

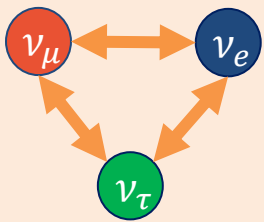
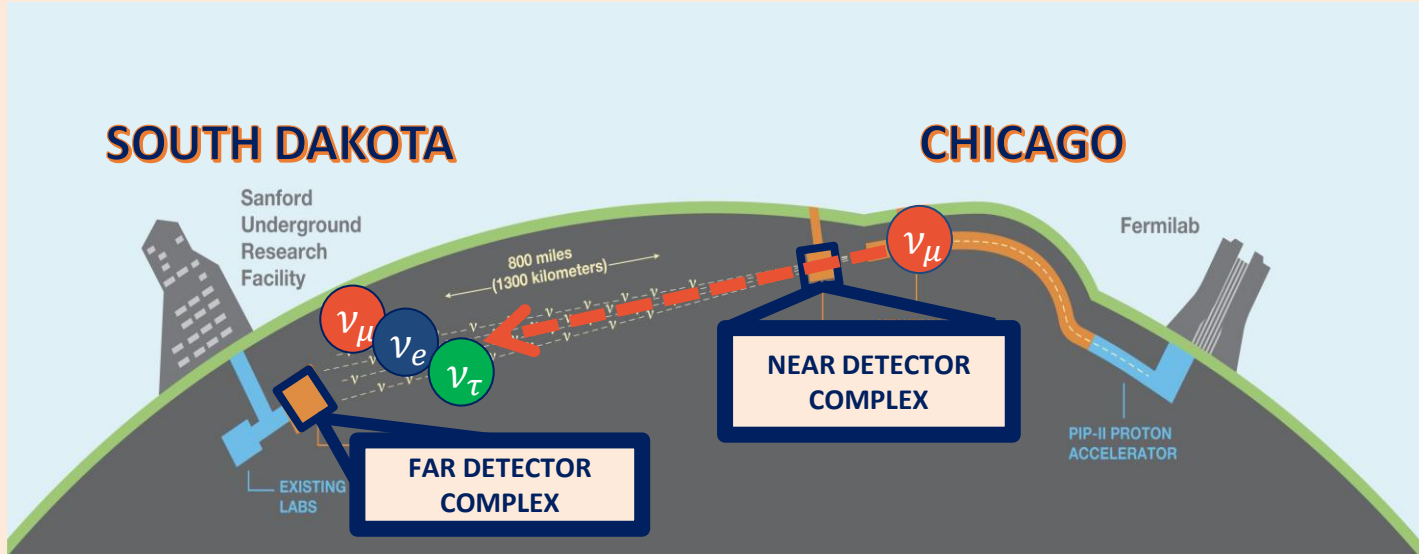
# $\nu$ event simulations in the SAND detector at the DUNE near site

Gianfranco Ingratta

PhD candidate INFN Bologna (Italy)

