ZBASE revival

Progress:

o some features are now running without crashing

o one can select LHC machine parameters

o introduced resonator impedances for 400-MHz cavities
(from Deepa's report)

o introduced resonator impedances for transverse damper
(from W. Hofle) – details to be clarified

o conversion of resonator parameters to impedance
is working (can plot & save the result)

o copied impedance files for LHC experiments
(many & incomplete data sets)

Problems encountered / features to be added:

o Many path variables were set incorrectly (at least for lxplus)
→ fixed for the moment, may not work on other platforms

o Mkimpedance which creates impedance data for resonator was wrong in the transverse plane (factor 2 Pi missing & shunt impedance variable was overwritten!!); factor >20 error, funny impedance shaper

o Mkimpedance also does not order in frequency

o summing impedances does not seem to work

o treatment of beta function somewhat obscure (enters at various places)

o need to account for local beta when summing transverse impedances

o resistive wall impedance type(s) must be added

o Z_T low-frequency limits & Z/n independent of HOM data

o data for LHC experiments ?

$$\frac{Z}{n} = -i\frac{R_S}{Q}\frac{f_{rev}}{f_R}$$

$$k_{\parallel} = \frac{R_S\omega_R}{2Q}$$

```
drwxr-xr-x   4 zdata   si        2048 Feb 17  1997 alice
drwxr-xr-x   4 zdata   si        2048 Sep 11  1998 alice-nozdc
drwxr-xr-x   4 zdata   si        2048 Jul 27  1998 alice-vers1-jul98
drwxr-xr-x   4 zdata   si        2048 Jul 27  1998 alice-vers2-jul98
drwxr-xr-x   4 zdata   si        2048 Jul 27  1998 alice-vers3-jul98
drwxr-xr-x   4 zdata   si        2048 Dec  9  1999 alice-vers4-dec99
drwxr-xr-x   4 zdata   si        2048 Sep  7  1998 alice-zdc
drwxr-xr-x   4 zdata   si        2048 Dec 11  1996 atlas
drwxr-xr-x   4 zdata   si        2048 Dec 11  1996 atlas-urmel
drwxr-xr-x   4 zdata   si        2048 Apr 17  1997 cms
drwxr-xr-x   4 zdata   si        2048 Apr 22  1998 cms-dec97
drwxr-xr-x   4 zdata   si        2048 Apr 22  1998 cms-dec97-0.4tap
drwxr-xr-x   4 zdata   si        2048 Apr 22  1998 cms-dec97-1.4tap
drwxr-xr-x   4 zdata   si        2048 May 27  1998 cms-dec97-20cm
drwxr-xr-x   4 zdata   si        2048 May 27  1998 cms-dec97-20cm-10cmtap
drwxr-xr-x   4 zdata   si        2048 May 27  1998 cms-dec97-20cm-20cmtap
drwxr-xr-x   4 zdata   si        2048 May 10  2000 cms-highlumi2-april2000
drwxr-xr-x   4 zdata   si        2048 May 10  2000 cms-highlumi-april2000
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmshighlumi-mafia
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmshighlumi-stst-mafia
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmshighlumi-urmel
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmslowlumi-mafia
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmslowlumi-stst-mafia
drwxr-xr-x   4 zdata   si        2048 Nov 20  1996 cmslowlumi-urmel
drwxr-xr-x   4 zdata   si        2048 Apr  8  1999 cms-totem
drwxr-xr-x   4 zdata   si        2048 Apr  9  1999 cms-totem-20cmtaper
drwxr-xr-x   4 zdata   si        2048 Apr 12  1999 cms-totem-50cmtaper
drwxr-xr-x   4 zdata   si        2048 Aug  5  1996 cms-withrfscreen
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2-11cmscr
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2-6cmscr
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2-8cmscr
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2-8cmtap
drwxr-xr-x   4 zdata   si        2048 Jul  8  1997 felix2-9cmscr
drwxr-xr-x   4 zdata   si        2048 Sep 18  1997 felix-centralpart
drwxr-xr-x   4 zdata   si        2048 Sep 18  1997 felix-outerpart
drwxr-xr-x   4 zdata   si        2048 Apr 17  1997 lhc-b
```

which version shall we pick?

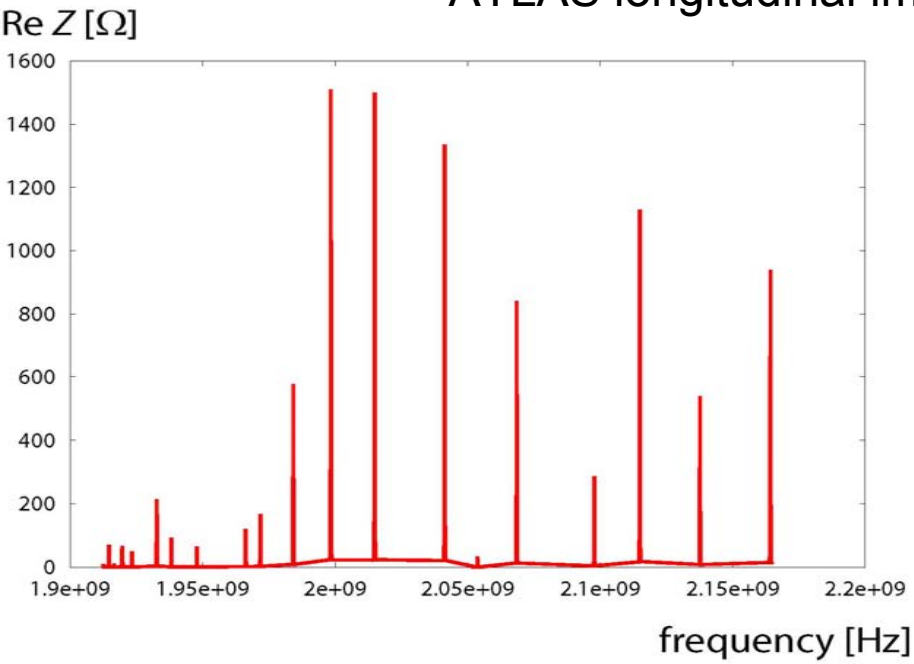
data look quite different from version to version; often incomplete; different designs

