

PPA09

Discussion:

1. Does it make sense to go forward with Lol
2. Goals of 1st, 2nd phases
3. Timeline
4. Next steps

We do not see the path yet to providing a high energy (100+ GeV) electron beam. Should we proceed in any case to propose demonstration experiment ?

In my opinion, yes.

- Performing an experiment focuses the community of interested people, gives a home to those interested
- Important issues needed for long-term can be addressed, such as long plasma cells
- seeded instability could lead to the high gradients after all ...

Financial scope of project should stay modest until we have

- shown good results with protons (what we promise in Lol - TBD)
- have a viable scheme to get to high energy beams

Assume we will use SPS beamline (first concusion !?)

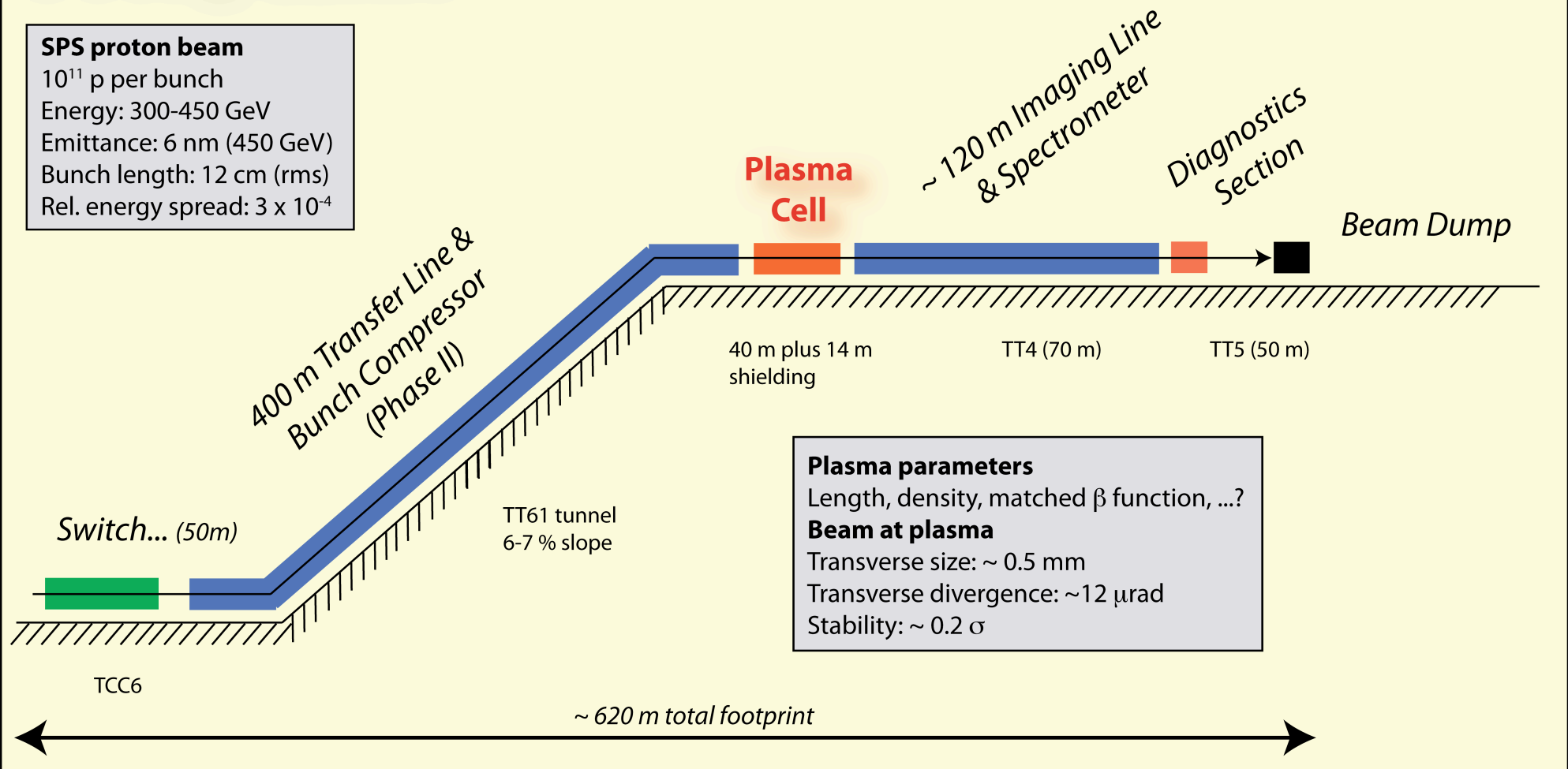
Demonstration experiment – possible sequence

