

# SIGMA Hybrid Data Overview

Nuclear Threat Reduction, Detection Science, Data Assessment

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# Talk Outline

- SIGMA Data Refresh
- SIGMA Threat Inject
- Why NaI only?
- NaI Calibration
- PFA Discussion
- Conclusion/Timescales

# SIGMA Data Refresh

- Pilot 3
  - 06/08/2018 – 09/10/2018
  - ~100 D3S, ~10 static
  - 1s spectra uploaded every second
    - 0-3Mev
    - 4096 bins D3S
    - 1024 bins Nal

Detector	Location	Quantity
D3S	Bus Stop	76
	Road-side cabinets	2
	Parliamentary and Diplomatic Police	30
	British Transport Police	12
Nal log	Underground station	6
	St Thomas' Hospital	3
	Roadside cabinets	3
PERM-S	Roadside cabinets	2

Activity	Dates
Detector deployment	6 <sup>th</sup> Aug 18 – 9 <sup>th</sup> Oct 18
Alert adjudication	17 <sup>th</sup> Sep 18 – 10 <sup>th</sup> Dec 18
Detector maintenance	11 Oct 18
Police Scenarios	14 <sup>th</sup> , 16 <sup>th</sup> Nov; 18 <sup>th</sup> , 13 <sup>th</sup> Dec
Detector Recovery	18 <sup>th</sup> Dec 18 – 7 <sup>th</sup> Feb 19

## OFFICIAL

### Kromek D3S Revision 1.1

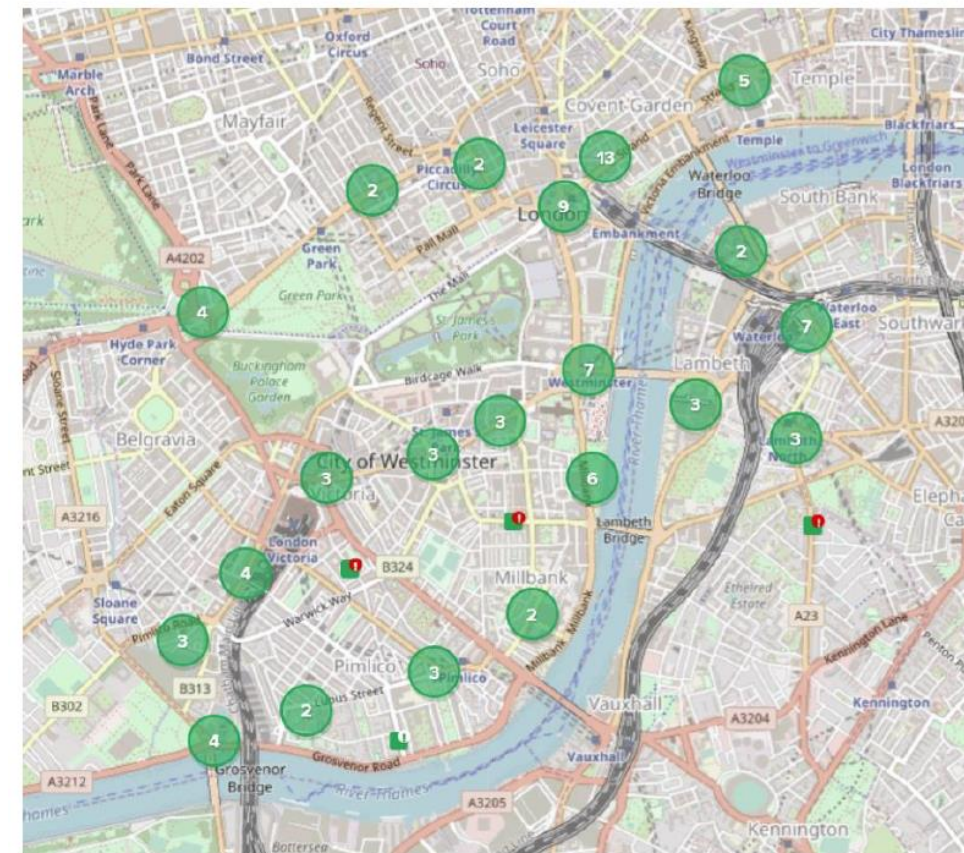
2 x 1 x 0.5 inch Csl (TI) gamma detector

