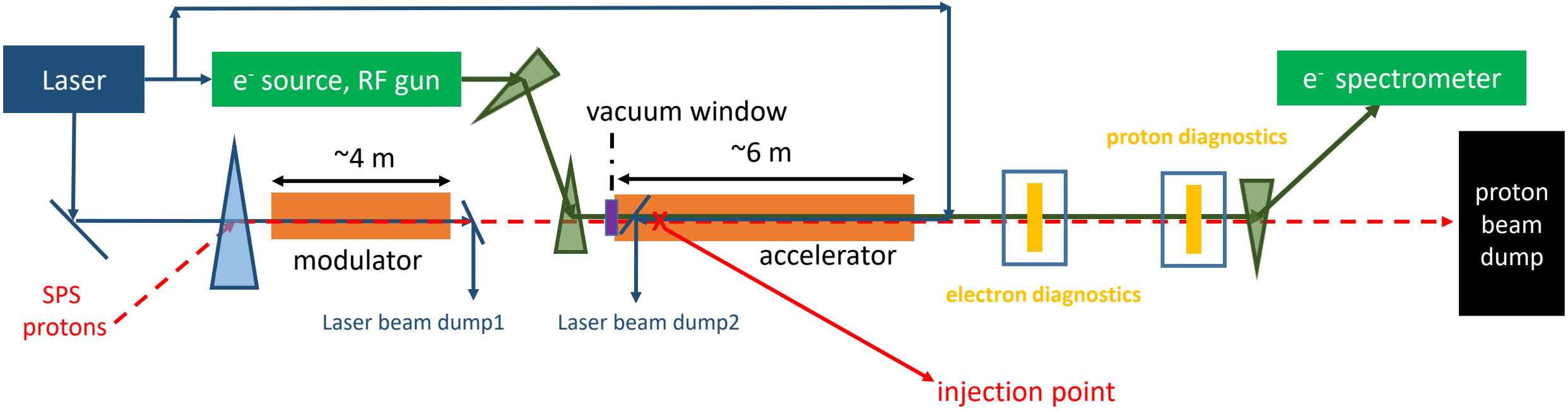
Run2 layout


Laser
e⁻ source, RF gun
vacuum window
~4 m
~6 m
proton diagnostics
e⁻ spectrometer
proton beam dump
modulator
accelerator
SPS protons
Laser beam dump1
Laser beam dump2
electron diagnostics
injection point

- %-level energy spread → beam loading
- emittance preservation → blowout regime

} beam matching is a necessary condition

Matching: wakefield focusing force exactly compensates beam divergence.

In the blowout: $E_r = \frac{n_e\, e\, r}{2\, \varepsilon_0}$ $\xrightarrow{\text{eq. motion}}$ $\frac{d^2 r}{dt^2} = q\, E_r$

$$r(t) = r_0\, e^{i\frac{\omega_p}{\sqrt{2\,\gamma}}t} = r_0\, e^{iKt}$$

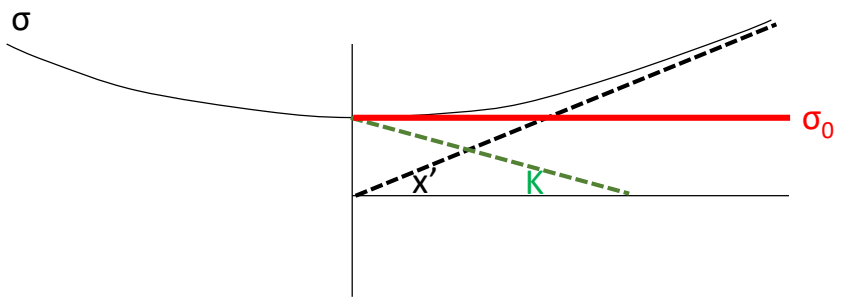
envelope equation: $\sigma'' + \underbrace{\left(K^2\sigma - \frac{\varepsilon^2}{\sigma^3}\right)} = 0$

