TMCI theory: decomposition on the low-intensity modes (from a constant inductive impedance)

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SOME PAST WORK

- Sacherer integral equation solved using a decomposition over Laguerre polynomials of the radial functions (Besnier1974, Chin1985 in the code MOSES)
- Laclare1987 (CAS) obtained an Eigenvalue problem without any decomposition => Summing over the azimuthal modes
- Garnier1987 proposed a decomposition on the low-intensity Eigenvectors
- Berg1995 included a transverse damper

number; it can take on the values 0...M − 1. A feedback system is modelled by adding an additional term to $K_k$ with $Z_\perp(q\omega_0 + \Omega)$ replaced by $Z_{FB}(q\omega_0 + \Omega)e^{-2\pi iq\Delta s/L}$, where $Z_{FB}$ is the Fourier transform of the feedback response, and $\Delta s$ is the distance between the pickup and kicker. Here $q$ is the combination $p + M\alpha$.  

Elias Métral, 06/02/2017, HSC section meeting, CERN
Burov2014 developed a Nested Head-Tail Vlasov Solver (NHTVS) with transverse damper

Sacherer integral equation with transverse damper solved using a decomposition over Laguerre polynomials of the radial functions by Mounet2015 in the code DELPHI

“NEW” HERE

Decomposition on the low-intensity Eigenvectors following Laclare-Garnier1987 formalisms (but from a constant inductive impedance) + Transverse damper

- A different formula from Garnier1987 was obtained (involving also the low-intensity Eigenvalues) => More detail in future
- I checked 2 cases I computed in the past with Laclare1987 formalism (without damper) and it gave the same results
- Some preliminary studies with transverse damper => To be checked/continued

NB: a water-bag distribution (for the synchrotron amplitudes) is used here (as we can push further the analytical computations) but any can be considered
Laclare1987: Eigenvalue problem without decomposition

“New” here: Decomposition on the low-intensity Eigenvectors following Laclare-Garnier1987 formalism
RESONATOR IMPEDANCE: CASE OF THE (BROAD-BAND) SPS

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\[ Q' = 7 \]
RESONATOR IMPEDANCE:
CASE OF THE (BROAD-BAND) SPS

“New” here:
Decomposition on the low-intensity Eigenvectors following Laclare-Garnier1987 formalism

Q’ = - 7
RESONATOR IMPEDANCE + TRANSVERSE DAMPER: CASE OF THE (BROAD-BAND) SPS

No transverse damper

With transverse damper (reactive, 50 turns)
RESONATOR IMPEDANCE + TRANSVERSE DAMPER:
CASE OF THE (BROAD-BAND) SPS

No transverse damper

With transverse damper
(resistive, 50 turns)
RESONATOR IMPEDANCE + TRANSVERSE DAMPER: CASE WITH $fr \times taub = 0.8$ (instead of 2.8 before)

No transverse damper

With transverse damper (reactive, 50 turns)
RESONATOR IMPEDANCE + TRANSVERSE DAMPER: CASE WITH \( fr \times \tau_{aub} = 0.8 \) (instead of 2.8 before)

No transverse damper

With transverse damper (resistive, 50 turns)
NEXT

- Reminder: “water-bag” longitudinal distribution of the synchrotron amplitudes => Can be extended to any distribution
- Detailed check of the effect of the transverse damper
- More detailed comparison with DELPHI
- Etc.