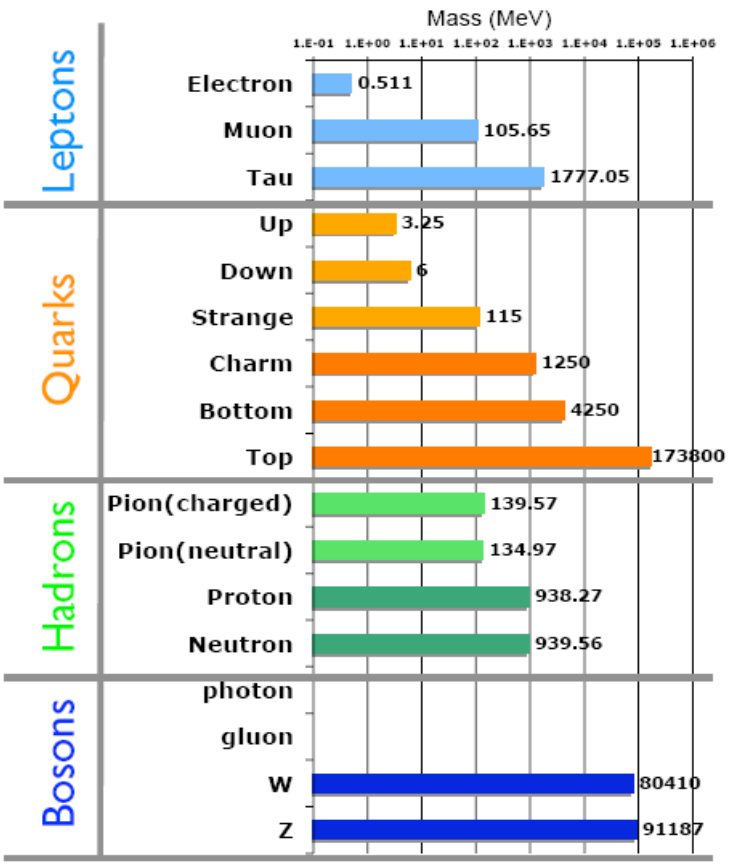
Rolf Wideröe Prize Lecture

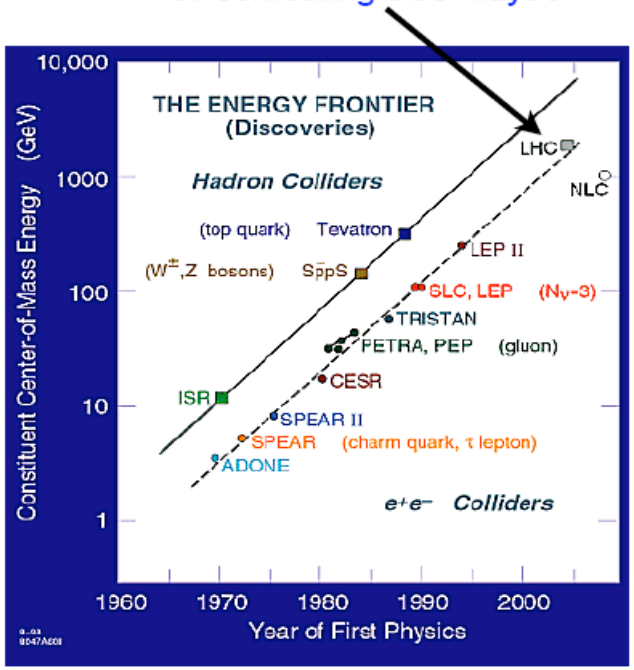
Lyn Evans

IPAC'17 Copenhagen

History/energy line vs discovery



Higgs and super-symmetry ?
Or something else maybe



Behind the history plot is hidden the technological development required for each step

Obs: you can notice different particle species used in the different colliders electron-positrons and hadron colliders (either $\bar{p}$-p as Tevratron, p-p as LHC)

ISR

Van der Meer publishes paper on stochastic betatron cooling of transverse emittance.

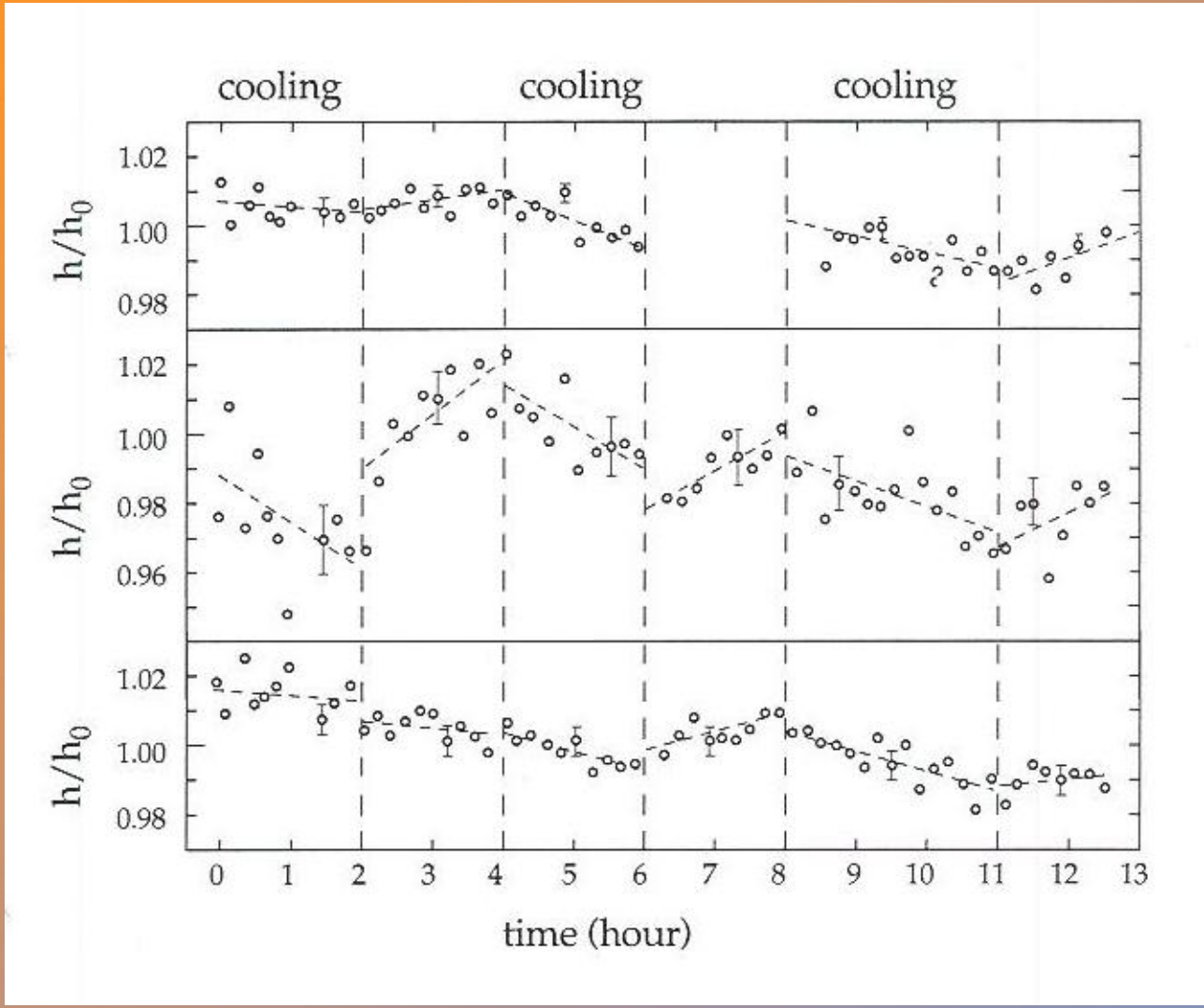
History

1972 Schnell feasibility study of stochastic cooling experiment at the ISR.

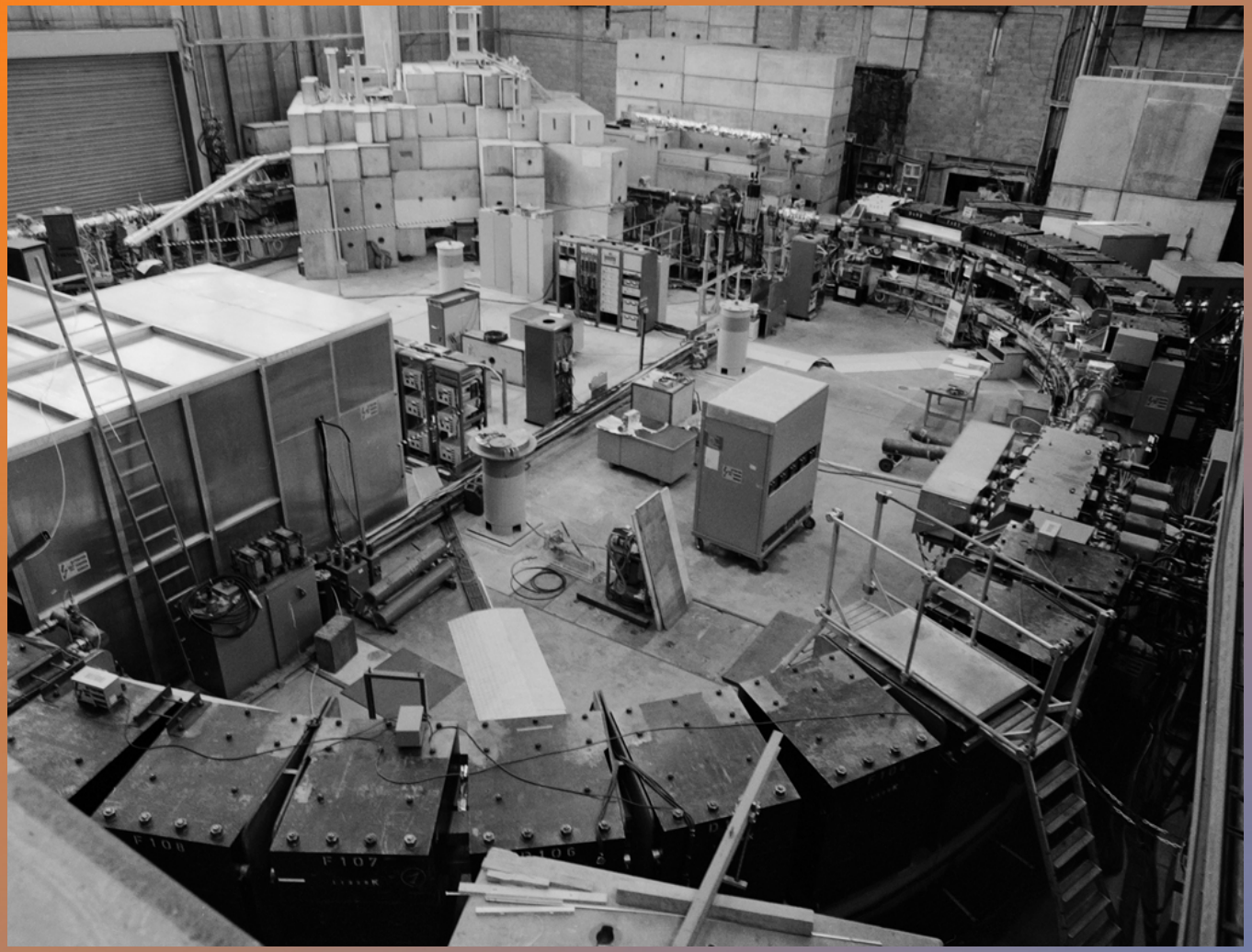
1973 Discovery of weak neutral currents.

1974 First experimental demonstration of stochastic cooling.
Rubbia et al. propose p-pbar colliding beam experiment at the SPS.

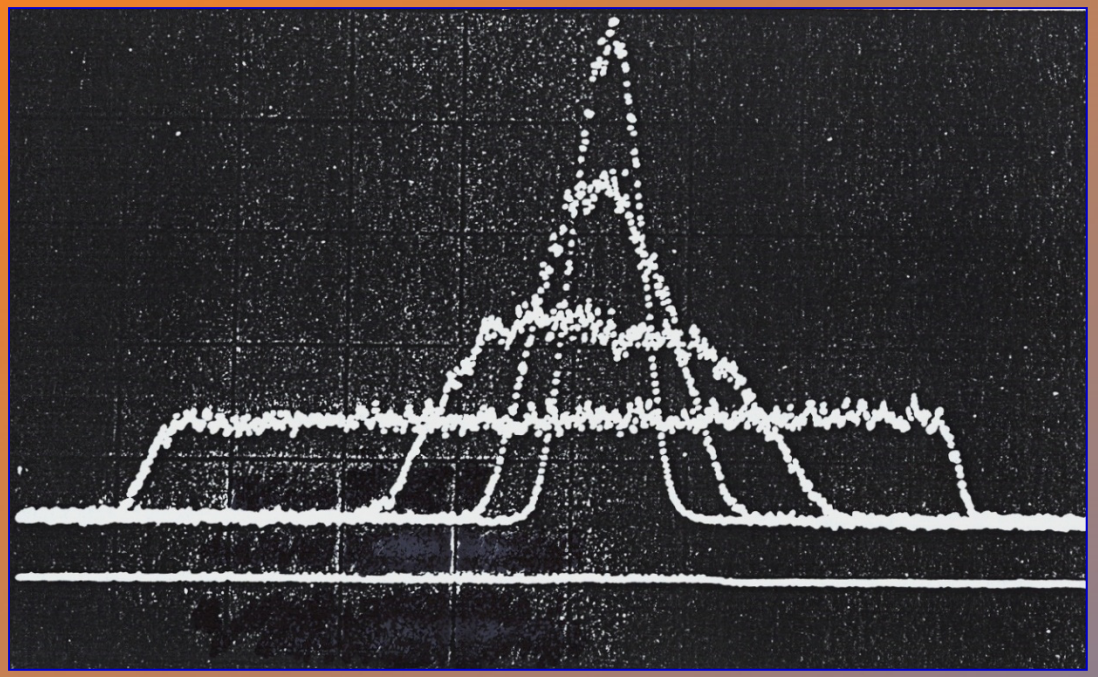
1976 First design report based entirely on electron cooling.
ICE construction started.


cooling
cooling
cooling
h/h0
1.02
1.00
0.98
h/h0
1.02
1.00
0.98
0.96
h/h0
1.02
1.00
0.98
0 1 2 3 4 5 6 7 8 9 10 11 12 13
time (hour)

Initial Cooling Experiment



Momentum Cooling in ICE



Schottky scan after 1, 2 and 4 min.

Signal height proportional to the square root of density and width proportional to Δ p/p.

History

1977 Thorndahl invents filter method of fast momentum cooling.
Theory, Hereward and Sacherer. Thorndahl cooling tested on ICE.
SPS storage experiments started.