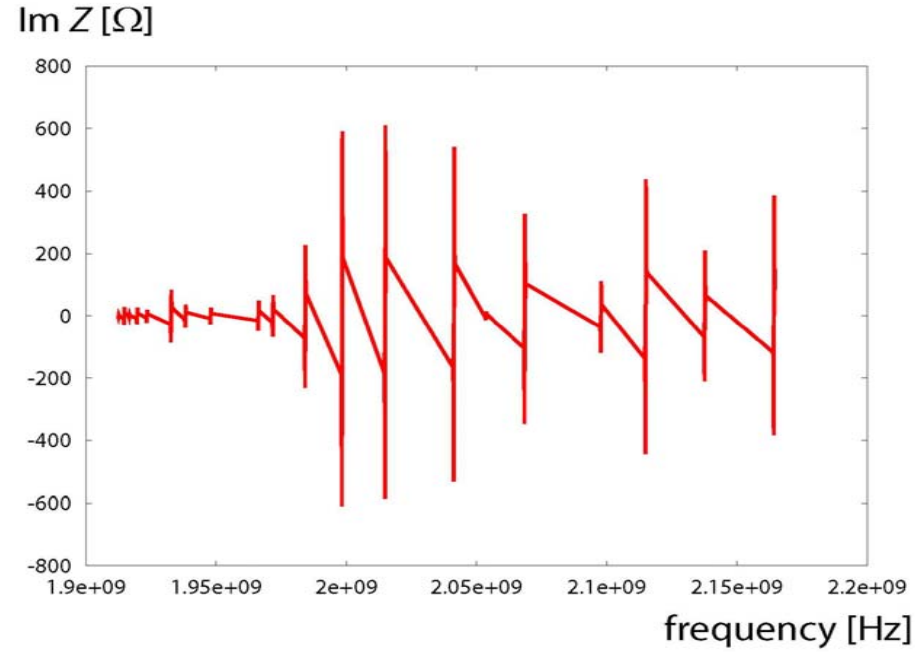
?

many possible choices for CMS

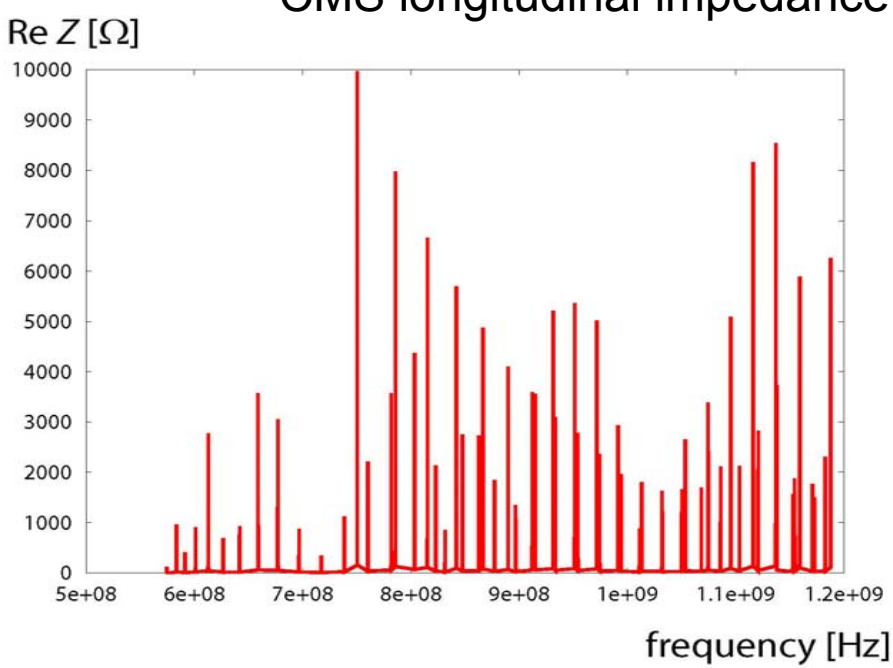
I chose the files marked by red errors

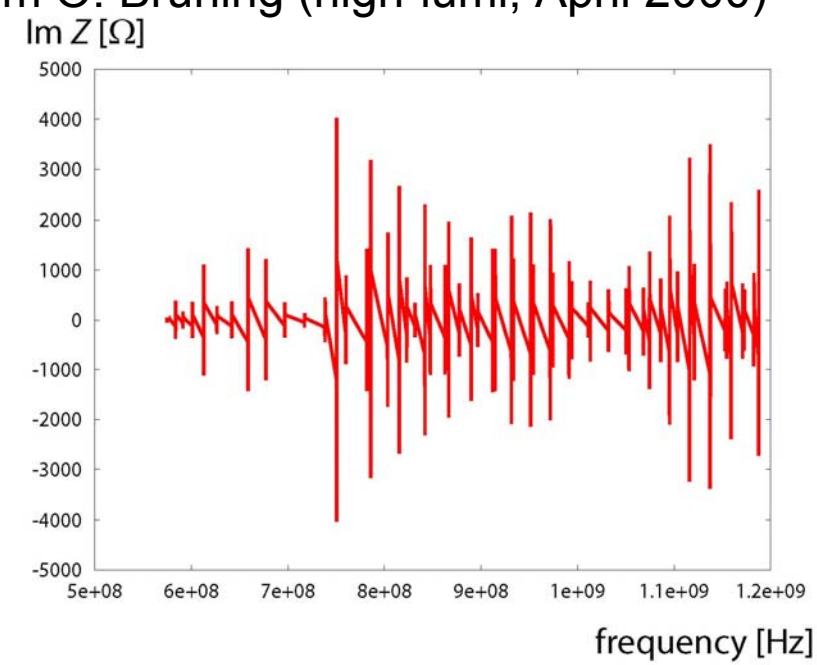
ATLAS longitudinal impedance from O. Bruning, 1996



