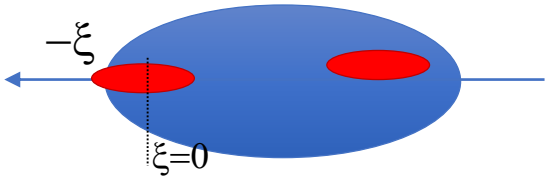
Some WG activities to be continued post the input to the ESU (CLIC PiP):

1) Physics potential of a Multi-TeV gg-collider, assuming no Multi-TeV e-e+ collisions
- assumption: NAT-technology may give better performance for e- than e+
- update in meeting January 18

2) Modelling of transverse instabilities in PWFA:
- benchmark (recent) simplified models of PWFA wake
- use that to optimize global PWFA LC parameters (not done so far)
- update this meeting

Recent discussions about the PWFA BBU studies
(e- e- blow out regime)

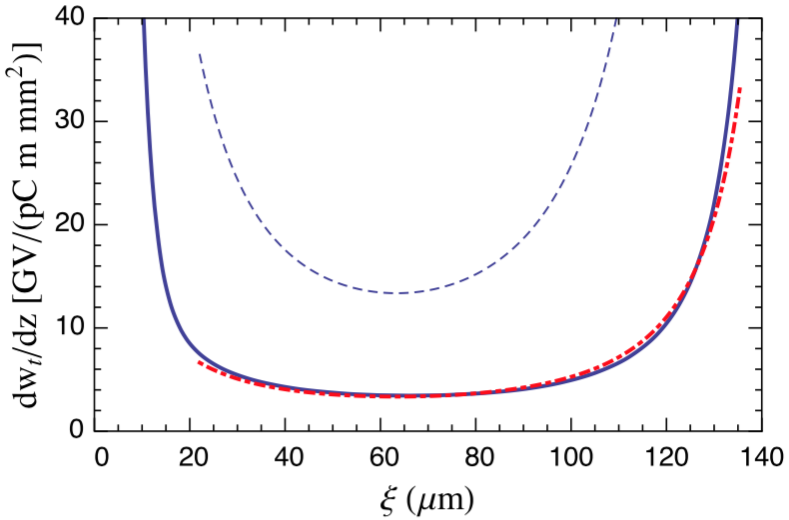
Focus lately: witness beam intra-beam wake :



Simple models based on metallic structure **single-bunch wake expressions** are suggested as a good representation of the PWFA blow-out BBU:

G. Stupakov, PR AB **21**, 041301 (2018)

$$\frac{dw_t}{dz} = \frac{8}{(r_b(\xi) + 0.75k_p^{-1})^4}$$



V. Lebedev, PR AB **20**, 121301 (2017)

Assumption $r_b >> 1/k_p$

$$W_\perp(\xi, \xi_2) \approx \frac{8\tilde{\xi}}{r_b(\xi) r_b{}^3(\xi_2)} \theta(\tilde{\xi}), \qquad \tilde{\xi} = \xi - \xi_2$$

Good agreement between simple expressions, and more complex models :

