



# IF03: Solid State Detectors and Tracking Status and Plans

Artur Apresyan, Steve Worm, Tony Affolder

*January 27, 2022*



# Where are we?

- The current stage of the Snowmass Process is the generation of White (Contributed) Papers.
  - Topical Group Summaries, Instrumentation Summaries to follow
- Today's meeting will focus on White Paper progress and planning
  - First drafts of the complete white papers expected

## Next steps: finish line approaching

- Instrumentation Frontier White Paper Wrap-up
  - Combined Snowmass-IF / CPAD workshop in February: **CANCELLED**
  - **INSTEAD**: community meeting on Feb 18:
    - <https://indico.fnal.gov/event/52840>
    - The plan is to hear WP status reports and plans from all Topical Groups.

# White Paper Timelines

11/21

12/21

1/22

2/22

3/23

★ 11/19 IF White Paper Wrap- Finalize list of WPs

★ 12/16 IF03 Meeting – Outline with author responsibilities

★ 1/27 IF03 Meeting – First Drafts

2/18/22 Virtual community meeting – Finalizing Drafts



3/15- White Paper Deadline to be including in WG reports



# Snowmass Important Dates

- White Paper submission to arXiv: no later than March 15, 2022. Late submissions and updates are likely not to be incorporated in the working group reports, but will be included in the Snowmass on-line archive documents.
- Preliminary reports by the Topical Groups due: no later than May 31, 2022.
- Preliminary reports by the Frontiers due: no later than June 30, 2022.
- Snowmass Community Summer Study (CSS): July, 2022 at UW-Seattle.
- All final reports by TGs and Frontiers due: no later than September 30, 2022.
- Snowmass Book and the on-line archive documents due: October 31, 2022.

# White Paper Content, Templates, Topic Summaries

- White papers should address
  - Challenges that are being tackled
  - Briefly summarize the physics motivation,
  - Recent results and a roadmap for near- to middle-term R&D.
- Suggested length of 10-15 pages
  - One page executive summary
  - Executive summaries will be used to build up Topical Group Summary
- Topical Group Summary should give a general overview of the area of silicon trackers, in addition to specific summaries of each WP
  - Suggested length of 5-10 pages, with 1-2 page executive summary
- LaTeX template at <https://snowmass21.org/submissions/start>

# White papers in IF03

- 4D trackers and precision timing: **R. Heller, A. Schwartzman**
- Integration and Packaging: **S. Mazza**
- Novel Sensors for Particle Tracking: **S. Seidel**
- Mechanics, lightweight materials, cooling: **A. Jung**
- Simulation tools: **B. Nachman**
- Monolithic integrated silicon detectors, CMOS (MAPs): **C. Vernieri**
- Non-silicon trackers:

# Backup

# White papers (1)

## 1. Physics motivations for requirements of tracking detectors (Requirements)

- IF9\_IF3-EF9\_EF0-AF4\_AF1-143: **Muon collider tracker requirements**: contact S. Jindariani (FNAL)
  - EF1\_EF2-IF3\_IF0\_Valentina\_Maria\_Martina\_Cairo-047: **Strange Quark as a probe for new physics in the Higgs Sector**: contact V.M.M. Cairo (SLAC)
  - EF3\_EF0-RF1\_RF0-IF3\_IF6-077: **Searching for  $B_s \rightarrow \Phi \nu \nu$  and other  $b \rightarrow s \nu \nu$  processes at CEPC**: contact M. Ruan (IHEP China)
  - EF4\_EF0-AF3\_AF0-IF3\_IF5\_GrahamWilson-119: **Exploring precision electroweak physics measurement potential of  $e^+e^-$  colliders**: contact G. Wilson (KU)
  - EF5\_EF7-TF7\_TF0-IF6\_IF3-CompF3\_CompF0\_Ben\_Nachman\_(bpnachman@lbl.gov)-035: **Jets and jet substructure at future colliders**: contact B. Nachman (LBNL)
  - RF-EF-OF-CompF-011: **Letter of interest from the US LHCb Group**: contact M. Artuso (Syracuse0)
  - **Solid State & Tracking in BRN**- Marina Artuso (Syracuse)-IF03 Presentation
  - **Silicon detectors R&D and physics drivers for future machines**- Caterina Vernieri- IF03 Presentation
  - **Parameters for future trackers**- Simone Griso (LBNL)-IF03 Presentation
  - **EF perspective (Maxim Titov) and RF perspective (Mariana Artuso (Syracuse)-CPM 130**
- Will be organized by EF and RF liaisons to IF (Maxim, Caterina, Marina)
  - Designed to give requirements/motivation for the rest of the White Papers