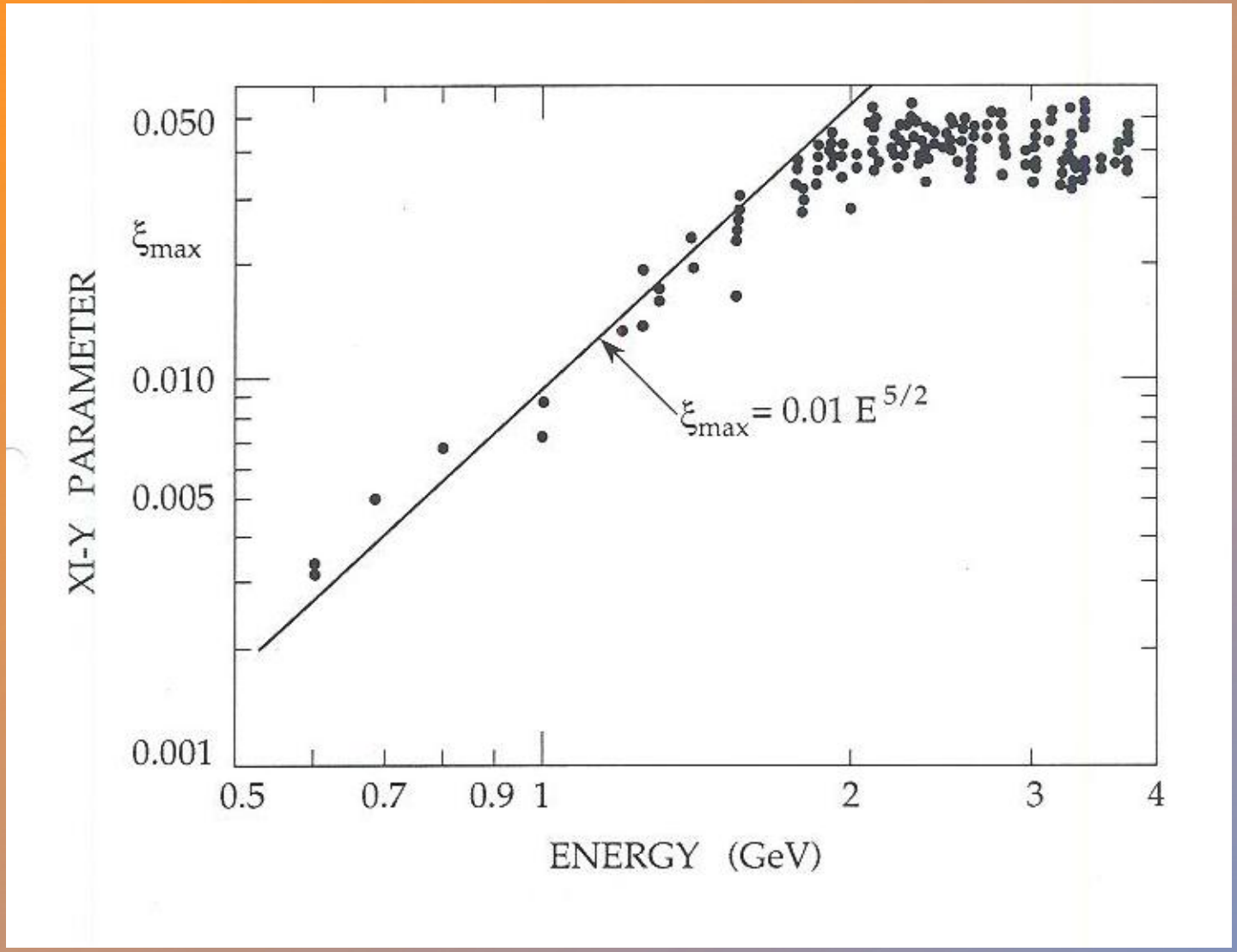
1978 Second design report based entirely on stochastic cooling.
Authorisation of p-pbar project (June 1978).

1980 Start eleven-month shutdown for SPS modifications.
Protons circulating in AA (June).

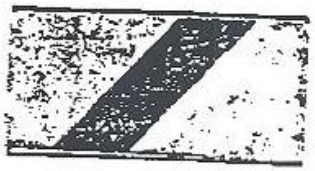
1981 10^{th} July first proton-antiproton collisions in SPS (4 a.m.).
November first technical run (0.2 inverse nanobarns).

1982 First real physics run October – December (28 inverse nanobarns).
Peak luminosity 5 x $10^{28}cm^{-2}s^{-1}$. W found.

1983 January W annoucement
April – July collider run. Luminosity $1.6 10^{29}cm^{-2}s^{-1}$. Z_0 found.


0.050
ξ_{max}
0.010
0.005
0.001
XI-Y PARAMETER
$\xi_{max} = 0.01\ E^{5/2}$
0.5
0.7
0.9
1
2
3
4
ENERGY (GeV)

The control room of the AA

THIS MORNING AT
4.15 AM. 
PROTONS AND ANTIPROTONS
COLLISIONS HAVE BEEN
PRODUCED IN SPS AND
CLEARLY DETECTED IN
THE FORWARD TELESCOPES
OF EXPERIMENT UA1.

What did we learn?

RF noise.
Beam-beam interaction
Intrabeam scattering

Two 300 kW klystrons with circulators and loads

Low level measures to reduce RF noise in the LHC

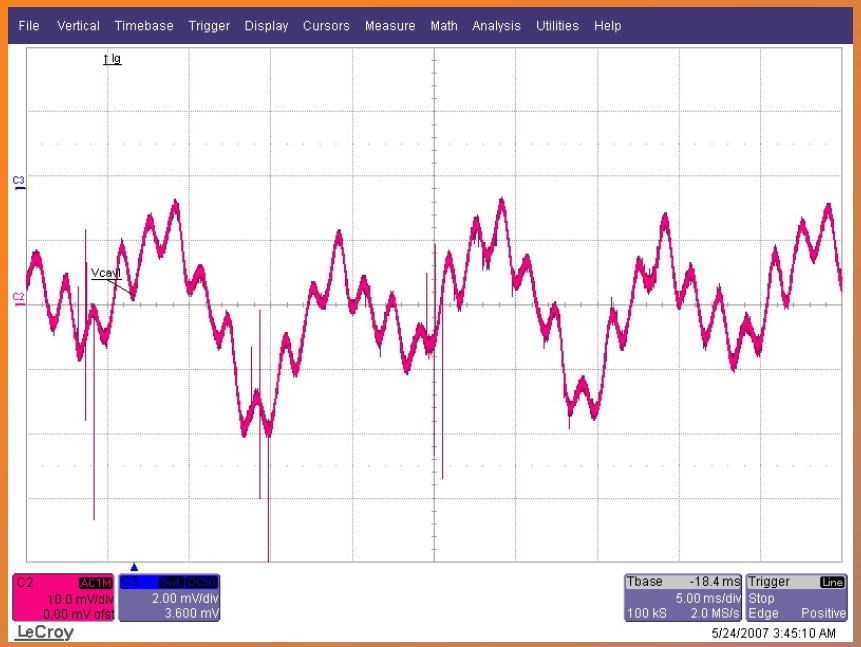


Fig 1: Klystron with no Low Level loop.
Measurement shows phase noise @ 400.8 MHz (10 mV/degree), 5 ms/Div

