New 250 GeV beam parameters

J. List,

ILD General Meeting

7.11.2017

CR-0016

LINEAR COLLIDER COLLABORATION
Designing the world's next great particle accelerator

CHANGE REQUEST NO. ILC-CR-0016	EDMS No: **D*1159725**	Created: **14/9/2017**
		Last modified: **25/9/2017**

LUMINOSITY IMPROVEMENT AT 250GEV CM

The luminosity at the center-of-mass energy 250GeV can be improved by factor ~1.65 by adopting the horizontal emittance at IP factor 2 smaller than in the TDR. This is achieved by modifying the damping ring design slightly.

CR-0016

Accepted at TCMB meeting in Strasbourg

CHA… …QUEST …CR-0016	EDMS No: **D*1159725**	Created: **14/9/2017**
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Rationale

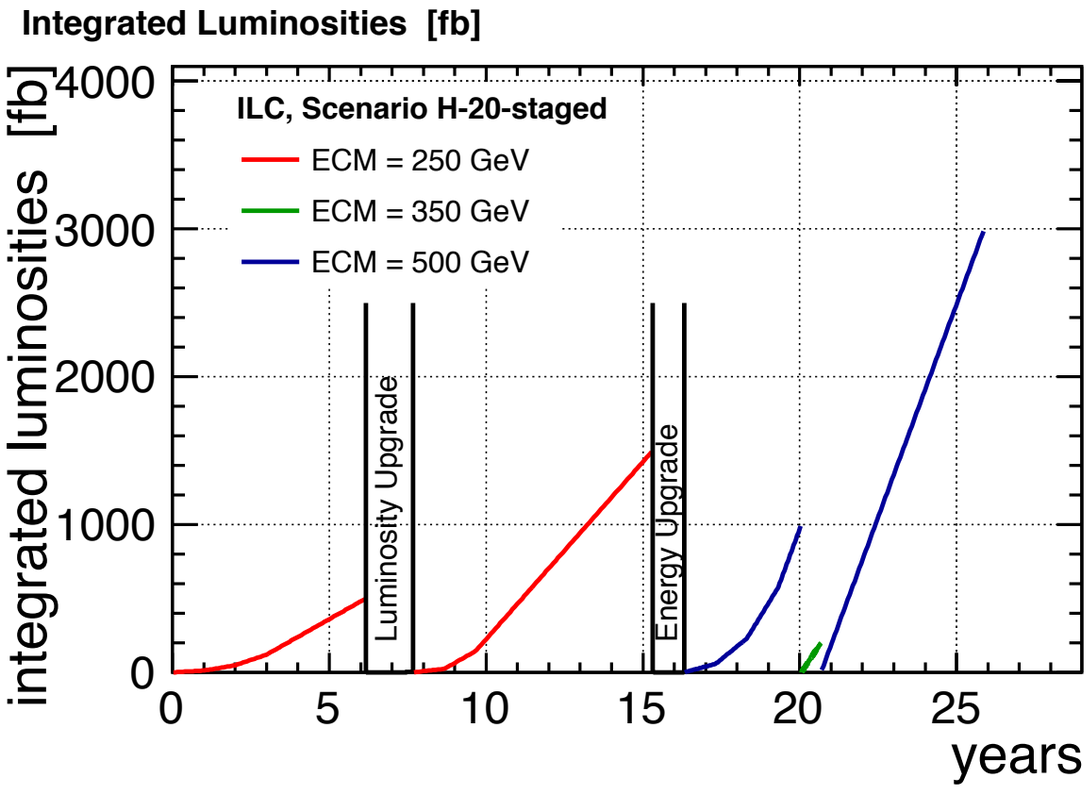
1. improved design of damping ring lattice
   => normalized horizontal emittance ~6 μm -> ~4 μm

2. revisited increase of emittance from damping ring to IP
   => emittance at IP ~10 μm -> ~5 μm

3. with these and TDR BDS optics, beam size at IP is reduced by a factor $\sqrt{2}$
   => geometric luminosity larger by a factor $\sqrt{2}$

4. smaller beam size => enhanced pinch effect => actual **luminosity larger by factor ~1.65** (CAIN)

Impact on Run Plan



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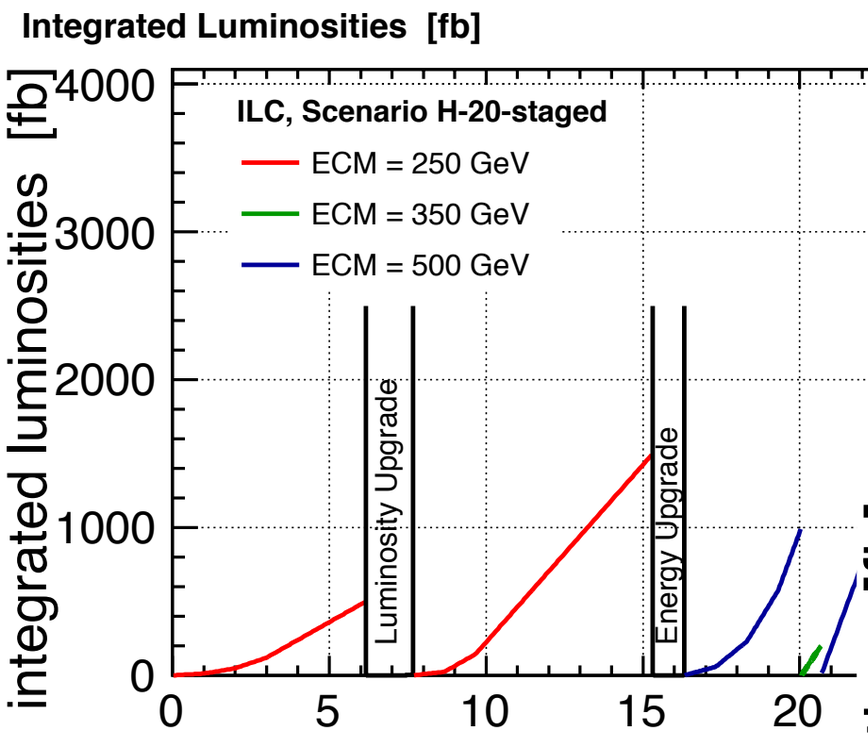