= 0, if beam is matched

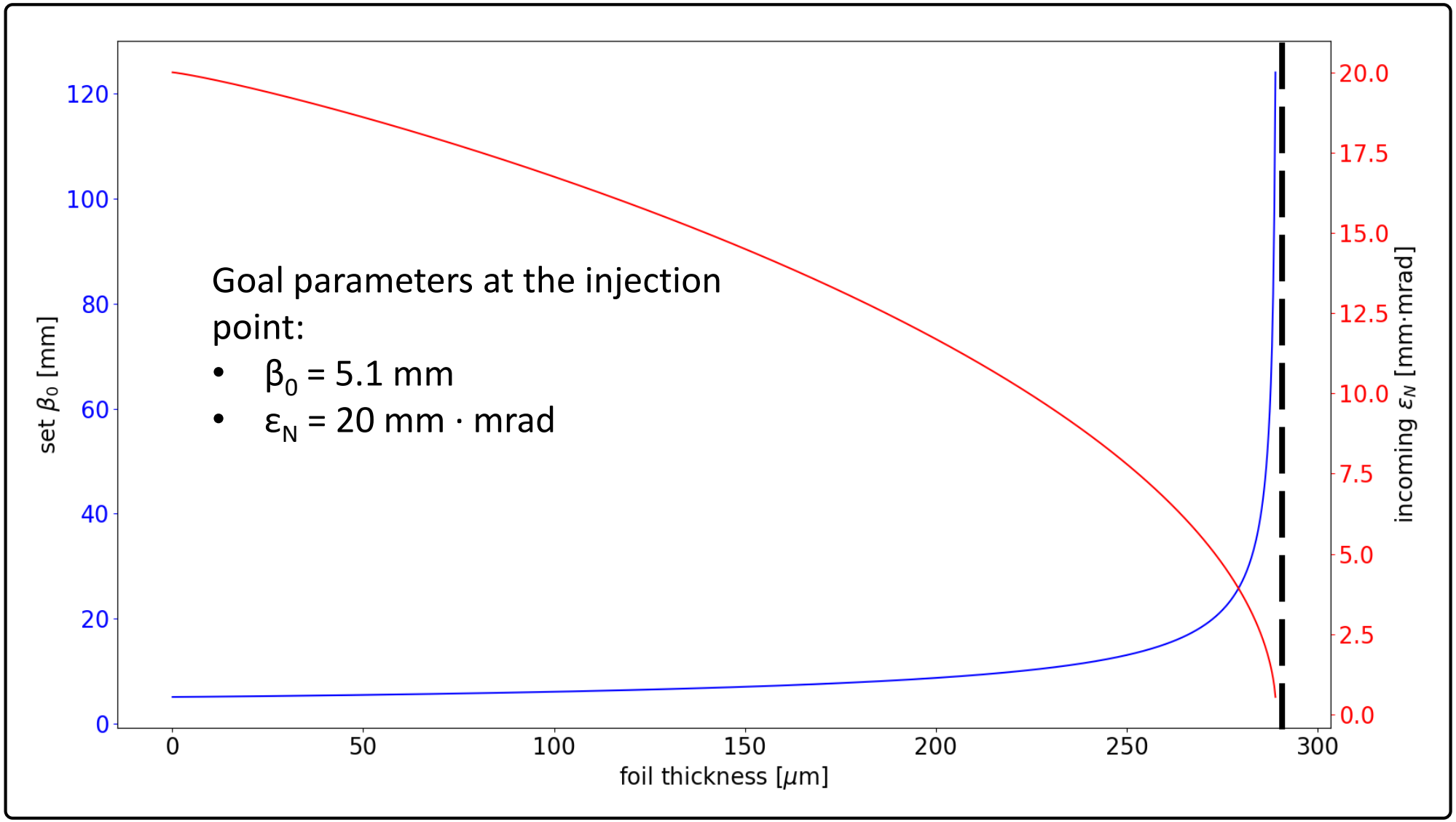
$$\beta_0 = \sqrt{\frac{2\,\epsilon_0\, m_e\, c^2\, \gamma}{n_e\, e^2}}$$

matching is only β dependent!

