

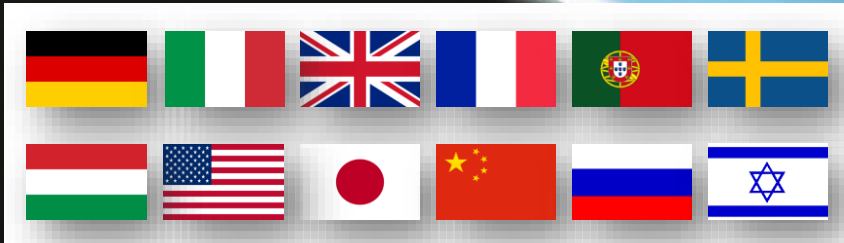
EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS



Imperfections, Redundancies, Diagnostics, Control&Feedback

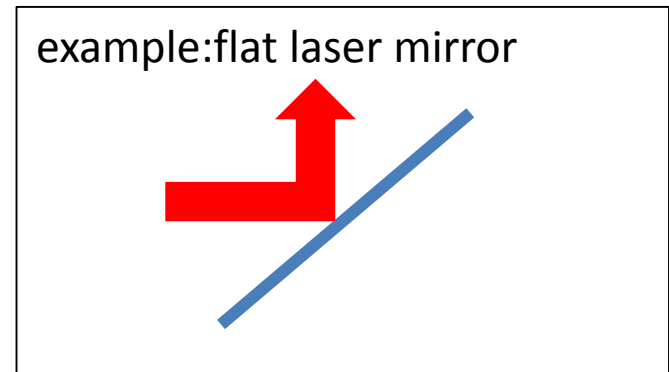
Discussion convener:

Arnd Specka, LLR Ecole Polytechnique – CNRS/IN2P3



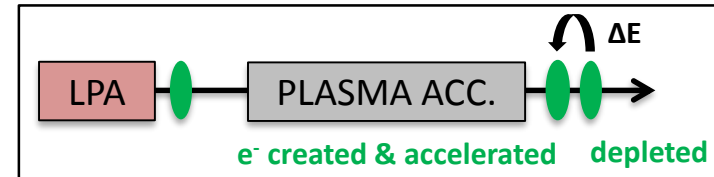
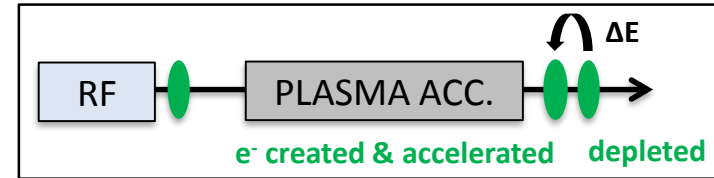
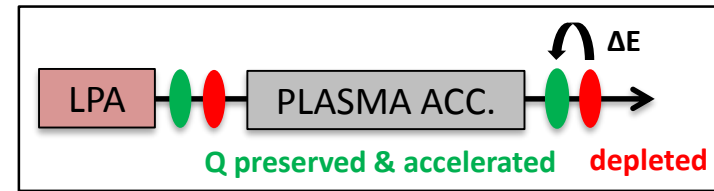
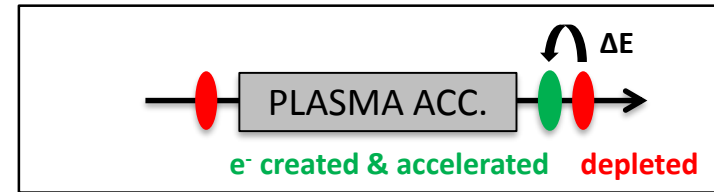
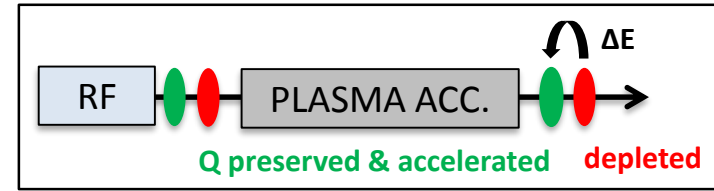
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 653782.