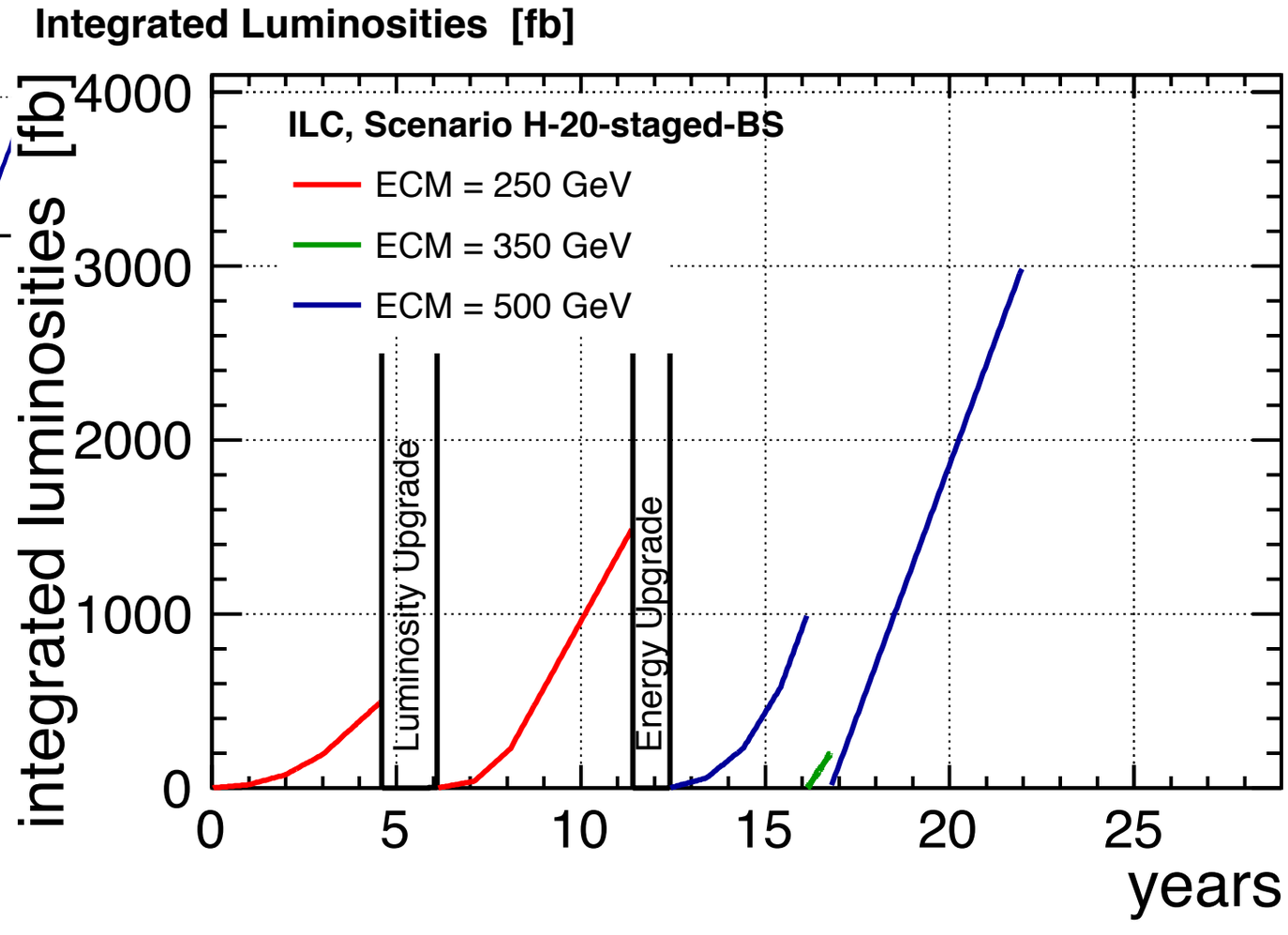

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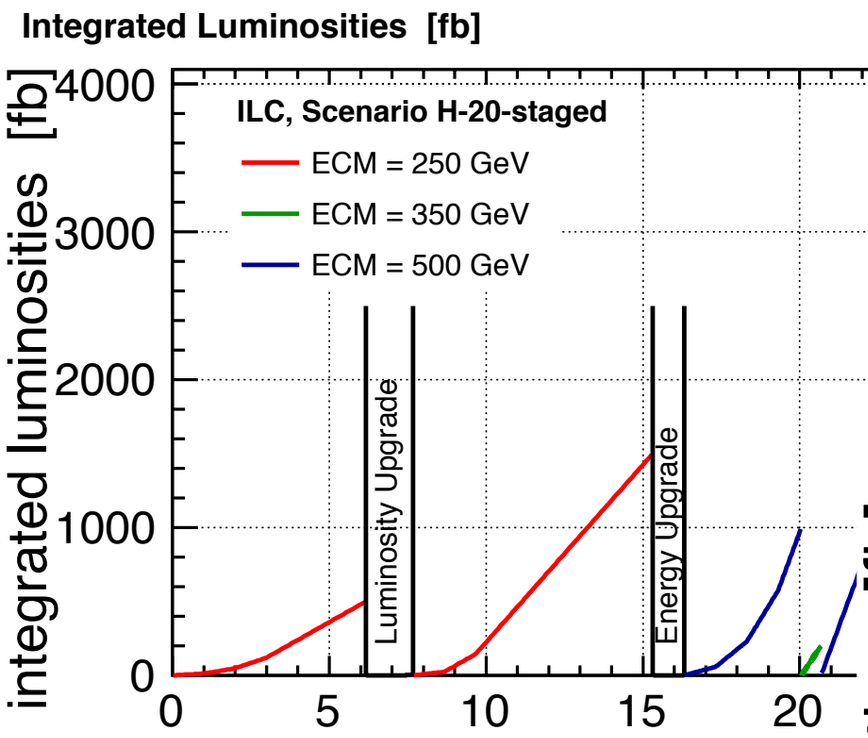
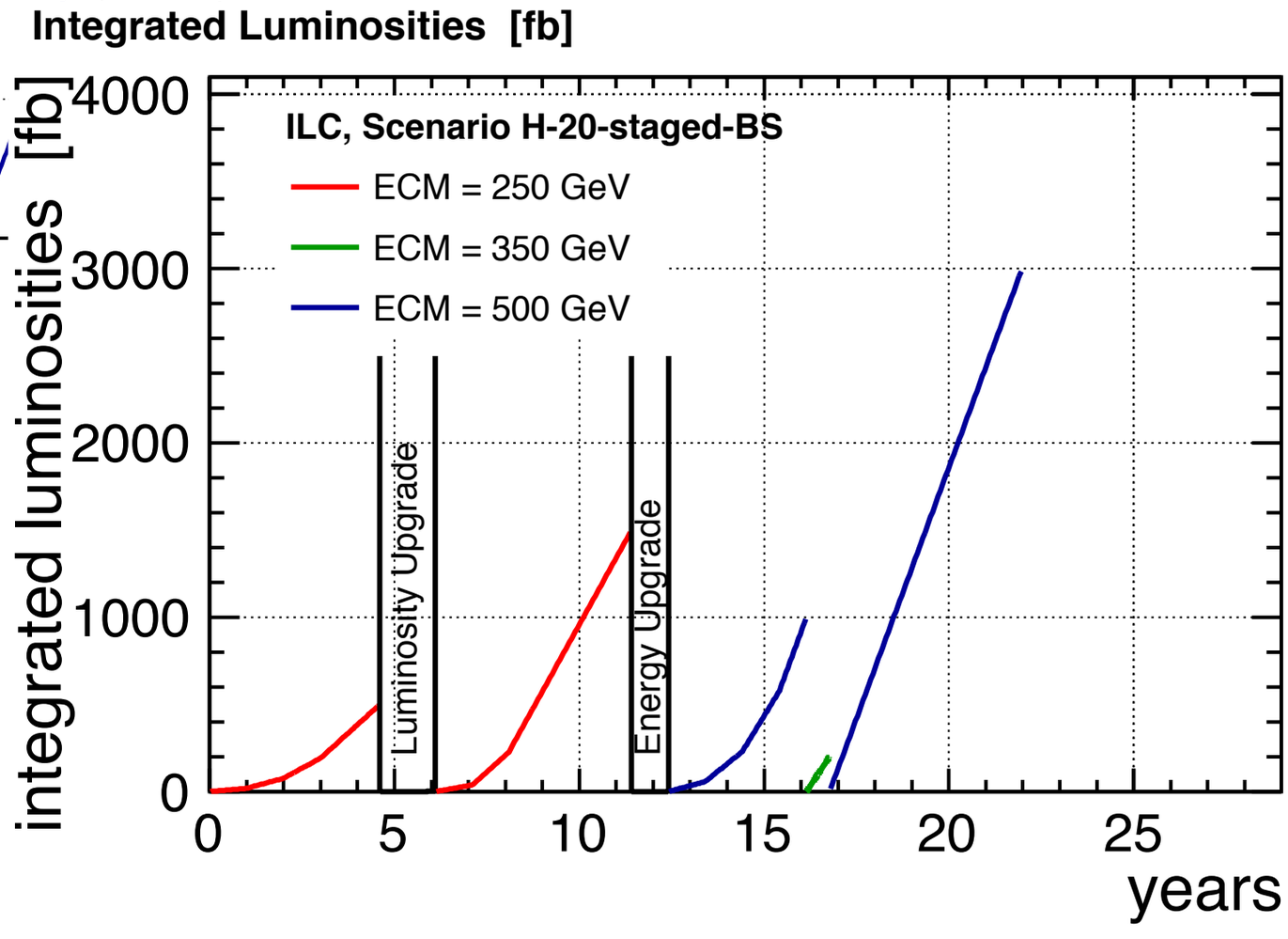


