SnowMass2021

- Accelerator Frontier
  - AF7: Accelerator Technology R&D
    - Targets and Sources→ Co-conveners



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Sources

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Argonne National Lab.

Snowmass Community Planning Meeting

Oct. 5, 2020

Sources: Letter of Interest – Snowmass 2021

We have received 14 LOIs on Sources.

- ❑ High brightness / high average current electron sources:
  - Cathodes
  - Normal and super conducting RF guns
- ❑ High Intensity Positron Sources
- ❑ Muon Sources
- ❑ High intensity ion sources:
- ❑ Heavy Ion Sources

It's not too late! You can still submit a LOI at https://www.snowmass21.org/docs/upload.php
We are Accelerator Frontier and topical group AF7: Accelerator Technology R&D

Sources LOI Overview

AuthorLOI	Title	Link
M. Biagini	LEMMA: a positron driven muon source for a muon collider	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF4_AF7-135.pdf
G. Bisoffi	INFN Position Paper for Snowmass'21 on Accelerator	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF1_AF7_GBisoffi-LRossi-100.pdf
I. Chaikovska	Physics and technology challenges in generating high intensity positron beams	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF1_AF7_Iryna_Chaikovska-116.pdf
D. Filipetto	Pushing Brightness and Current limits of Normal-Conducting Radiofrequency Electron Sources	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF6_Filippetto-194.pdf
C-K. Huang	Physics-based high-fidelity modeling of high brightness beam injectors	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF1-CompF2_CompF0_Huang-183.pdf
S. Karkare	Prospects for Future Electron Source Development	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF7_Siddharth_Karkare-052.pdf
A. Lumpkin	Mitigationof Emittance Dilution Due to Wakefields in Accelerator Cavities Using Advanced Diagnostics with Machine Learning Techniques	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF7_Lumpkin-132.pdf
N. Moody	Development of next generation rugged electron sources for low emittance, high quantum efficiency, and/or high average current applications	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF0_Nathan_Moody-059.pdf
P. Piot	Bright Electron and Positron Beams and High-Charge Electron Bunches for Beam-driven Structure-WakeField Accelerators	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF6-234.pdf
J. Schieck	A Proton-Based Muon Source for a Collider at CERN	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF4_AF7-EF0_EF0_C._T._Rogers-065.pdf
D. Schulte	Muon Collider Accelerator Facility	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF4_AF7-102.pdf
E. Simakov	High current field emission electron sources for linear colliders and RF source applications	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF6_Evgenya_Simakov-047.pdf
E. Wang	High current high brightness SRF gun	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF0-015.pdf
D. Xie	Production of Heavy Ion Beams with Electron Cyclotron Resonance Ion Sources	https://www.snowmass21.org/docs/files/summaries/AF/SNOWMASS21-AF7_AF7-017.pdf

Sources: Grand Challenges

- High Brightness Electron Beams (for ILC, CLIC, FELs, UED/UEM, ERLs, Electron cooling of hadron beams)
  - Cathodes
    - Low Mean Transverse Energy (MTE) – small transverse emittance
    - Quantum Efficiency (QE) – high QE especially needed for e- cooling and ERLs
    - Emission response time
    - Long Lifetime
    - Compatibility with operation condition
    - Polarization
  - Guns
    - High accelerating gradient
    - High average current
    - Ultra-high vacuum level for good cathode lifetime
  - Injectors
    - Choice of cathodes + guns, and optimization of the injector with accelerating cavities.

Sources: Grand Challenges

- High Intensity Positron Sources / Muon Sources
  - Positron sources for e+e-/ μ+μ- collider projects (ILC, CLIC, SuperKEKB, FCC-ee, LEMMA, etc.)
  - Polarization;
  - High intensity (orders of magnitude higher than existing positron sources)
  - Positron→ μ± (e.g. Low EMittance Muon Accelerator)
  - Proton→muon (MAP Muon source for Muon Collider Collaboration)
- Heavy Ion Sources
  - High reliability
  - Low emittance

Sources: Required R&D Area

- High Brightness Electron Beams
  - Cathodes
    - Photocathodes
      - High QE
      - Long lifetime
      - Low TME
      - Polarization
        - » Required for colliders
    - Field emitters
    - Thermionic cathodes
  - Guns
    - DC guns:
      - pushing the gap voltage and accelerating gradient;
      - Reliability;
    - Normal Conducting rf guns:
      - CW operation;
      - Reliability;
    - Super-Conducting rf guns
      - Compatible cathodes;
      - Reliability;
  - Injectors
    - Modeling tools for injector design/simulations;
    - Facilities for injector development.
  - Beam diagnostics and control tools
- High Intensity Positrons
  - Polarization and intensity
    - Electron→positron
    - Photon→positron
- Protons
  - Production and acceleration of proton beams from high power lasers
- Muons
  - Positron→ μ± (e.g. Low EMittance Muon Accelerator)
  - Proton→muon (MAP Muon source for Muon Collider Collaboration)
- Heavy Ions Sources
  - Electron Cyclotron Resonance Ion Sources(ECRISs)
  - Electron Beam Ion Source (EBIS)
  - …

Sources: Liaison Identification

- Accelerator Frontier→ AF7: Accelerator Technology
  - Targets/Sources linked in the generation of positrons/muons/hadrons
  - RF/Sources →RF gun design
- Accelerator Frontier→ AF4: e^+e^-/ $\mu^+\mu^-$ collider, EIC
- Accelerator Frontier→AF6 AAC: particles sources
- Computational Frontier→CompF3: Machine Learning: e.g. Injector optimization
- …..