What DUNE is doing …
… that GridPP sites should know

Andrew McNab
University of Manchester
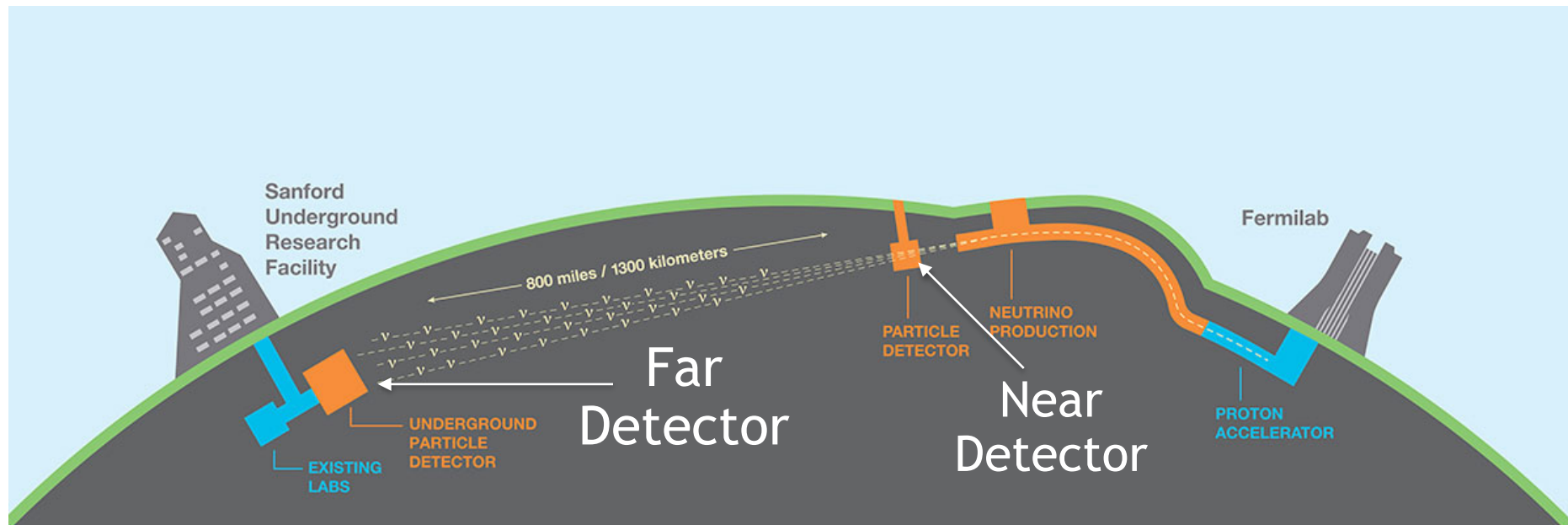
GridPP52,

