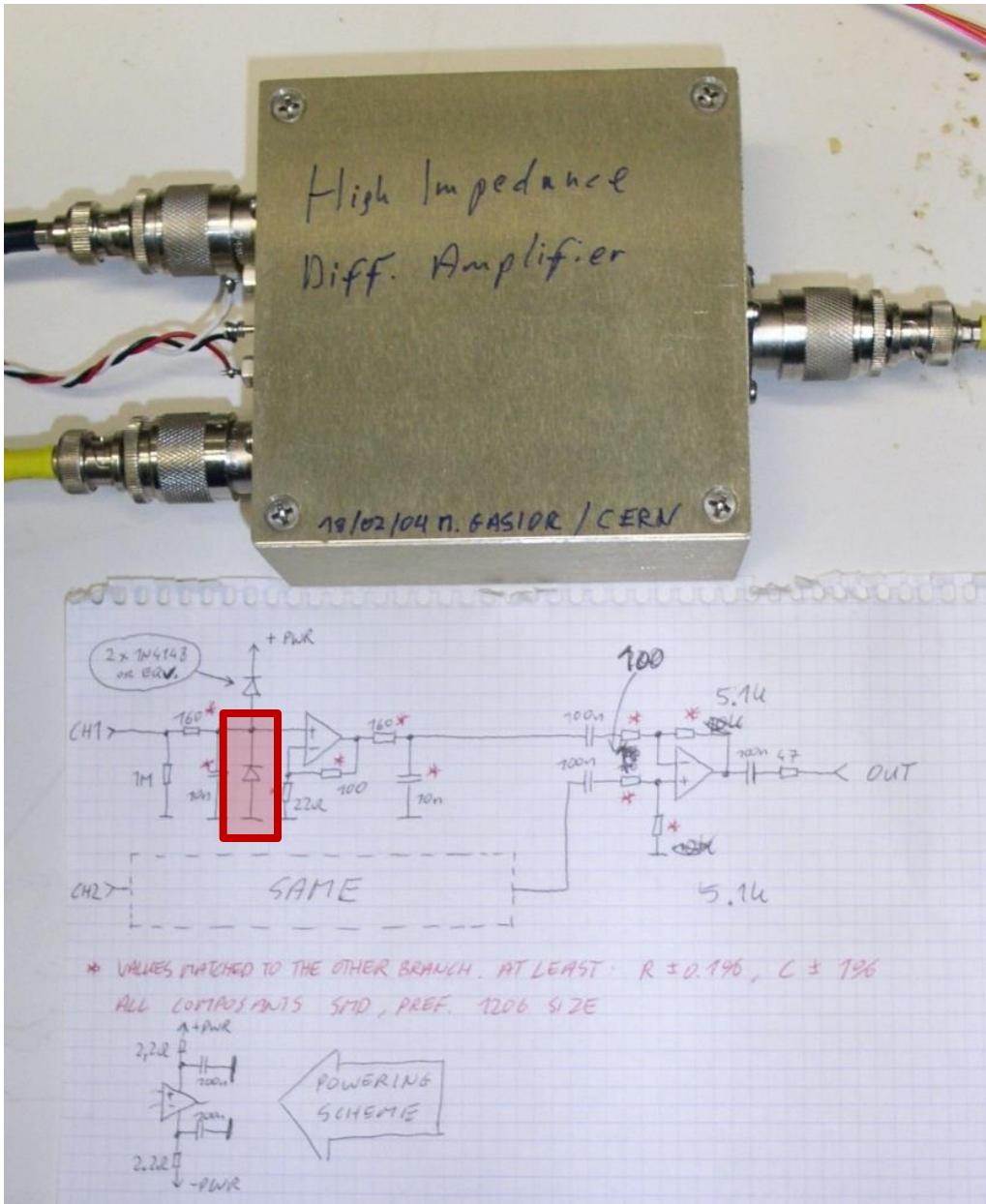
Beam Instrumentation Group, CERN

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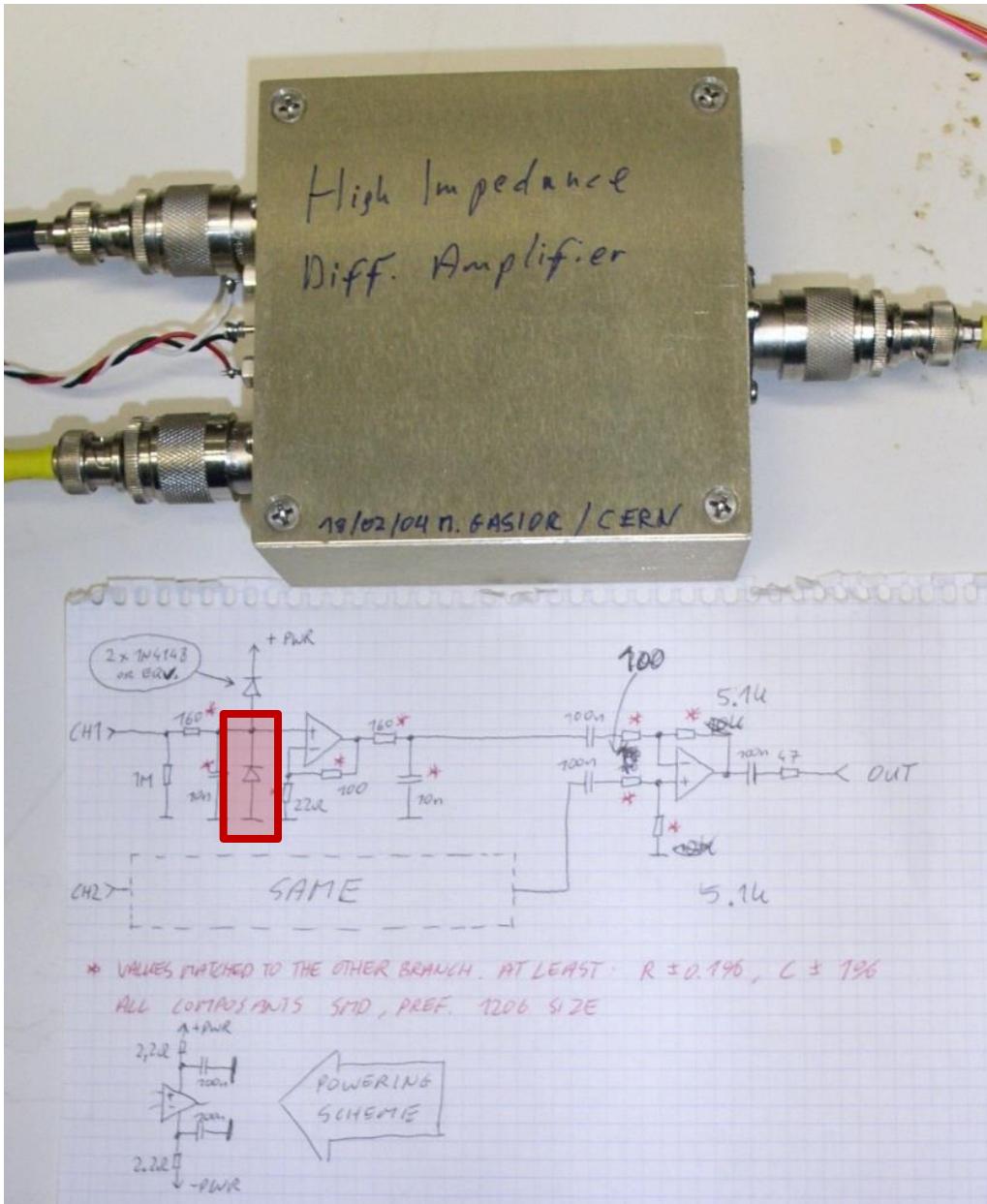
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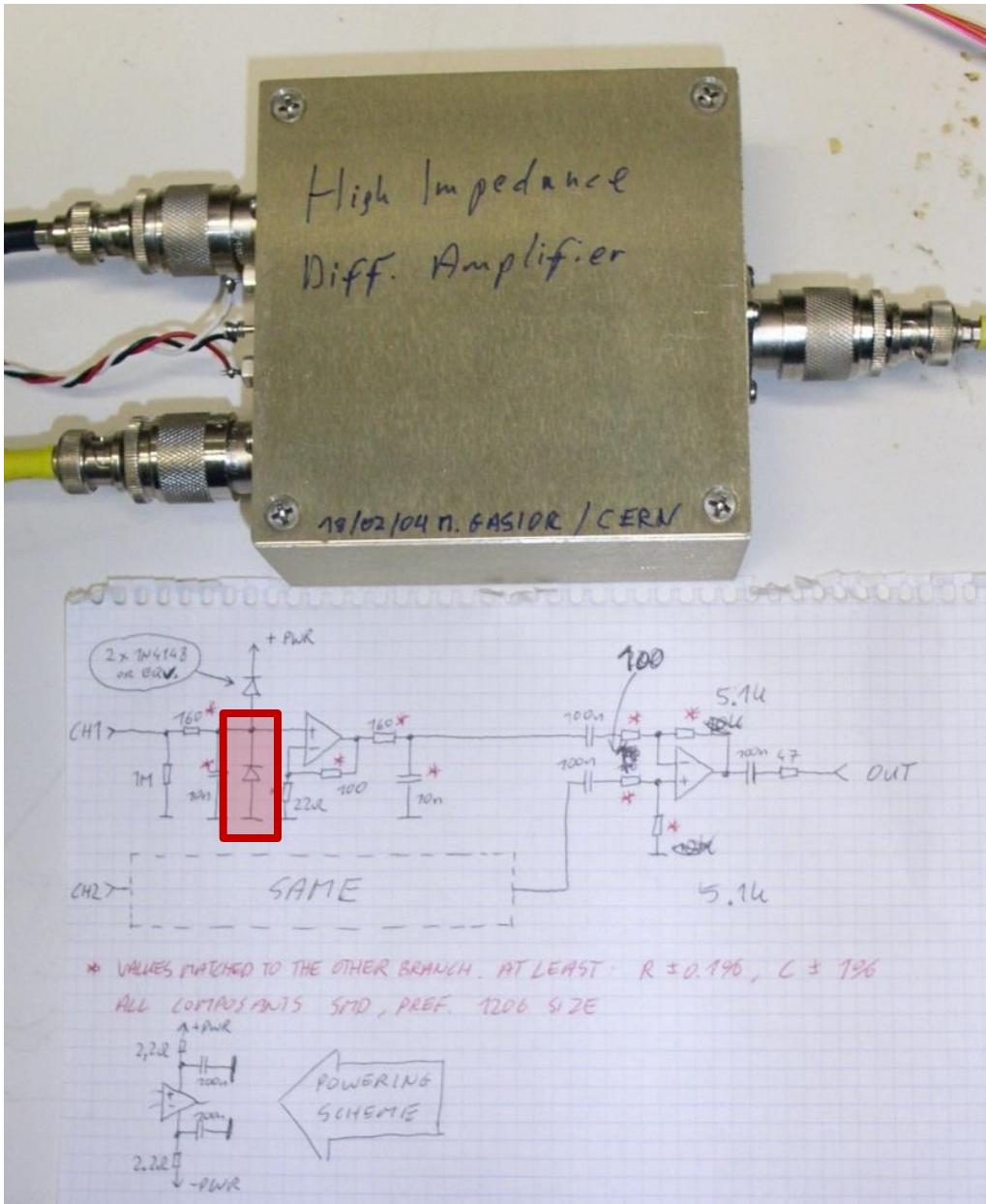
- On the input of the RHIC high impedance amplifier there were protecting diodes, connecting the input to the power supplies.
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- This error on the schematic triggered thinking about diode detectors.

- Reactions of the colleagues for the idea of measuring the tunes using diode detectors fitted generally between this two extreme ones:

- "Great idea, should work!"
- "Come on, too simple... If it worked, it would have been used before".

Diode detectors – old good stuff, but ...

BEAM DYNAMICS EXPERIMENTS AT SPEAR*

SLAC-PUB-1452
June 1974

The SPEAR Group†
Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305

Introduction

The single-particle properties of beams in storage rings are well understood, but high density single and colliding beams suffer from a variety of instabilities due to self-forces and interactions with their surroundings. The chief experimental problems in the study of stored beams arise from the difficulty of devising beam-diagnostic probes which do not affect the stored beams or disturb the phenomena being studied, and which give unambiguous results when different phenomena act on the probes simultaneously.