1. Plasma cell + diagnostics: expect to see **modulation of proton bunch** by plasma
 - Start with best beam available from SPS (bunch every 30s)
 - Longest plasma cell we can get with high confidence
 - Plasma cell after last machine dipole for dispersion free region
 - Initial diagnostics:
 - Beam position monitors
 - Streak camera
 - Transition radiation measurement
 - Plasma monitoring
 - (spectrometer)
 - (EOS in plasma – investigate possibility to carry this out)
 - Measurements:
 - Characterize modulation vs density (amplitude, fluctuations) & compare to simulations
 - Strength of E-field in plasma & comparison to simulations

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SPS proton beam

10^{11} p per bunch
Energy: 300-450 GeV
Emittance: 6 nm (450 GeV)
Bunch length: 12 cm (rms)
Rel. energy spread: 3×10^{-4}



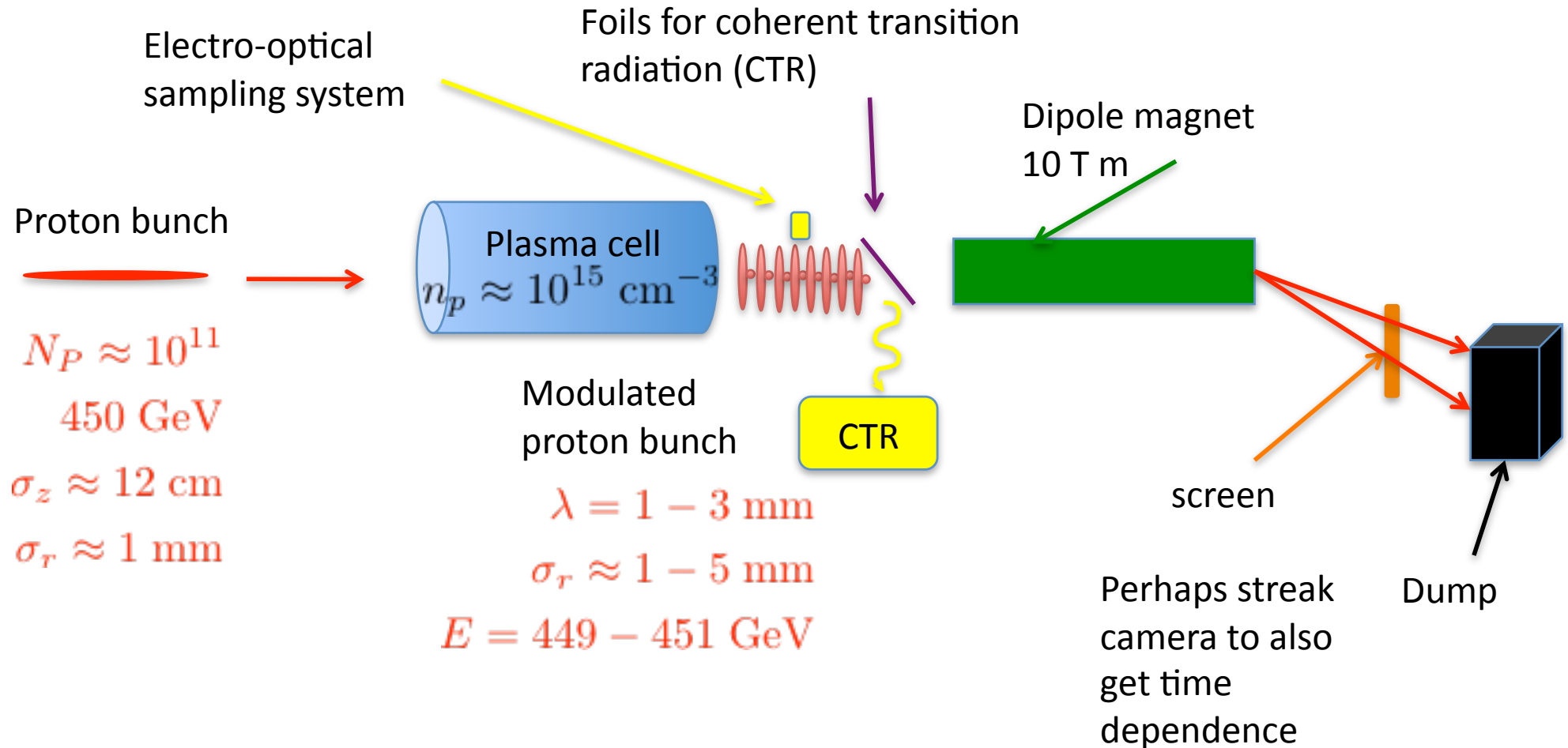
Plasma parameters

Length, density, matched β function, ...?

Beam at plasma

Transverse size: ~ 0.5 mm
Transverse divergence: $\sim 12 \mu\text{rad}$
Stability: $\sim 0.2 \sigma$

Potential setup? Is it OK?



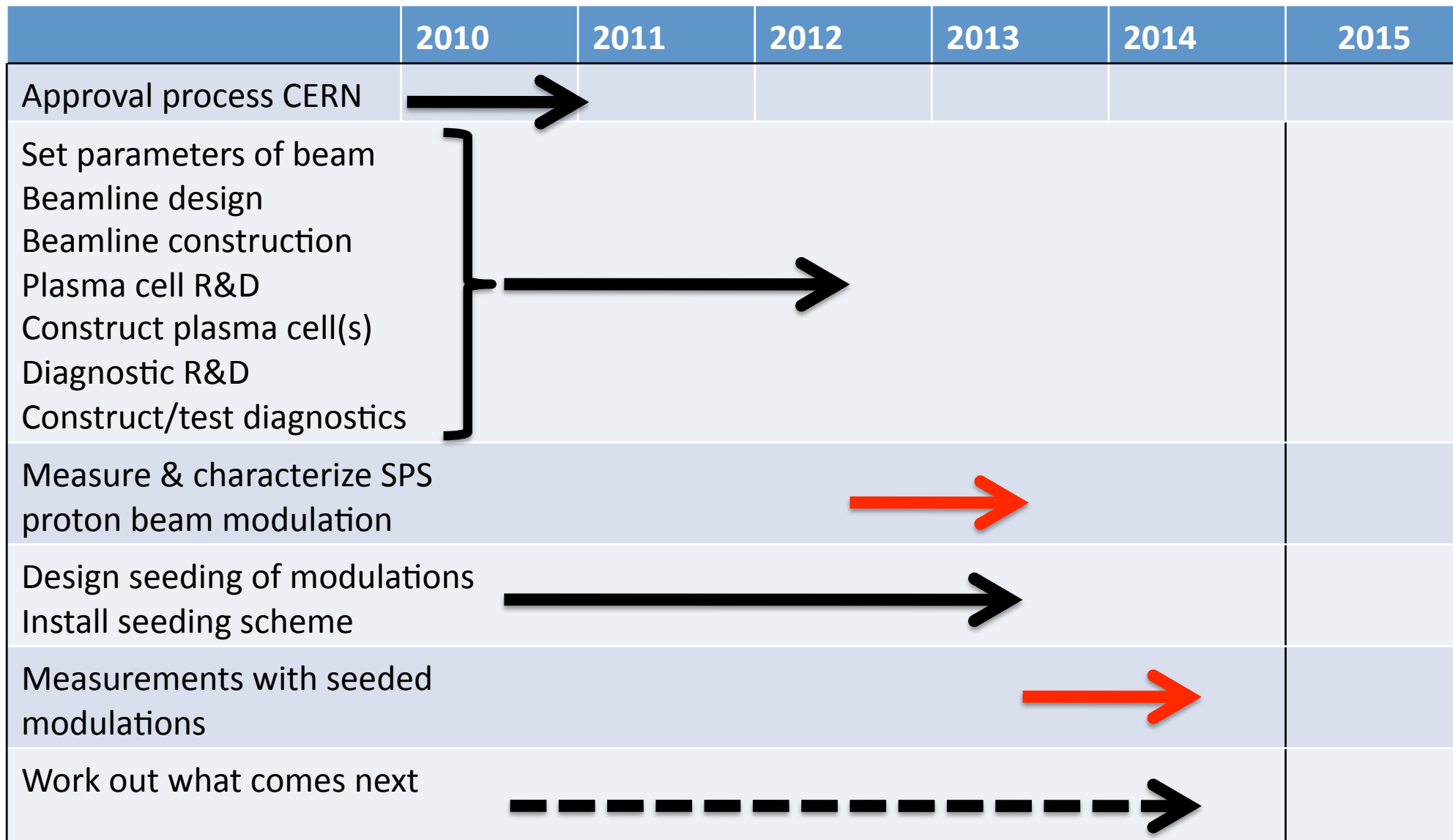
Demonstration experiment – possible sequence

