Emittance for the ”2 windows – 2 beam dumps” injection scheme

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Summary from previous discussions

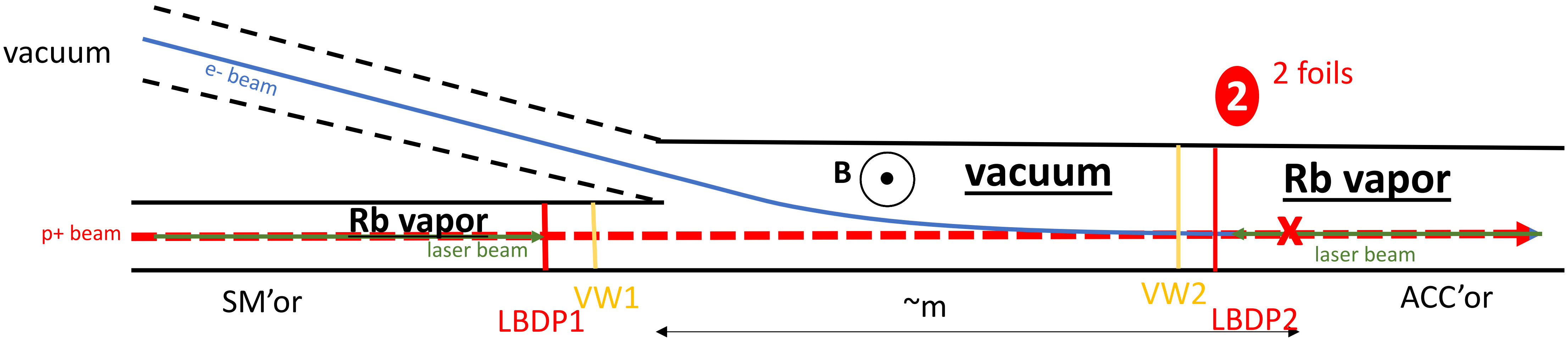
- Due to scattering in Rb vapor, we put aside the option with long Rb column and SiN window in the transfer line

- The option with the 3rd expansion volume is maybe not practical because of remaining scattering and implementation of the expansion volume in the transfer line (BUT: still to be checked)

- The realistic option left is the "2windows-2dumps" –to limit the scattering we are considering ~200nm SiN for the vacuum window and ~100 µm Al for the laser beam dump.
  → What is the smallest emittance we can inject?

Which scheme we are talking about

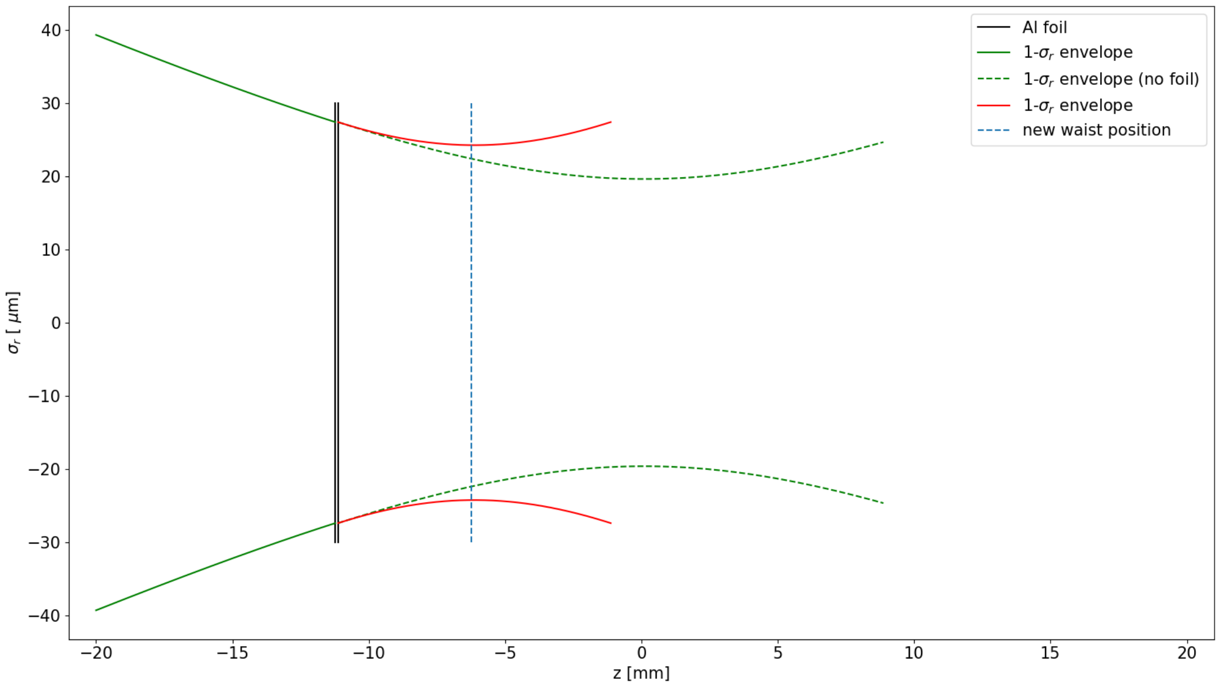
- 2 vacuum windows – 2 beam dumps
- Gap area in vacuum
- Electron beam crosses two foils before the waist



