## Update on White Paper on: Beam Delivery Systems on Advanced Linear Colliders

Glen White and Spencer Gessner Snowmass AF6 Meeting February 15, 2022





### White Paper on BDS



- The White Paper on Beam Delivery Systems served as the basis for an article in an upcoming ICFA newsletter with Glen White as lead author:
  - https://www.overleaf.com/project/61d8d43b1b1ddd ab446dbfe8
- Much of the content is shared with Snowmass White paper draft:
  - https://www.overleaf.com/read/ndtfcdyvfrfq

#### 

Spencer Gessner, Mark Hogan, and Glen White  $SLAC\ National\ Accelerator\ Laboratory$ 

Erik Adli, Gevy Jiawei Cao, and Kyrre Sjobak University of Oslo

Sam Barber, Cameron Geddes, Carl Schroeder, Davide Terzani, and Jeroen van Tilborg  ${\it Lawrence~Berkeley~National~Laboratory}$ 

Chris Doss and Michael Litos University of Colorado Boulder

Philippe Piot
Northern Illinois University

Ihar Lobach and John Power
Argonne National Laboratory

Carl A. Lindstrøm

Deutsches Elektronen-Synchrotron DESY
(Dated: February 10, 2022)

### **Outline of White Paper on BDS**

SLAC

CONTENTS	
I. Executive Summary	5
II. Introduction	5
A. Physics Drivers and Goals (S. Gessner)	5
III. Traditional BDS (G. White)	5
A. Diagnostics, Tune-up dump, Machine Protection	6
1. MPS Collimation	7
2. Skew Correction	7
3. Emittance Diagnostics	8
4. Polarimeter, Laser Wire photon and Energy Diagnostics	8
5. Tune-up and Emergency Extraction System	8
B. Collimation System	9
C. Muon Suppression	10
D. Halo power handling	10
E. Tail-folding octupoles	11
F. Final focus	11
G. Energy bandwidth	13
H. Feedback systems and stability	14
I. CLIC	15
IV. Energy Scaling of BDS Length (G. White)	15
A. Bending sections	16
B. Matching / transport / diagnostics / collimation sections	17
C. Final focus system	17
D. Overall scaling	18
V. Extensions to existing designs (G. Cao)	18
A. Beam Aspect Ratio	18
VI. Physical Limitations and Effects on Beam Spot Size	20
A. Oide Effect (C. Doss)	20

B. Chromatic Effects (C. Lindtrom)	21	
C. Scattering in Plasma (S. Gessner)	21	
D. Beamstrahlung (C. Schroeder, D. Terzani)	21	
E. CSR	22	
VII. Plasma Lenses	23	
A. Passive Plasma Lenses (C. Doss, M. Litos)	23	
B. Active Plasma Lenses (K. Sjobak, D. Terzani, S. Barber, J. van Tilborg)	25	
C. Scattering and Chromaticity (C. Lindstrom)	26	
VIII. Case Studies	26	
A. Beam-Driven Plasma (S. Gessner)	26	
B. Gamma-Gamma	27	
C. Detector-Free Design	27	
D. Laser-Driven Plasma (C. Schroeder)	27	
E. Beam-driven Structure (I. Lobach, J. Power)	27	
1. Drive train structure	27	
2. Main train structure	27	
3. SRF driver vs NC driver	27	
4. Trade-offs between bunch charge and repetition rate	27	
X IX. Machine-Detector Interface (M. Swiatlowski)	30	
A. Scattering of beam particles by plasma	30	
B. Scattering of plasma particles by beam	30	
C. Betatron radiation	30	
D. Notes from Caterina and Michael	30	
X. Conclusion	30	
XI. Appendix	30	
References	31	
4		

# Contributions from Early Career Members

John Power encourage grad students and post-docs to get involved in this work:

- Postdocs Ihar Lobach at Argonne and Davide Terzani at Berkeley and they agreed to contribute.
- Erik Adli's student Gevy Cao is working on Guinea-PIG beam-beam simulations for the paper.
- All of the students/postdocs participated in the recent USPAS courses on particle colliders:
  - https://uspas.fnal.gov/programs/2022/onlinetamu/index.shtml

Current draft is 33 pages long!

 I will follow up with HEP detector physicist Max Swiatlowski on Machine-Detector Interface section.

Need to work on compelling executive summary!