32 mm x100 mm LiF:ZnS neutron detector



### Physical Sciences Inc. PERM-S (unheated and heated variants)

2 x 4 x 16-inch Nal (TI) gamma detector



Map indicating locations and number of detectors deployed in P3

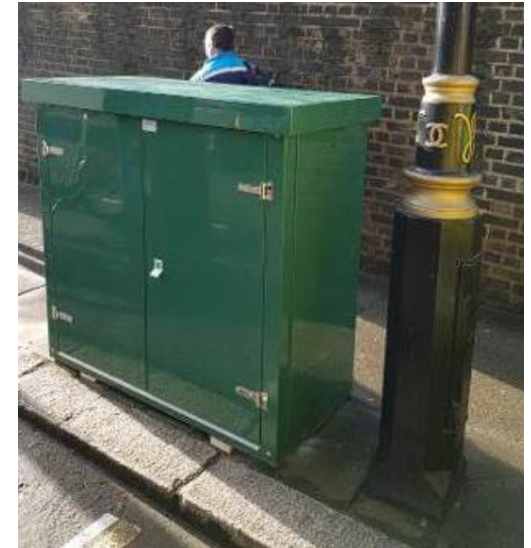
# P3 Detector Deployment Illustrations\*



D3S bus stop deployment



Nal station deployment



Roadside cabinet outside

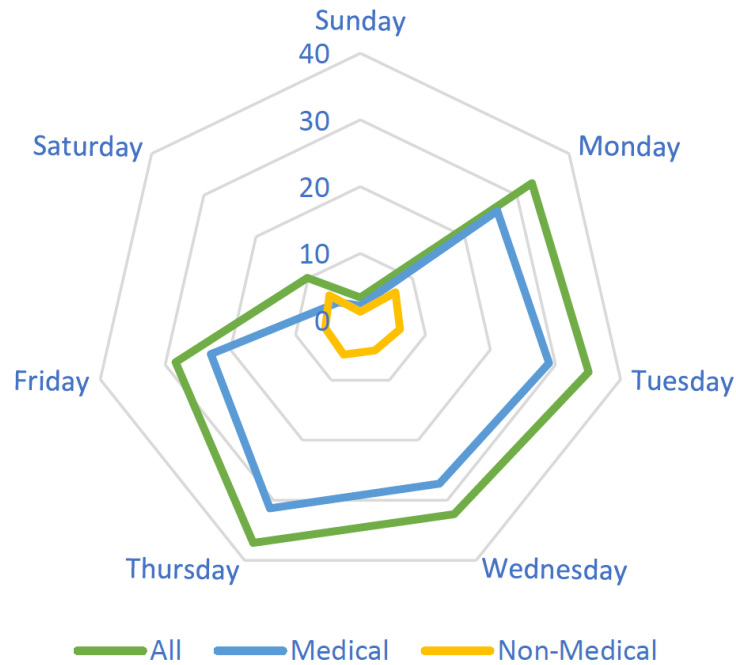


Roadside cabinet inside

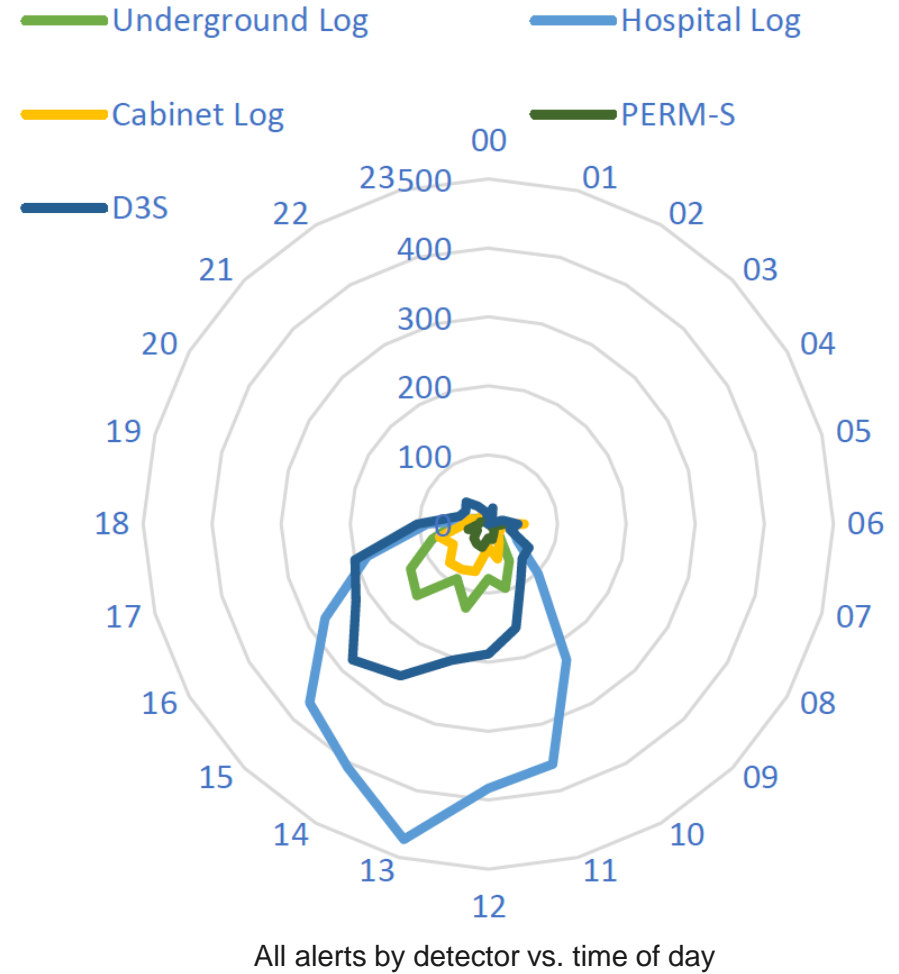
\* Figures on this slide are from P2, however are still illustrative of P3 deployments