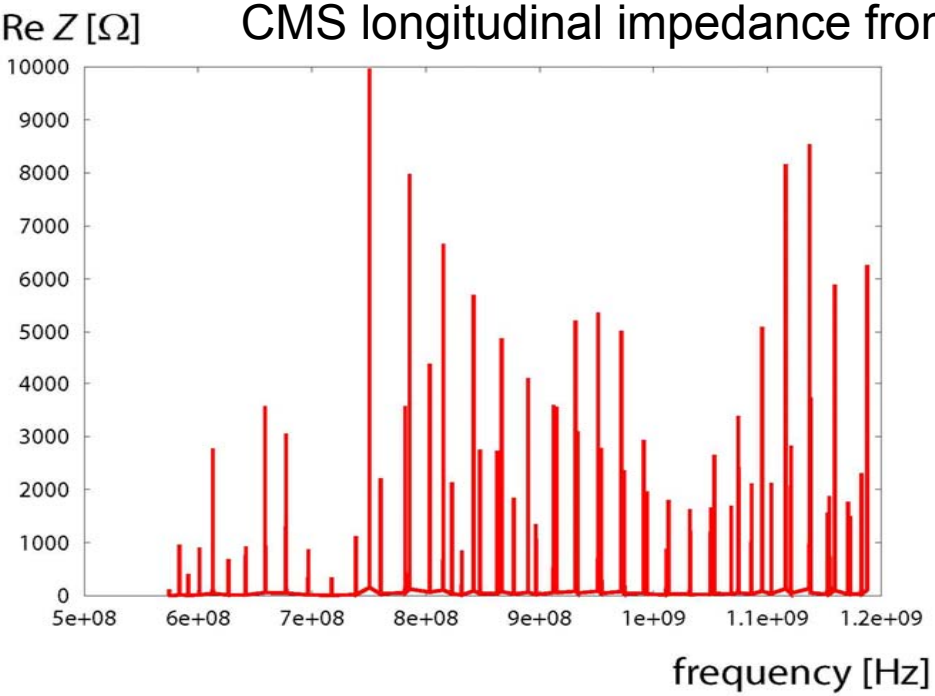


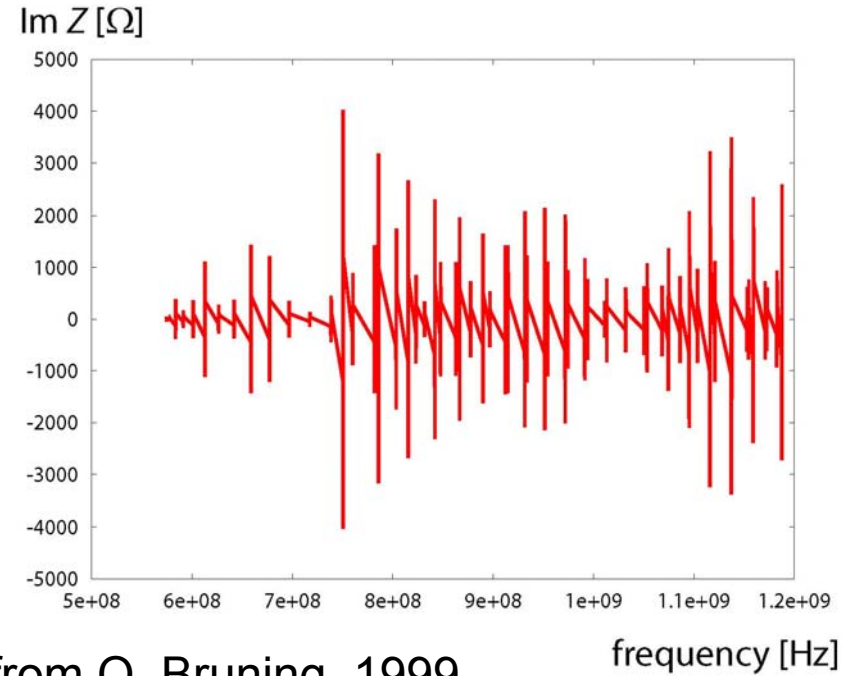
CMS longitudinal impedance from O. Bruning (high-lumi, April 2000)