complete
2 ab^{-1} @ 250 GeV
after ~11 years
(instead of 15 y)



Potential Drawbacks

1. **vertical disruption parameter increases from ~25 -> ~35**
   => might need more accurate IP position control

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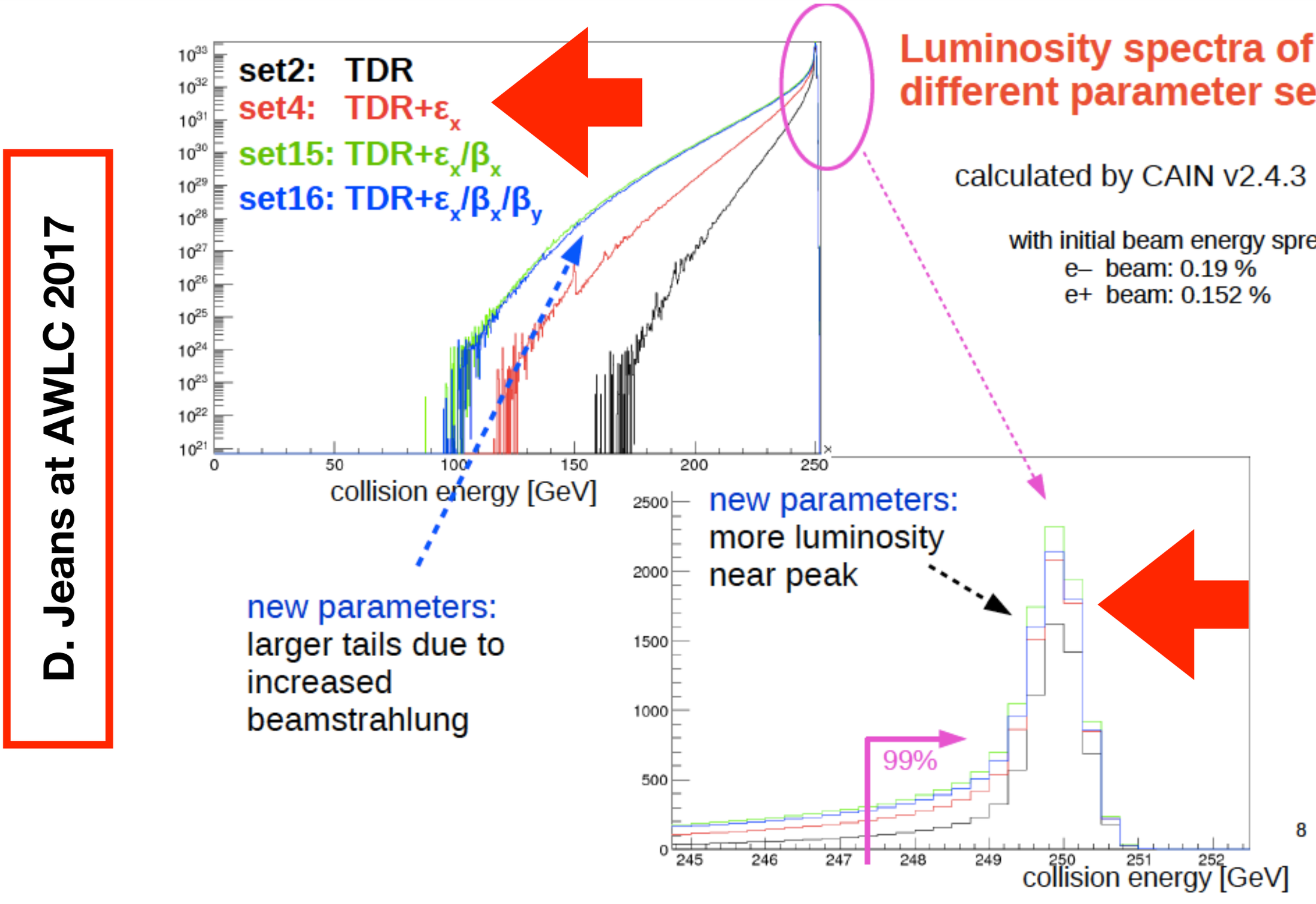
   => check impact on e.g. Higgs recoil mass!