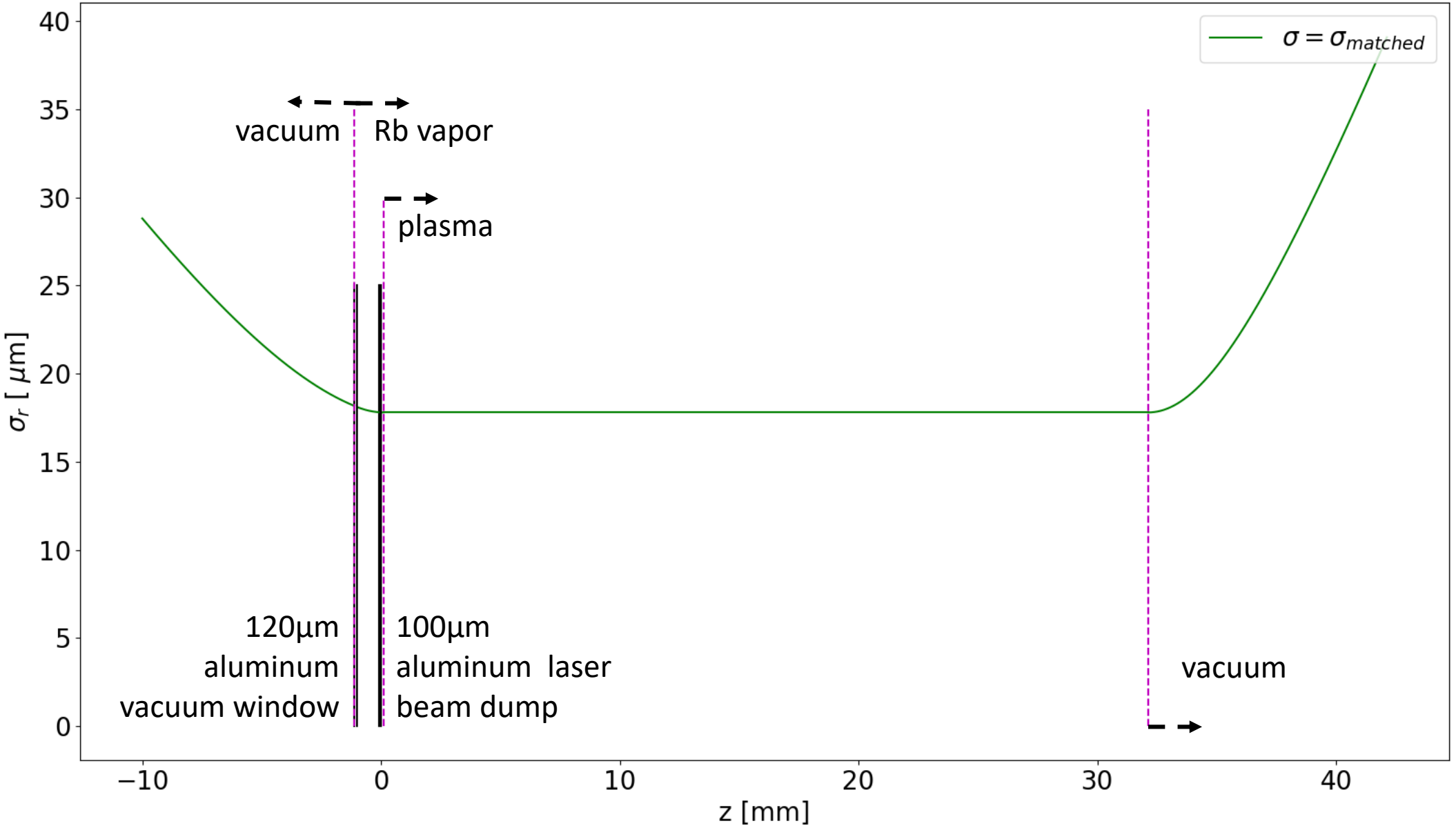
if the beam is injected at the waist ($\sigma'_0 = 0$) with a spot size σ_0, the beam size can be preserved along the plasma