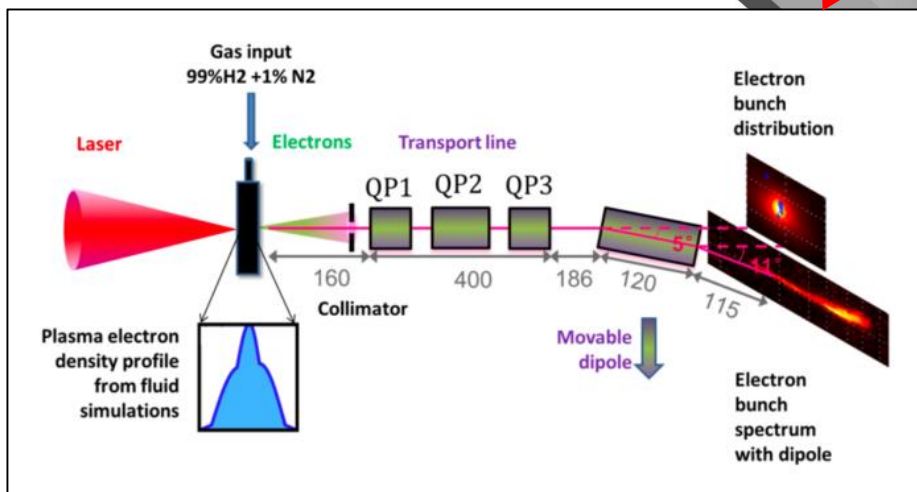
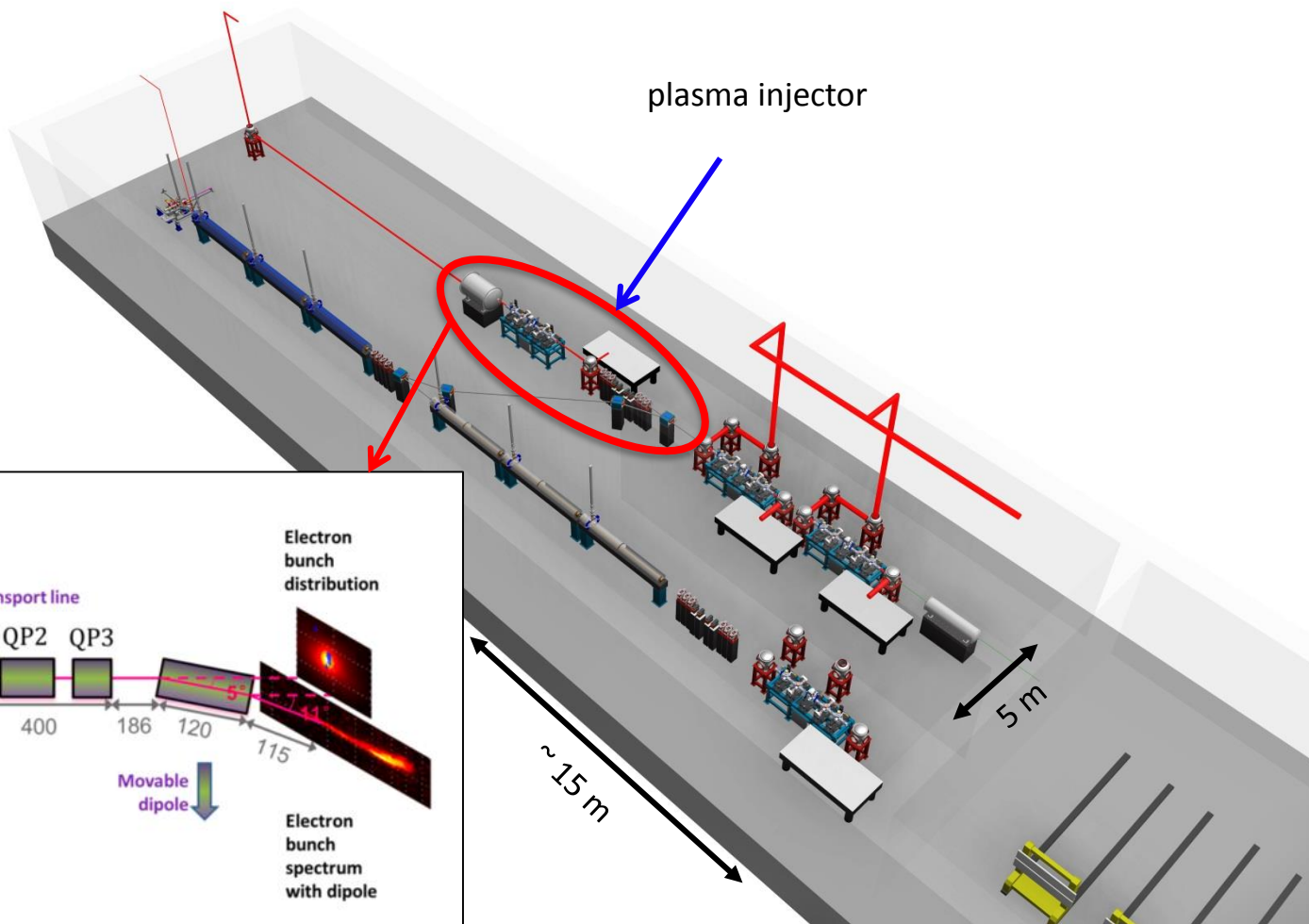
- Original title of the session:
Diagnostics & correction devices (dipoles, mirrors,...), realistic imperfections and required redundancies
- Imperfections : **assess!**
- Redundancies : **anticipate!**
- Diagnostics : **measure!**
- Control&Feedback : **mitigate!**
- **AIM: list of diagnostic/control elements with their**
 - functionalities
 - footprint & geometry constraints
 - measurement/action ranges
 - measurement/action precision