CERN Computing School 2022 Kraków

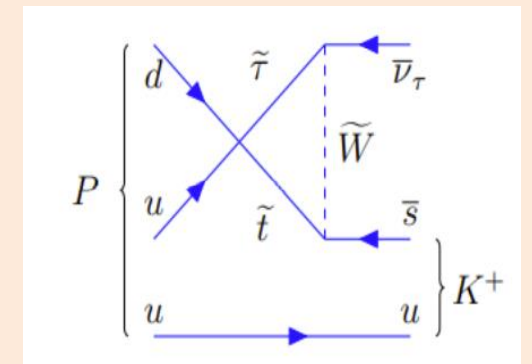
# The DUNE experiment



NEUTRINO OSCILLATIONS

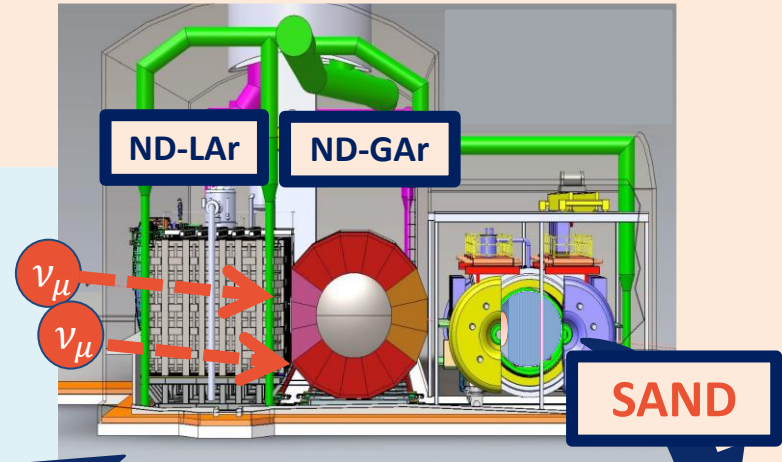
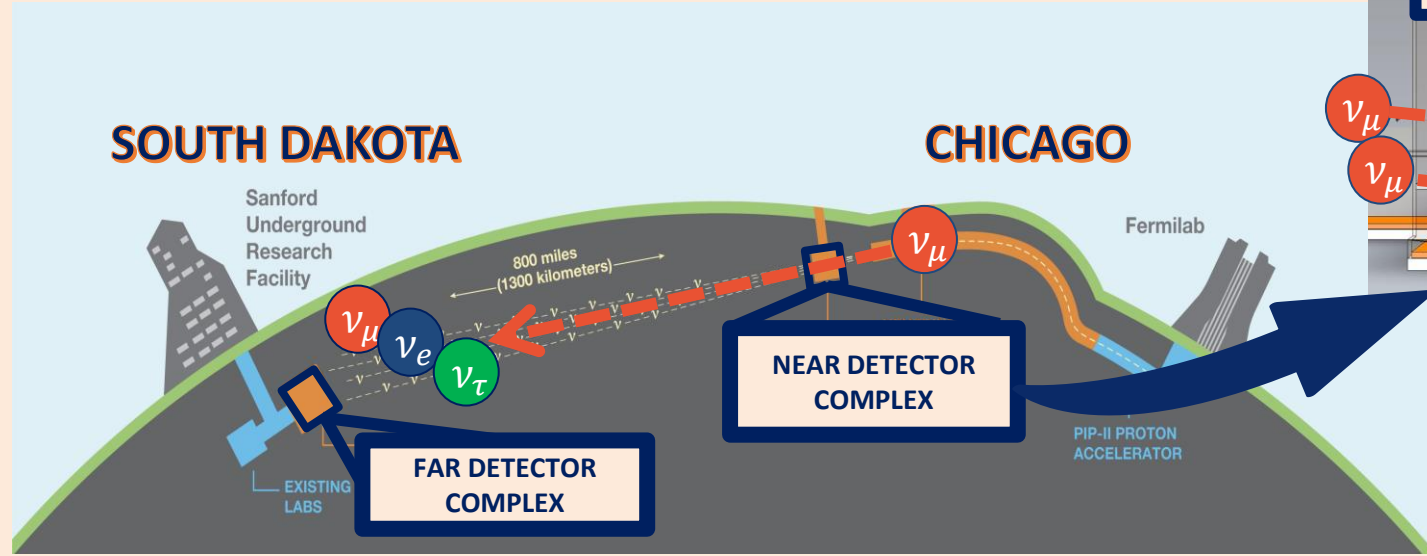


OBSERVATION OF SUPERNOVAS

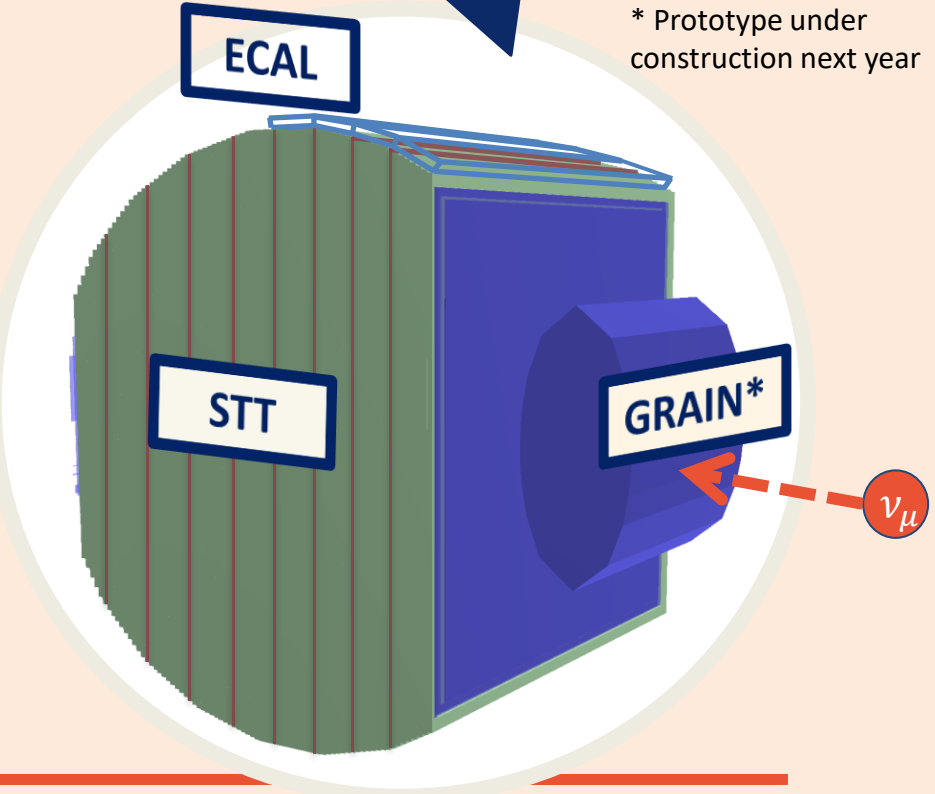


BSM PHYSICS

# The SAND detector



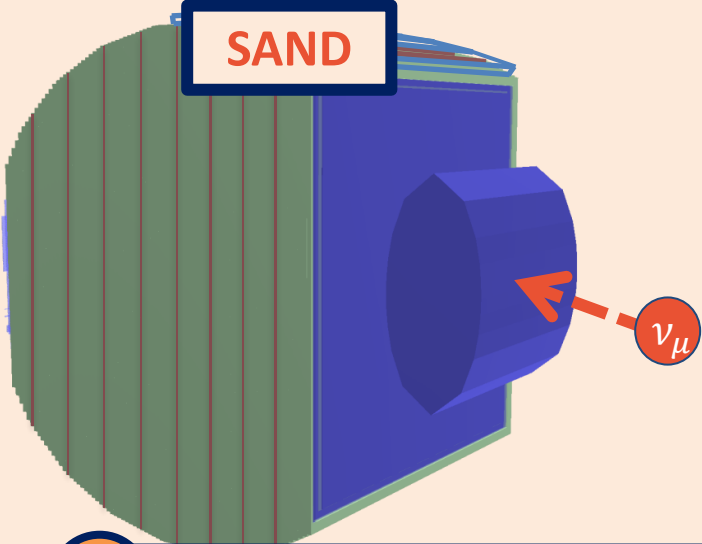
\* Prototype under construction next year



SAND PHYSICS PROGRAM
• MONITOR $\bar{\nu}/\nu$ BEAM STABILITY
• MEASURE OF FLUX COMPOSITION
• REDUCE SYSTEMATIC UNCERTAINTIES
• BSM PHYSICS

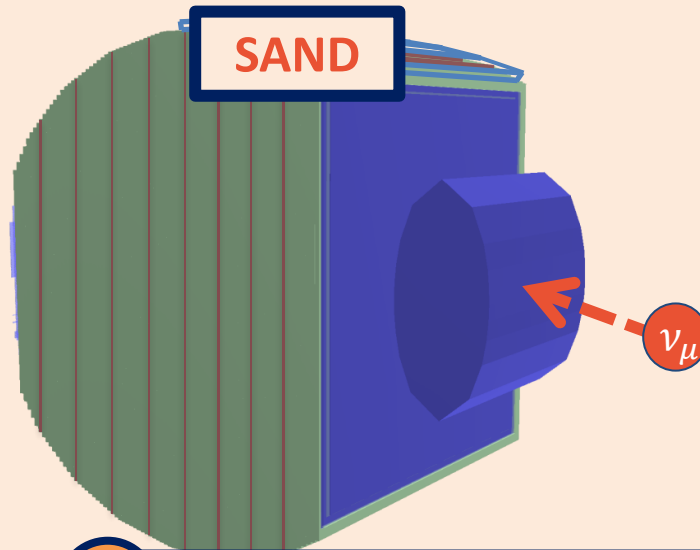
SAND COMPONENTS
• ELECTROMAGNETIC CALO
• STRAW TUBE TARGET TRACKER (STT)
• ACTIVE LIQUID ARGON TARGET (GRAB)