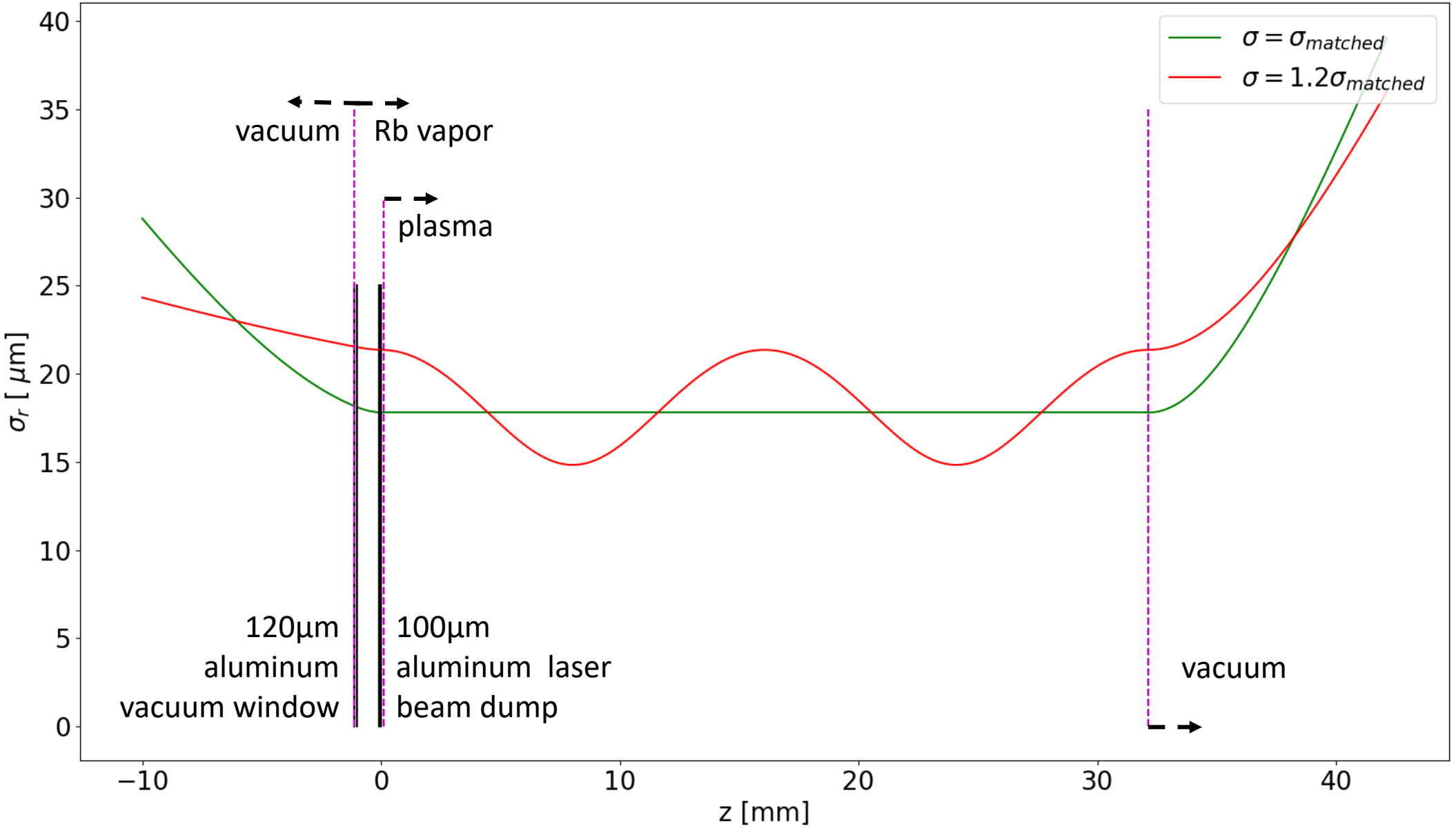
Foils increase emittance and shorten beta function
→ calculate backwards the incoming parameters