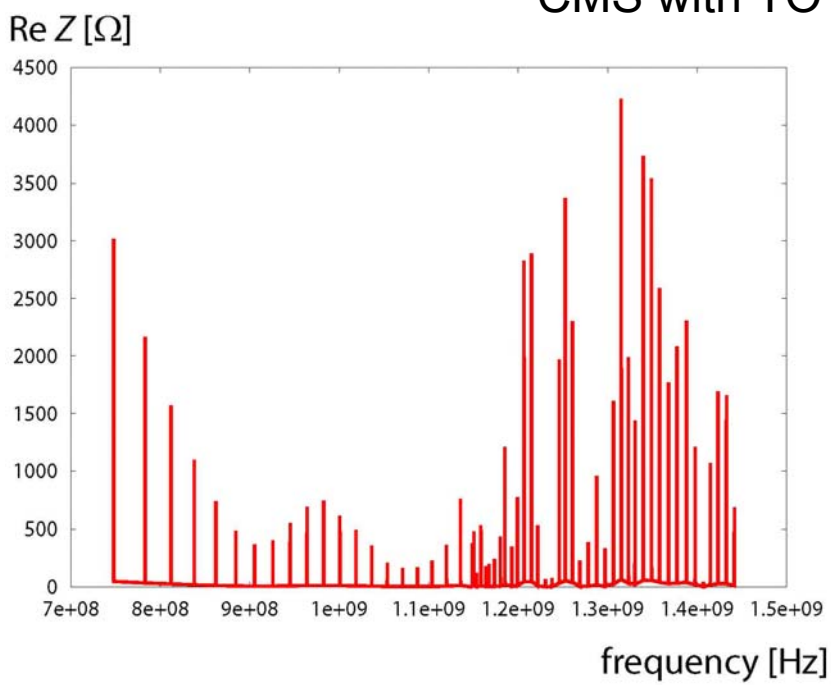


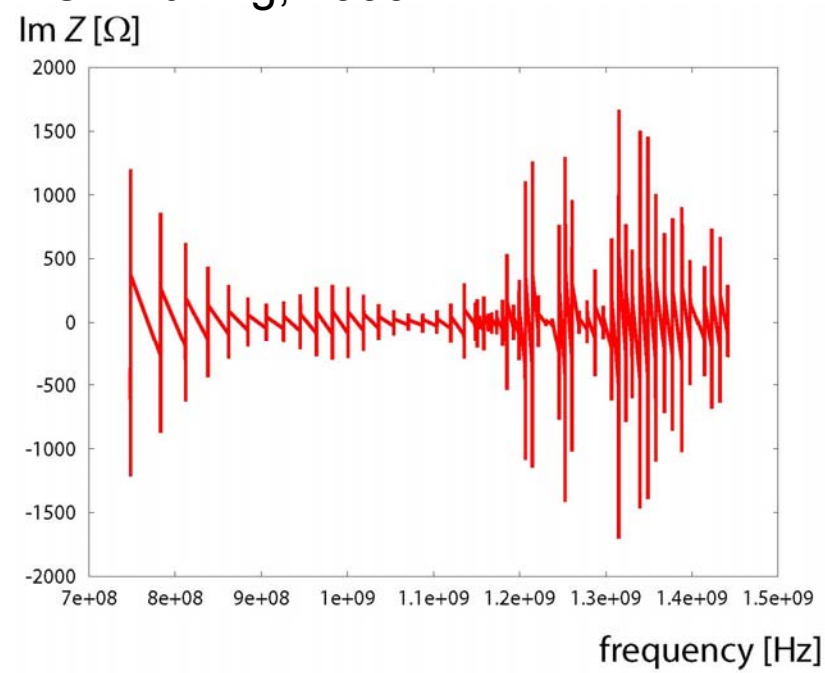
CMS longitudinal impedance from O. Bruning (high-lumi, April 2000)