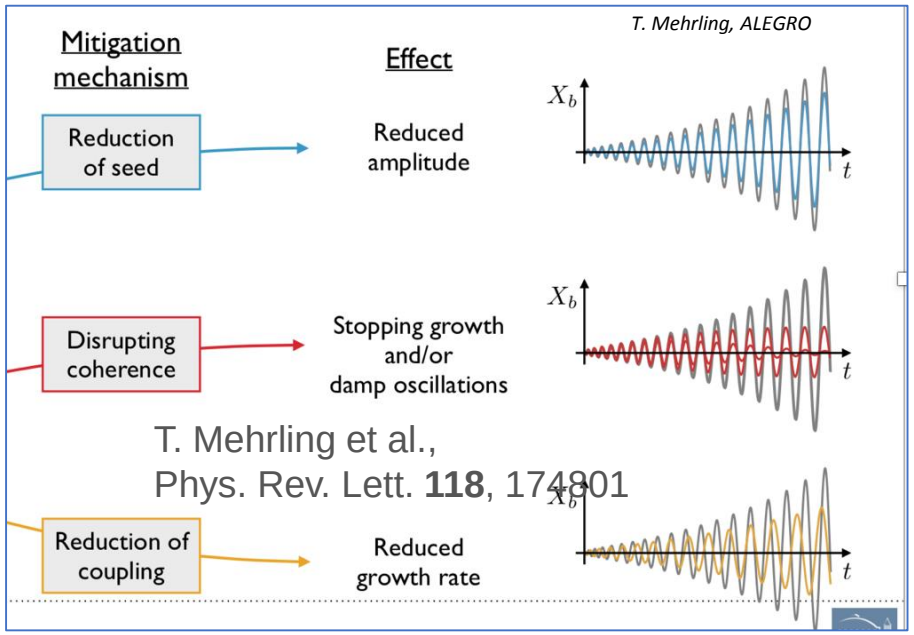
G. Stupakov, PR AB **21**, 041301 (2018)
P. Baxevanis and G. Stupakov, arXiv:1710.08504 (2017)

- Expressing the hosing instability in terms of a wake function will allow a more **global parameter optimization**
- Follows $1/a^4$ scaling, the wake 4-8 OM higher than RF structures (a~1 mm)
- If not mitigated, the claim is that very little charge can be accelerated, leading to low efficiency.

Instabilities, mitigation

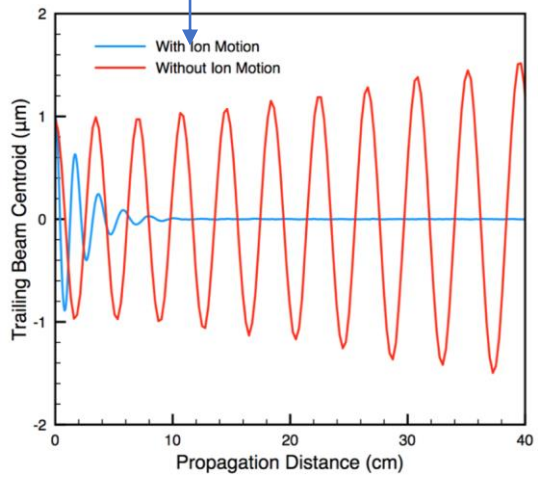
Relativist regime
C. Huang et al. PRL
99, 255001 (2007) (UCLA)
(but this mitigation already included in wake model on previous page?)

Strong focusing:
Feature of the blow out regime.



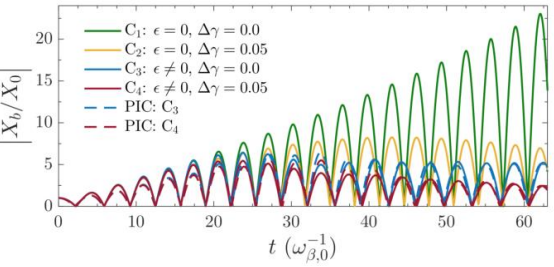
T. Mehrling et al.,
Phys. Rev. Lett. **118**, 174801

Ion motion: surprising and interesting results from Weiming An

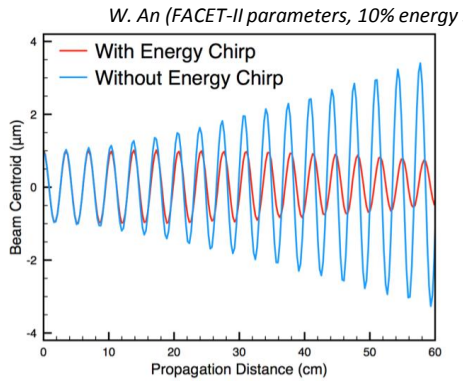


Energy gain and energy spread

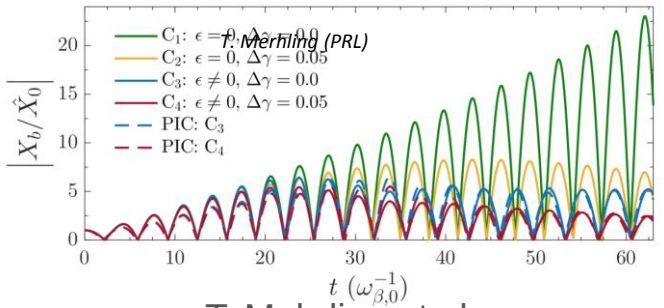
Mitigation of seed :
depending on length of ramp :
expect factors of few reduction in amplitude.
Growth rate still the same.



