

WG2 (Collider Design) summary for Wed morning discussion

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- **Motivations**
 - Long term, mid term, near term
- **Status of technologies**
- **Structure of WG for future ALEGRO**
 - Mechanisms for encouraging common efforts of design work



- **Long term**
 - **30 TeV e+e- or gg collider**
- **Mid term**
 - **Stand-alone advanced collider**
 - **Upgrade of ILC or CLIC**
- **Near term**
 - **Plasma Electron Proton Ion Collider**



- **30 TeV e^+e^- or gg collider**

From these examples, the goal would be to do **systematic searches for resonances and thresholds** in the 10 - 50 TeV energy region.

They give guidance that a narrow CM energy spectrum may not be needed. We can measure the resonance or threshold energies from calorimetry on the final state.

On the other hand, **CM energy, luminosity, and beam polarization** are crucial.

M. E. Peskin
March 2018

Can advanced acceleration technologies provide this?



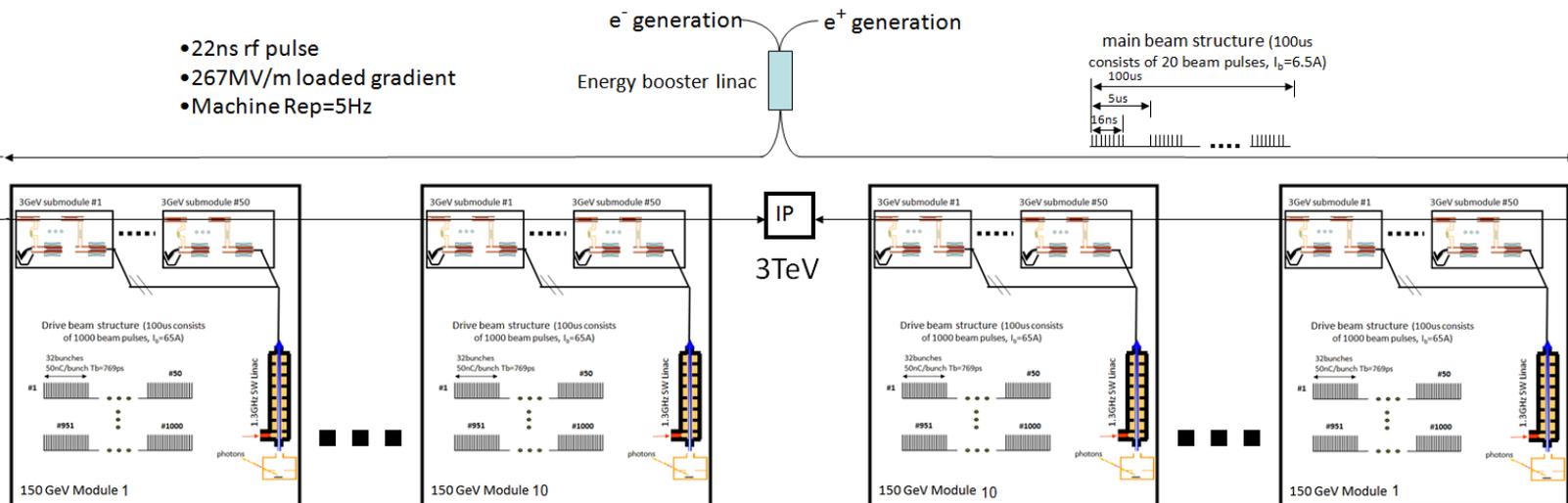
Motivations – mid-term

• Stand-alone advanced collider – example

Parameter	Concept dielectric TBA
Colliding species & e^+e^-	e^+e^-
Upgrade or stand-alone	stand-alone
Final E CM, TeV & 1.0	3
Luminosity, $10^{34} \text{cm}^{-2} \text{s}^{-1}$	6.34×10^{34}
Effective $L^* \text{, m}$	
Detector forward exclusion angle, mrad	
Total length, km	18
Length of beam delivery, km	3
Repetition rate, Hz	5
Total wall plug power, MW	400/286/245