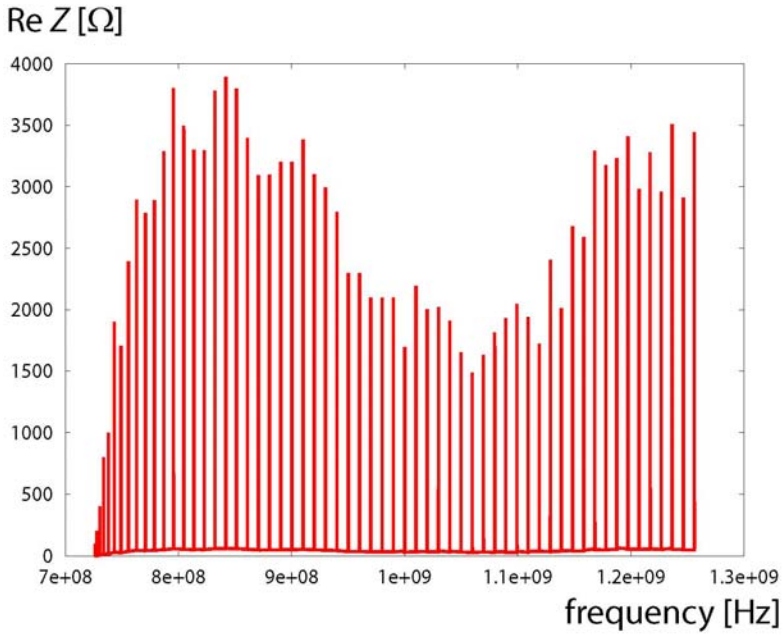


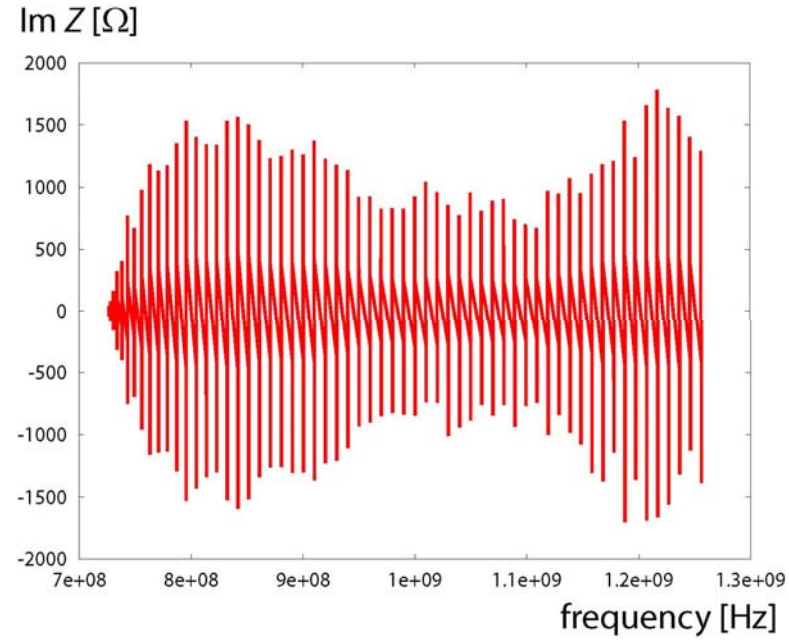
CMS with TOTEM from O. Bruning, 1999



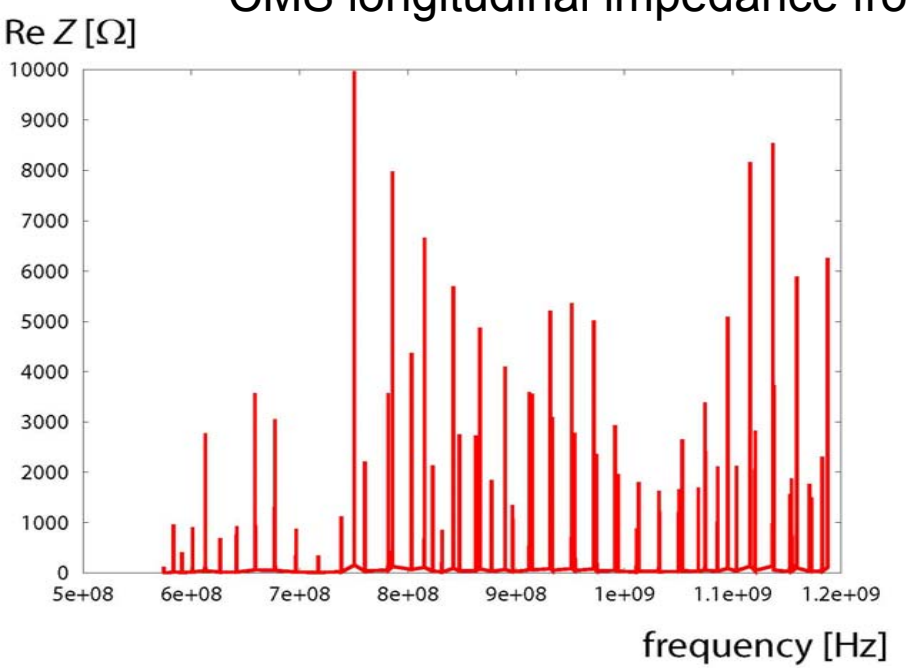


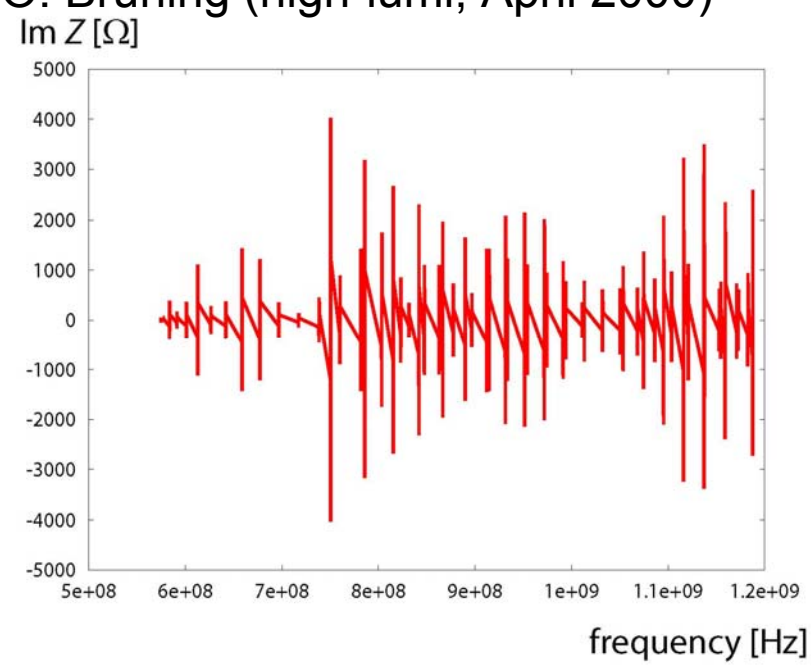
CMS longitudinal impedance from Y. Luo, 2002



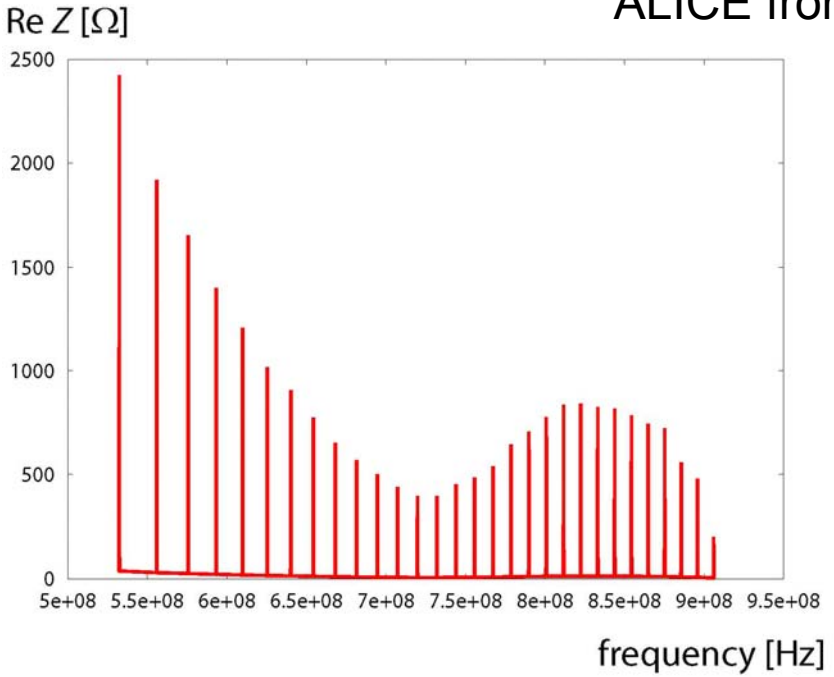


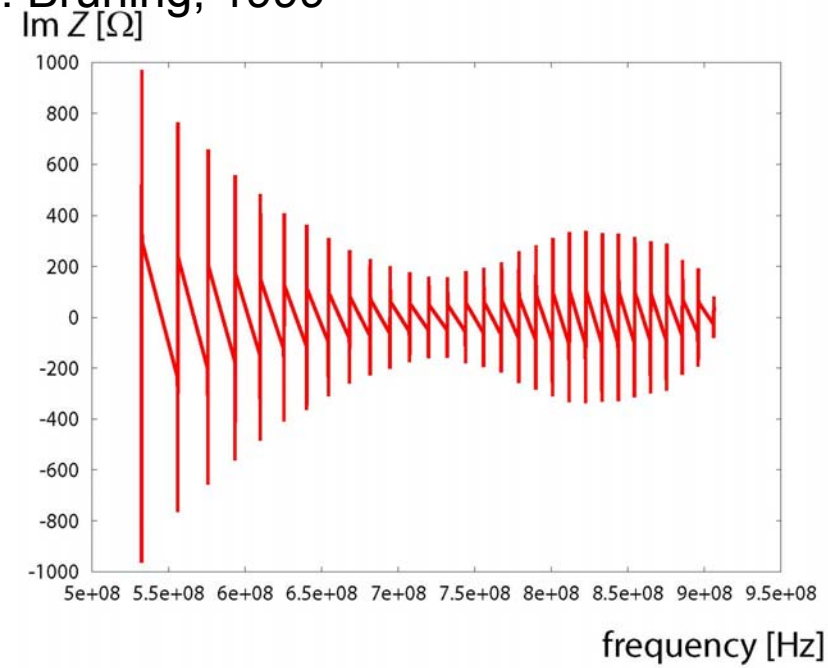
CMS longitudinal impedance from O. Bruning (high-lumi, April 2000)