# Simulation Tools



1 DETECTOR SIMULATION (GEGEDE)

# Simulation Tools

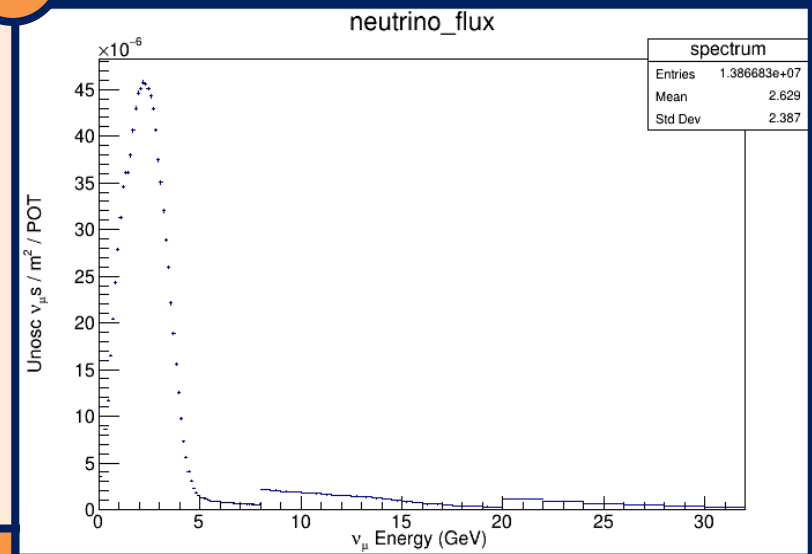


1

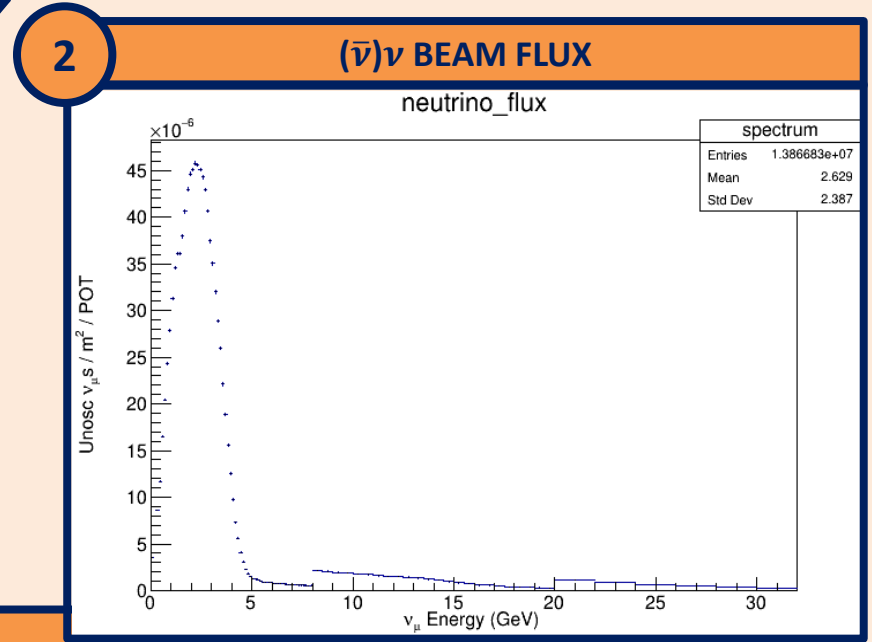
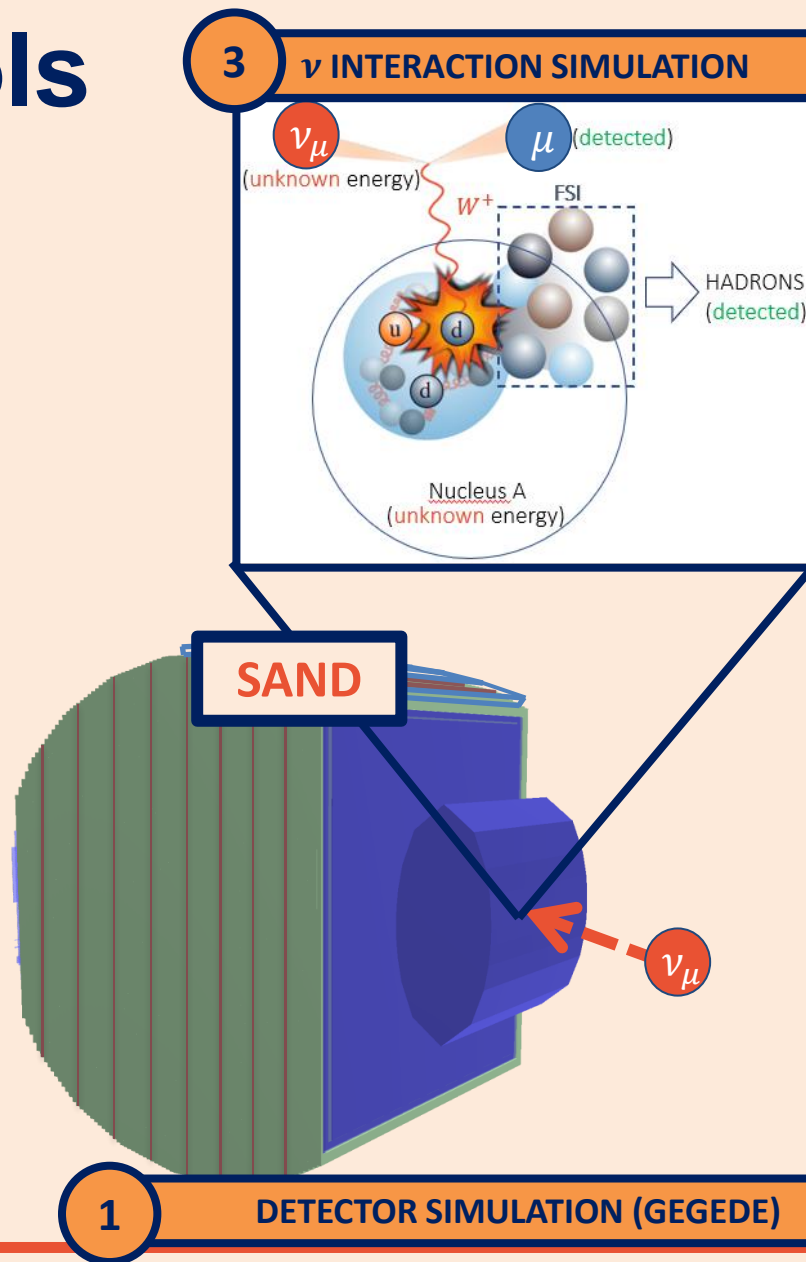
DETECTOR SIMULATION (GEGEDE)

2

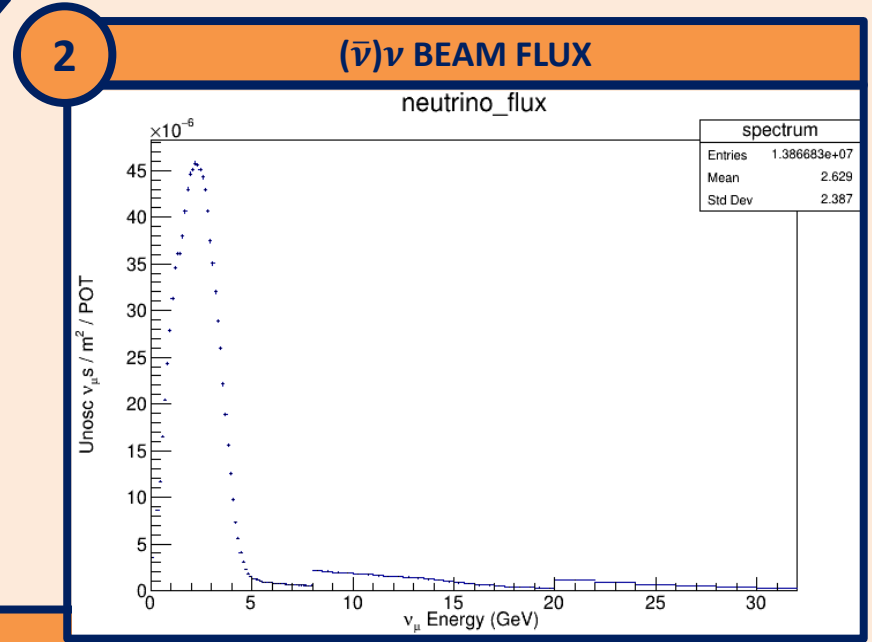
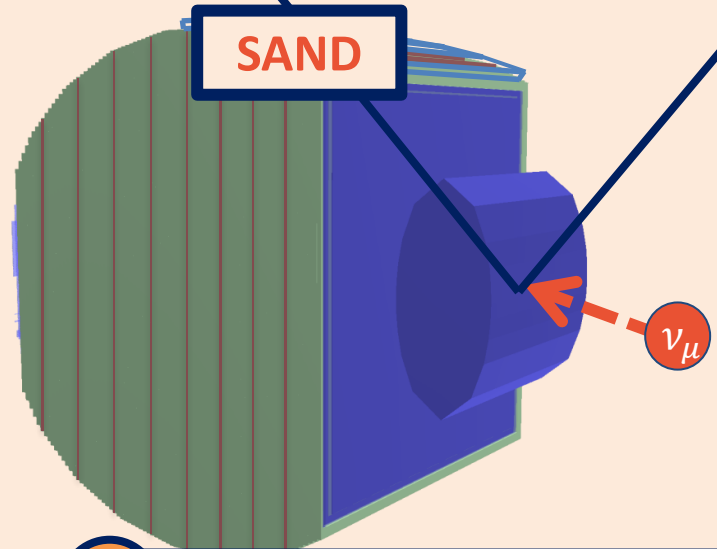
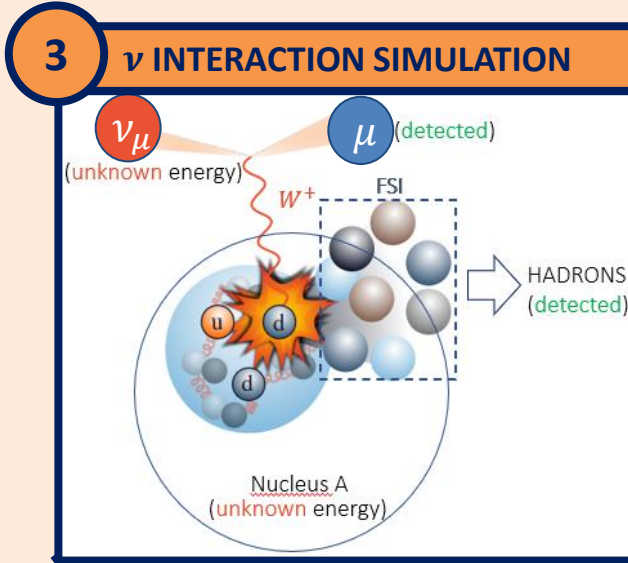
$(\bar{\nu})\nu$  BEAM FLUX



# Simulation Tools



# Simulation Tools



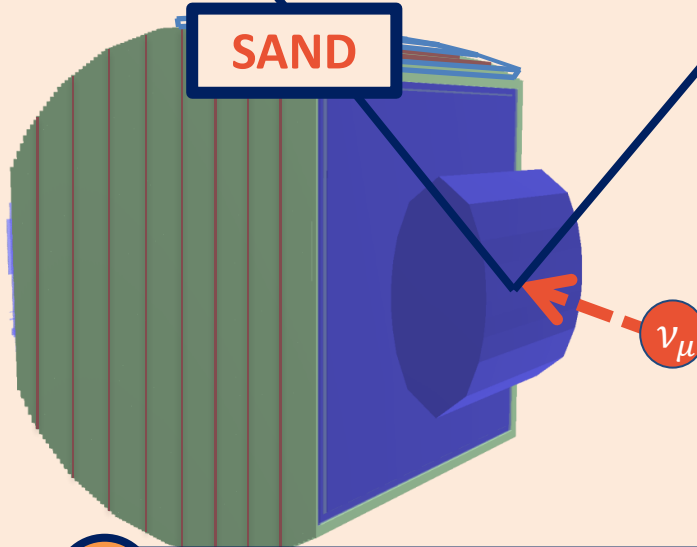
**1** DETECTOR SIMULATION (GEGEDE)