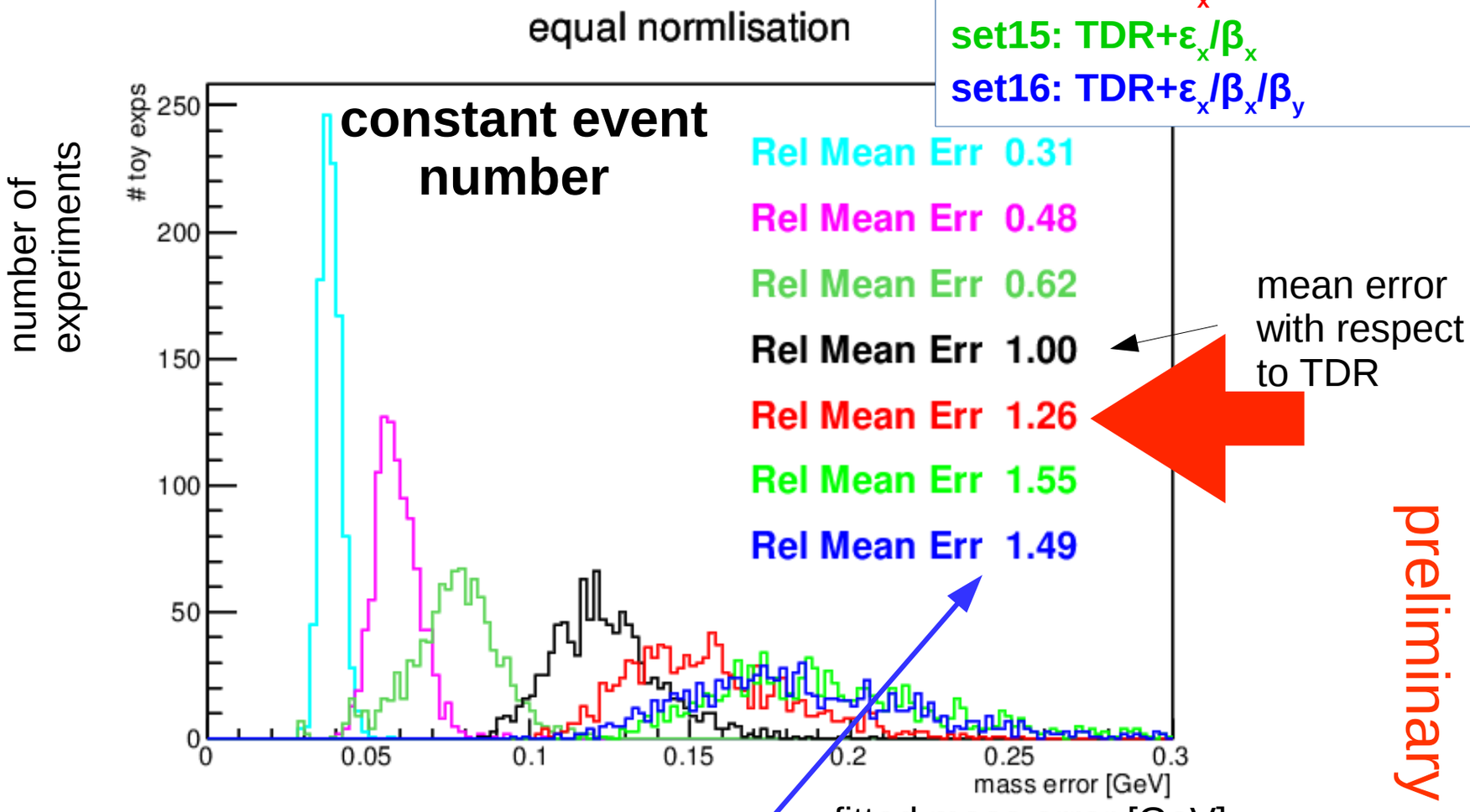
Luminosity spectra



Impact on Higgs mass

D. Jeans at AWLC 2017

expected mass measurement errors
using different beam spectra



with same **number of events**:
new spectra less powerful,
mass resolution degrades by 25 ~ 55% compared to TDR

Impact on Higgs mass

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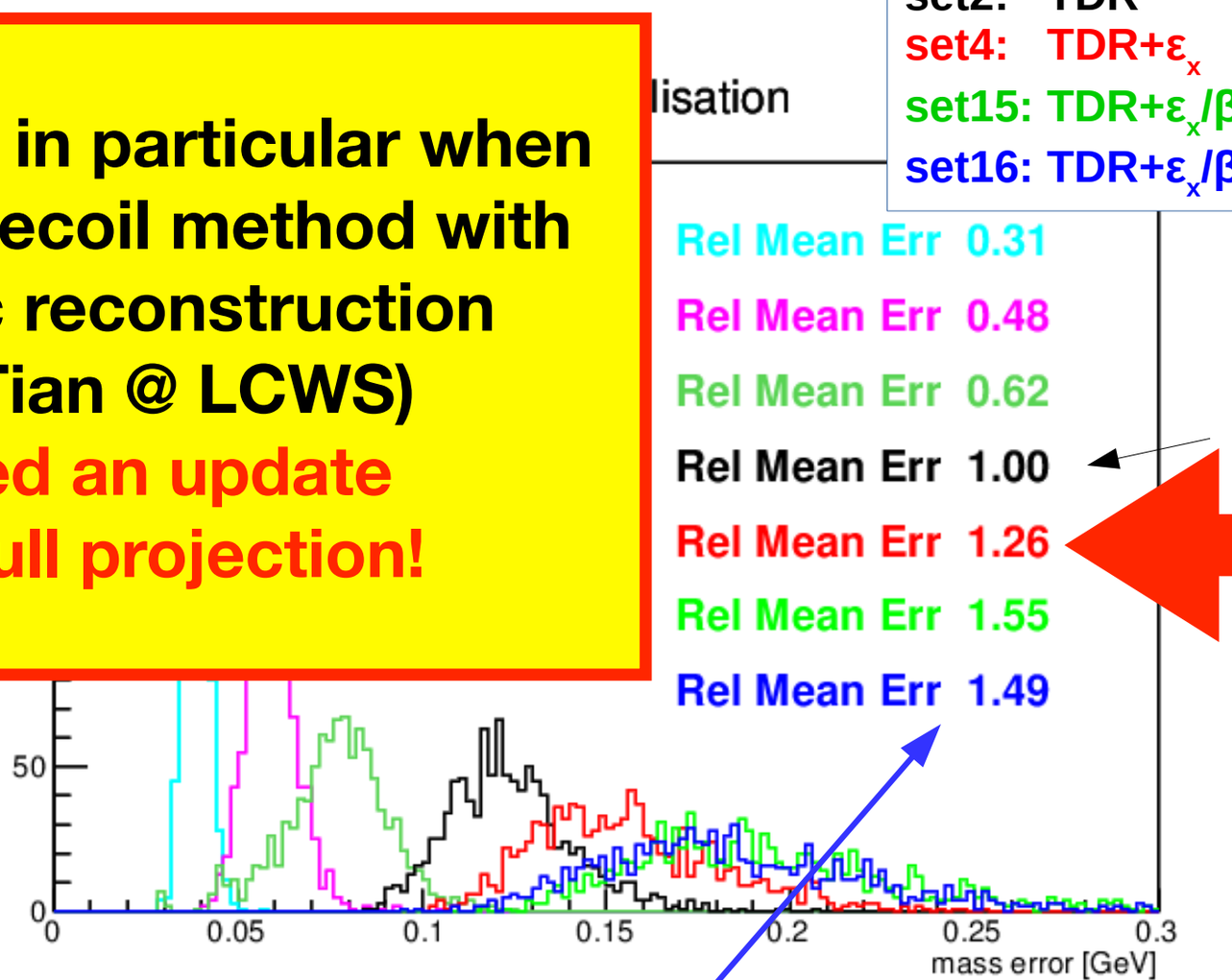
Probably ok, in particular when combining recoil method with kinematic reconstruction (c.f. J.Tian @ LCWS)
=> need an update of the full projection!