The klystron Polar Loop

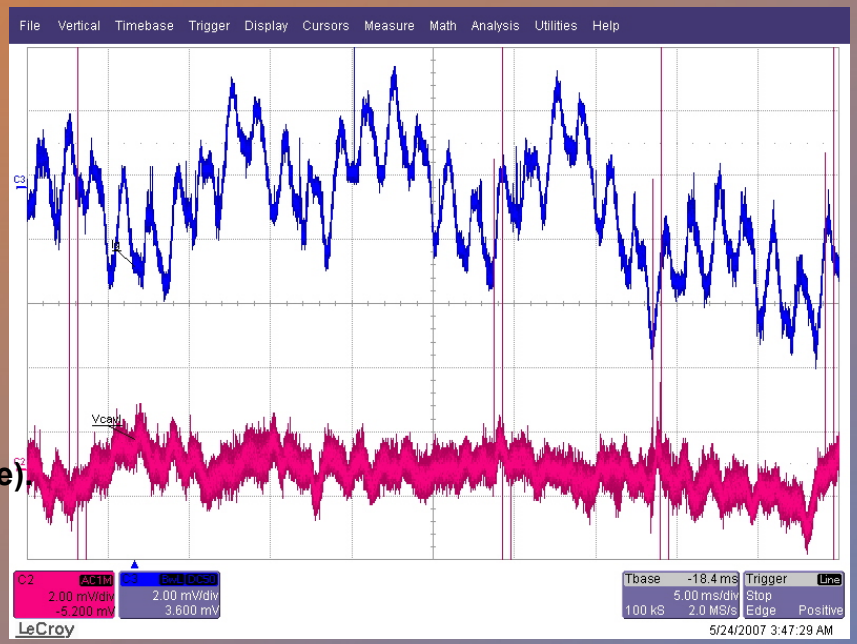
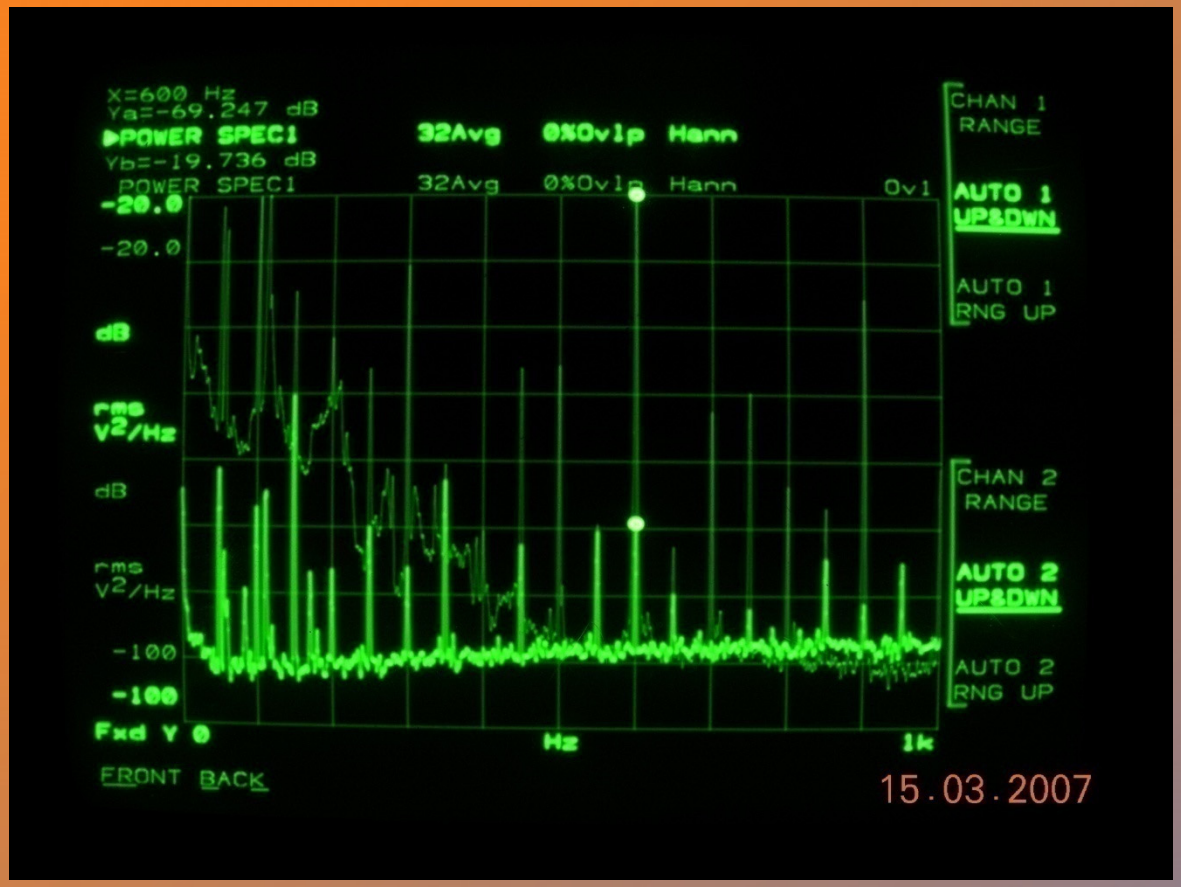


Fig 2: Phase loop closed: red (2mV/dg= phase error) measure ~0.2 dg
Blue is phase compensation (that is the phase shifter control voltage)

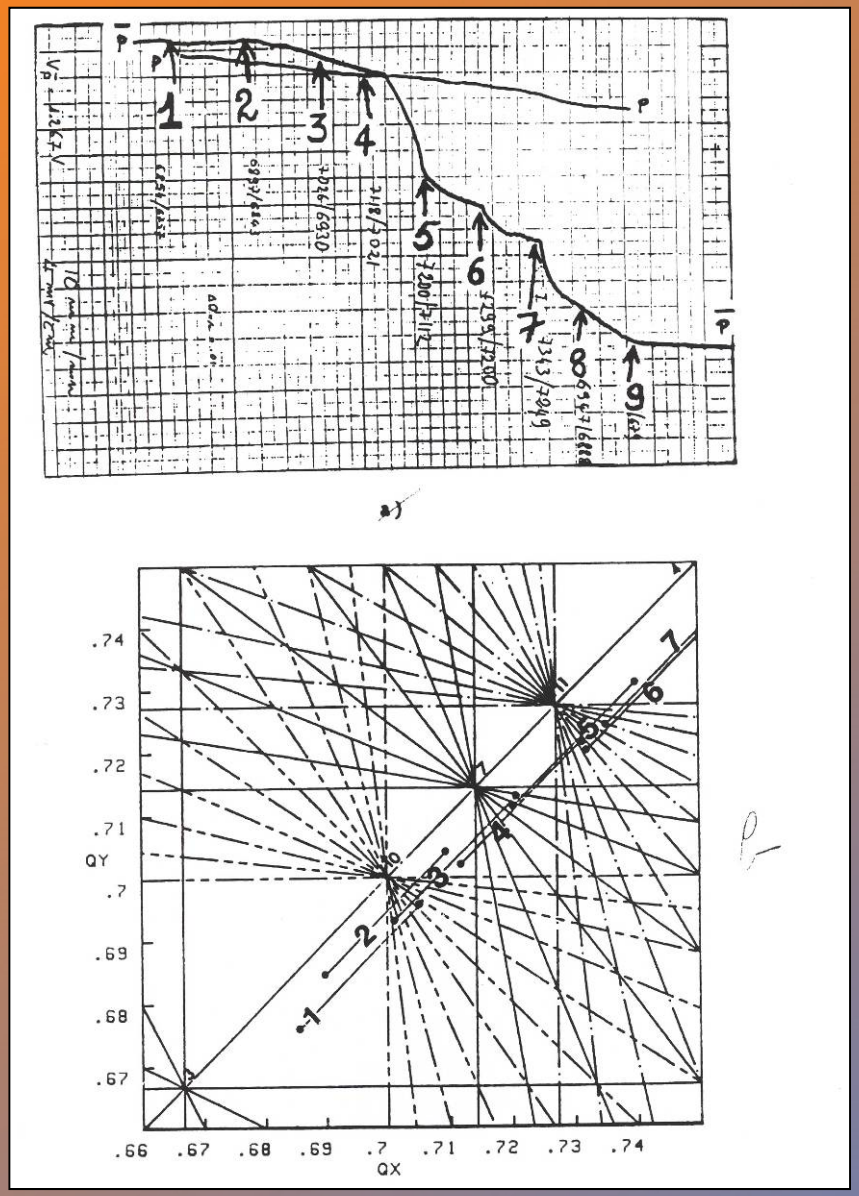
Low level measures to reduce RF noise in the LHC