2. Plasma cell + seeded modulation to add **reproducibility and stronger fields**
 - Optimal seeding to be worked out:
 - Laser seeding of plasma
 - Laser seeding of bunch
 - Plasma seeding of bunch -> second plasma cell
 - Heated gas + beam ionization
 - Chirp+grating
 - Spectrometer definitely needed
 - Next generation plasma cell (longer) ?
 - Measurements:
 - Demonstrate reproducibility
 - Demonstrate stronger fields
 - Demonstrate validity of simulations
 - Determine if this is scheme for GeV/m gradients over long distances

Demonstration experiment – possible sequence

3. Plasma cell + bunch compression: generation of **GeV/m fields**, demonstration of **scaling principles with protons**
 - Ring compression ?
 - Magnetic compression + slicing ?
 - Bunch forming (hard edge) ?
4. Plasma cell + bunch compression + electron injection: **demonstration of electron acceleration**
 - Should come before 3 ? (use electron bunch to seed plasma ?)
 - Demonstrate electron acceleration with modulated proton beam ? Spectrometer easier ?

Possible Timeline



The path to approval at CERN goes through the SPSC

- Submit ca 10 page **Letter of Intent**. Contents:
 - **motivation**
 - **sketch of experiment**
 - **beam needs**
 - **estimated cost**
 - **estimate of manpower**
 - **collaboration & task assignment**
- Lol should be submitted 2-4 weeks prior to an SPSC meeting
- Times of next meetings: April 13,14 June 29,30

Let's choose a date for the next meeting. Proposal March 11-12. Use this meeting to decide if we are ready to submit Lol/contents of Lol.

To be worked out until next meeting (please come with rough estimate of cost):

- parameters of first plasma cell (length, density range, diameter, B and RF fields, windows, laser or RF parameters)
 - IPP (Helicon scheme), UCLA (Laser ionized gas)
- footprint of experimental apparatus (plasma cell + diagnostics, where can different elements fit). Maybe 2-3 versions.
 - CERN (BPMs, dumps, spectrometer magnet), MPP (TR, EOS), NN (spectrometer detector), SLAC (streak camera)
- concept for diagnostics
 - DESY+MPP (TR, EOS), SLAC (Streak camera), CERN+DESY (BPMs), NN (spectrometer), NN (beam dump monitor), IPP (plasma monitors), UCLA (plasma monitors)

To be worked out until next meeting – continued:

- work out proton beam parameters entering plasma – is it important to have quadrupole focusing ?
 - CERN, Novosibirsk, Düsseldorf
- investigation of reliability of instability-driven simulation – what can we expect to see for 1m, 5m, 10m of plasma in terms of modulation, E-field in plasma. Sensitivity to density fluctuations.
 - Düsseldorf (3D), Novosibirsk (2D), UCLA (boosted frame)
- worked out proposals for seeding instability
 - USC (with chirp + grating), UCLA (pre-heated gas + ionization), CERN (SPS double bunch 2.5 ns spacing), NN (laser)

- accounting of available beamline elements; investigate energies which can be delivered with existing components (> 250 GeV ?)
 - CERN
- transverse emittance after magnetic compressor
 - MPP
- new ideas on bunch compression !
 - All