In the SPEAR electron-positron storage ring, we have apparatus and methods for measuring center-of-mass motions of our beams on all three axes, as well as motions with higher moments. The shapes of the beam bunches can also be accurately measured. We will describe the techniques we have used to study instabilities and measure operating characteristics.

Center-Of-Mass Motions

There are directional antennas (striplines) inside the vacuum envelope¹ which detect the electromagnetic field of the whole bunch. When the beam executes betatron oscillations, there is a small amplitude modulation of the signals from the striplines. We detect and measure this modulation to give us information on betatron wave numbers, line strengths and widths.

The wave analyzer has an oscillator which automatically tracks the center of the receiver pass band. By connecting this oscillator to the beam excitation system and sweeping the receiver and exciter simultaneously, we observe directly resonant responses of the beam with freedom from harmonic or intermodulation responses. (Fig. 1). A similar technique has been used at the Bevatron,² to measure the phase response of the beam.

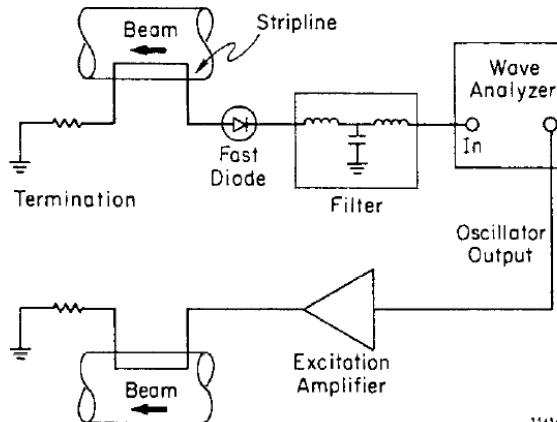


FIG. 1--The system for betatron and synchrotron-frequency response measurement. The oscillator is not used when observing self-excited lines.

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Marek was 14 months old

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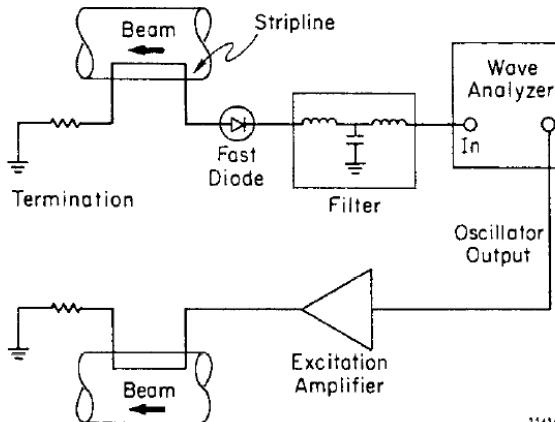


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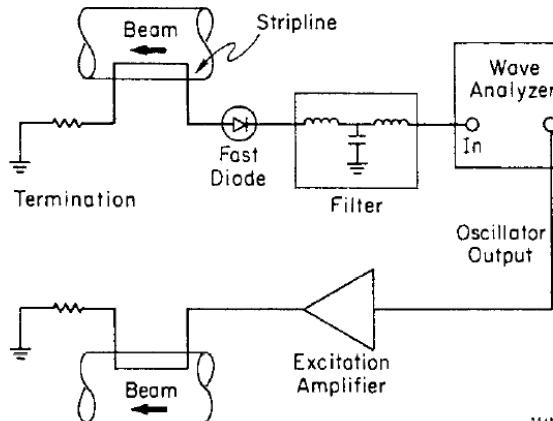


FIG. 1--The system for betatron and synchrotron-frequency response measurement. The oscillator is not used when observing self-excited lines.

- Diode detectors were used in the past, but with relatively low load.
- For a single 1 ns LHC bunch repeating every 89 μs (duty cycle ≈ 10⁻⁵) low impedance load would spoil the idea.
- Load in the order of 10 MΩ was required. The question was how such a detector would behave in the presence of losses.

A short diversion...



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The Free Encyclopedia

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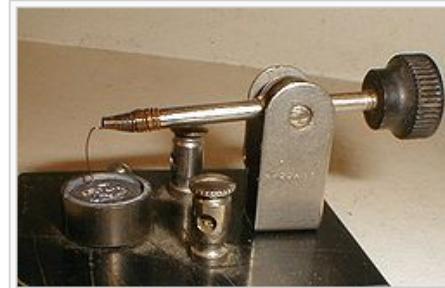


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Cat's-whisker detector

From Wikipedia, the free encyclopedia

A **cat's whisker detector** (sometimes called a **crystal detector**) is an antique **electronic component** consisting of a thin wire that lightly touches a crystal of **semiconducting mineral** (usually **galena**) to make a crude point-contact **rectifier**. Developed by early radio researchers **Jagadish Chandra Bose**, **G. W. Pickard** and others, this device was used as the **detector** in early **crystal radios**, from about 1906 through the **Second World War**. It gave this type of radio receiver its name. It was the first type of **semiconductor diode**, and in fact the first **semiconductor electronic device**. The term cat's whisker was also sometimes used to describe the crystal receiver itself. Cat's whisker detectors are obsolete and are now only used in antique or antique-reproduction radios.



Galena cat's whisker detector

Contents [hide]

- 1 Description
 - 1.1 Crystal
 - 1.2 Whisker
- 2 Types
- 3 History
- 4 See also
- 5 References
- 6 External links

Description

[\[edit\]](#)

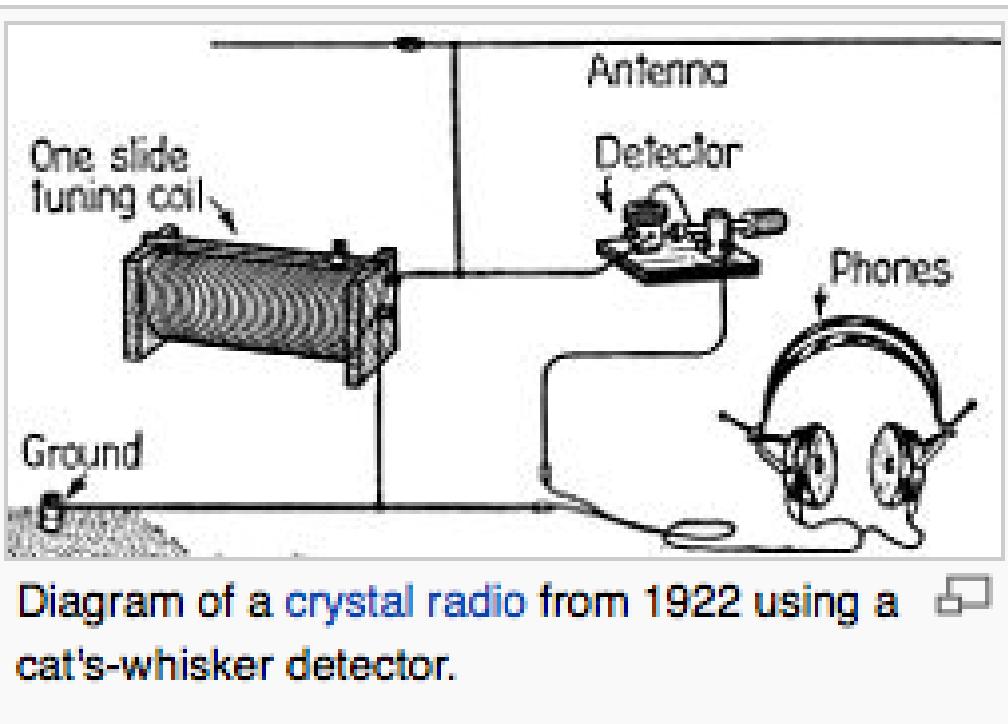


The tip of the wire contacting the surface of the crystal formed a crude and unstable point-contact **metal–semiconductor junction**, forming a **Schottky barrier diode**. This junction conducts **electric current** in only one direction and resists current flowing in the other direction. In a

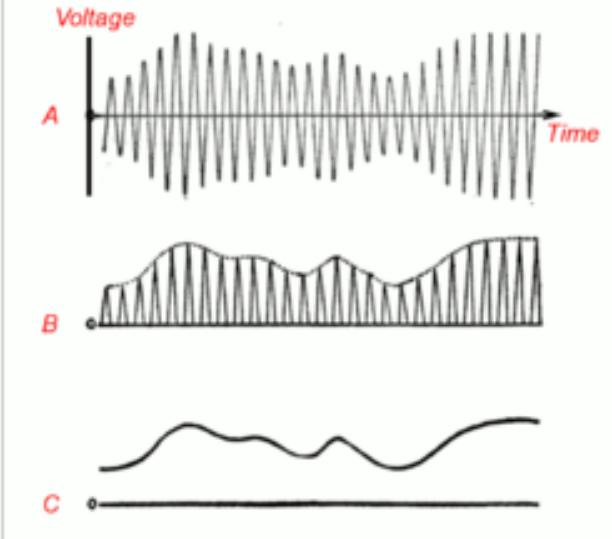


Precision cat's whisker detector using iron pyrite crystal, early 1900s. The crystal is inside the metal capsule under the vertical needle "whisker" (right). The leaf springs and thumbscrew

When was it done?



http://en.wikipedia.org/wiki/Cat%27s-whisker_detector



How a crystal detector works in a radio receiver.^{[5][6]} (A) The amplitude modulated radio signal from the receiver's tuning section. The rapid oscillations are the radio frequency carrier wave. The audio signal (the sound) is contained in the slow variations (modulation) of the size of the waves. This signal cannot be converted to sound by the earphone, because the audio excursions are the same on both sides of the axis, averaging out to zero, resulting in no net motion of the earphone's diaphragm. (B) The crystal conducts current in only one direction, stripping off the oscillations on one side of the signal, leaving a pulsing direct current whose amplitude does not average zero but varies with the audio signal. (C) A bypass capacitor across the earphone smoothes the waveform, removing the radio frequency carrier pulses, leaving the audio signal.

MIT Radiation Laboratory Series available on line

Microwaves pre-dated Hewlett-Packard!

CHAPTER 1 INTRODUCTION

BY E. M. PURCELL

1.1. Microwaves.—The microwave region of the electromagnetic spectrum is commonly taken to include frequencies of 10^9 cycles per second and higher. The upper frequency limit exists only as an active frontier lying, at the time of writing, not far below 10^{11} cycles per second. It is not necessary here to attempt to fix the boundaries more precisely. Instead, it may be asked why it is profitable and proper to single out for special treatment this section of the r-f spectrum. The answer to this

Edward Mills Purcell

(August 30, 1912 – March 7, 1997) was an [American](#) physicist who shared the 1952 [Nobel Prize for Physics](#) for his independent discovery (published 1946) of nuclear magnetic resonance in liquids and in solids. [2]

[Nuclear magnetic resonance \(NMR\)](#) has become widely used to study the [molecular](#) structure of pure materials and the composition of mixtures.

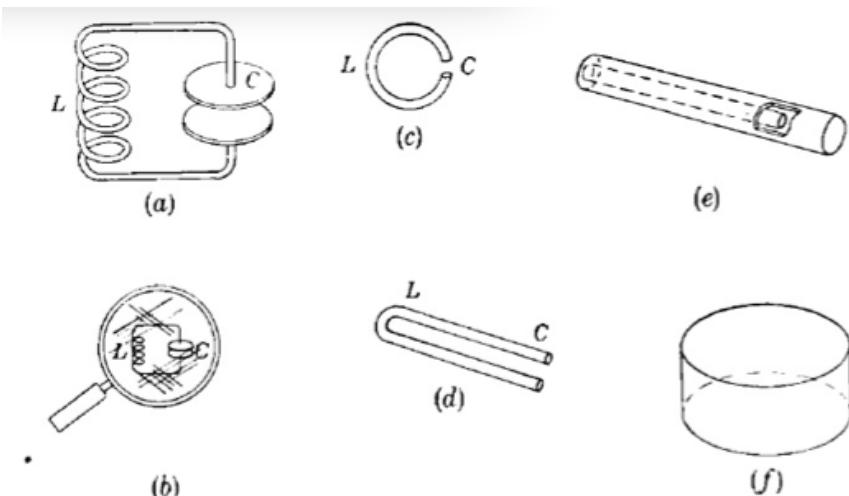
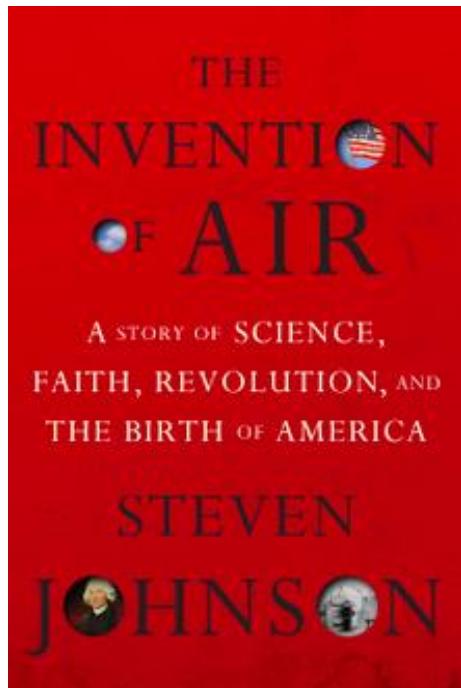
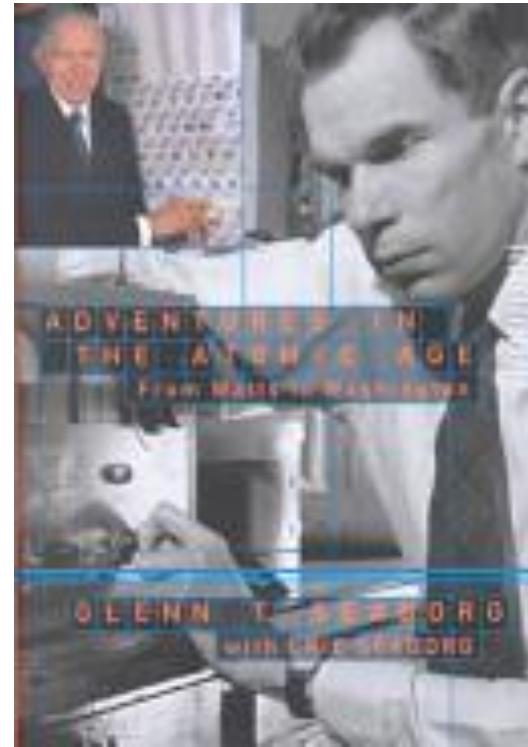


FIG. 1-1.—Resonant circuits at low frequencies and at microwave frequencies.

2 of my favorite books



It is the story of Joseph Priestley—scientist and theologian, protégé of Benjamin Franklin, friend of Thomas Jefferson—an eighteenth-century radical thinker who played pivotal roles in the invention of ecosystem science, the discovery of oxygen...



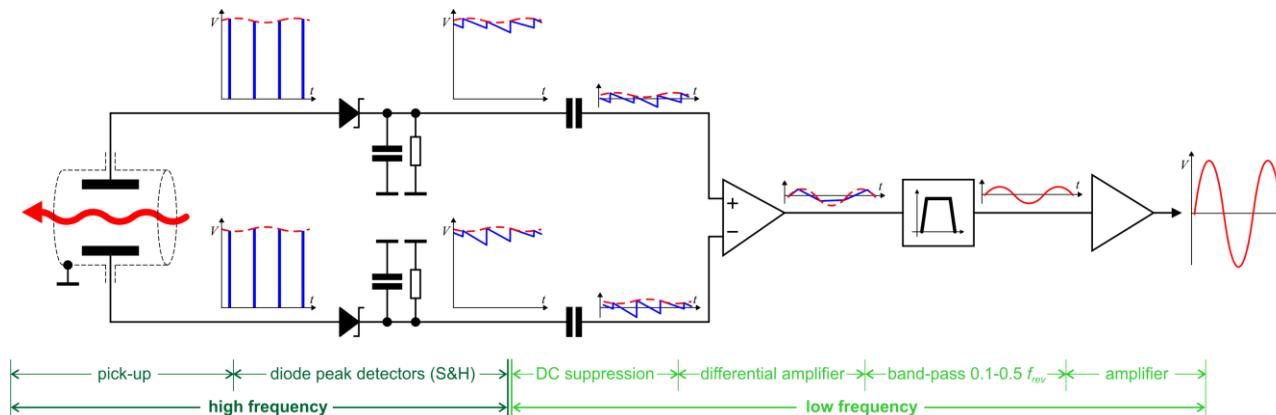
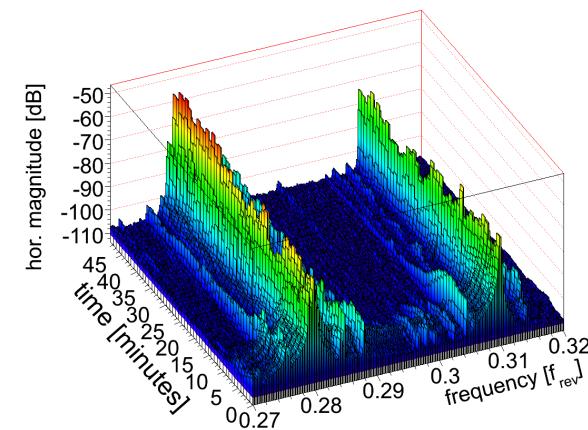
**Adventures in the Atomic Age
From Watts to Washington**

Dr. Glenn Theodore Seaborg was co-recipient of the 1951 Nobel Prize in Chemistry for his transuranium element research. He was a co-discoverer of plutonium and heavier elements through element 102.

Where was I going...