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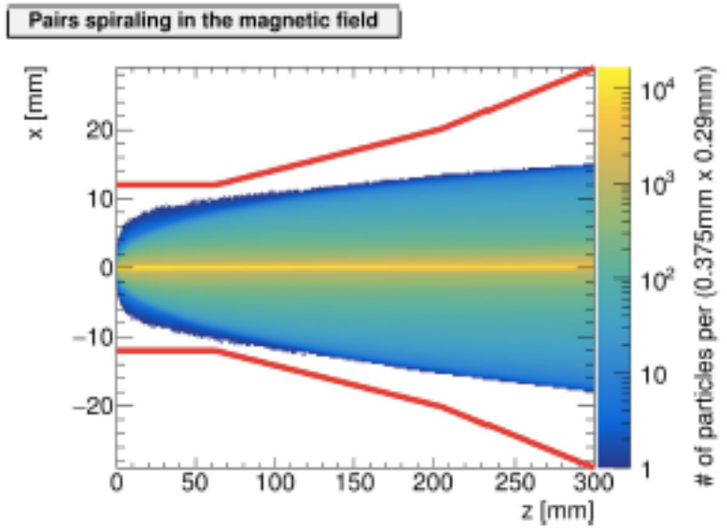
Drawbacks

1. vertical disruption parameter increases from ~25 -> ~35
   => might need more accurate IP position control

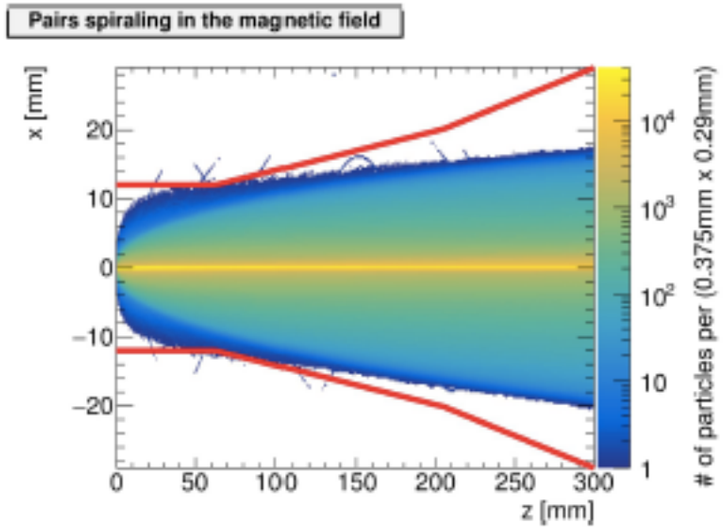
2. energy loss by beamstrahlung will be larger by a factor ~2.6
   => check impact on e.g. Higgs recoil mass!

3. **incoherent pair creation increases by factor ~3**
   => is it only the amount, or also the angle / energy spectrum?
   => any impact on VTX or BeamCal?

some of SiD's findings @ 5 T (A. Schütz, LCWS)



(a) ILC250 set (TDR)



(b) ILC250 set (A)

Hitting cone?
(no, note log scale…)

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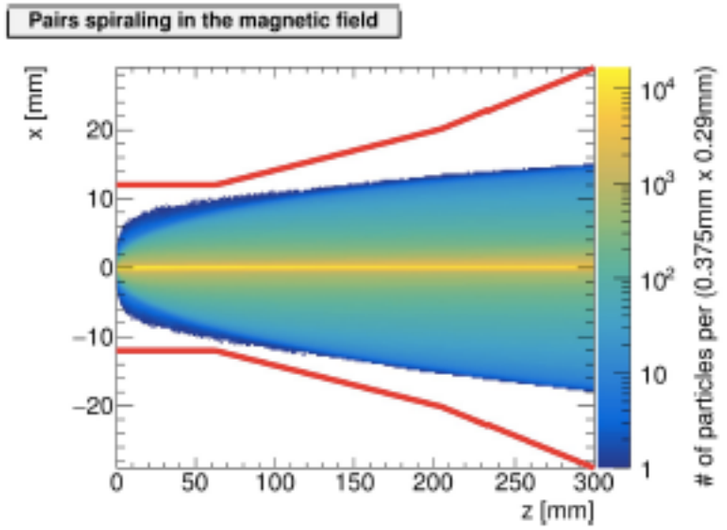

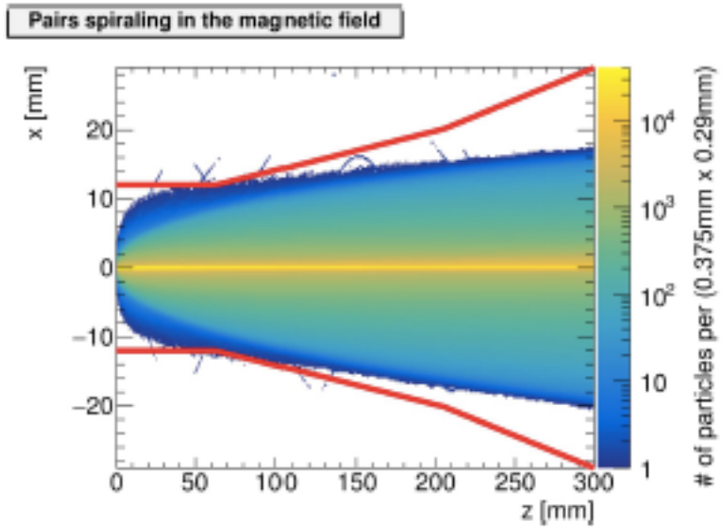

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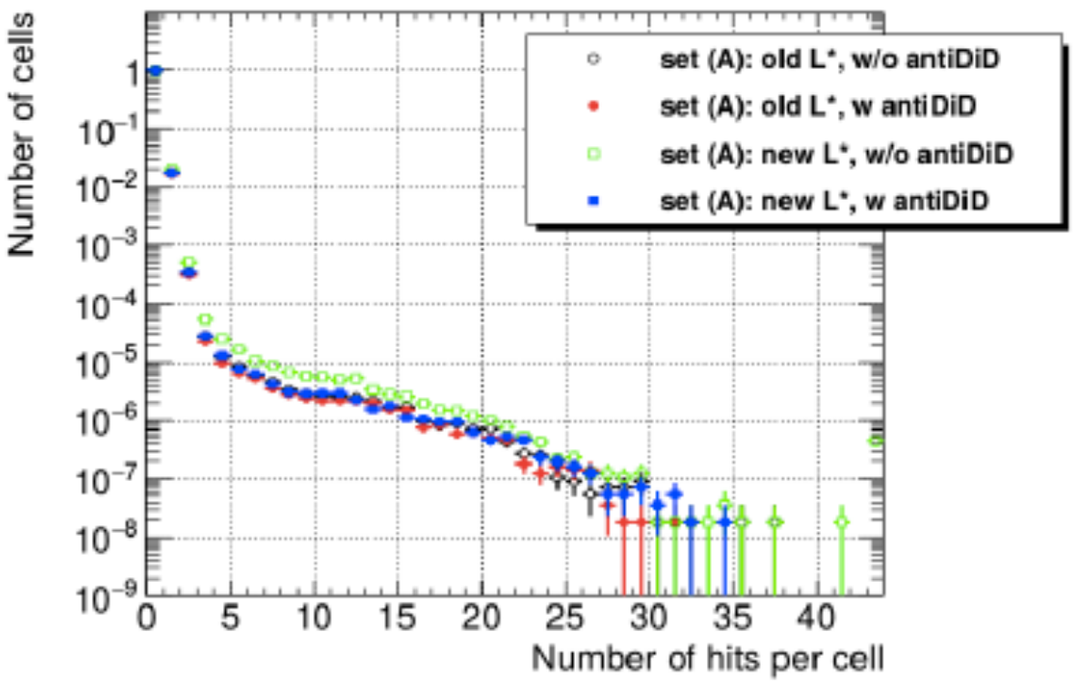
(a) ILC250 set (TDR) (b) ILC250 set (A)