Ambleside, 2024

Overview

- DUNE Overview

- Recent/future activities

  - DC24, DDC25, protoDUNE

- DUNE software and computing context

  - RS&DC: Pandora, Rucio/justIN

  - Monday ops meetings

- GPUs in DUNE

  - justIN GPU support

  - Pandora
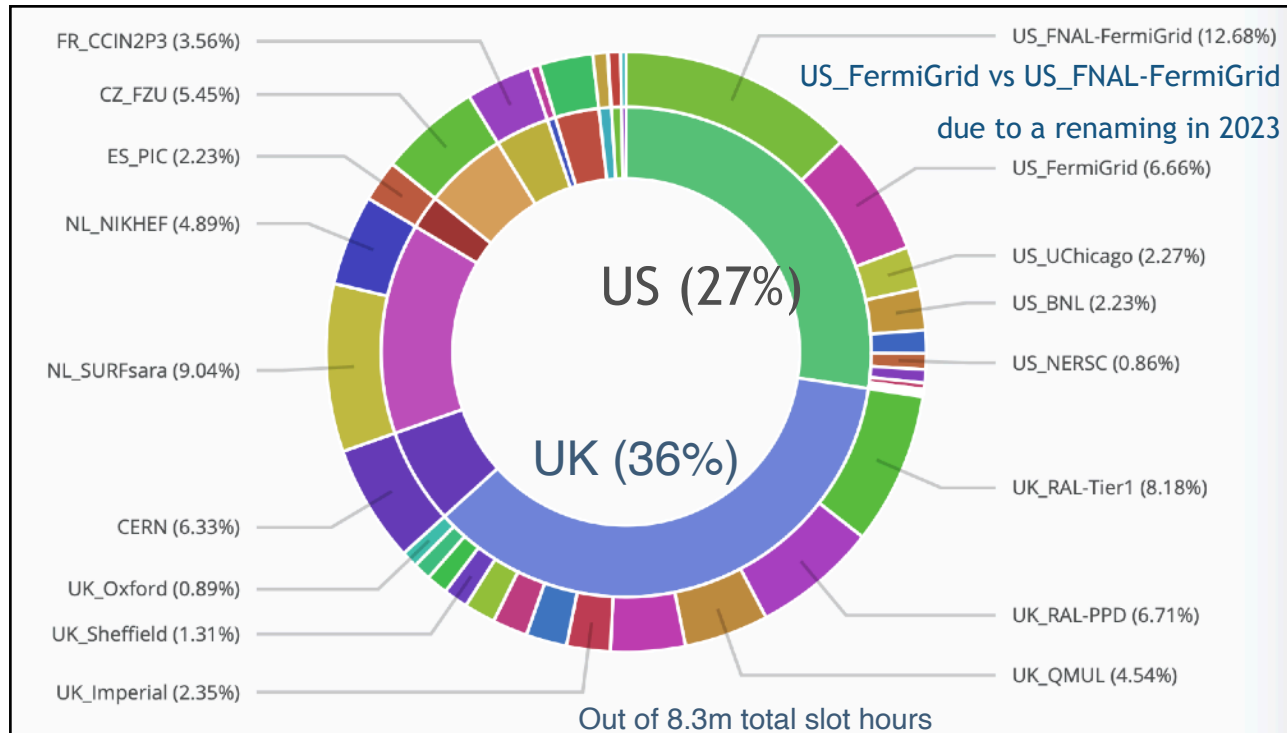
  - ND

DUNE / LBNF overview

- *"Make neutrinos at FNAL then detect some of them in South Dakota (and maybe supernovae and proton decays)"*

  - Construction underway. Start taking data later this decade

  - protoDUNE experiments running at CERN **now** and taking data to mid September

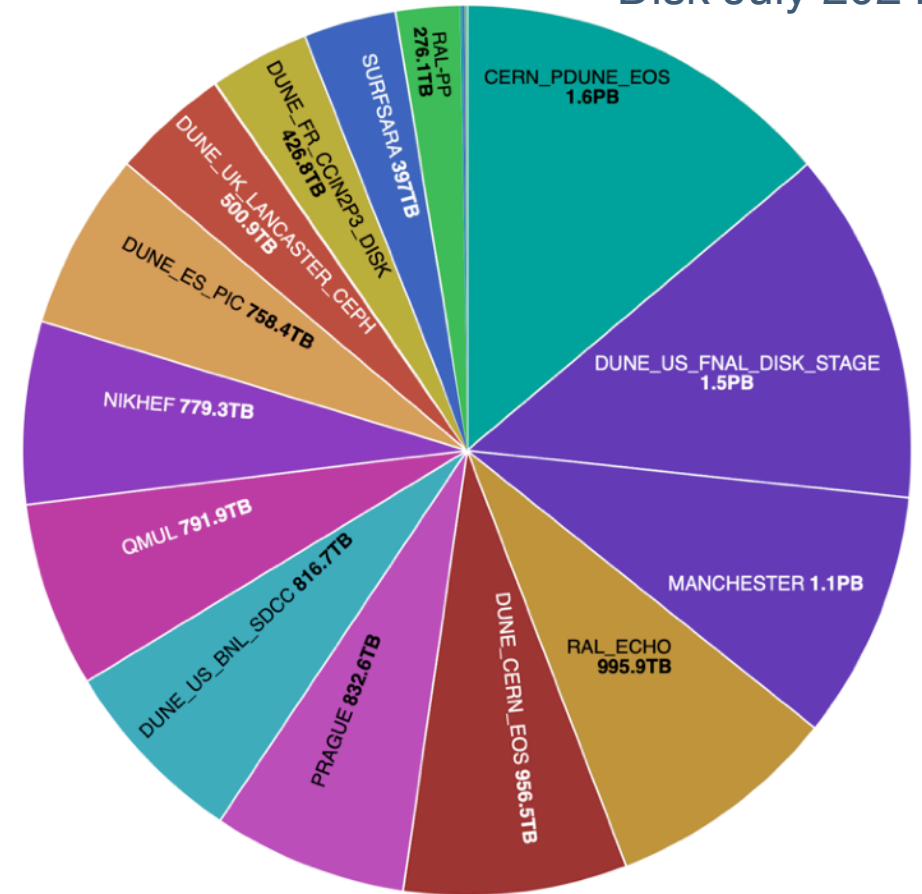- DUNE is part of the **Long** Baseline Neutrino Facility (LBNF)