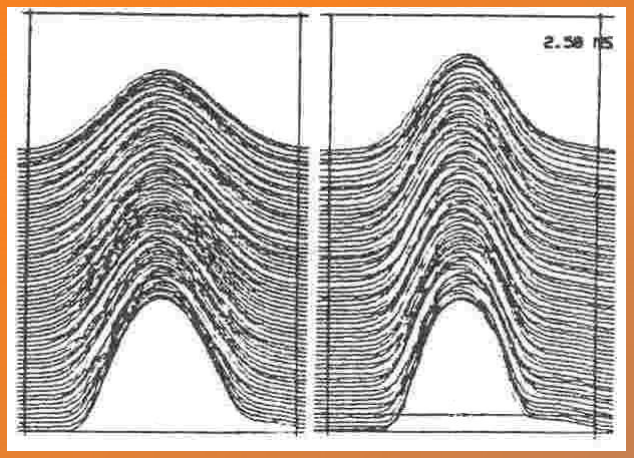
The RF feedback

Fig 5: Spectrum of the cavity phase noise. (1 MV acc, Q=60000) from DC to 1 kHz (10 dB/div vertical). Trace in the background= RF fdbk open. Highlighted trace = RF fdbk closed). Measured on the SM18 tes

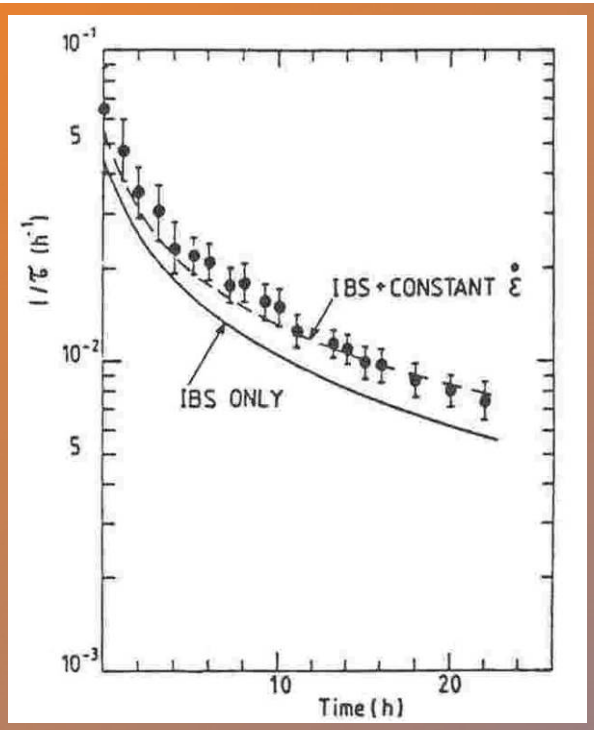
A beam-beam resonance scan at the SPS collider



Intrabeam scattering in the SPS.

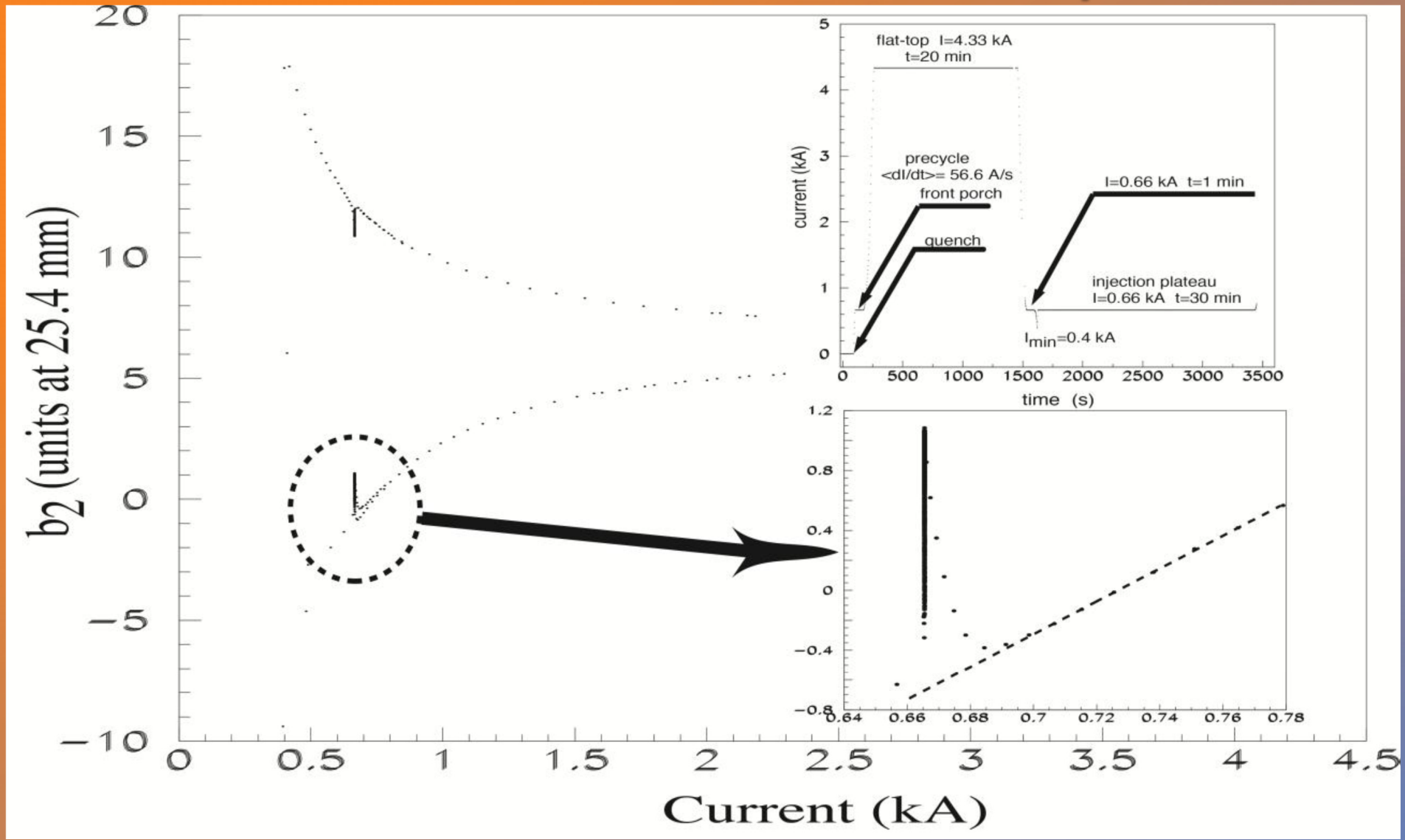


Bunch lengthening with time for a strong proton bunch (left) and a weak antiproton bunch (right).