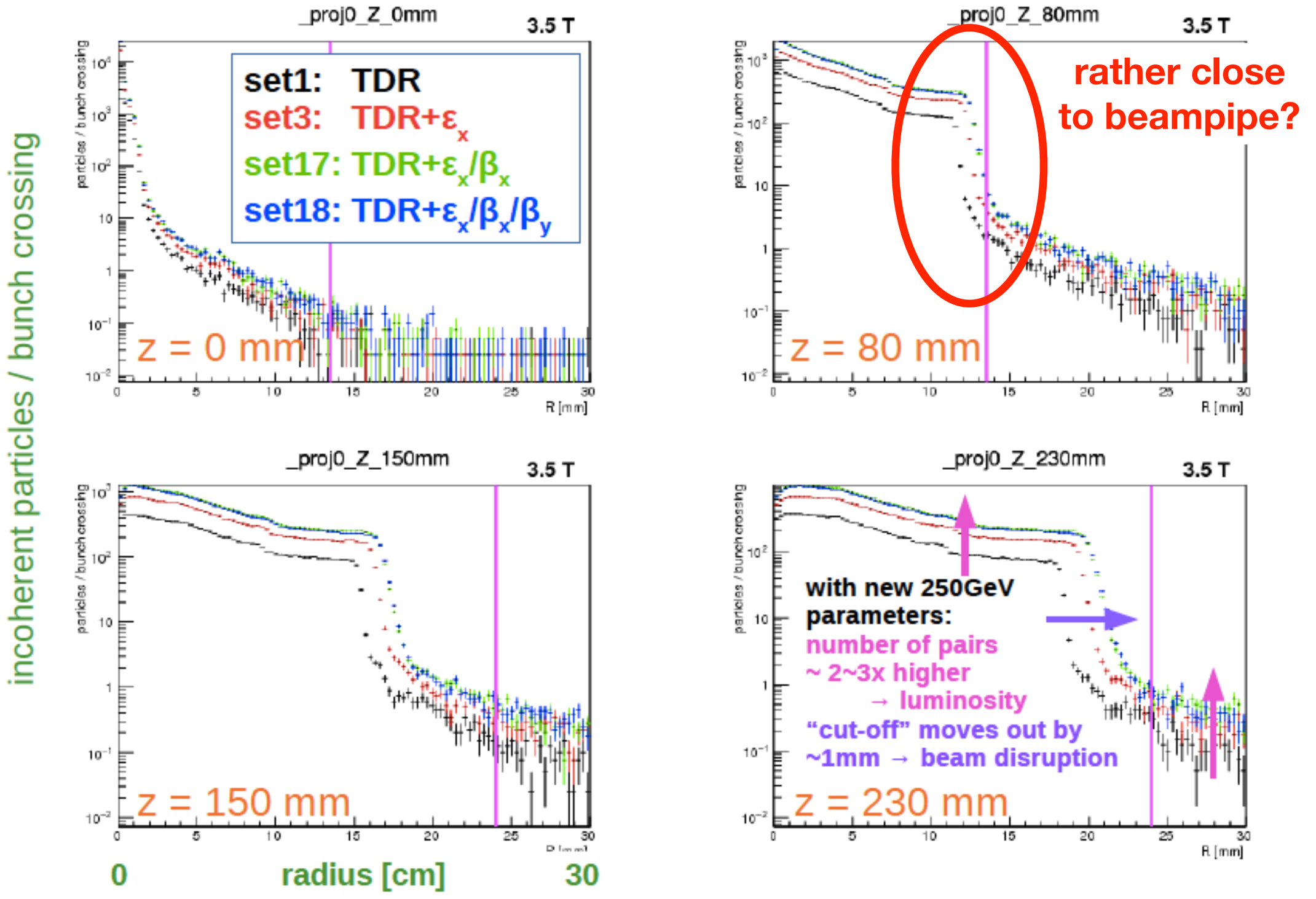


(b) Layer 0

VTX occupancy:
relative impact of anti-DID depends on L*

(note: "old L*" < "new L*" for SiD, so not directly transferable to ILD => we should finally have a look!)

ILD's findings (D. Jeans, AWLC)



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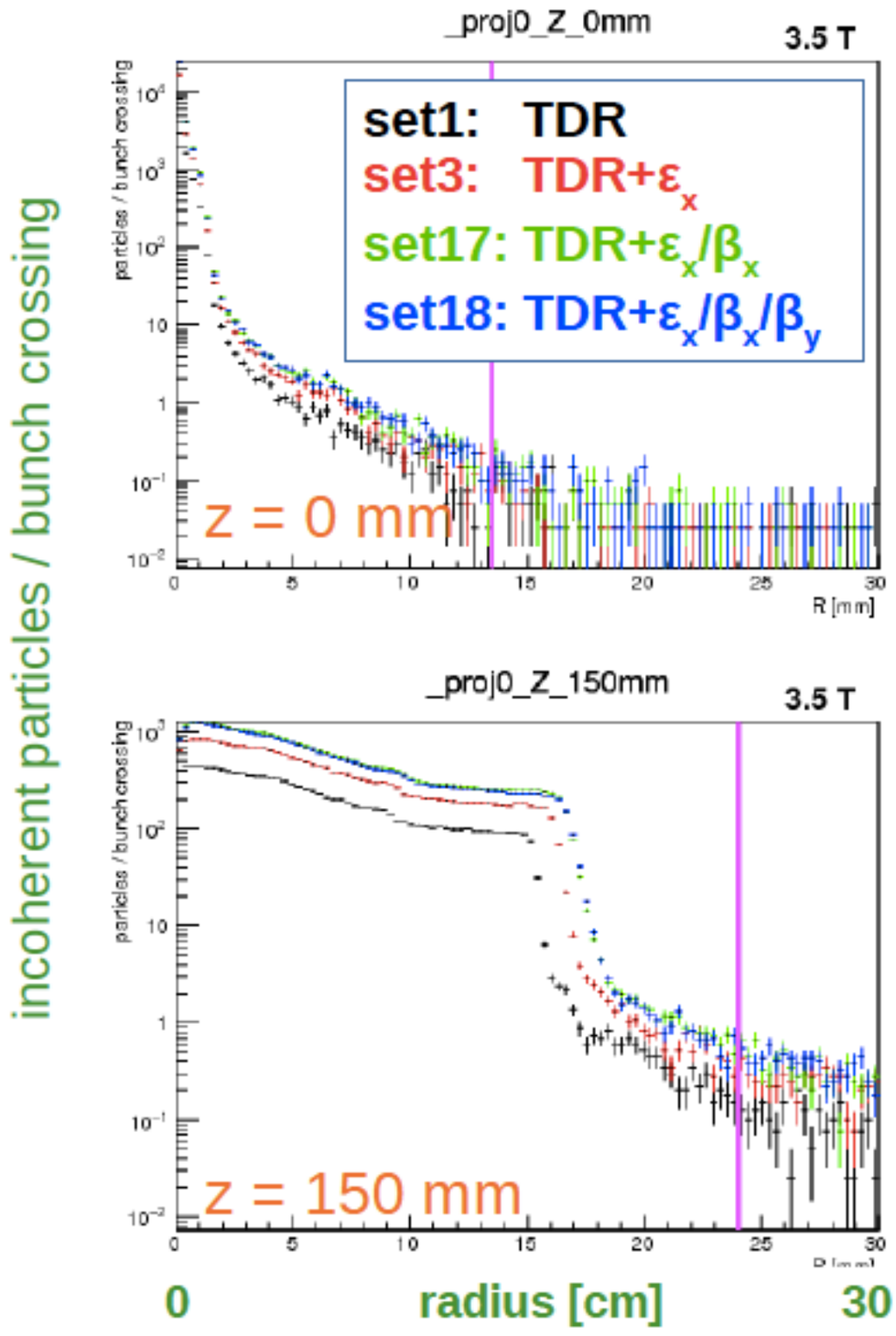
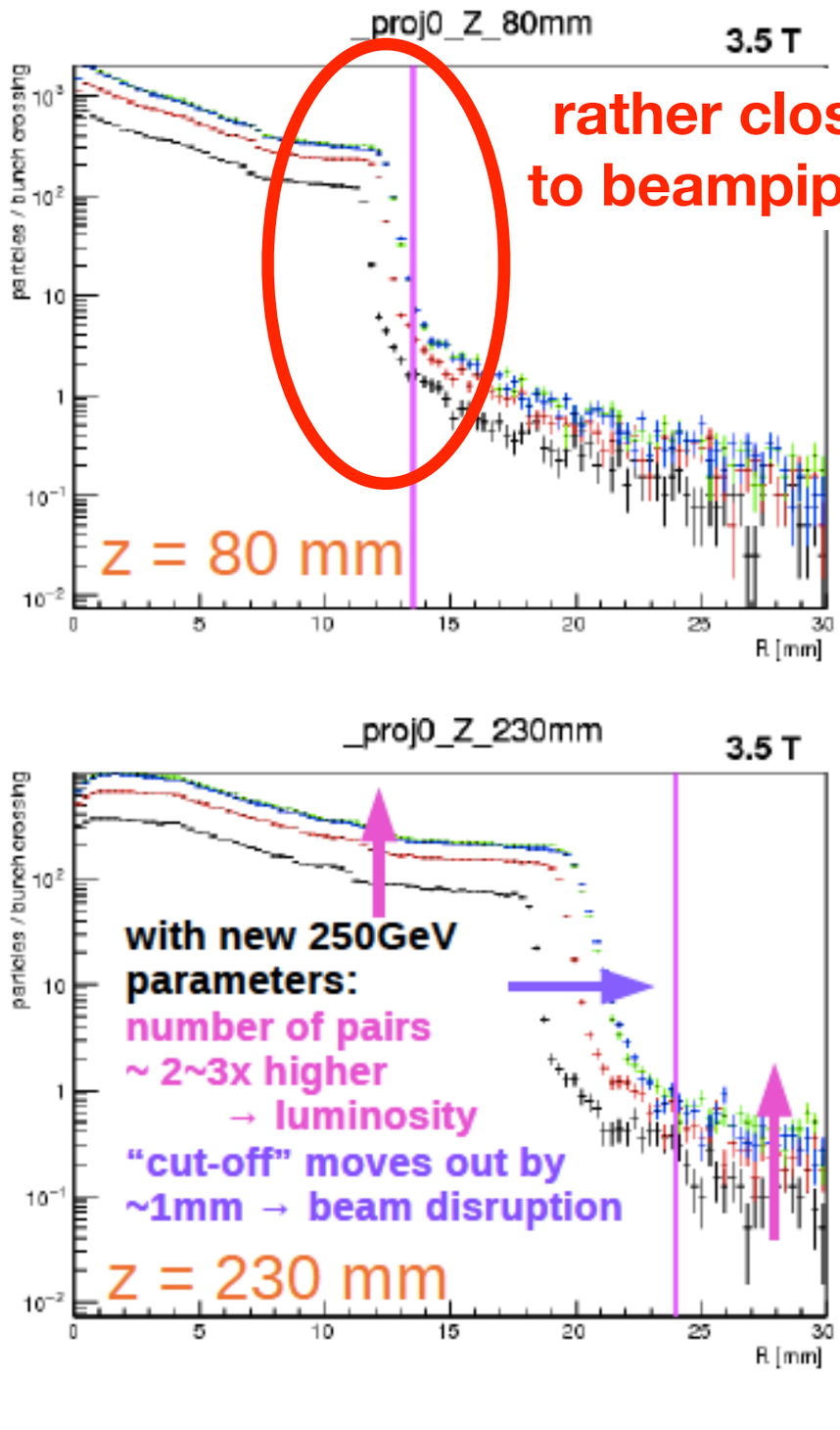
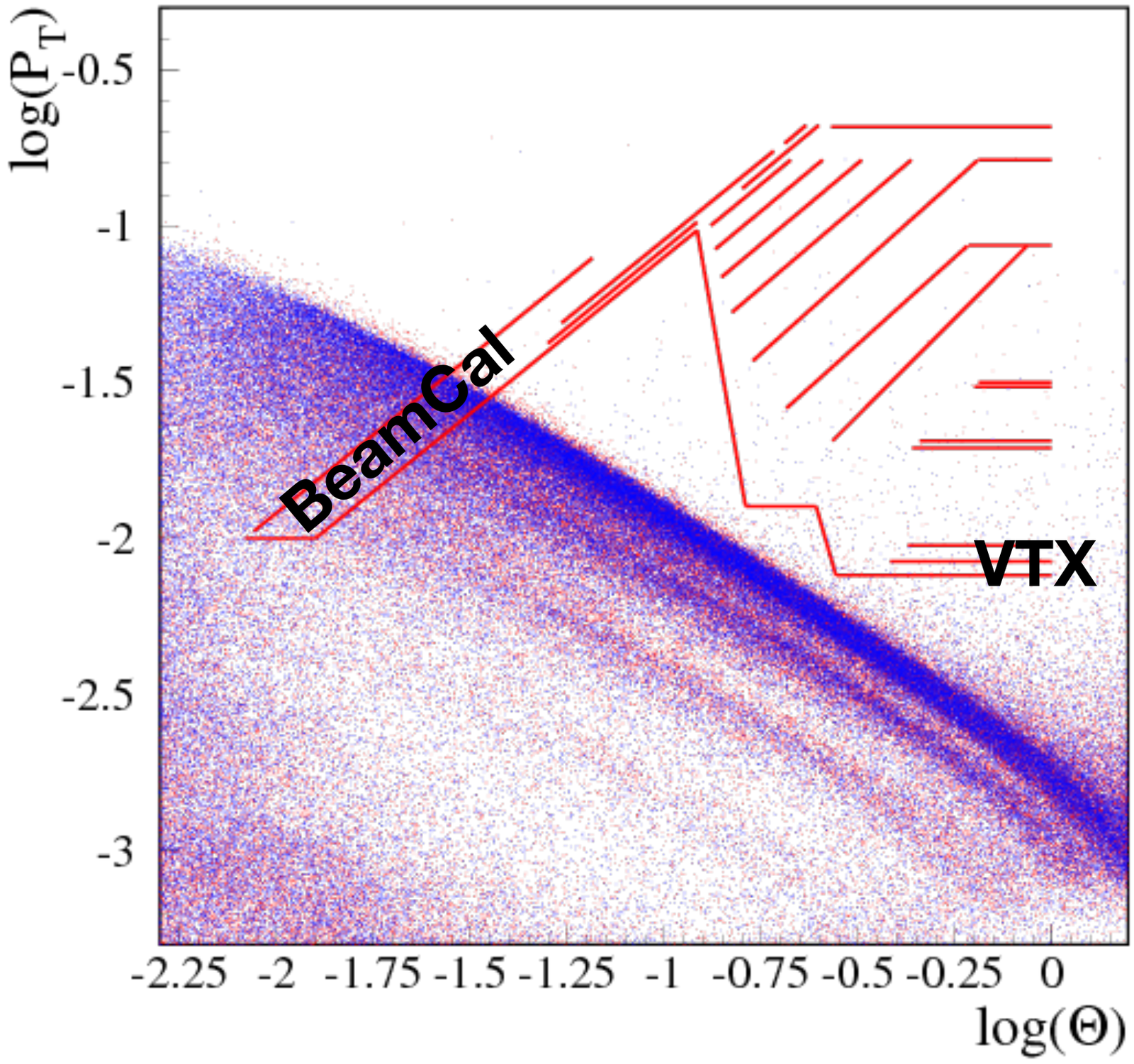