The UK is the main non-DOE contributor

This is very visible and very much appreciated

We make sure to credit GridPP and IRIS

Disk July 2024

CPU used by DUNE production, 2023

US_FermiGrid vs US_FNAL-FermiGrid
due to a renaming in 2023

Out of 8.3m total slot hours

DUNE in WLCG DC24

- DUNE has run several private data challenges and participated in DC24 this spring

- Aim was to test BNL (as SURF) to FNAL tape; keep up processing; and processing supernova candidates

  - All at 25% of final far detector goals, which will be comparable to LHCb *now,* so very achievable

  - In practice, only the keep up processing was pushed to the target scale, including some last minute reconfigs of our services

- This was an important preparation for protoDUNE data taking this summer

  - We did another validation closer to the start of data taking, as the cryostat filled

- We plan to do DUNE DCs in the spring each year when there isn't a WLCG DC

PIC to other sites

number of running DUNE jobs

FNAL downtime
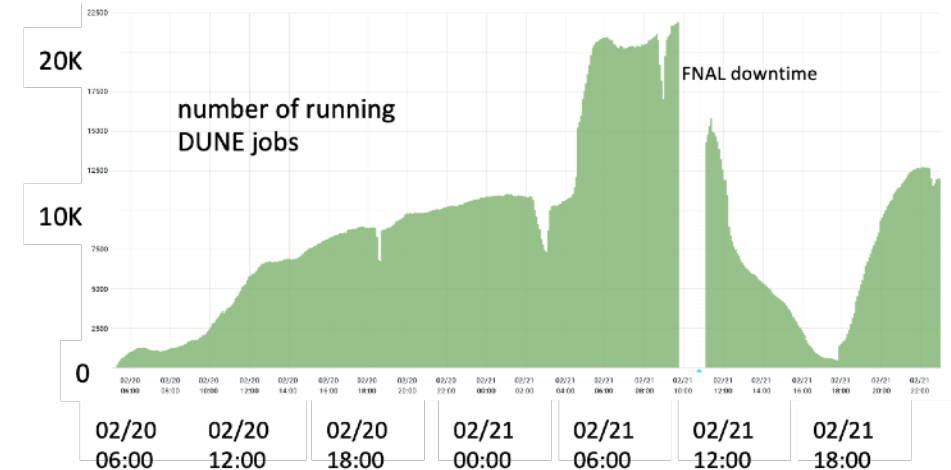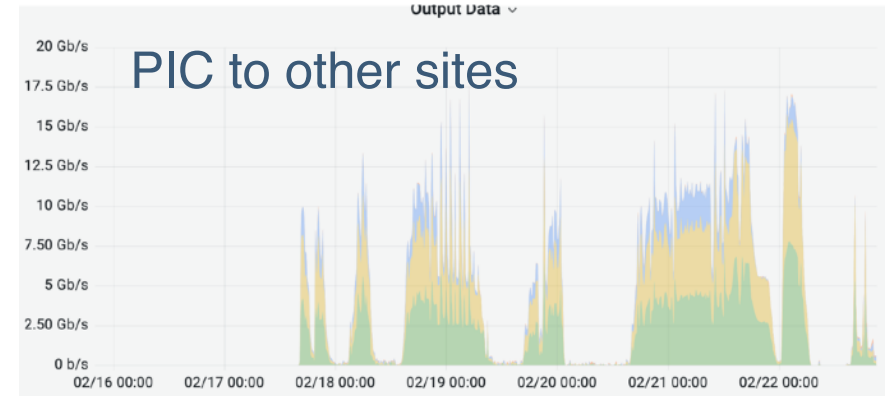
protoDUNE at CERN in 2024

