ND Physics Simulation and Reconstruction

AKA ND Sim/Reco
AKA ND Reco/Sim

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Summer 2022 Consortium Meeting (30-August 31, 2022)

WSU Wichita State University
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ND Physics Sim/Reco group

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Bi-weekly meetings - Wednesday at 10 am Central

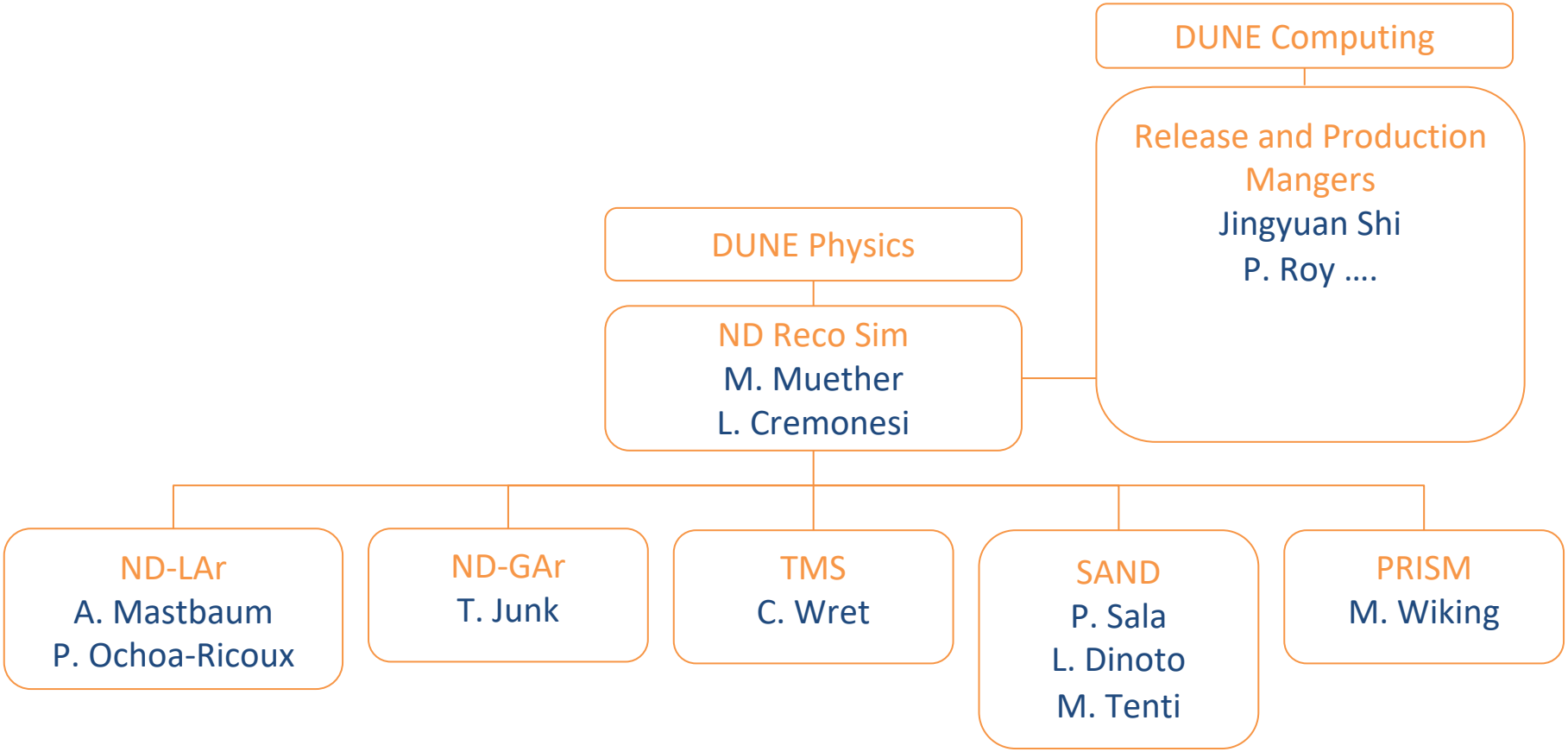
DUNE-ND-SW-INTEGRATION @LISTSERV.FNAL.GOV

#nd-reco-sim

What is ND Reco/Sim?