# P3 Alarms, no ground truth

- ~7500 alarms total
  - 3000 across ~100 D3S
  - 4500 across ~10 NaI



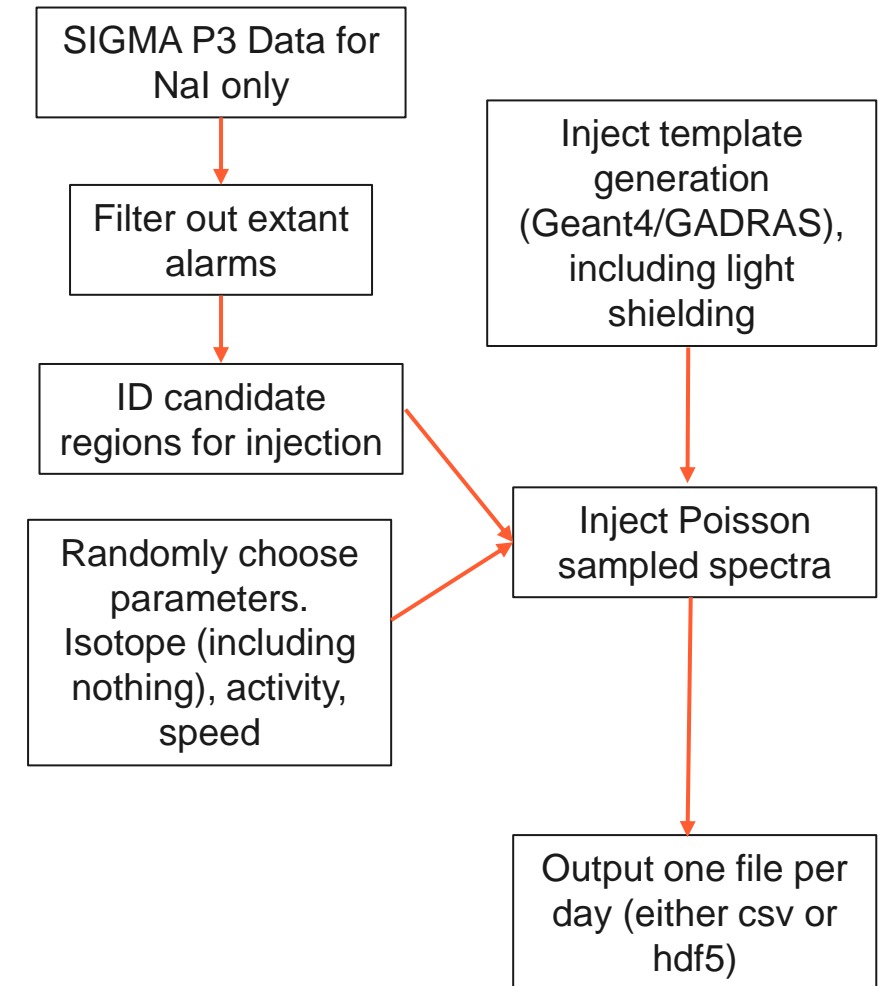
Bus stop D3S alerts by alarm type vs. day of the week