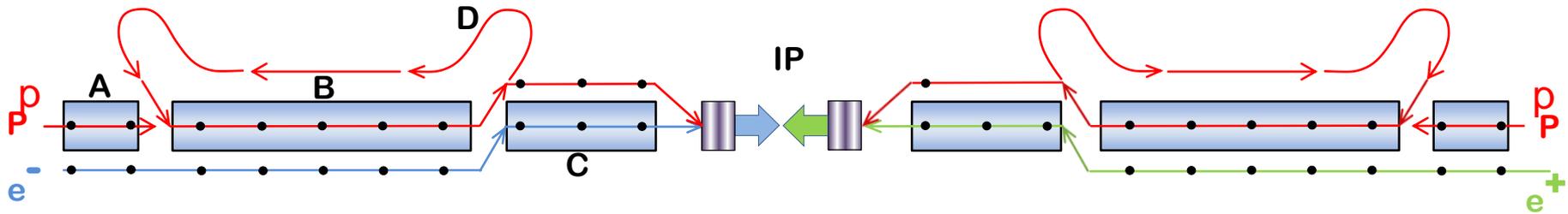
Colliding beam power
 IP beam sizes, X/Y
 IP beam length, Z,
 IP beam n-emittance
 IP beam E-spread,
 Colliding bunch population
 Initial E of colliding
 Driver type & laser
 Adv. acc. media & p
 Driver E/bunch, J
 Adv. acc. transform
 Length of single ad
 Number of adv. acc
 Effective gradient c

- 22ns rf pulse
- 267MV/m loaded gradient
- Machine Rep=5Hz



John Power, ANL

- Upgrade of ILC or CLIC
 - Example – upgrade of ILC to ~TeV CM



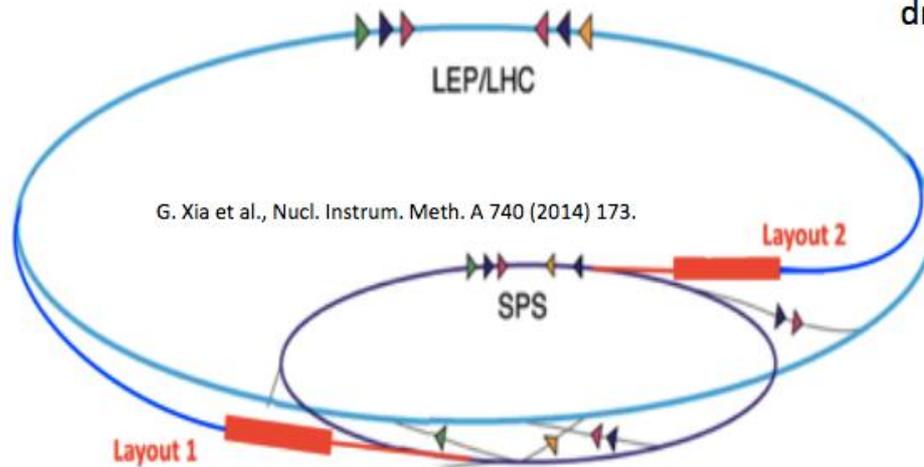
Concept of ILC 250 GeV CM Higgs Factory upgrade to ~2 TeV CM using plasma acceleration driven by proton beam

• Plasma Electron Proton Ion Collider

Physics with an Electron-Proton or Electron-Ion Collider

PEPIC: Plasma Electron Proton/Ion Collider:

Create ~50 GeV electron beam within 50–100 m of plasma driven by SPS protons, But luminosity $< 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$.



- What is the electron energy, e.g. $E_e \sim 100\text{--}150$ GeV in 200m?
- Which luminosity can we reach?
- What is the physics programme, e.g focus on QCD and low-x physics?

- **Focus on QCD:** Large cross sections \rightarrow low luminosity enough (HERA level)
- Many open physics questions !
 - \rightarrow High energy ep collider: E_e up to $O(50 \text{ GeV})$, colliding with LHC proton;
 - \rightarrow e.g. $E_e = 10 \text{ GeV}$, $E_p = 7 \text{ TeV}$, $\sqrt{s} = 530 \text{ GeV}$ already exceeds HERA cm energy.

Edda
Gschwendtner,
CERN



- **Gradient established for plasmas**
- ...
- **Beam quality, efficiency, project integration => ...**



- **WGs should be structured according to systems of collider (for near term future)**
 - **WG Physics Case**
 - **WG Acceleration (plasma, swfa, etc)**
 - **WG Power Sources (drive beam, laser, etc)**
 - **WG Luminosity Delivery (beam sources, beam cooling, tolerances, stabilization, focusing)**
 - **May need to be split to several groups eventually**
 - **WG Detector (Machine Detector Interface)**