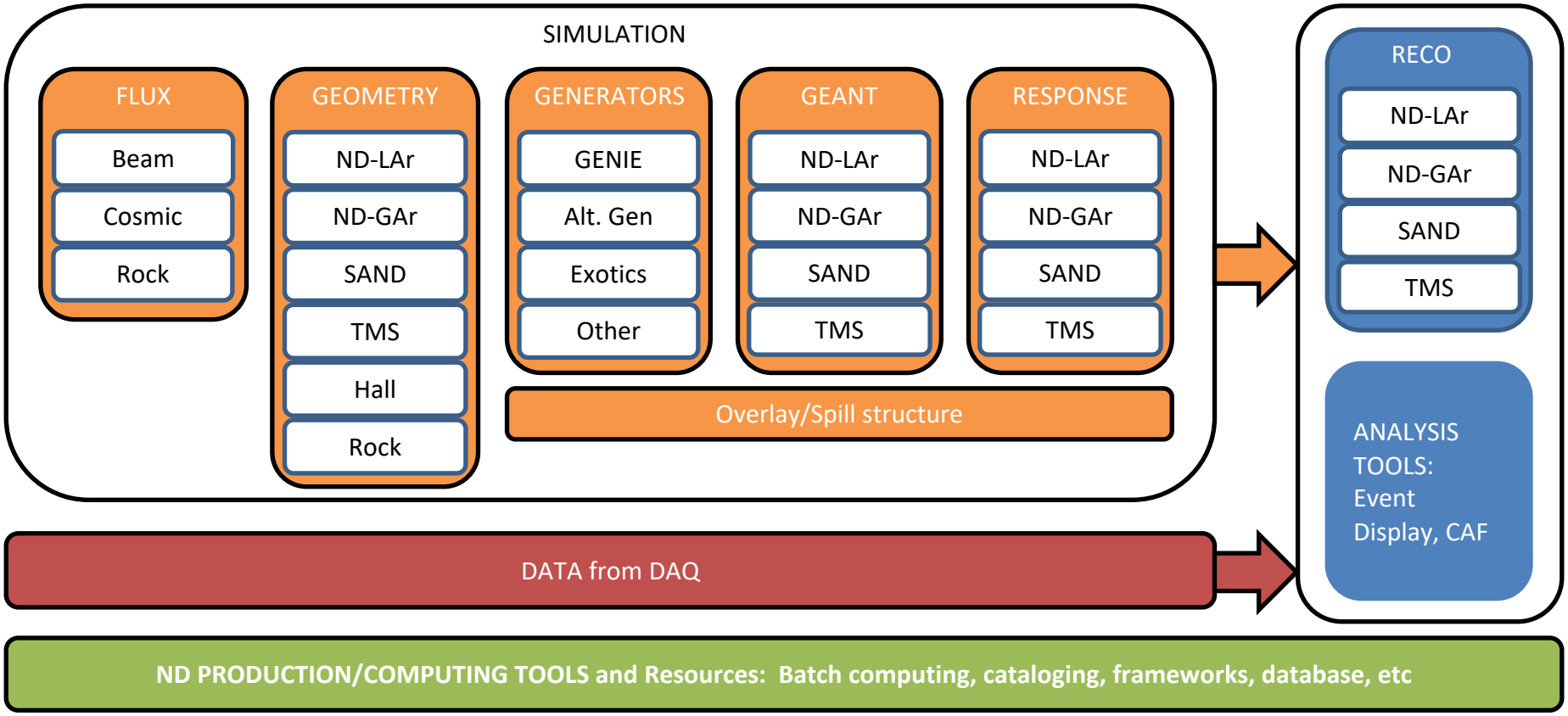
- Physics group that coordinates the development of the ND reconstruction and simulation for physics studies.
- Additional coordination with other physics groups (e.g. LBL, exotics, neutrino interaction, etc), DUNE Computing and FD Reco/Sim.
- Near detector **PHYSICS** studies and plots should get approved by our group before being shown publicly (APB policy is currently being updated accordingly)

DUNE ND Reco/Sim Org.



ND Software overview

- Working on developing fully-integrated end-to-end production-ready simulation and reconstruction software for the ND detector suite.



Staged Production Process/Status

Stage Steps

Freezes Mini-Production Validation Full Production

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Geometry + GENIE	GEANT	Detector Response	Detector Reconst.	CAF

Stage 1/2 Production 1

- Priority samples Completed: Interactions ND-LAr volume (1e19 POT), Hall + ND-LAr + TMS (1e19 POT)

Does the software exist?