- one-does-it all v/s
- one-by-one option
- RW: user area perspective

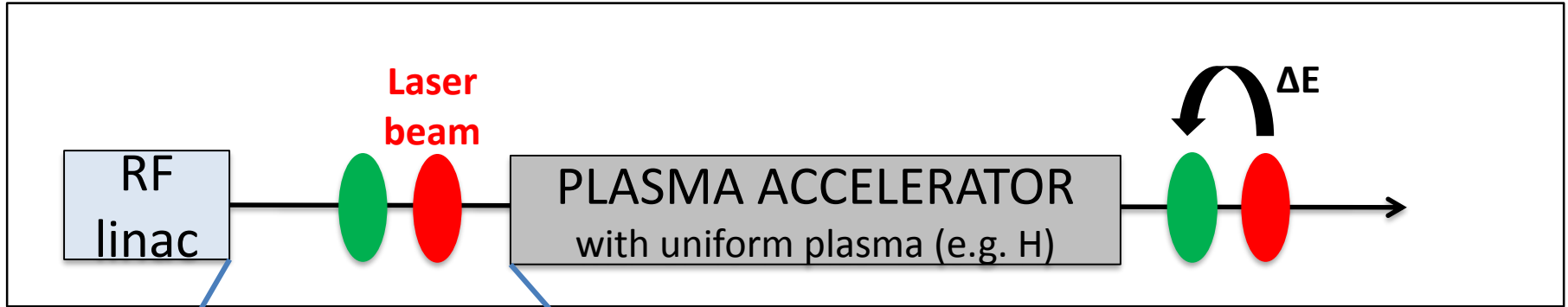
- **identify clearly which monitoring and control functionalities are common to all, which are proper to a single configuration**





See poster: B. Cros et al., 'Electron injector for multi-stage laser-driven plasma accelerators', IPAC'17, **WEPVA001**

3D design by Dariusz Kocoń (ELI-Beams)



