Advanced and Novel Accelerators for High Energy Physics Roadmap Workshop 2017
April 25-28, 2017 at CERN

WG1: Laser wakefield accelerator (LWFA)

Conveners: Arnd Specka (CNRS)
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Charge to the working groups

- **Identify scientific and technological bottlenecks of each scheme and their possible solutions to produce a TeV lepton collider.**
- **Detailed charge:**
  - Identify parameters/elements necessary for the scheme
  - Determine to what extend they have been proved and demonstrated
  - Evaluate likelihood and timescales for testing/proving solutions
  - Identify key experiments to be performed
  - Identify existing or new facilities to perform key experiments
  - Identify realistic time scales
  - Identify panorama, what is in the making?

Deliverable (as of 18/04/2017)

«You already knowingly, willingly and happily agreed to write after the workshop:

shinny brochure: summarizes workshop and promotes the field **to distribute to shakers and movers**.»

Suggested sections:

- **State of the art of the acceleration scheme relevant to HEP**
  describe the main performance/parameters relevant to HEP that have been achieved
- **Main challenges to be addressed in the next five(5) year**
  describe which experiment/simulation/theory will or can/must be done in the next five(5) years (2018-2022) and which facility/resources are needed, emphasis on existing/planned facilities
- **Main challenges to be addressed in the next ten(10) year:**
  describe which experiment/simulation/theory will/can/must be done in the next ten(10) years (2018-2027) and which facility/resources are needed, emphasis on facilities that needs to be planned and built
- **Long term view for the acceleration scheme application to HEP:**
  describe intermediate steps (facility, etc.) that are needed to show relevance to HEP with emphasis on those that could already be of interest for HEP, e.g., beam test facilities, etc.
- **Technologies that need to be developed to reach the goals above**
  (e.g., high peak.average power lasers, super computer, simulation methods, etc.)
- **Conclusions of the WG and outlook.**

All this in five(5) pages maximum. Deadline May 28, 2017.

Parameter table

Electron Injector			
Conventional? Specify			
If in plasma specify injection mechanism			
Parameters:			
Energy (MeV)			N/A
Relative energy spread (%)			N/A
Charge per bunch (nC)			N/A
Population x 1e9 (# e-)	0		
Normalized emittance (mm-mrad)			N/A
Summary of electron injector			N/A
Electron damping ring			Yes
Positron Injector			
Specify Source			
(brehmastarhlung, plasma, etc.)			
Parameters:			
Energy (MeV)			N/A
Relative energy spread (%)			N/A
Charge per bunch (nC)			N/A
Population x 1e9 (# e-)	0	0	
Normalized emittance (mm-mrad)			N/A
Summary of positron injector			N/A
Positron damping ring			Yes
Accelerator section			
Plasma (PWFA, LWFA)			
Type:			
Laser ionized			Yes
Gas or alkaly (H, He, Ar, Li, Rb, etc)			
Capillary discharge			Yes
Glass capillary			Yes
Other			Yes
Parameters:			
Length of single plasma (cm)			N/A
Density (x1e16/cc)			N/A
Accelerating gradient (GV/m)			N/A
Relative density niformity (%)			N/A
Longitudinal profile (ramp, gradient, etc.)			N/A
Hollow plasma channel			N/A
Hollow gas channel			N/A
Summary of accelerator section			N/A
Dielectric (DWA, DLA)			
Structure geometry (cylindrical, planar, etc.)			N/A
Dielectric constant			N/A
Operating frequency			N/A
Inner diameter (microns)			N/A
Outer diameter (microns)			N/A
Clading (none, metallic, layer, etc.)			N/A
Accelerating gradient (GeV/m)			N/A
Drive beam			
Parameters:			
Type (electrons, laser, other?)			
Pulse/bunch length (microns)			N/A
Transverse size at focus (microns)			N/A
Normalized emittance (mm-mrad)			N/A
Laser wavelength (nm)			N/A
Bunch charge (nC) or laser energy (mJ)			N/A
Energy per particle (electron, etc) (GeV)			N/A
Gaussian focused intensity (W/cm^2)	#DIV/0!	#DIV/0!	
Transverse shape (Gaussian?)			N/A
Longitudinal shape (Gaussian?)			N/A
Rayleigh range (laser, m)	#DIV/0!	#DIV/0!	
Beta* (electron beam, m)	#DIV/0!	#DIV/0!	
Summary of drive beam			No solution
Initial electron witness beam			
Parameters:			
Pulse/bunch length (microns)			N/A
Transverse size at focus (microns)			N/A
Normalized emittance (mm-mrad)			N/A
Bunch charge (nC)			N/A
Energy per particle (GeV)			N/A
Transverse shape (Gaussian?)			N/A
Longitudinal shape (Gaussian?)			N/A
Beta* (m)	#DIV/0!	#DIV/0!	
Beam loading used?			Yes
Summary of electron witness beam			N/A
Initial positron witness beam (if different from electron)			
Parameters:			
Pulse/bunch length (microns)			N/A
Transverse size at focus (microns)			N/A
Normalized emittance (mm-mrad)			N/A
Bunch charge (nC)			N/A
Energy per particle (GeV)			N/A
Transverse shape (Gaussian?)			N/A
Longitudinal shape (Gaussian?)			N/A
Beta* (m)	#DIV/0!	#DIV/0!	
Beam loading used?			Yes
Summary of positron witness beam			N/A
Final electron witness beam			
Parameters:			
Normalized emittance (mm-mrad)			N/A
Bunch charge (nC)			N/A
Energy per particle (GeV)			N/A
Summary of electron witness beam			N/A
Final positron witness beam (if different from electron)			
Parameters:			
Normalized emittance (mm-mrad)			N/A
Bunch charge (nC) or laser energy (mJ)			N/A
Energy per particle (GeV)			N/A
Summary of positron witness beam			N/A