Written and working
Written and partially working
Work in progress
Not started

	Stage 1 Geo + GENIE	Stage 2 GEANT	Stage 3 Detector Response	Stage 4 Detector Reco	Stage 5 Analysis files
ND-LAr	done	done	full	ML-Reco	CAFs
ND-LAr + TMS	done	done	partial	ML-Reco + Hough/A*	CAFs
TMS Only	done	done	cheated	Hough/A*	CAFs
ND-GAr	done	done	full	GArSoft	CAFs + GArAna
SAND+STT+GRAIN	done	done			CAFs

Is it integrated with the production tools?

Written and working
Written and partially working
Work in progress
Not start

GPUs
(see slide x)

	Stage 1 Geo + GENIE	Stage 2 GEANT	Stage 3 Detector Response	Stage 4 Detector Reco	Stage 5 Analysis files
ND-LAr	done	done	full	ML-Reco	CAFs
ND-LAr + TMS	done	done	partial	ML-Reco + Hough/A*	CAFs
TMS Only	done	done	cheated	Hough/A*	CAFs
ND-GAr	done	done	full	GArSoft	CAFs + GArAna
SAND+STT+GRAIN	done	done	Full/fast		CAFs

Do files exist?

Yes produced officially
Yes in small numbers
Work in progress
Not started

	Stage 1 Geo + GENIE	Stage 2 GEANT	Stage 3 Detector Response	Stage 4 Detector Reco	Stage 5 Analysis files
ND-LAr		done		ML-Reco	CAFs
ND-LAr + TMS		done		ML-Reco + Hough/A*	CAFs
TMS Only		done		Hough/A*	CAFs
ND-GAr					
SAND (ecal+magnet)					
SAND+STT					
SAND+STT+GRAIN					

ND Production Status

- Jingyuan has been our Production liaison, producing files up to Stage 2
- Working on integration of Stage 4 (reconstruction) cheating the detector response stage for now
- At the moment we are producing 1e20 POT for FHC/RHC and each geometry (~60TB through EdepSim):
  - dune_nd_production_2022_v1_FHC_fiducial_nd_hall_with_lar_tms_sand_TDR_edep
    dune_nd_production_2022_v1_RHC_fiducial_nd_hall_with_lar_tms_sand_TDR_edep
    dune_nd_production_2022_v1_FHC_fiducial_nd_hall_with_lar_tms_sand_TDR_topvol_TMS_edep
    dune_nd_production_2022_v1_RHC_fiducial_nd_hall_with_lar_tms_sand_TDR_topvol_TMS_edep
    dune_nd_production_2022_v1_FHC_anti_fiducial_nd_hall_with_lar_tms_sand_TDR_edep
    dune_nd_production_2022_v1_RHC_anti_fiducial_nd_hall_with_lar_tms_sand_TDR_edep

Immediate Goals

- ND samples to be produced for LBL next analyses:
- [ ] ND-LAr + TMS numu CC inclusive
- [ ] ND-LAr + TMS nu-on-e (stretch goal)
- [ ] ND-GAr (interactions in GAr)
- [ ] SAND hydrogen (mainly STT no need of GRAIN for this)

To-Do and Action Items

- [ ] Move to GENIE-3
- [ ] Production tools development:
  - [ ] Better use of POMS – Jingyuan/Tejin?
  - [ ] Metadata and SAM/Rucio – Jingyuan/Tejin?
- [ ] Production tools integration
  - [] NDLAr reco GPU–AndrewM
  - [ ] ND GAr integration
  - [ ] SAND integration
- [ ] What's missing from CAFs to enable systematics studies?
- [ ] Detector systematics:
  - [ ] Develop within subdetector working groups
  - [ ] File based or parametrisation as a function of CAF variables
- [ ] Include digitisation:
- [ ] ND-LAr ready but output needs to be make as input for LAr ML reco (1-2 months)
- []TMSnotworthit
  - [ ] Spill structure (stretch goal)

Future Meeting

- Joint computing/ND Reco Sim meeting at upcoming collaboration meetin.
- ND Sim/Reco Workshop in Novemeber?
  - ND Reco/Sim meeting about FILE STRUCTURE
  - ND Reco/Sim meeting about DETECTOR SYSTEMATICS

Additional Discussion Points from TRJ

- Short-term needs (prototypes: 2x2, MINERvA, TOAD, others?)
- Short-term needs (TDR: ND-LAr, TMS, SAND components)
- Long-term needs -- what is our software supposed to look like when we have the detectors built for Phase 1 and they start running?
- Longer-term needs: Phase 2. Do we need to design Phase 2 now?