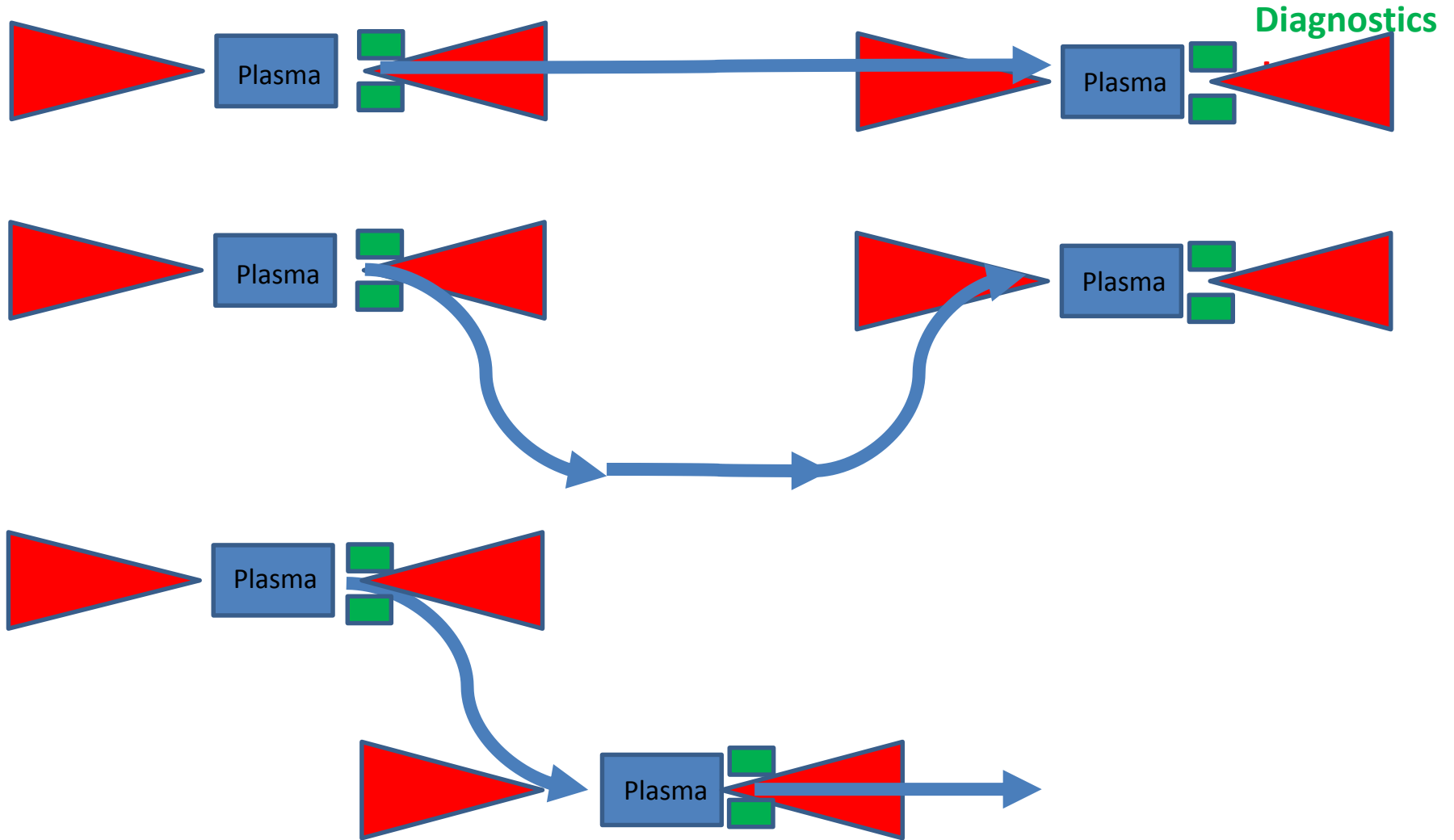
- Laser injection
- electron injection
- Laser diagnostics
- electron diagnostics

electron injection

electron diagnostics

Laser injection

Laser diagnostics



- determine working point(s) of plasma accelerator(s)
- determine robustness/sensitivity of these WPs to:
 - how are parameters of outgoing electron beam affected
 - driver parameters (laser or particle)
 - plasma parameters
 - simulations (full PIC, simplified?) -> WP2
published results -> WP3
- **=> sensitivity response matrix also for LPFA PWFA**
- define “phase space acceptance” of WP (injection efficiency)
- define desired measurement ranges for outgoing electron beam diagnostics

- incoming electron beam (all schemes)
- incoming laser beam (laser driver)
- outgoing electron beam (all schemes)
- [outgoing laser beam (laser driver)]
- plasma diagnostics (n_e, \dots)
-

- ahead of / at / downstream of interaction point
- pulse energy
- pulse duration, spectrum
- phase front (“near field”) -> determines spot quality
- focal spot size, shape, transverse energy distribution

- steering mirrors: position, angle of laser
- deformable mirrors: phase front correction
-> excellent spot quality is vital to LWFA
- optical delay lines (synchronization)
- passive stability v/s active feedback
- ...

- 6D phase space, up to 2nd order moments
- zero order moment: charge
- 1st order moments (averages):
positions, angles, energy, arrival time (synch)
- 2nd order moments: (spreads and correlation)
spot size, divergence, emittance, E-dispersion, duration,
spot shape, chirp
- more refined (but potentially essential):
 - slice energy spread
 - long. bunch shape

- LPA injector: (depends on energy)
 - conventional macroscopic transport diag's v/s miniaturized devices (plasma lenses)
 - is the injected phase space well enough defined?
 - single-shot non destructiveness v/s reproducibility
 - ...
- RF-injector/beam-driven:
 - standard diagnostics to be integrated in transport line
 - extra space for sophisticated diagnostics ? (e.g. bunch duration)
 - single-shot/non-destructiveness may not be mandatory
 - ...

- 1-5 GeV: more space required
- single-shot emittance measurement at 5GeV?
undulator radiation ?
- measurement of bunch duration/beam current?
- beam steering? (assumes reproducibility)
- ...