- Horizontal Drift cryostat refilled in April

  - Cosmics then SPS beam from June to Sept 18th

  - (Liquid Ar to be transferred to Vertical next month, and beam for it next year)

- Data transferred from DAQ into Rucio-managed storage by DUNE ingestion daemons at CERN

  - Data primarily sent to Fermilab

  - Keep up processing also done at other sites

    - All managed with new justIN workflow system

    - Outputs to "nearby" storage then transferred to Fermilab with Rucio rules
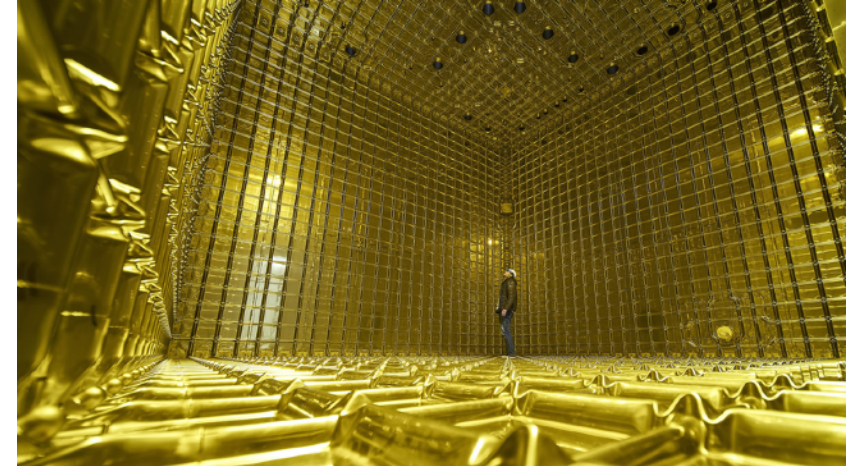
DUNE UK RS&DC project

- "Reconstruction Software and Distributed Computing" - funded 1st April 2024 to 30 Sept 2028

- Continues WP1 of the DUNE UK construction project

  - That's the **Reconstruction Software** side, including the Pandora framework

  - and the **Distributed Computing** part that concerns us

- Distributed Computing is divided into

  - Data Management effort is based at Edinburgh

    - Significant DM effort at Fermilab/Brookhaven too - mostly Rucio

  - Workflow Management effort is at Manchester and RAL-PPD

    - Workflow uses systems and expertise at Fermilab, but we provide ~all the dev effort - new justIN workflow system plus HTCondor

Workflow Management

justIN 🕐

- Centered on the justIN workflow management system developed by Manchester and RAL-PPD

- This replaces some of the book-keeping for workflows previously provided by Fermilab product SAM from the Tevatron era

  - and ties together MetaCat (replacing SAM's metadata system to find filenames)

  - and Rucio (replacing SAM's replica management system to find copies of files)

- Underneath the system still uses the global DUNE HTCondor Pool and GlideInWMS

  - But instead of using jobsub + Fermilab schedds, we have dedicated HTCondor schedds for justIN on the RAL OpenStack Cloud

  - Adds just-in-time matching of jobs to HTCondor slots based on nearby unprocessed files for that workflow

- justIN was first used by DUNE globally for the data challenge at the end of 2022