Conclusions

- Cold weather may stimulate fruitful discussions, which in turn can set the direction of a development.
- An error on a hand made schematic can make a breakthrough in a development.
- The key people who made the diode detection project successful and with whom I had/have so much pleasure to work with:
Rhodri Jones, Peter Cameron (BNL), Andrea Boccardi, Ralph Steinhagen.
- Good old ideas should be reviewed to make sure that they cannot be further improved with the recent technology advancement.
- Even with the excellent ADCs that we have today good analogue processing may pay off.
- Diode-based tune measurement works well already on quite a few machines.
- Diode detectors most likely can be used for other applications.
- Marek got a reputation to do everything with diodes:
„When Marek wants to open a bottle the first tool he thinks about is a diode.”
- For the “serious equation part” and references please look into the corresponding paper.
- A few pieces of beam sound can be found at: www.cern.ch/gasior/pro/BBQ/index.html

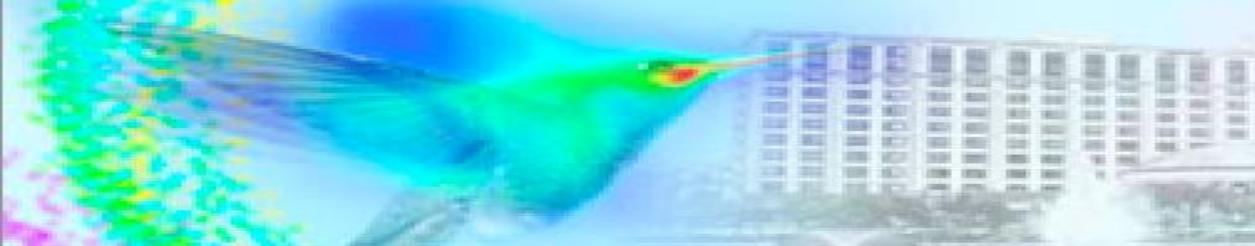


M.Gasior, CERN

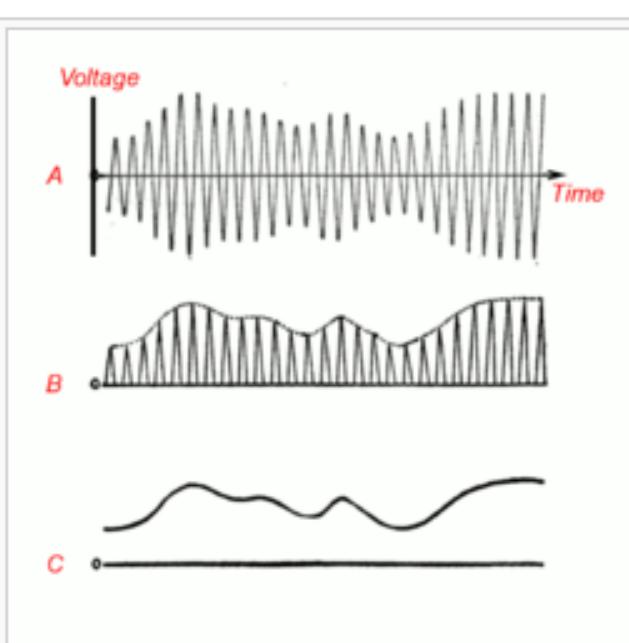
High Sensitivity Tune Measurement using Direct Diode Detection

Diode tune systems

Machine	Lab	max f_{rev} [kHz]
LHC	CERN	11
SPS	CERN	43
PS	CERN	477
PSB	CERN	1800
LEIR	CERN	1440
RHIC	BNL	78
Tevatron	Fermilab	48
SIS18	GSI	1400
CNAO	CNAO	2800
CesrTA	Cornell	390



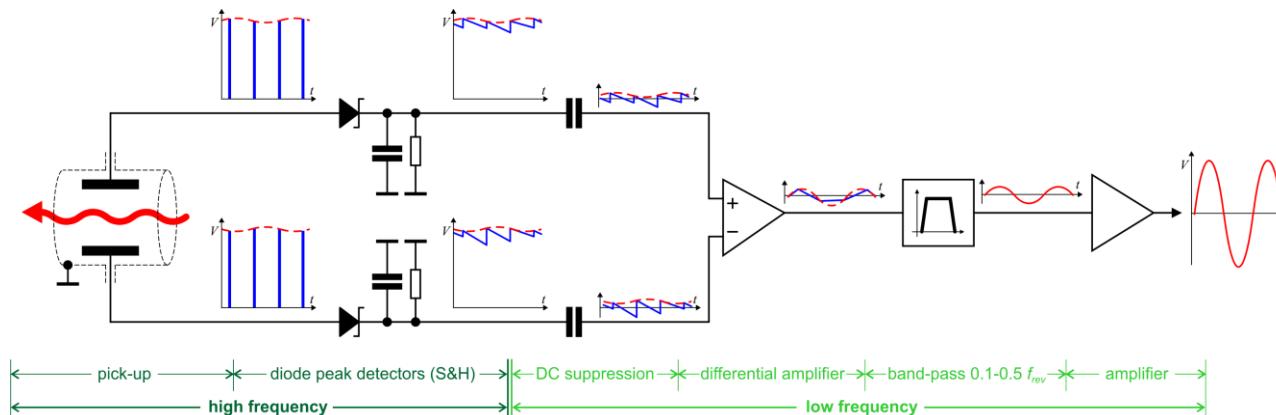
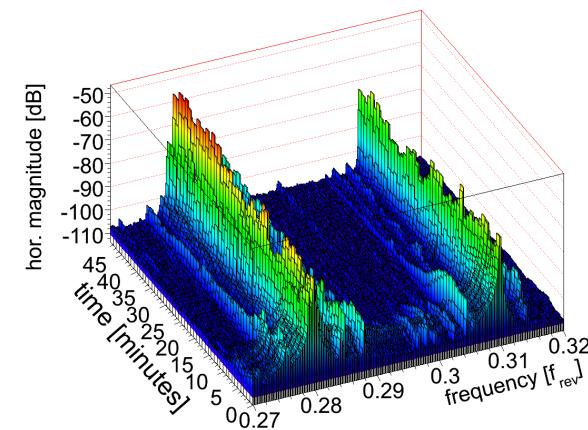
Look familiar?