simple extrapolation in 3.5 T B-field no x-ing angle, backscatter etc

ILD's findings (M. Berggren)



Blue points: 500 GeV TDR

Red points: 250 GeV NEW

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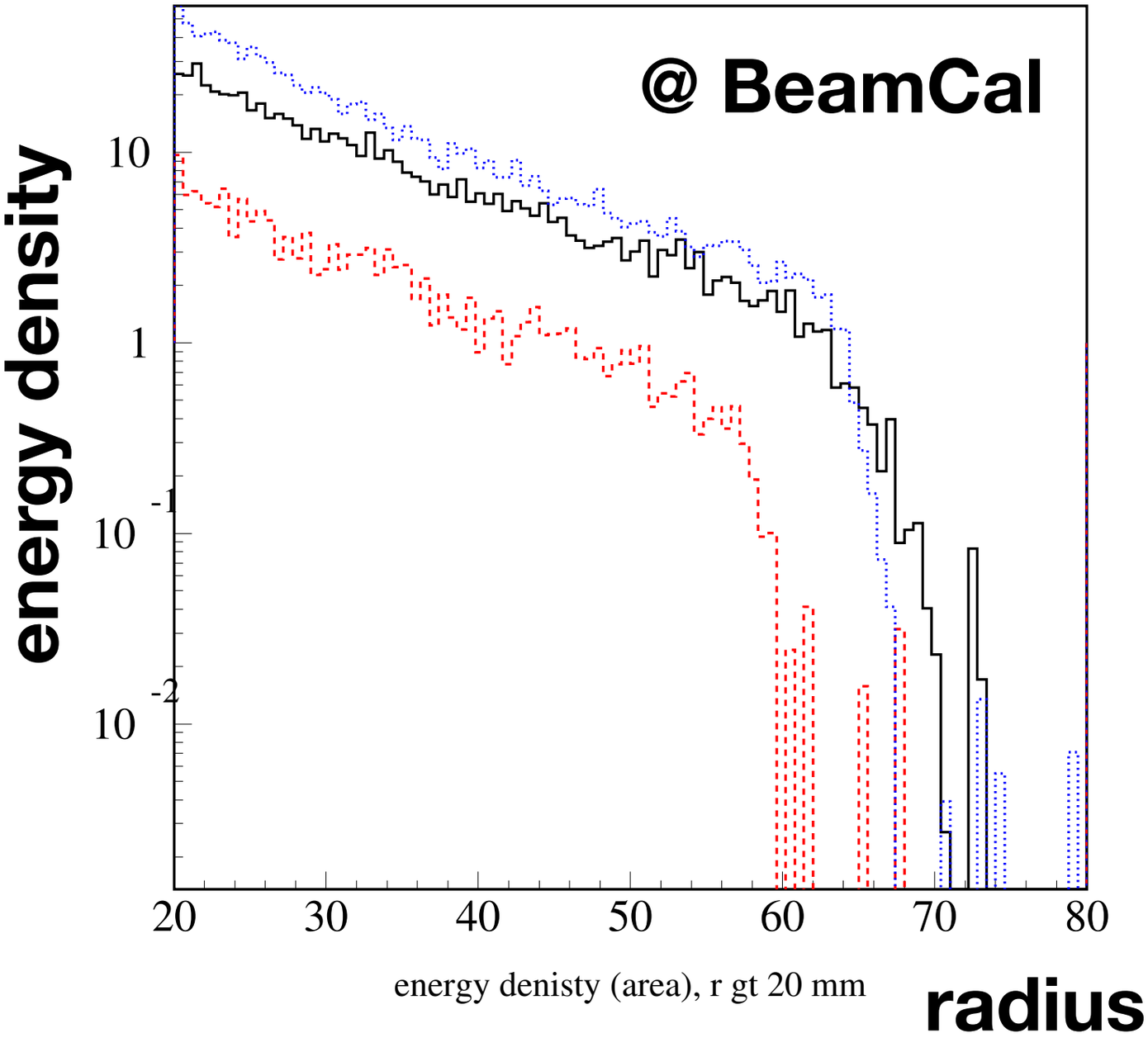

Blue:
500 GeV TDR

Black:
250 GeV NEW

Red:
250 GeV TDR

Conclusions

- increase in luminosity highly appreciated
  => communicated to TCMB @ Strasbourg

- ILD detector seems ok with new beam parameters

- but: statement based on simplified checks so far
  => still need to do the full studies,
  both on pair background and Higgs mass

- …and don't forget that we also changed L* since last complete background study!

- Does ILD need to assign higher priority (= more person power) to update of pair background etc?