W. An (FACET-II parameters, 10% energy spread)

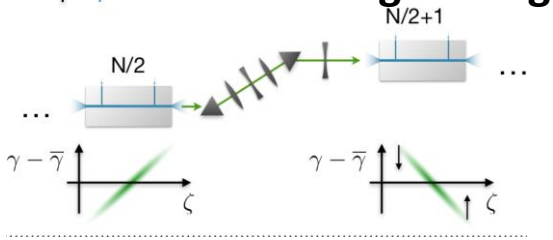


T. Mehrling (PRL)



T. Mehrling et al.,
Phys. Rev. Lett. **118**, 174801

Clever ideas for high energy spread:



T. Mehrling
C.A. Lindstrøm
- can they be realized in practice in a short, emittance preserving interstage?

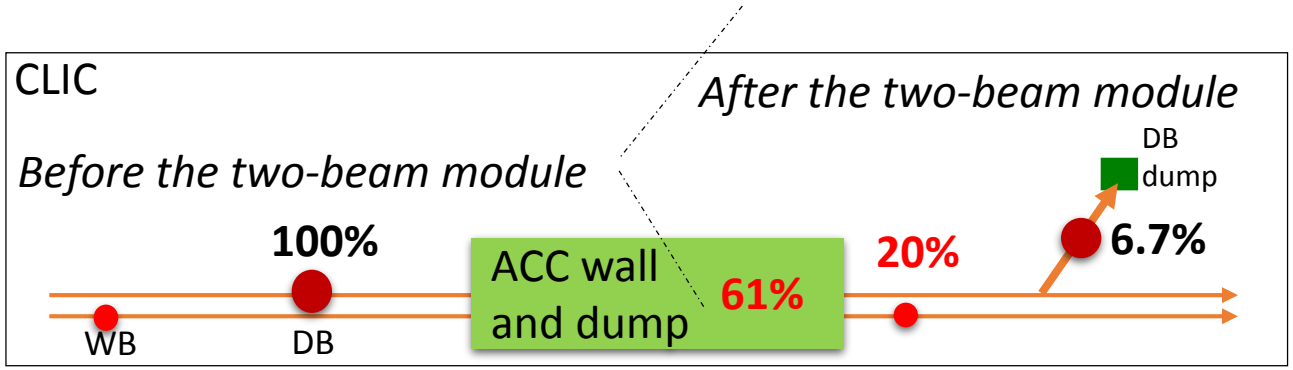
Mitigation methods exists.

Lacking: systematic parameter studies, emittance growth through many stages, to verify that suppression is sufficient.
CLIC expertise needed!

Instabilities

Why are the linear community scrutinizing the witness-bunch single bunch wake?
The single-bunch wake (witness bunch wake) decides how much charge can be loaded into a NC RF collider (CLIC).

CLIC:
Limit for transverse single bunch wake: **100 kV/pC/m/m**
Goal attained by spreading pulse charge into multi-bunch trains. Greatly **limits** the CLIC wake to RF efficiency to ~25%.
N = 600 pC/e



Current PWFA-LC concepts: **single bunch acceleration**
- may also loose on efficiency if charge needs to be reduced

Crucial questions:
- can sufficient mitigation of instability be obtained for PWFA single bunch?
- are the simplified wake field models accurate enough, and scalable enough, to do an optimization of a single stage?
- further benchmarking with PIC simulations and experiment needed

n_b = 312 @ 2 GHz