What happens to the beam

Multiple Coulombian scattering takes place:

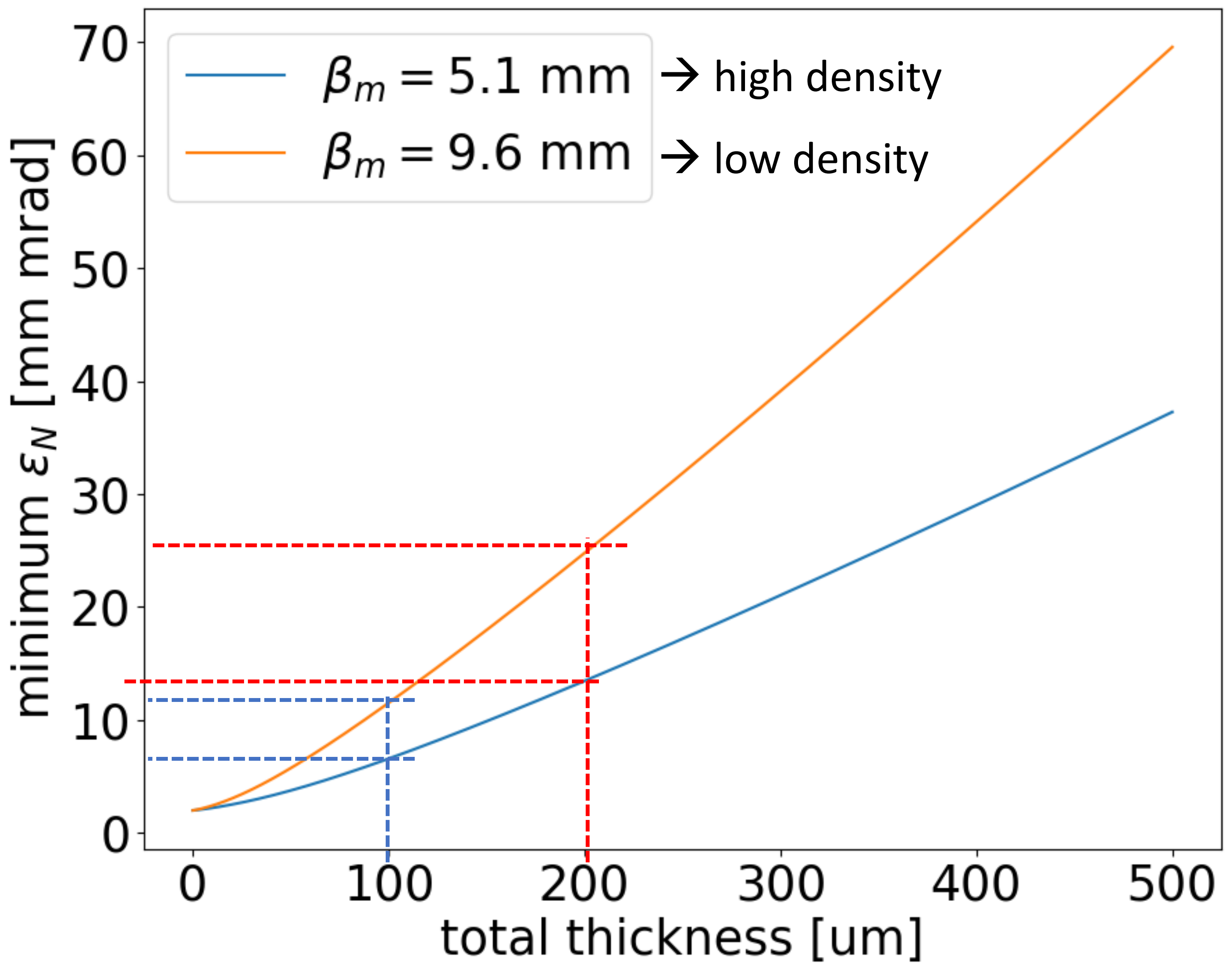
- emittance grows $\varepsilon_f = \sqrt{\varepsilon_i^2 + \sigma^2 \vartheta^2}$
- Assuming $\varepsilon_f \beta_f = \varepsilon_i \beta_i$ (σ = const at the foil), we can calculate β
- The position of the waist moves closer to the foil: $z_w = \sqrt{\left(\frac{\left(\varepsilon_f^2 + \varepsilon_i^2\right)}{\vartheta^2 \, \varepsilon_i} - \beta_f^*\right) \cdot \beta_f^*}$