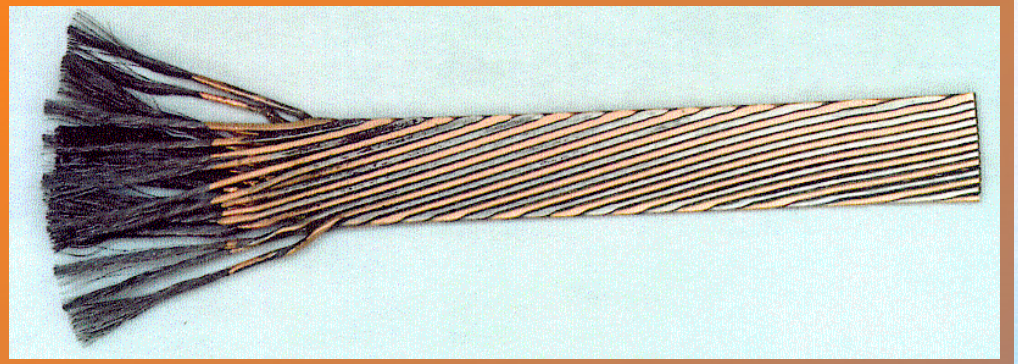


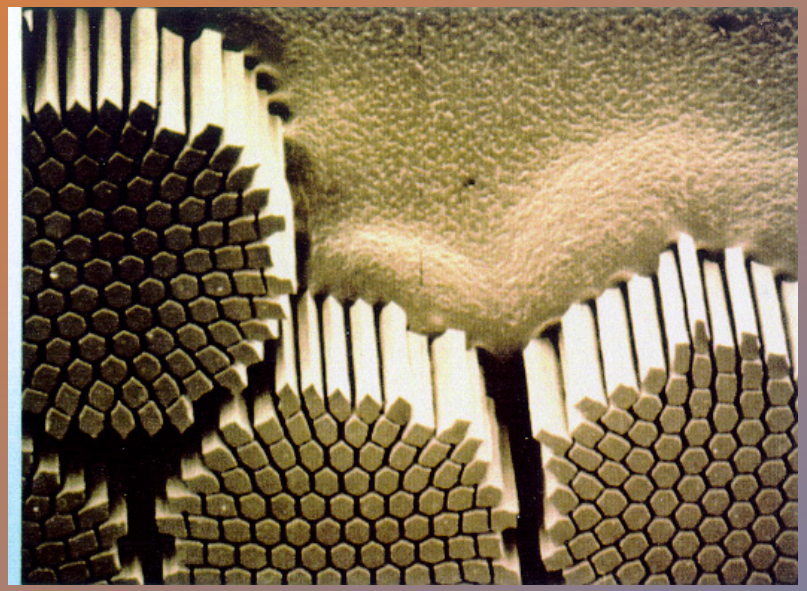
IBS growth rate compared with theory.