# White papers (2)

## 2. 4D trackers, precision time + position; OR precision position + moderately good time (Timing)

- IF3\_IF0\_University\_of\_California\_Santa\_Cruz-018: **Use of extremely thin ‘LGAD’ ultra-fast silicon detectors for fast timing and tracking in high radiation sections at future colliders**: contact: S. Mazza (UCSC)
- IF3\_IF7\_Karri\_DiPetrillo-142: **Precision timing detectors for future colliders**: contact K. DiPetrillo
- IF3\_IF7-131: **4-dimensional trackers**: contact A. Schwartzman (SLAC)

## 3. Monolithic integrated silicon detectors, CMOS (MAPs)

- IF3\_IF2\_Jessica\_Metcalf-154: **Silicon Pixel Detectors in Space**; contact. J. Metcalfe (ANL)
- IF3\_IF7\_Martin\_Breidenbach-113: **Large area CMOS monolithic active pixel sensors for future colliders**: contact M. Breitenbach (SLAC)
- IF7\_IF3\_Leo\_Greiner-160: **Monolithic active pixel sensors for high performance tracking**: contact L. Greiner (LBNL)

## 4. Integration and Packaging (Integration)

- IF3\_IF5\_Simone\_Mazza-175: **High density 3D integration of LGAD sensors through wafer-to-wafer bonding**: contact S. Mazza (UCSC)
- IF3\_IF0\_Ronald\_Lipton-080: **3D Integration of Sensors and Electronics**: contact R. Lipton (FNAL)
- **2.5/3D integration**- Robert Patti (NHanced Semiconductor INC)-IF03 presentation

# White papers (3)

## 5. Mechanics, lightweight materials, cooling (Mechanics)

- IF3\_IF0\_Jung-118: **Light-weight and highly thermally conductive support structures for future tracking detectors**: contact: A. Jung (Purdue)
- **Mechanics supports for future tracking detector**-Eric Anderssen (LBNL)-IF03 presentation
- **Future cooling - Yadira Padilla- upcoming IF03 meeting No longer involved. IS THERE ANYONE THAT COULD PROVIDE INPUTS HERE?**

## 6. Novel Sensors for Particle Trackers (Novel)

- IF3\_IF0\_N\_Fourches-107: **Beyond CMOS sensors, submicron pixels for the vertex detector** : contact: N.T. Fourches (CEA-Saclay)
- IF3\_IF9\_Jessica\_Metcalfe-161: **Thin Film Detectors**: contact Jessica Metcalfe (ANL)
- IF3\_IF0\_H\_Kagan-130: **3D Diamond Detectors**: contact: H. Kagan (OSU)
- **Silicon Sensors in 3D Technology**: contract S. Seidel (New Mexico)

## 7. Non-silicon trackers: (Non-silicon)

- IF3\_IF2\_Mazziotta-100: **Gamma-ray Scintillator Fiber Tracker**: contact M. Nicola Mazziotta (INFN Bari)
- IF0\_IF0-RF0\_RF0\_Daniel\_Ambrose-094: **Mu2e-II Tracker**: contact D. Ambrose (Minnesota)
- IF0\_IF0-043: **Identification of TeV hadrons: Transition Radiation Detectors**: contact M. Albrow (FNAL)
- IF3\_IF0\_Pavel\_Murat\_129: **Exploration of charge particle tracking using InAs quantum dots in GaAs semiconductor matrix**. Contact M. Hedges (Purdue)

## 8. Simulation Tools for Silicon Detector Developments (Simulation)

- **Simulation tools and radiation damage** - Ben Nachman (LBNL)-IF 03 presentation
- **Simulation tools and radiation damage** - Timo Peltola (Texas Tech)- IF03 presentation

# Completeness and contacts

- Is the White Paper list capturing the community completely?
  - Is your Lol incorporated in one of the papers?
- Is there any optimization to be done with the groupings?
  - Should we split any?
- For each White Paper, we would like a contact person to simplify communication
  - Can each White Paper please volunteer 1-2 persons?