How a crystal detector works in a radio receiver.^{[5][6]} (A) The amplitude modulated radio signal from the receiver's tuning section. The rapid oscillations are the radio frequency carrier wave. The audio signal (the sound) is contained in the slow variations (modulation) of the size of the waves. This signal cannot be converted to sound by the earphone, because the audio excursions are the same on both sides of the axis, averaging out to zero, resulting in no net motion of the earphone's diaphragm. (B) The crystal conducts current in only one direction, stripping off the oscillations on one side of the signal, leaving a pulsing direct current whose amplitude does not average zero but varies with the audio signal. (C) A bypass capacitor across the earphone smoothes the waveform, removing the radio frequency carrier pulses, leaving the audio signal.

Conclusions

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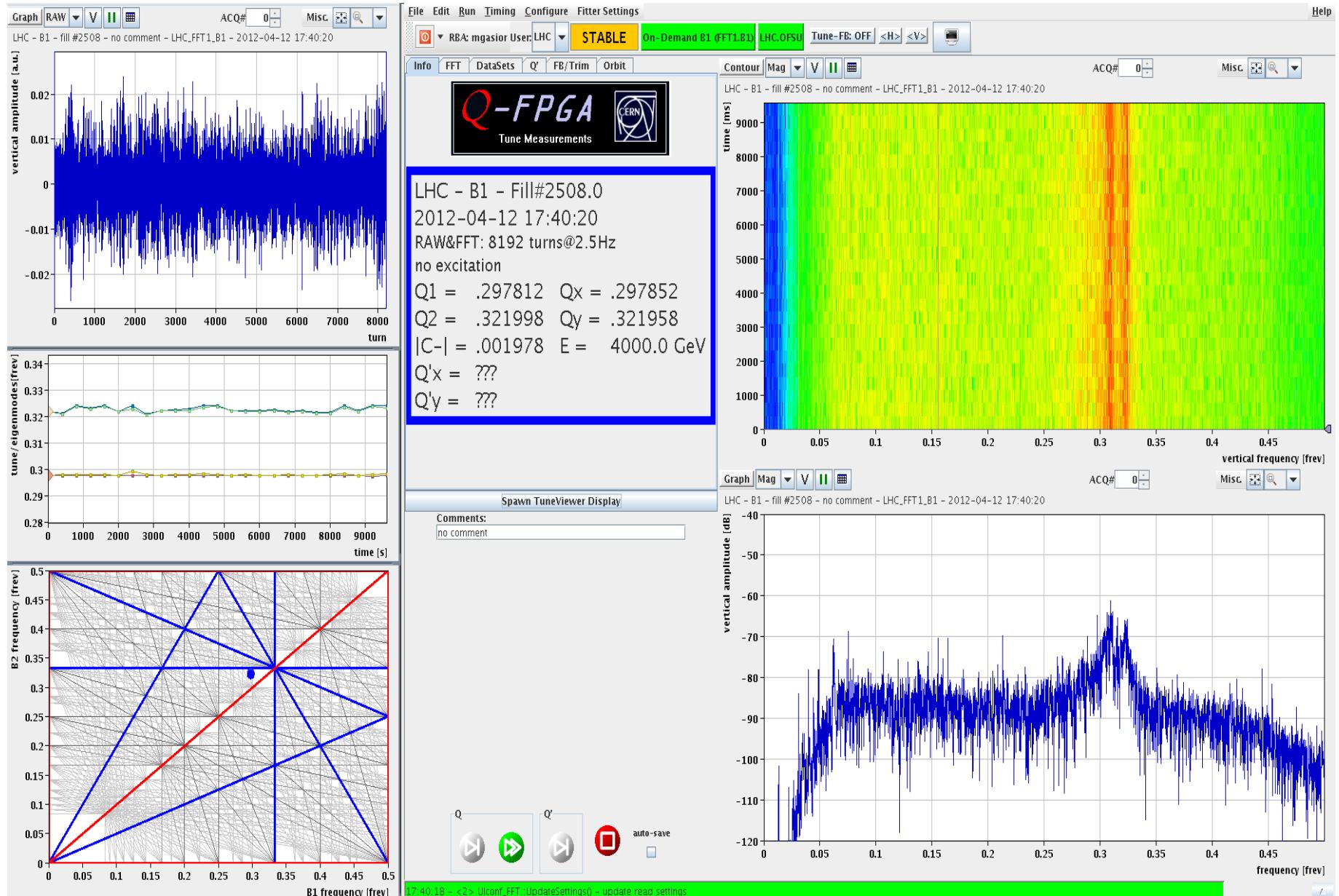
M.Gasior, CERN