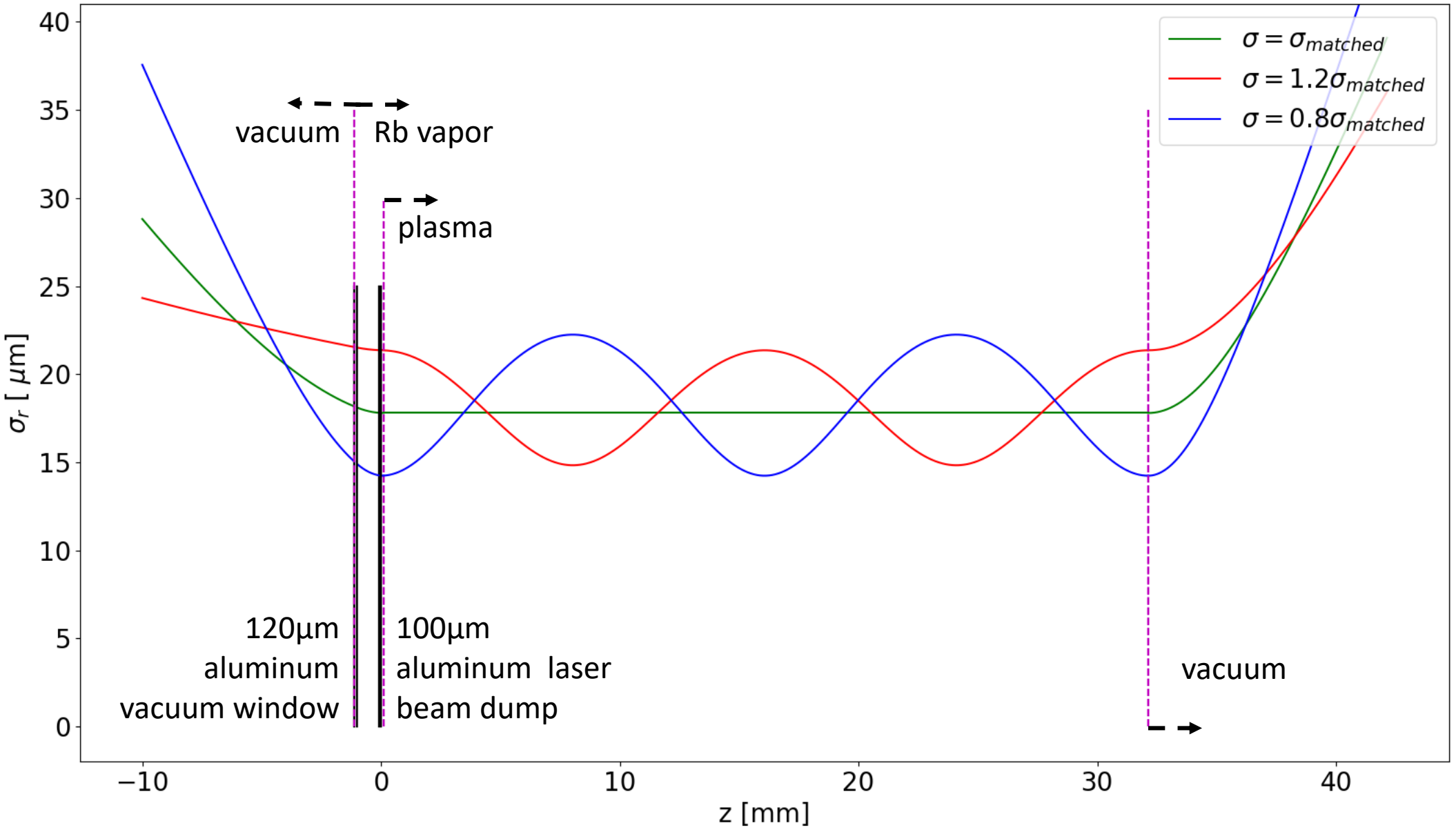
for E = 165 MeV and n_e = 7E+14 cm^{-3}, β_0 = 5.1 mm



for E = 165 MeV and n_e = 7E+14 cm^{-3}, β_0 = 5.1 mm



for E = 165 MeV and n_e = 7E+14 cm^{-3}, β_0 = 5.1 mm



Next:

- How do we include energy spread in matching?
- What if we don’t inject exactly at the waist?
- How do we check we are (not) matched, looking at the accelerated beam?
- How do we measure the incoming beam parameters?

Stay tuned!