With the request that $z_w > 0$ we can calculate the minimum emittance we can achieve after the scattering

Minimum emittance at the injection point

initial emittance: 2 mm mrad



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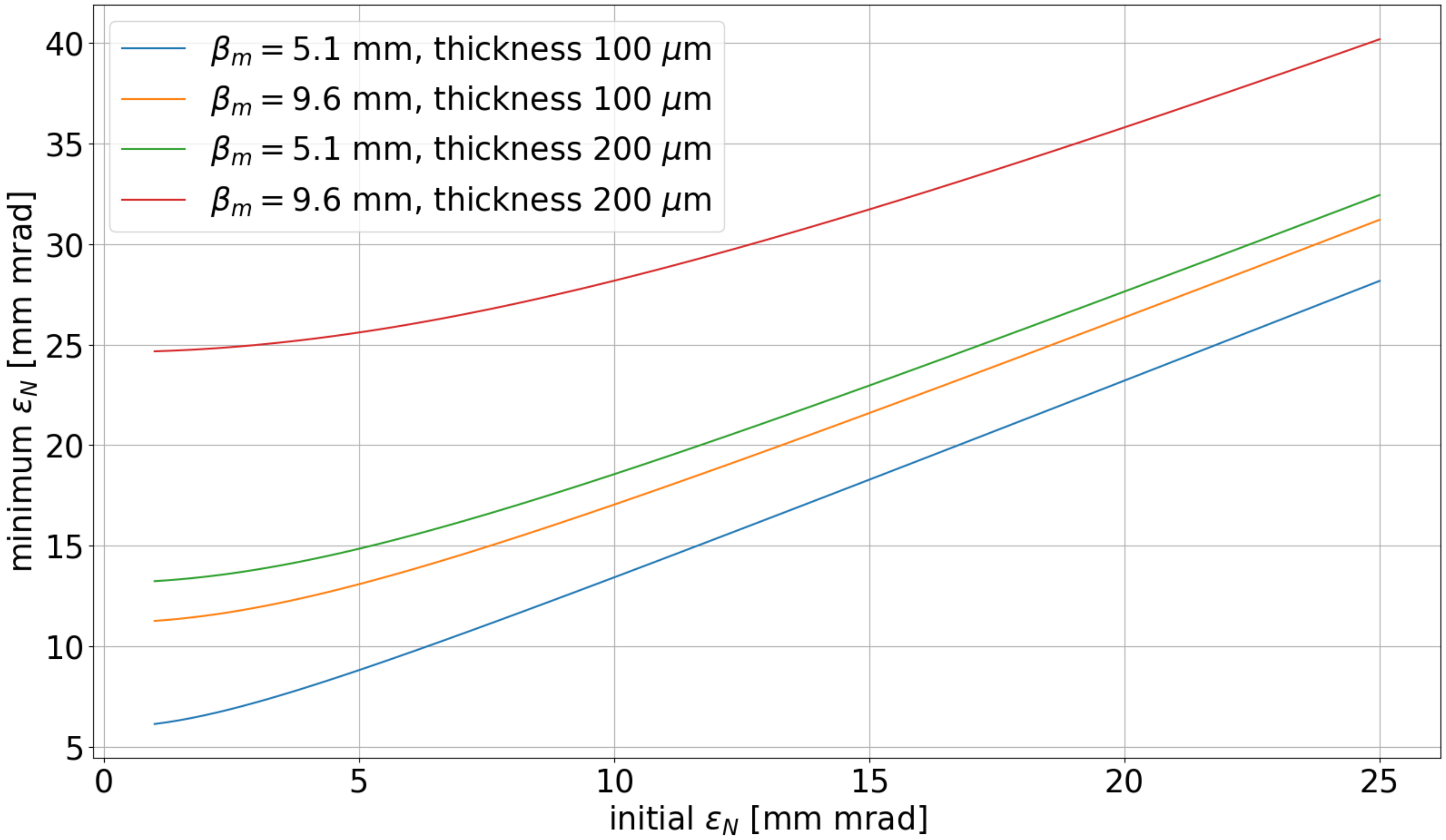

Conclusions

- We should limit as much as possible the amount of material on the beam path
  e.g: 200 nm Si_3N_4 membrane (window) + 100 um Al (LBDP)

- Final AWAKE beam delivery to experiments will likely happen at high density --> we have a chance to keep the injected emittance below 10 mm mrad, if e-source and TL provide <2 mm mrad

- BUT: all our preparatory and physics studies will start at low density
  →can we do measurements with ~ 10 – 15 mm mrad (blowout, beam loading..) and prove our claims before moving to high density?

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AWAKE, WDL, VACUUM

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RF,ABT

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SIMULATIONS, RF, ABT, ALL

Thank you for your attention!