Persistent currents and snapback

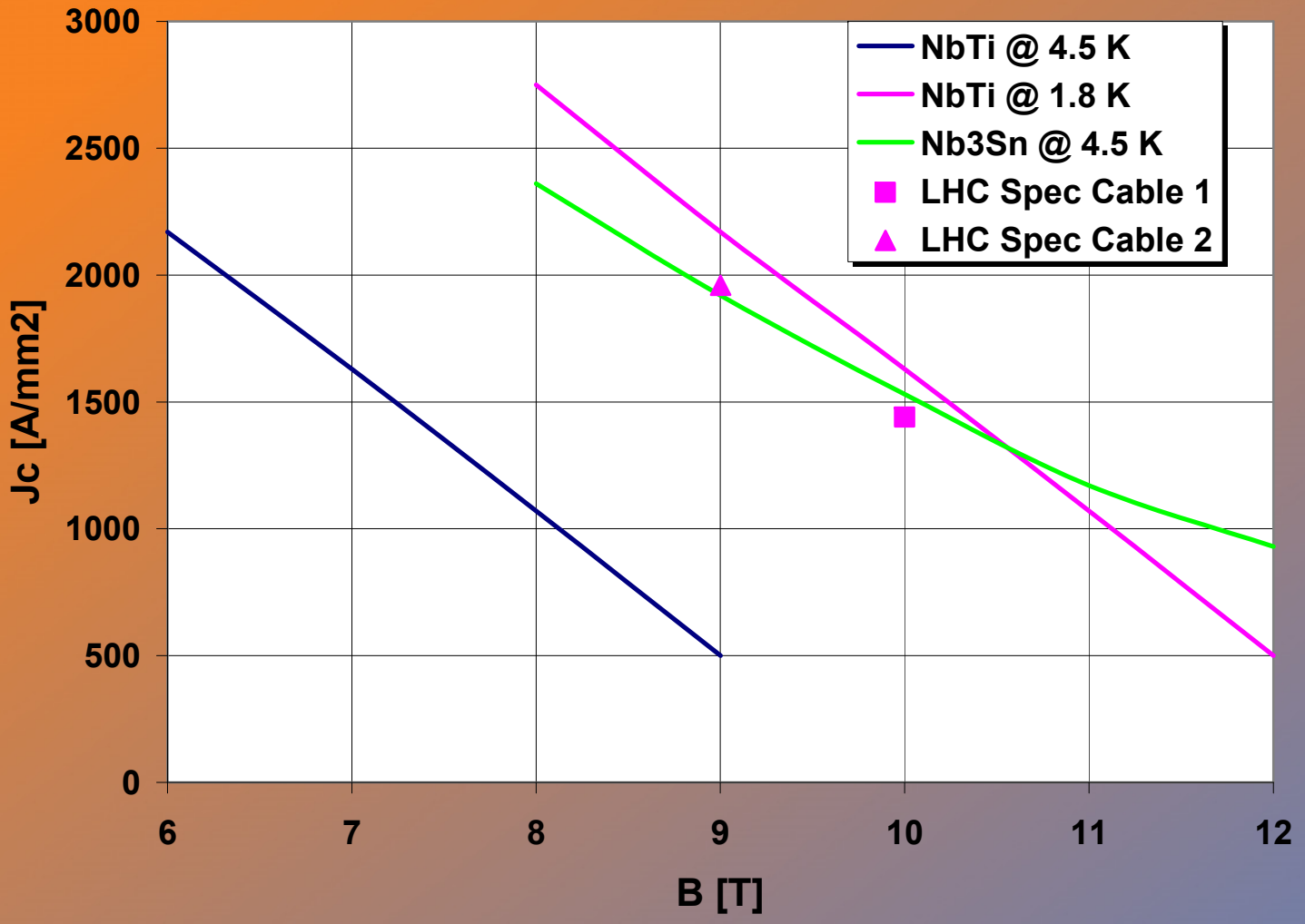


7000 km of superconducting cable Nb-Ti

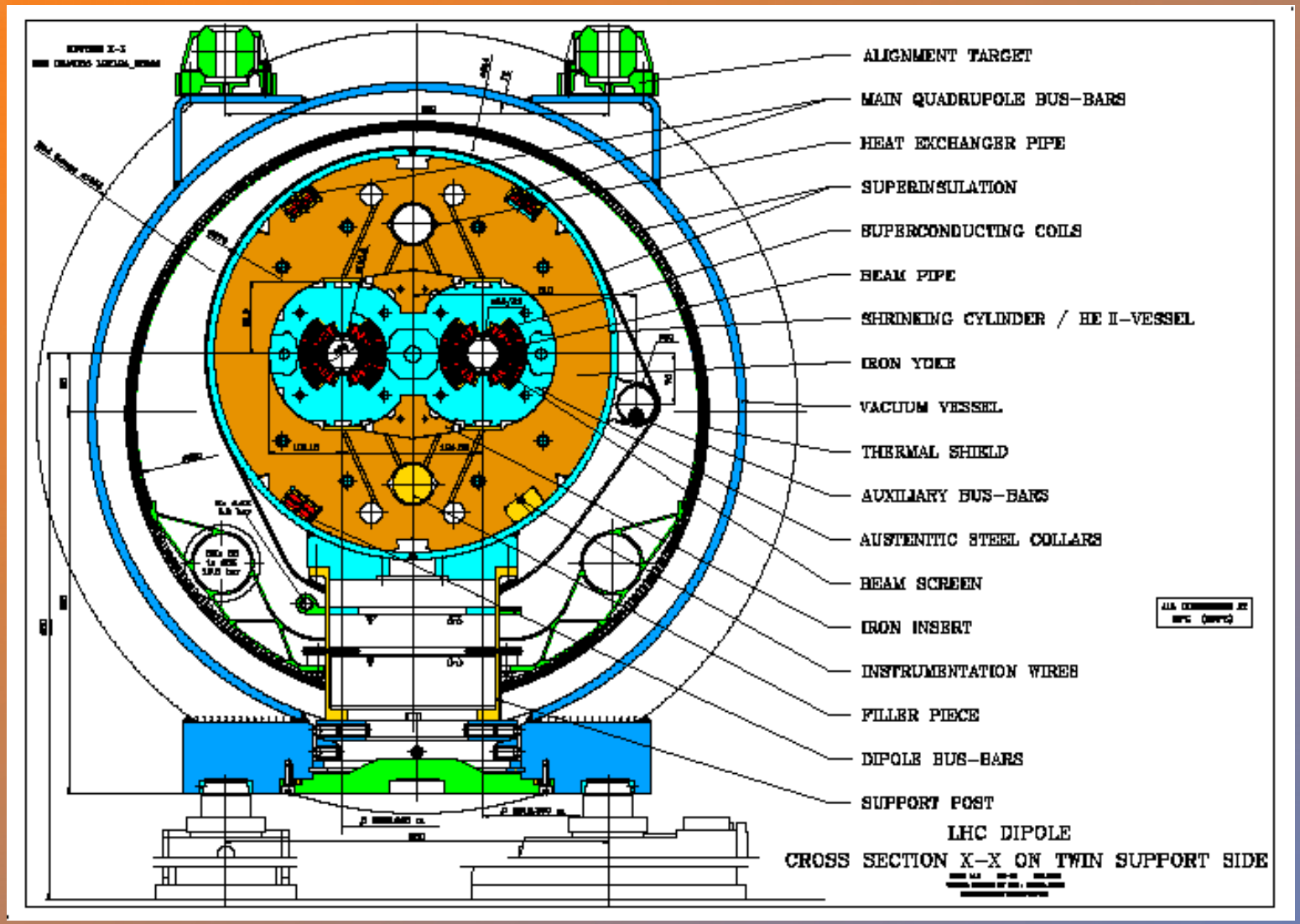




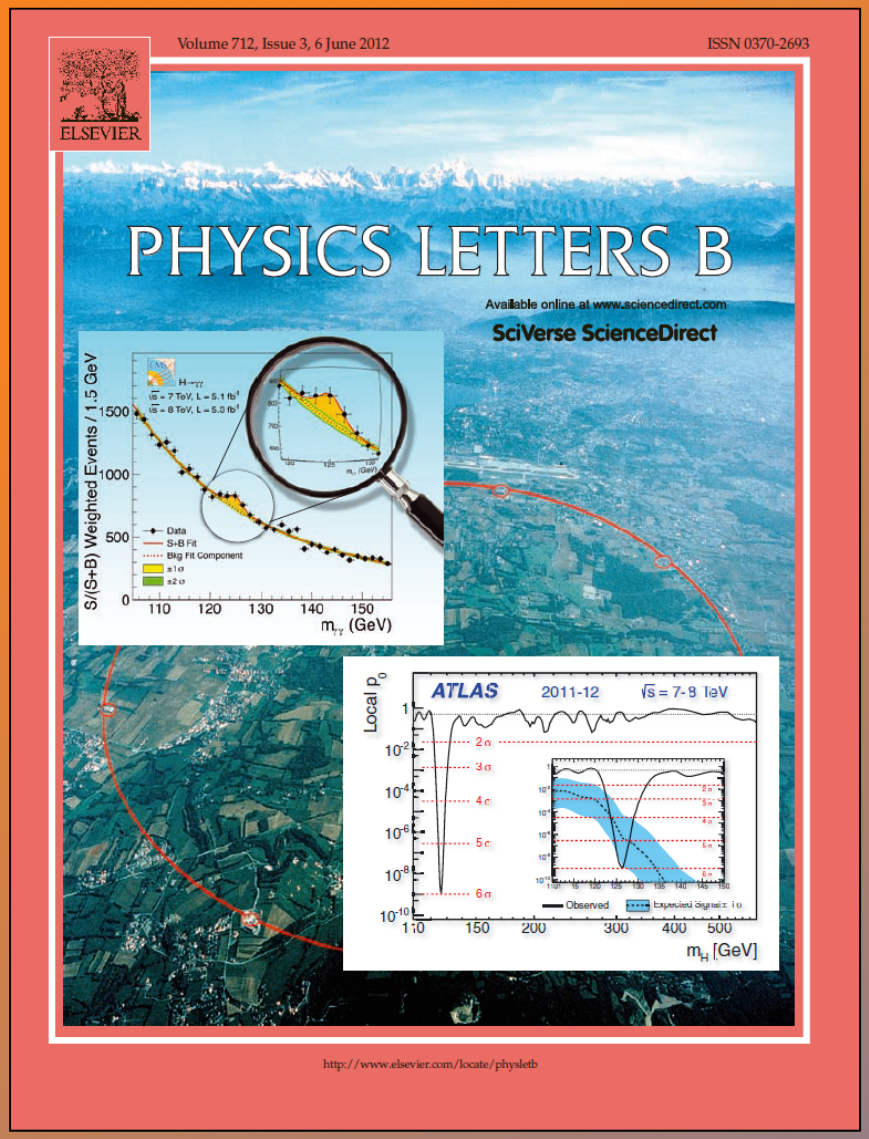
Critical current density of technical superconductors