WG1: schedule (25/04)

14:30-16:00	**1:30**	**LWFA electron Acceleration**	
	0:10	Conveners	Charge to to the WG
	0:15	Alban Mosnier	Electron acceleration - Introductory Overview
	0:10	Arie Irman	Recent result in ionization induced injection
	0:10	Masaki Kando	Improvement in beam pointing stability
	0:10	Oznur Mete-Apsimon	Witness beam scattering by plasma ions and electrons"
	0:35	**discussion**	**State of the art of the acceleration scheme relevant to HEP** Identify parameters/elements necessary for the scheme
16:30-18:00	**1:30**	**Alternative and Novel Acceleration Schemes (electrons and positrons)**	
	0:10	Simon Hooker	Excitation and control of plasma wakefields by trains of laser pulses”.
	0:10	Alexander Debus	Traveling-Wave Electron Acceleration (TWEAC) -- Electron acceleration
	0:10	Andreas Döpp	PWFA with LWFA generated electrons
	1:00	**discussion**	**State of the art of the acceleration scheme relevant to HEP** Determine to what extend they have been proved and demonstrated Identify key experiments to be performed

WG1: schedule (26/04)

S2C	**26-avr**	**09:00-10:30**	**1:20**	**Injection / Positron production**	
			0:05	Vladimir Andreev	external injection strategy of an electron bunch to minimize the energy spread of accelerated electrons
			0:05	Igor Pogorelsky	positron prodution?
			0:10	Mike Downer	Compton x-rays, gamma-rays from self-aligned combination of LWFA and plasma mirror
			1:00	**discussion**	electron and positron sources **cross-fertilization with XFEL application of LWFA** Identify realistic time scales?
S2D	**26-avr**	**11:00-12:30**	**1:30**	**Modeling and testing of concepts**	
			0:20	David Bruhwiler	Simulation Codes - Introductory Overview
			0:05	Mike Downer	Single-shot diagnostics of LWFA structures: holography, shadowgraphy, streak camera, tomography, Faraday rotation
			0:05	Christina Swinson	10 um laser-wakefield mapping using an electron beam probe.
			0:05	Wim Leemans	Bella
			0:55	discussion	Identify existing or new facilities to perform key experiments
S2E	**26-avr**	**14:00-16:00**	**2:00**	**Work session on parameter ranges, technologies, interfaces, strategies,**	
					laser parameters
					plasma source developments
					Identify panorama, what is in the making?
					fill in the spreadsheet table?
S2F	**26-avr**	**16:30-18:00**	**1:30**	**synthesis**	
					State of the art LWFA
					Main challenges 5y
					Main challenges 10y
					Long term view for HEP: