

Status and next steps for SAND simulation, reconstruction and analysis

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DUNE Italia

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Agenda of the session

- Very packed agenda including
 - Calibration studies
 - Reconstruction with dedicated contributions for each subdetector
 - Physics-driven analyses

Please ensure to stay in the allocated time slots!

	Introduction on the status of the activities <i>Alice Campani</i> <i>Auditorium B. Touschek, INFN - LNF</i>	15:15 - 15:20
	DAQ: status and plans <i>Dr Nicolò Tosi</i> <i>Auditorium B. Touschek, INFN - LNF</i>	15:20 - 15:30
	SAND calibration studies <i>Antonio Surdo et al.</i> <i>Auditorium B. Touschek, INFN - LNF</i>	15:30 - 16:10
16:00	GRAIN simulation and reconstruction <i>Auditorium B. Touschek, INFN - LNF</i>	16:15 - 16:35
	GRAIN simulation and reconstruction <i>Auditorium B. Touschek, INFN - LNF</i>	16:35 - 16:45
17:00	Coffee Break <i>Auditorium B. Touschek, INFN - LNF</i>	16:45 - 17:05
	ECAL simulation and reconstruction: status and next steps <i>Alice Campani et al.</i> <i>Auditorium B. Touschek, INFN - LNF</i>	17:05 - 17:20
	Tracker simulation and reconstruction <i>Giulia Lupi et al.</i> <i>Auditorium B. Touschek, INFN - LNF</i>	17:25 - 17:40
18:00	Status of the micro framework development (infrastructure, CI and fast reconstruction) <i>Dr Nicolò Tosi et al.</i> <i>Auditorium B. Touschek, INFN - LNF</i>	17:45 - 18:00
	Status of code integration and next steps <i>Auditorium B. Touschek, INFN - LNF</i>	18:05 - 18:20
	Heavy neutral lepton search: status and next steps <i>Alessandro Ruggeri</i> <i>Auditorium B. Touschek, INFN - LNF</i>	18:25 - 18:40
19:00	Beam monitoring <i>Federico Battisti et al.</i> <i>Auditorium B. Touschek, INFN - LNF</i>	18:45 - 19:00
	Solid hydrogen analysis <i>Federico Battisti</i> <i>Auditorium B. Touschek, INFN - LNF</i>	19:05 - 19:20

The Contributors

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+7 since last DUNE Italia

SAND physics/software workshops

Goal: **accelerate** progress toward **tagging a stable version** of the SAND Software, **start/boost** the development of the **new sandreco version**.

Approach: a collective work to

- **Review** the **status** of the current version of SAND software
- Define **short-term** actionable tasks
- Assign clear and trackable **issues** to be resolved **before** the **next workshop**

Online and in-person operational sessions:

- 1° SAND-Reco Workshop, Bologna, 9-12 Dec 2024
- 2° SAND-Reco Workshop, Bologna, 28-30 Apr 2025
- 3° SAND-Reco Workshop, Online, 12 July 2025 (with a dedicated uFW tutorial)
- 4° SAND-Reco Workshop, LNF, 12-14 Nov 2025 (later this week)

[Link to current actions list](#)

SAND physics/software activities in the past year

- Development of the SAND sim/reco software
 - **ECAL Clustering and PID** (D. Casazza, R. D'Amico)
 - **Kalman Filter integration** (G. Lupi, F. Battisti, V. Pia)
 - **CAF** (D. Casazza, L. Di Noto)
 - **GRAIN lens-based** (L. Di Noto, S. Repetto, A. Surdo) and **mask-based** (V. Cicero, F. Mei) reconstruction
 - Vertexing (A. Surdo, V. Pia, M. Pozzato)
- It is now close to a tagged version to be shared with the users
- **Development of a new, flexible and modular framework (uFW) for sand reco** (N. Tosi *et al*)

Bold means there is a presentation later in this session

Names are major (but not the only) contributors

SAND physics/software activities in the past year

- Spill building update to account for the TOF from proton production to neutrino interaction (F. Battisti, G. Santoni, M. Tenti)
- Porting of sandreco into the new modular framework (i.e. ufw)
- Integration within the global ND sim/reco workflow (G. Santoni and S. Lanzi)
- **Physics analyses:**
 - **Dark neutrino searches** (A. Ruggeri)
 - **Flux measurement with solid hydrogen**
(F. Battisti, A. Mengarelli, C. Roselli, G. Sirri)
 - **Beam monitoring** (F. Battisti, G. Sirri)
- Other related topics

Bold means there is a presentation later in this session

Names are major (but not the only) contributors

SAND physics/software milestones and deliverables

High priority:

- Have a stable sand-reco software version tagged (4 FTE x months)
- Integrate SAND info into CAF files via NDCAF_maker (6 FTE x months)
 - Development of CAF based physics analyses (12 FTE x months)
- Integrate sandreco into the ND sim/reco workflow (12 FTE x months)
- Include GRAIN in the sand reco software (12 FTE x months)

Additional:

- PID and event classification
- Continue development/improvements based on the needs/with the development of analyses
- Set up an event display
- Reduce reference to MC, i.e. truth-based info, in the reconstruction

Non-exhaustive list of PhD theses

In progress:

Denise Casazza	Neutrons detection in the calorimeter
Riccardo D'Amico	Rock Muons, interactions in calorimeter
Francesco Chiapponi	Target-Tracker Performance
Alessandro Ruggeri	Heavy Neutral Leptons
Lorenzo Pierini	Imaging of neutrino interactions (GPU)
Filippo Mei	Imaging of neutrino interactions with coded aperture masks (GPU)
Silvia Repetto	Sim/Reco of Nu Interactions in LAr (imaging with lenses)
Giulia Lupi	Nu interaction in Hydrogen, Extended Kalman Filter
Giacomo Santoni	Beam monitoring, beam time structure
Samuele Lanzi	Imaging of neutrino interactions in LAr (Machine Learning)

Completed:

Valentina Cicero	Tracking performance of optical-imaging in LAr (2023)
Valerio Pia	Calorimetric performance of optical-imaging in LAr (2023)
Matteo Vicenzi	Sim/Reco of Nu Interactions in LAr (2023)
Gianfranco Ingratta	(Anti)neutrino interactions on solid Hydrogen (2025)