- justIN was used for DUNE's part of the spring WLCG Data Challenge 2024

- After that justIN became the basis for all DUNE central production campaigns

  - More recently, justIN is being used for keep-up processing of protoDUNE data
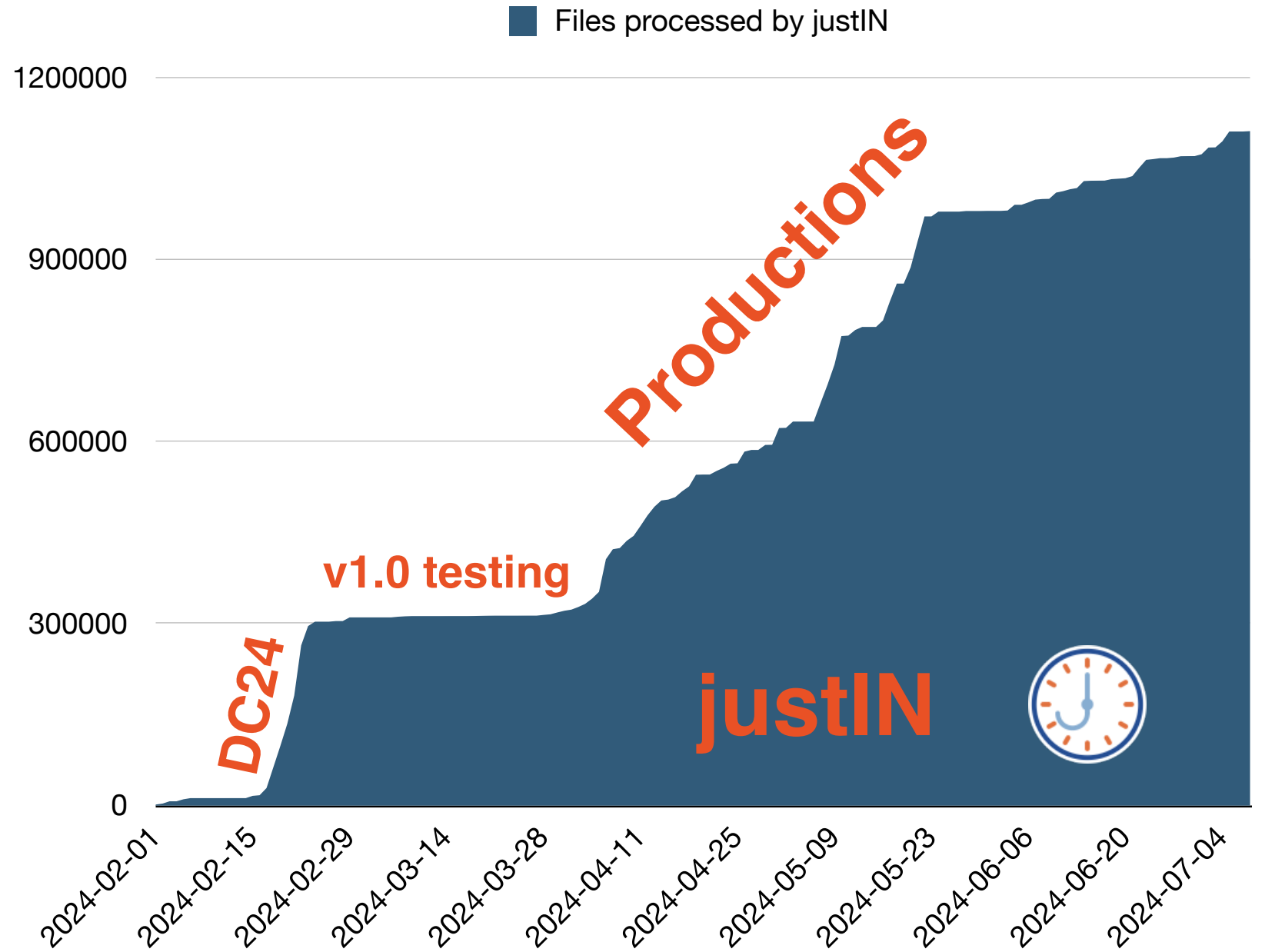
DUNE computing operations

- We have weekly operations meetings on Mondays - 2:30pm UK time

  - https://indico.fnal.gov/category/1207/

  - Sites are very welcome to attend! Problems, successes, updates, curiosity :)