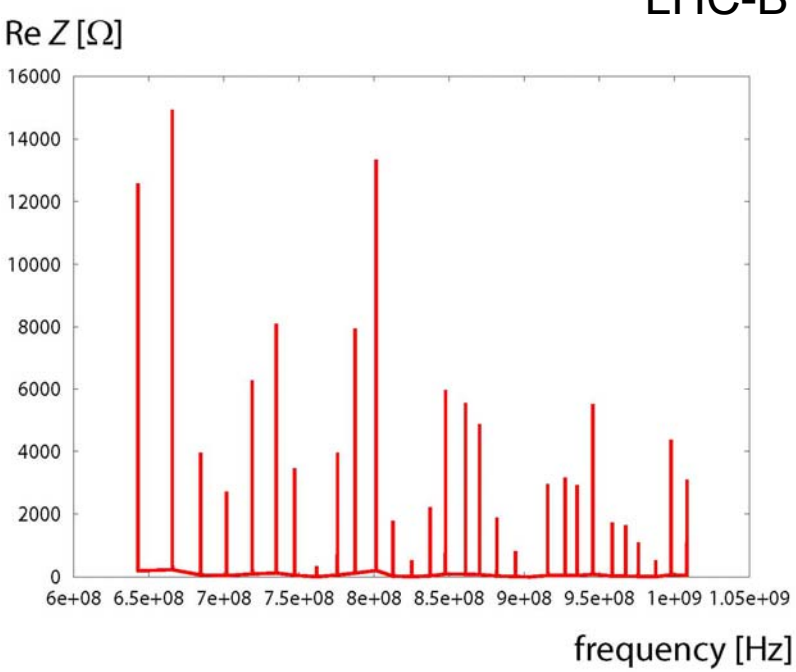


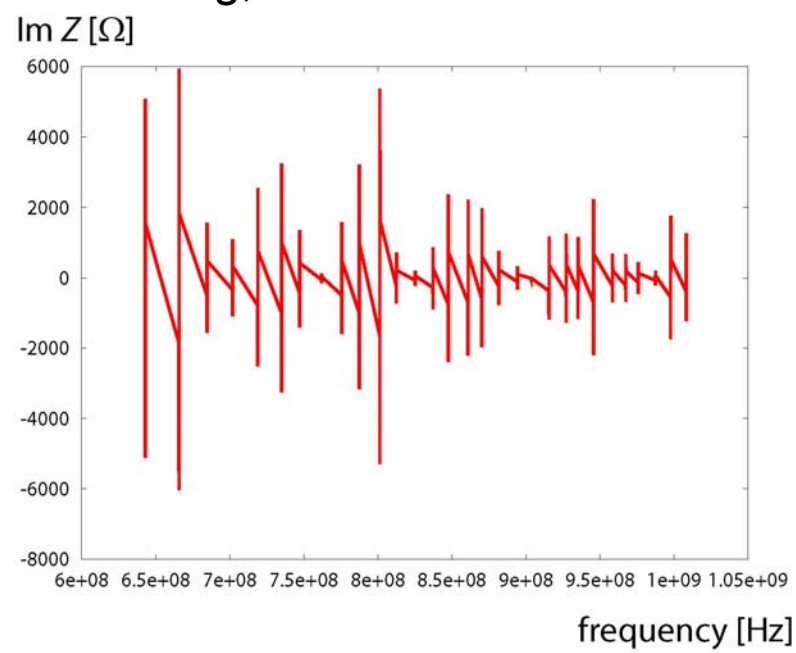
ALICE from O. Bruning, 1999



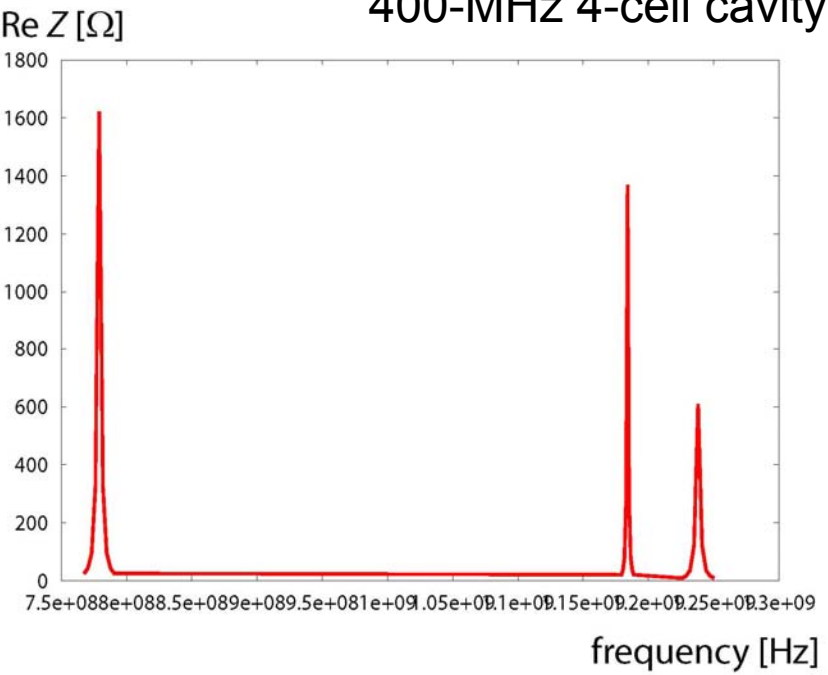


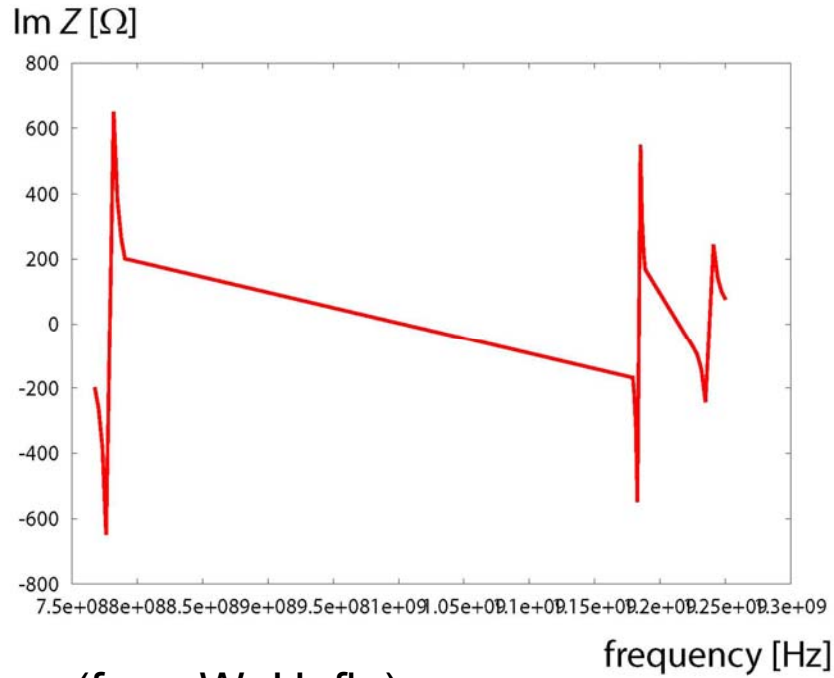
LHC-B from O. Bruning,1997



