

Superconducting electronics and detectors workshop overview

Superconducting electronics and detectors workshop

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Hall A Jefferson Laboratory

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New developments since 2015

- First workshop 2015
 - Focused on SNSPDs
 - Beginning activity at Argonne and JLab
 - C3 program on going
- 2022 workshop
 - Operation of SNSPD in magnetic field
 - C3 completion
 - Quantum computing
 - Broader superconducting detectors for QC and other application and emphasis on readout
 - Progress cryogenics : cryocoolers available
 - EIC detectors becoming reality

Program

- First day :
 - introduction
 - thin films and lithography

13:00	Superconducting thin films developements <i>F113, Thomas Jefferson National Accererator Facility Cebaf Center</i>	<i>Anne-Marie Valente-Feliciano</i> 13:00 - 13:45
14:00	Nb3Sn thin films <i>F113, Thomas Jefferson National Accererator Facility Cebaf Center</i>	<i>Uttar Pudasaini</i> 13:45 - 14:15
	IARPA C3 and SuperTools projects summary <i>F113, Thomas Jefferson National Accererator Facility Cebaf Center</i>	<i>Douglas Scott Holmes</i> 14:15 - 14:50
15:00	Discussion materials and lithography <i>F113, Thomas Jefferson National Accererator Facility Cebaf Center</i>	14:50 - 15:20

Thin films and lithography

- Superconducting materials suitable for detectors and electronics
 - Higher T_c
 - Operation in magnetic field
- Lithography techniques
 - Mass production
 - Costs
 - Where do we stand compared to CMOS ?

Readout of superconducting detectors

- CMOS standard cryogenics
- Superconducting electronics
- Usage for Quantum computing

Tuesday electronics and QC

09:00	Josephson Junction based Quantum Computing <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Briton Plourde</i> 09:00 - 09:30
	The EIC on a Table Top <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Robert Edwards</i>  09:30 - 10:00
10:00	Dune cryogenics electronics <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Hanjie Liu</i> 10:00 - 10:30
	Coffee break <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	10:30 - 11:00
11:00	Cryogenics ASICs at Fermilab <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Dr Davide Braga</i> 11:00 - 11:30
	CAEN Electronics readout <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Carlo Tintori</i> 11:30 - 12:00
12:00		

Tuesday : superconducting electronics

14:00	Superconducting Electronics and Application to Machine Learning Systems <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Dr Quentin Herr</i> 14:00 - 14:50
15:00	Superconducting Digital Electronics for Cryogenic Detectors <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Dr Elie Track</i> 14:50 - 15:20
	Coffee break <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	15:20 - 15:50
16:00	Cryotrons <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Prof. Karl Berggren</i> 15:50 - 16:35
	A superconducting nanowire pulse counter integrated with an SNSPD <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Matteo Castellani</i> 16:35 - 16:50
17:00	A superconducting binary shift register for SNSPD readout <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Reed Foster</i> 16:50 - 17:05

Question / discussion superconducting electronics

- How many channels can be handled now ?
 - In standard electronics
 - Superconducting electronics
- Future prospects
- Operation in magnetic field
- Temperature stages : LHe, LN, Ambient temperature
- Performances of superconducting electronics worth the hassle of cryogenics ?
- Impact of Quantum Computing in data analysis
- Status of lithography compared to silicon
- What is needed for fully integrated detector and superconducting electronics ?

Wednesday : Superconducting detectors

09:00	SNSPD at Argonne National Lab <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Whitney Armstrong</i> 09:00 - 09:30
	Transition Edge Sensors <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Thomas Gerrits</i> 09:30 - 10:00
10:00	UV pixellized SNSPDs at NIST <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Adam McCaughan</i> 10:00 - 10:30
	Coffee break <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	10:30 - 10:50
11:00	SNSPDs developments at JPL <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Matt Shaw</i> 10:50 - 11:20
	Superconducting Tunnel Junctions <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Stephan Friedrich</i> 11:20 - 11:50
12:00	Discussion detectors <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	<i>Alexandre Camsonne</i> 11:50 - 12:30
	Lunch <i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	12:30 - 13:00

Question / Discussion : detectors

- Maximum number of pixels
- Readout of detectors
- Operation in magnetic field
- Mass production / cost
- Substrates
- Improve speed of TES and STJ
- Energy measurement with nanowires
- Tuning of detector geometry for Nuclear Physics applications
- Operation costs

Wednesday afternoon : cryogenics

	Jefferson Laboratory Cryogenics overview	<i>Jonathan Creel</i>
15:00	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	14:40 - 15:10
	Refrigerator for Polarized Targets	<i>Chris Keith</i>
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	15:10 - 15:40
	Coffee break	
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	15:40 - 16:00
16:00	Low Temperature Turbo-Brayton Cryocoolers	<i>Mark Zagarola</i>
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	16:00 - 16:30
17:00	Discussion superconducting detectors and cryogenics	
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	16:30 - 18:00

Discussion/Questions cryogenics

- Jefferson Laboratory capabilities
 - Refrigerators mK
 - Liquid helium
- Cryocoolers
- Cost of operation
- Cryogenics computer farm ?

Thursday : applications

08:00	IARPA Supertools	
09:00		
10:00		
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	08:00 - 11:00
11:00	CUORE experiment	<i>Dr Guillaumon Pedro</i>
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	11:00 - 11:30
	Application of Superconducting Electronics and Detectors at EIC	<i>Whitney Armstrong</i>
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	11:30 - 12:00
12:00	Discussion and meeting close out	
	<i>F113, Thomas Jefferson National Accelerator Facility Cebaf Center</i>	12:00 - 12:45

Discussion / questions : application

- JLab
- EIC
- Double beta decay
- Others
 - Solid state physics, biology, medical applications
 - Experiments that could use superconducting detector
 - Application for tracker, Cerenkov, calorimetry
 - Cost of operation / construction vs benefit

Summary

- Many developments in terms of detectors and electronics
- Very sensitive detectors for energy and timing measurements
- Readout and cryogenics main limiting factor
- Interesting for places where cryo is already available target or magnets
- Could become more mainstream with use of cryocoolers
- Many technical points still to be discussed but very promising technology