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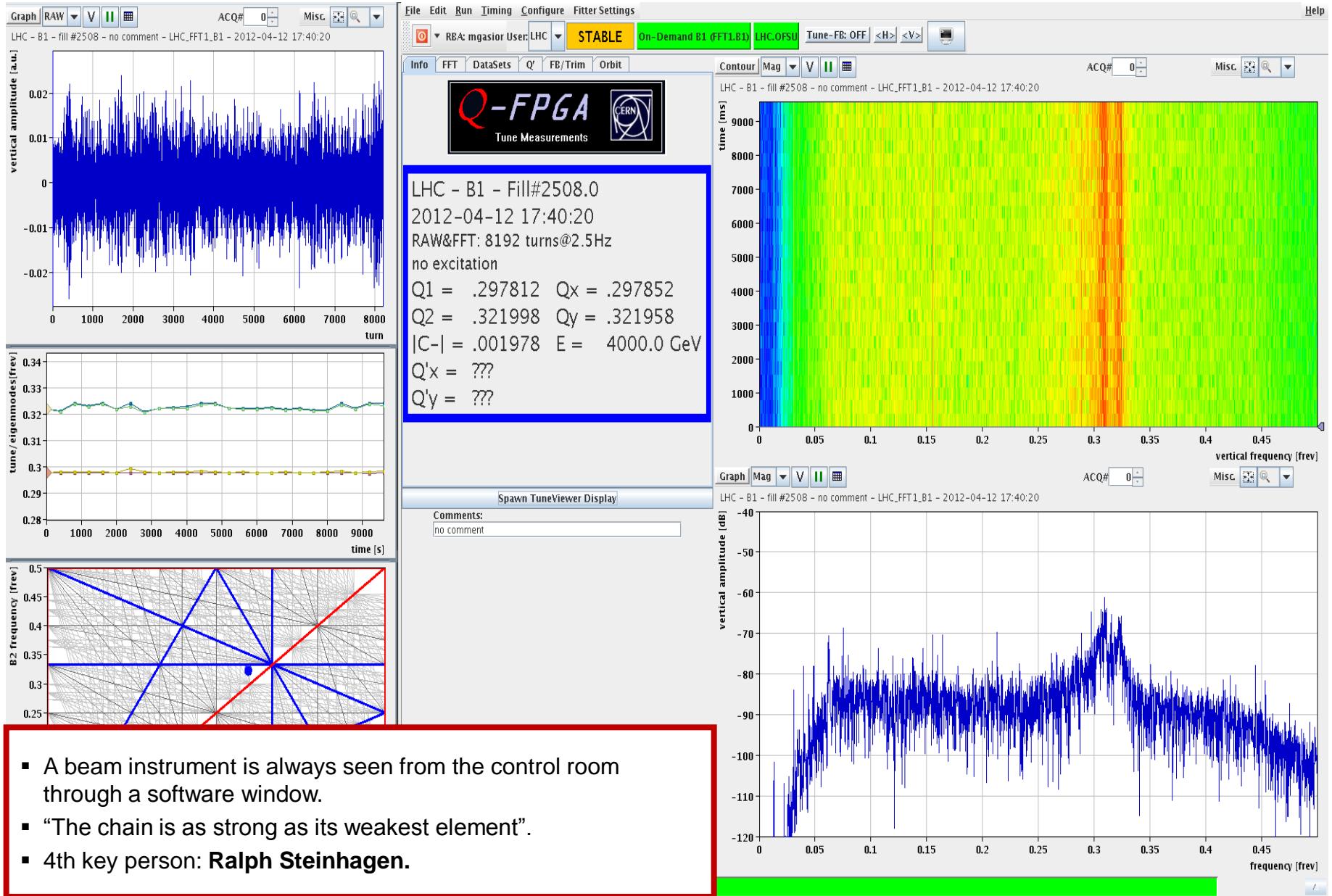
The tune measurement system seen from the control room



M.Gasior, CERN-

High Sensitivity Tune Measurement using Direct Diode Detection

The tune measurement system seen from the control room



- A beam instrument is always seen from the control room through a software window.
- “The chain is as strong as its weakest element”.
- 4th key person: **Ralph Steinhagen**.

Banquet was at
Virginia Living Museum

...more time to interact
with colleagues
&
New Orleans Jazz Band



BIW12





BIW12

Protect What's Precious

General Admission
New Membership Sales

A Family Membership pays
for itself in only two visits
Members receive Museum-wide
discounts, Platinum vouchers

Admission
Museum
Only
Museum &
Planetarium

Adults \$17
Children ages 3-12 \$13
\$17

AAA, Military, Senior Discount w/ID \$1 off.
Family Membership \$85
(Other levels available)







BIW12





BIW12



BIW12

Good Bye BIW!



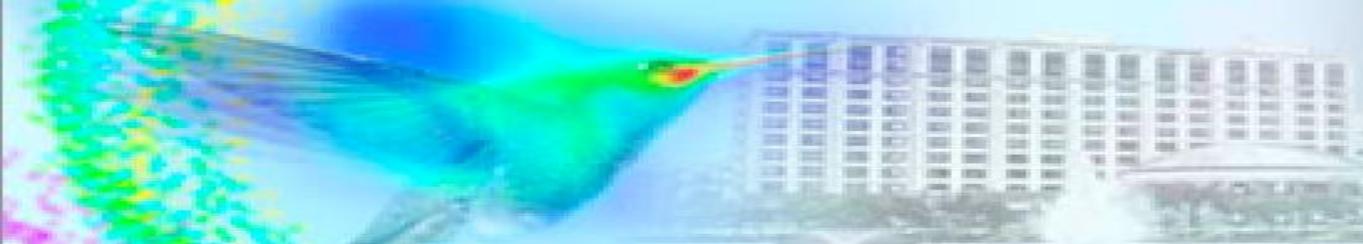
International Beam Instrumentation Conference

IBIC 2014
San Francisco

Fall 2014



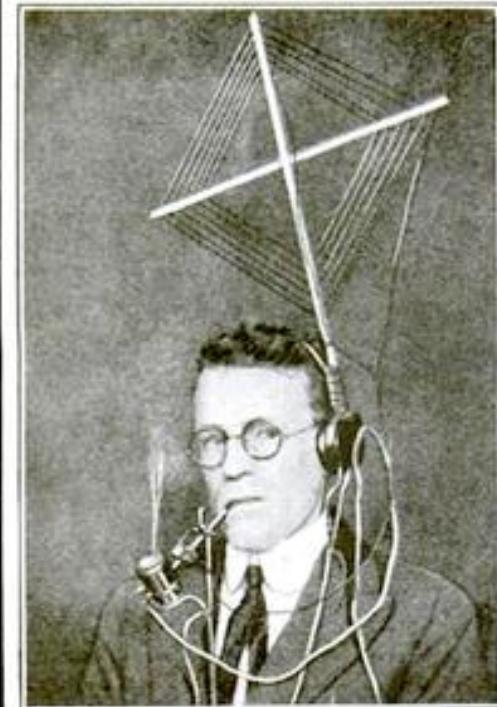
Hello IBIC!



An early portable cat's-whisker radio set with aerial

Thanks for your attention!

Bowl of Corn-Cob Pipe Holds Radio Set



THE most compact radio receiving set that has made its appearance is built on the bowl of a corn-cob pipe. It is the work of F. E. Wilson, of Detroit, who can fill his pipe at the close of day and settle back for a smoke while he tunes in the radio stations that are "in the air."

For an aerial, Mr. Wilson uses a small loop attached to the headband of his 2000-ohm phone. The tuning coil is made of 100 turns of enameled wire—No. 26—wound around the bowl of the pipe. A piece of galena is balanced on the pipe stem, while the catwhisker is arranged to pivot on the stem. This small set has been remarkably successful in picking up concerts within 10 miles of the broadcasting stations.