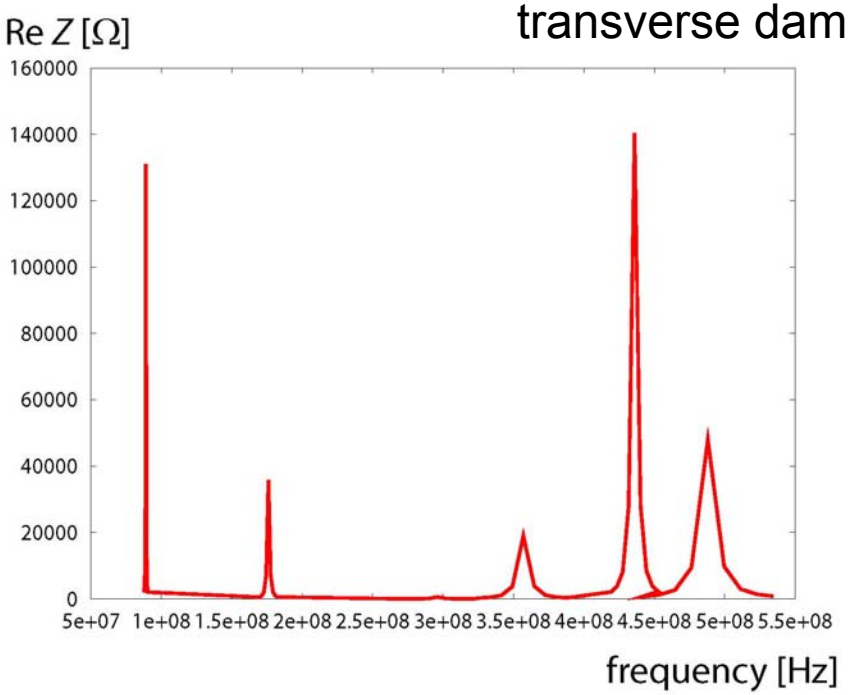


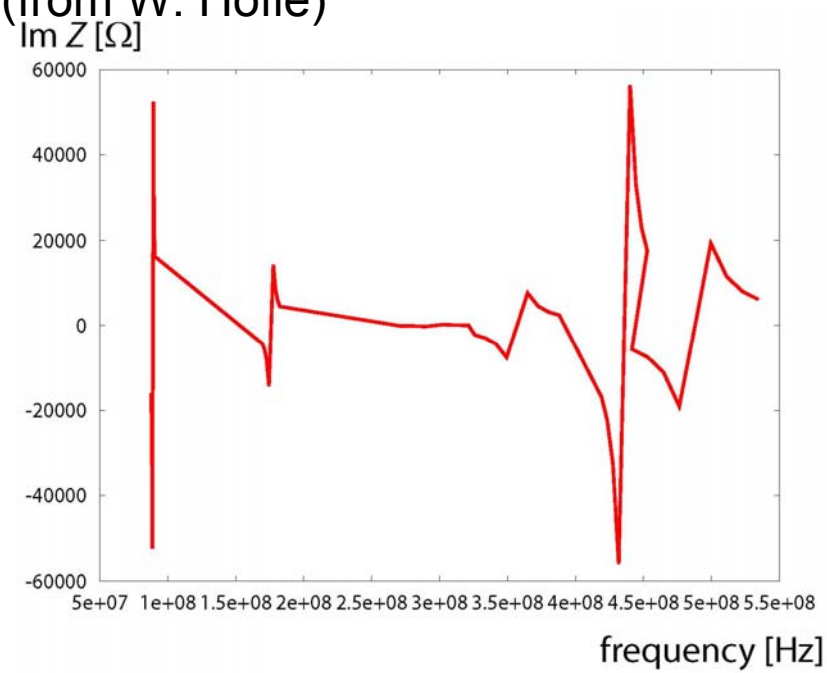
400-MHz 4-cell cavity (D. Angal, E. Haebel et al., 1998-2002)





transverse damper (from W. Hofle)





which HOM data of experimental chambers are available?