- There's also a Fermilab mailing list

  - dune-computing-sites on the Fermilab listserv - ask me if you want to be added

- We try to use GGUS tickets

  - But sometimes contact starts as email and continues like that

- For adding new storages, Rucio is under our direct control

- For adding new compute endpoints (CE/queue), we need to contact the OSG pilot factory admins - we do this on your behalf

DUNE and GPUs

- Pandora developers are making heavy use of GPUs for training machine learning modules

  - Need interactive access and want to move to grid too

- The Near Detector software is highly dependent on GPUs

  - GPUs used both in NDLAr simulation and ML based reconstruction

  - Currently run on Perlmutter at NERSC - lots of GPUs

- We don't yet have an agreed figure for how many GPUs we are going to try to get globally …
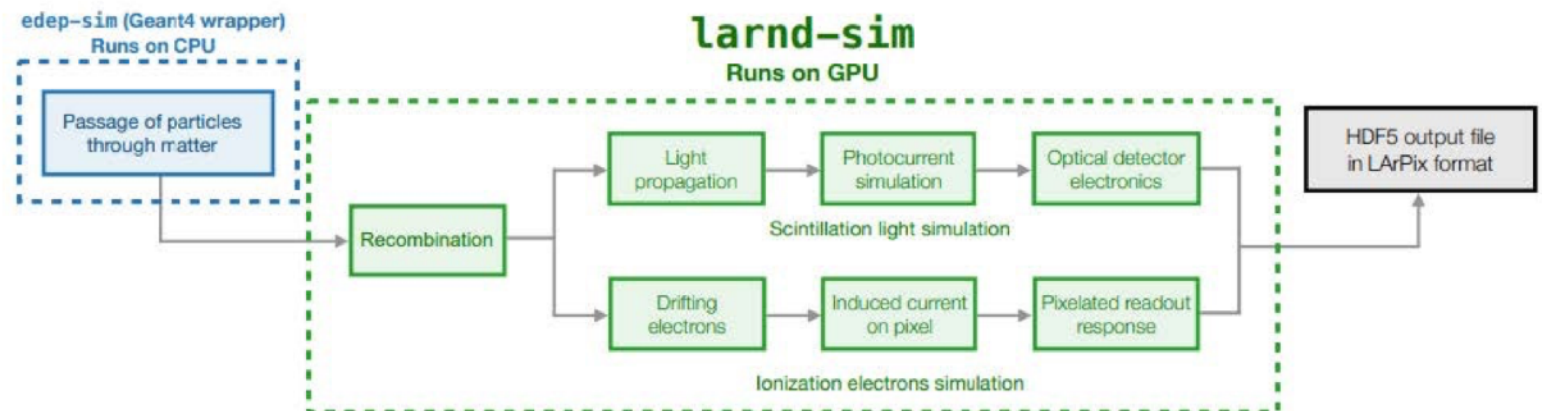
GPU support in justIN

- justIN's wrapper jobs gather and record info about job slots

  - Including GPU presence, memory, model, driver version etc

  - Used to direct jobs for a workflow that needs GPUs to suitable queues at sites

  - Currently this is GPU yes/no, but will allow memory etc requirements in future

- Typically, a site gives the pilot a number of GPUs based on the queue/classads whatever

  - GlideInWMS/HTCondor inside the pilot then matches GPUs based on ClassAds that we generate for the justIN jobs

- Work underway to add NERSC Perlmutter to DUNE HTCondor pool (via HEPCloud), and then have justIN workflows running at NERSC

  - Then transfer ND workflows to justIN, and so allow them to use non-NERSC GPUs

- For Pandora developers needing GPUs, we plan to provide a pathway from interactive development, to running justIN jobs in its interactive test mode, to running them on the grid

Summary

- Funding via IRIS to the GridPP sites is making a major and very visible contribution to DUNE computing resources

- STFC funded RS&DC project has started and is key to DUNE reco, data management and workflow management

  - Sites interact with old friends (Rucio, glideInWMS/HTCondor) and new (justIN) being developed by the project

- DUNE already has a major requirement for bulk GPU, which is currently provided by NERSC

  - We are integrating GPU support into the workflow system at this early stage and plan to use GPUs at sites that make them available