# Simulation Tools

## 4 PARTICLE PROPAGATION IN THE DETECTOR

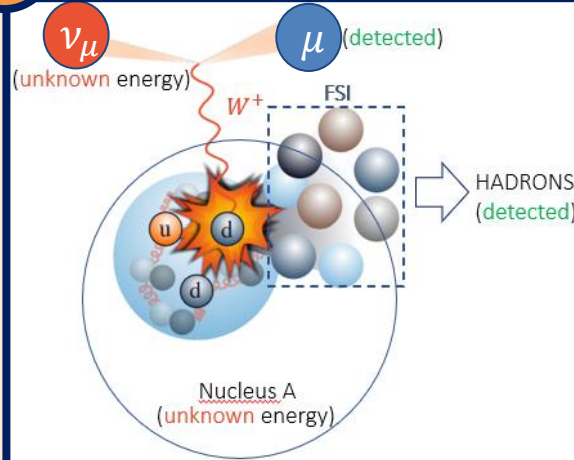


## 5 SIMULATE DETECTOR RESPONSE & DIGITIZATION



## 1 DETECTOR SIMULATION (GEGEDE)

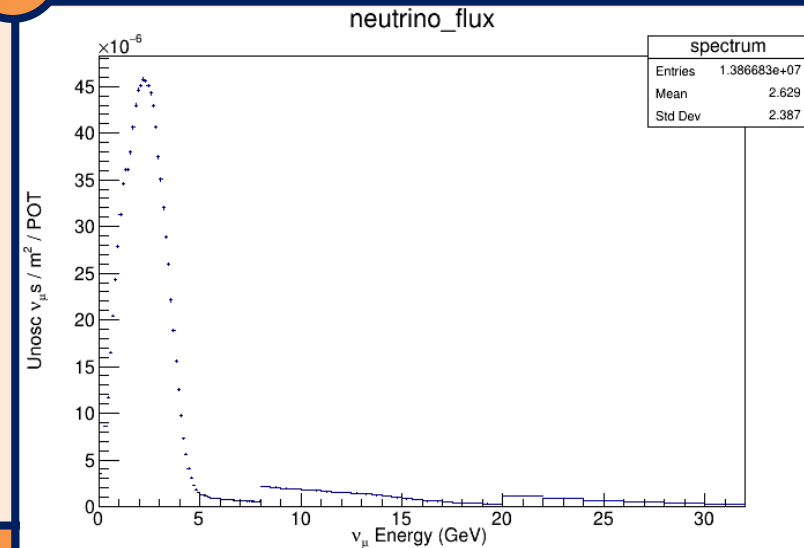
## 3 $\nu$ INTERACTION SIMULATION



## NEUTRINO EVENT GENERATORS



## 2 $(\bar{\nu})\nu$ BEAM FLUX





# Simulation Tools

## 4 PARTICLE PROPAGATION IN THE DETECTOR



## 5 SIMULATE DETECTOR RESPONSE & DIGITIZATION

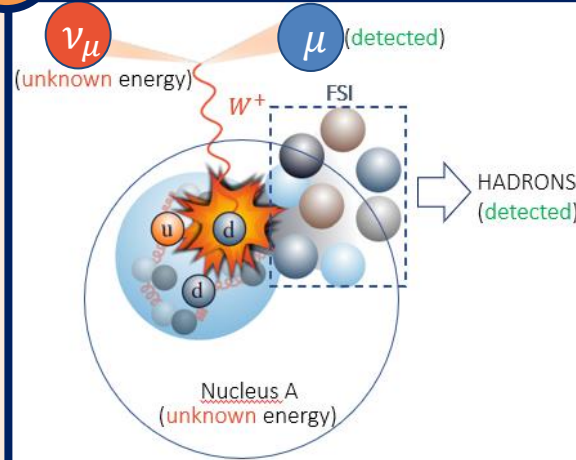
## 6 ANALYSIS

- VERTEX RECONSTRUCTION
- KIN. VARIABLE RECO : ENERGY, MIMENTUM, SCATTERING ANGLES
- ...