	longit.	transv.
ALICE	☺	☻
ATLAS	☺	☺
CMS high-lumi	☺	☻ *
CMS TOTEM	☺	☻
LHC-B	☺	☺

- transverse CMS data available for older calculation
  (why does impedance depend on lumi anyhow?)

other questions

(1) Form of the transverse broadband impedance:

LHC PN 36 quotes the following formula for the transverse broadband impedance:

$$Z_\perp = \frac{\omega}{c}\frac{R_s}{1+iQ\left(\frac{\omega_R}{\omega}-\frac{\omega}{\omega_R}\right)}$$

where R_s is in units of Ω

In the past I always used:

$$Z_\perp = \frac{\omega_R}{\omega}\frac{Z_t}{1+iQ\left(\frac{\omega_R}{\omega}-\frac{\omega}{\omega_R}\right)} = \frac{c}{\omega}\frac{R_s}{1+iQ\left(\frac{\omega_R}{\omega}-\frac{\omega}{\omega_R}\right)}$$

where R_s is in units of Ω/m^2

I think the second form is used when Zbase converts resonator parameters to impedance, but need to check instability routines

(2) Do both *E* and *M* modes couple to the beam?

(3) Longitudinal feedback is mentioned many times, but we don't have any.

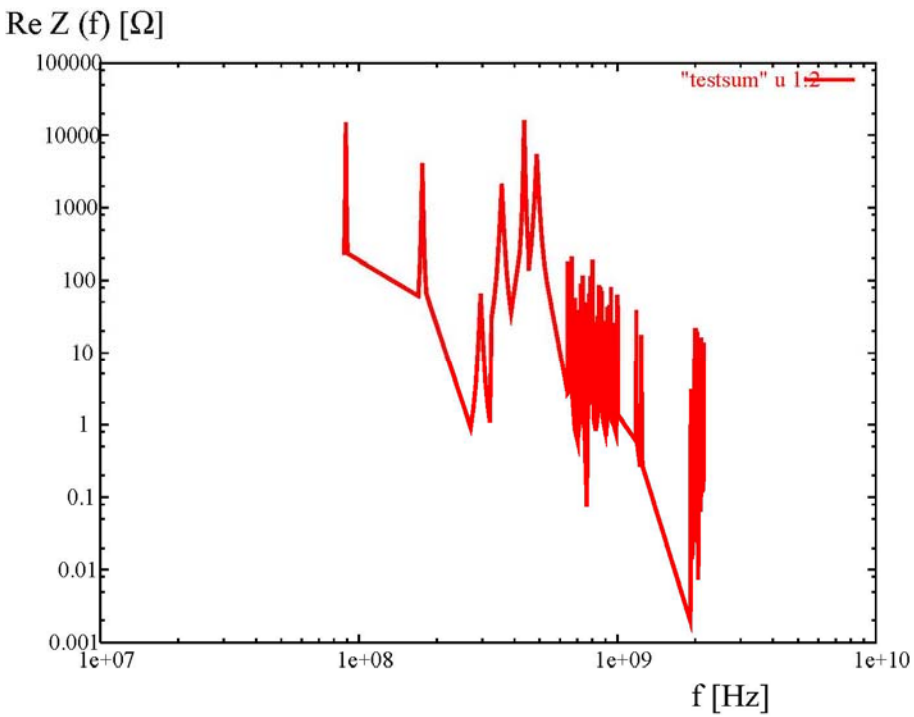
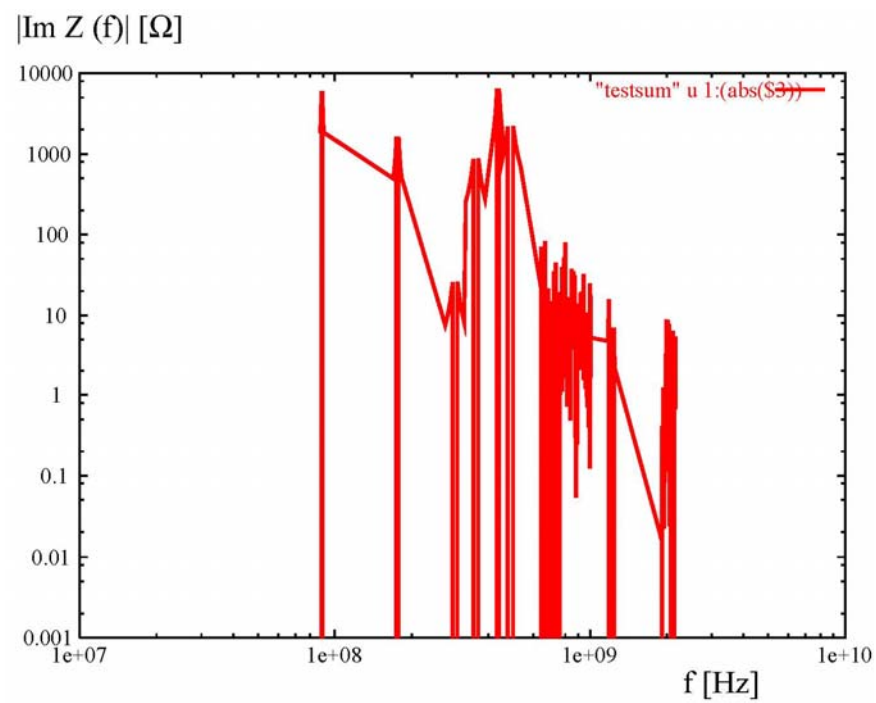
(4) Which β should we take for weighting experimental chamber transverse imp.?

ZBASE had links to external programs
ABCI, URMEL, MAFIA, MAD8

Maybe these need not be re-surrected?

We could perhaps think of making links to
GdfidL (but runs on large cluster)
and/or HFSS and MAD-X, at a later time

near-term plan:

- continue debugging, experimenting
  & understanding
- include in a first approximation impedance
  of all important LHC components
- store or compute for each item transverse &
  longitudinal impedance
- add resistive-wall type of impedance
- compute impedance sum
  (no crash, correct handling of β function)

sum longitudinal impedance:
ATLAS, CMS (Luo), ALICE, LHC-B, damper, 400-MHz rf