Cryodipole cross-section



The highlight of a remarkable year 2012



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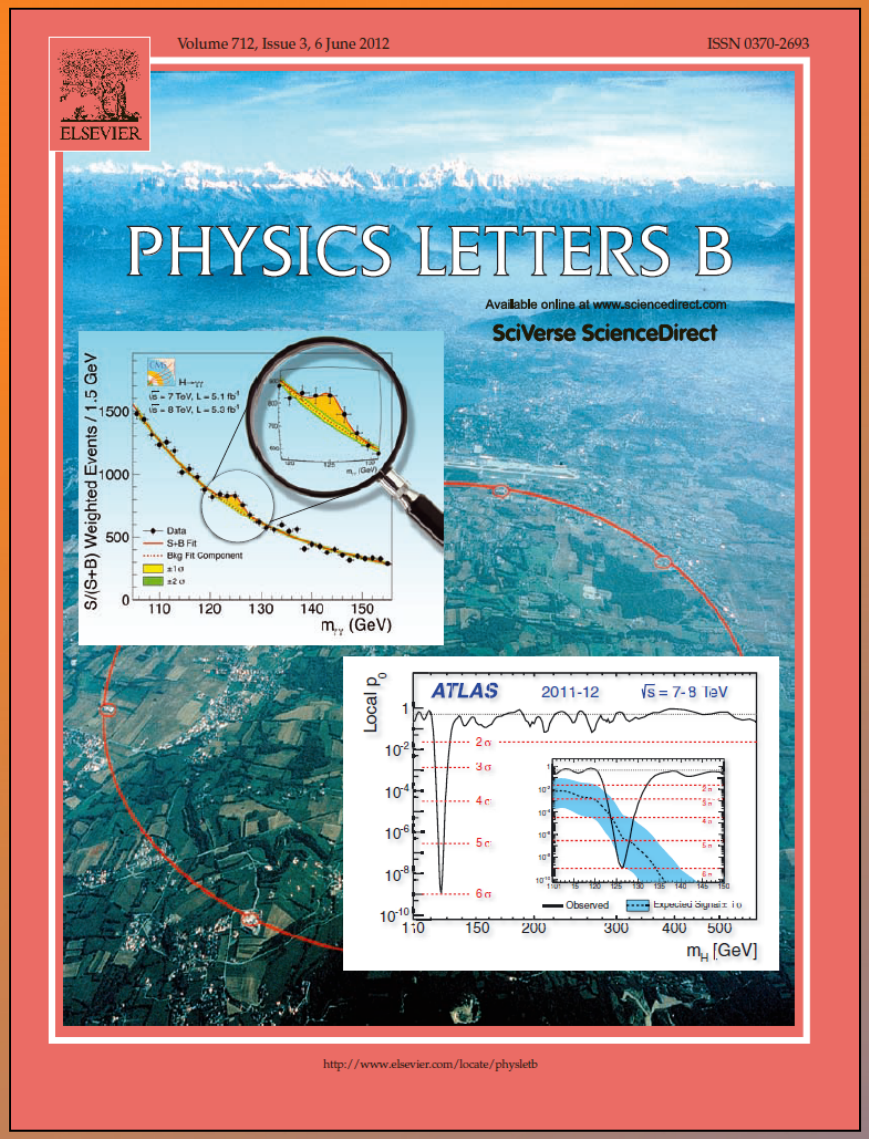
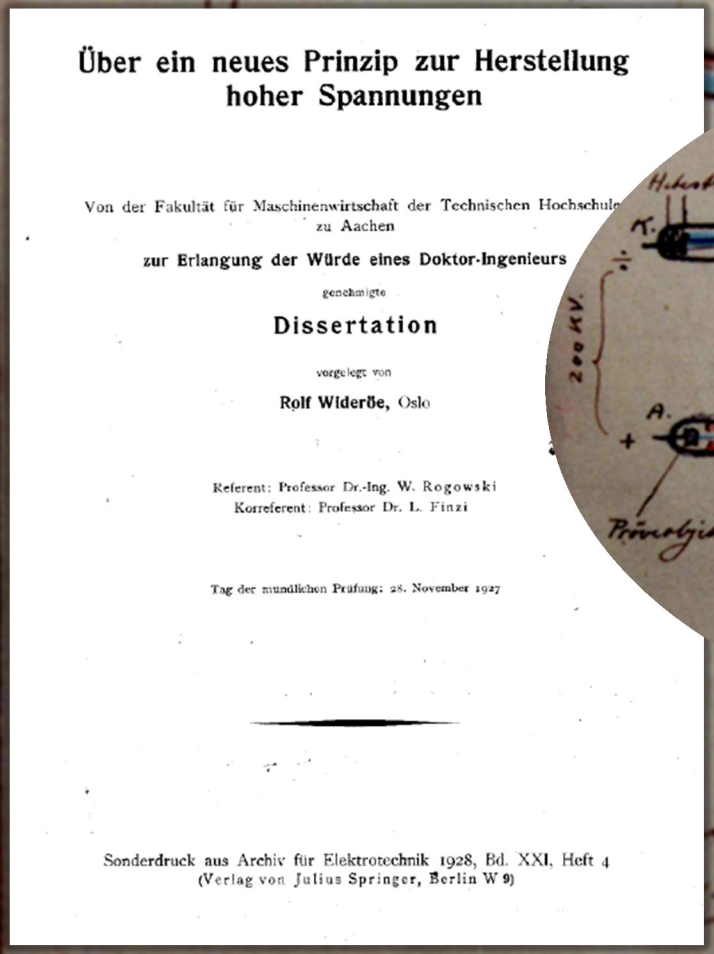


Symposium “90 Years of RF Accelerators”

Commemorating the 1927 PhD of Rolf Wideröe

September 6th, 2017 in Technical University Aachen, Germany

27 page PhD



Über ein neues Prinzip zur Herstellung hoher Spannungen

Von der Fakultät für Maschinenwirtschaft der Technischen Hochschule zu Aachen

zur Erlangung der Würde eines Doktor-Ingenieurs

genehmigte

Dissertation

vorgelegt von

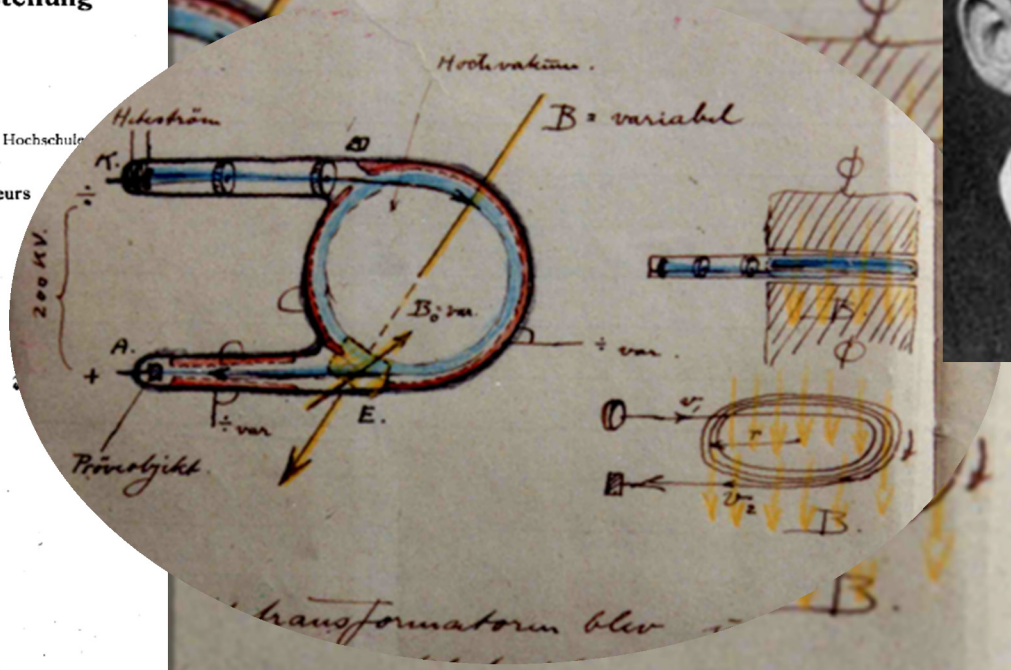
Rolf Wideröe, Oslo

Referent: Professor Dr.-Ing. W. Rogowski
Korreferent: Professor Dr. L. Finzi

Tag der mündlichen Prüfung: 28. November 1927

Sonderdruck aus Archiv für Elektrotechnik 1928, Bd. XXI, Heft 4
(Verlag von Julius Springer, Berlin W 9)

Idea circular accelerator (“Strahlentransformator”)



Please register at:

https://90years-rf-accelerators.de/