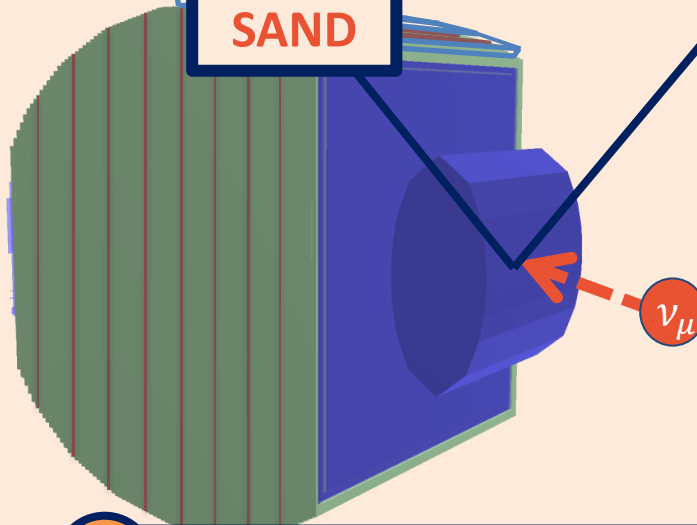
## SCOPE

- EXPLORE CAPABILITY OF SAND
- SAND SUBDETECTORS MATERIAL AND COMPOSITION BEST DESIGN

## 3 $\nu$ INTERACTION SIMULATION



SAND

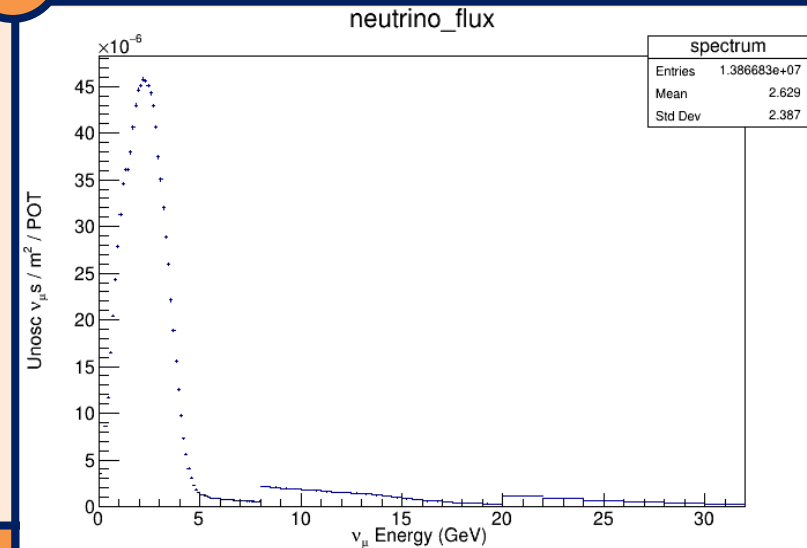


## 1 DETECTOR SIMULATION (GEGEDE)

## NEUTRINO EVENT GENERATORS



## 2 $(\bar{\nu})\nu$ BEAM FLUX

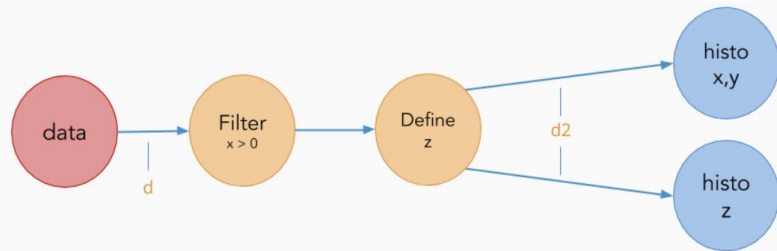


# Analysis tools



## ROOT::RDataFrame Class Reference

Dataframe



```
// d2 is a new data-frame, a transformed version of d
auto d2 = d.Filter("x > 0")
         .Define("z", "x*x + y*y");
// make histograms out of it
auto hz = d2.Histo1D("z");
auto hxy = d2.Histo2D({"hxy", "hxy", 16, -1, 1, 64, -1, 1}, "x", "y");
```