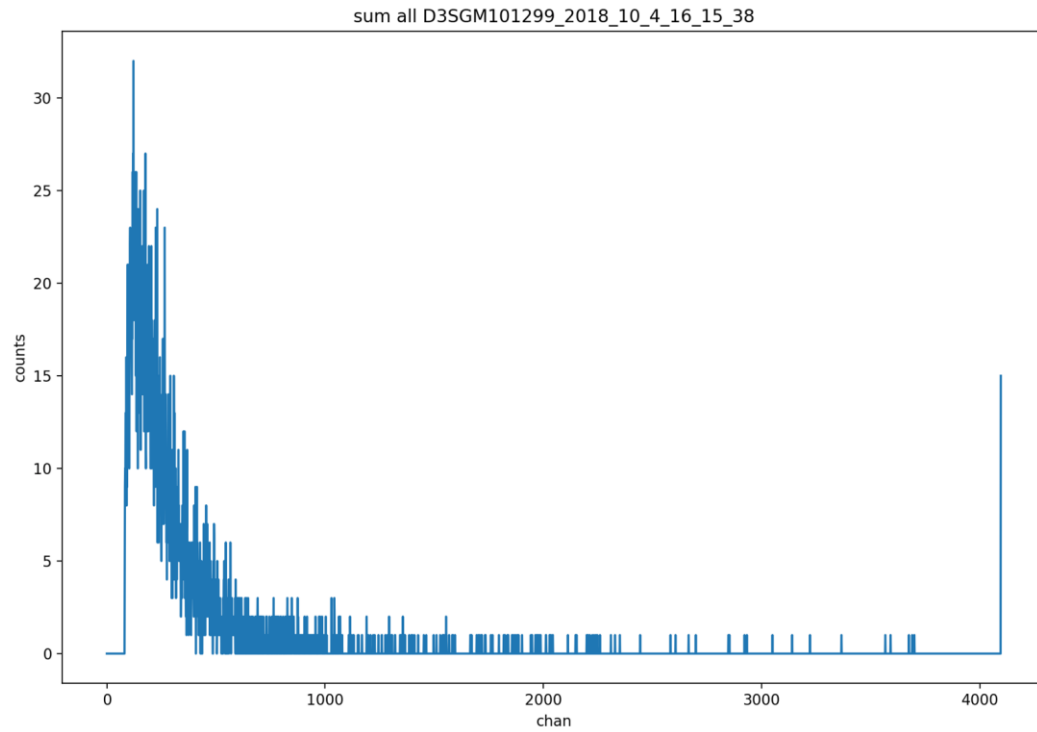
All alerts by detector vs. time of day

# SIGMA Threat Inject

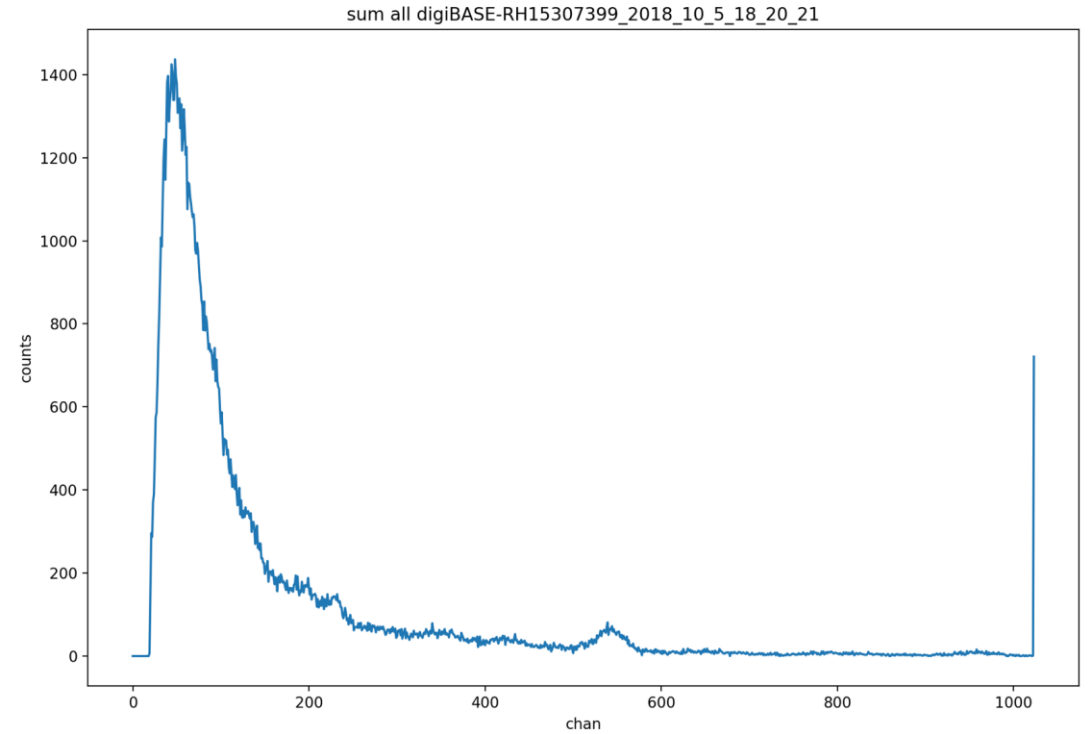
- Aim
  - Real background data
    - Valid contribution before, during and after alarms
    - Sufficient gaps to allow PFA estimation from full dataset
  - Ground truth with
    - Range of threat isotopes
    - Range of threat activities
    - Range of threat speeds
- Method
  - Generate spectral shapes representative of isotopes that can be scaled to activity (Geant4/GADRAS)
  - Filter out existing alarms
  - Identify candidate regions where alarms could be injected
  - Leave some blank (for PFA)
  - Randomly choose
    - Isotope, activity, speed
    - Add relevant Poisson sampled spectra given isotope, activity and distance.



# Why NaI only?



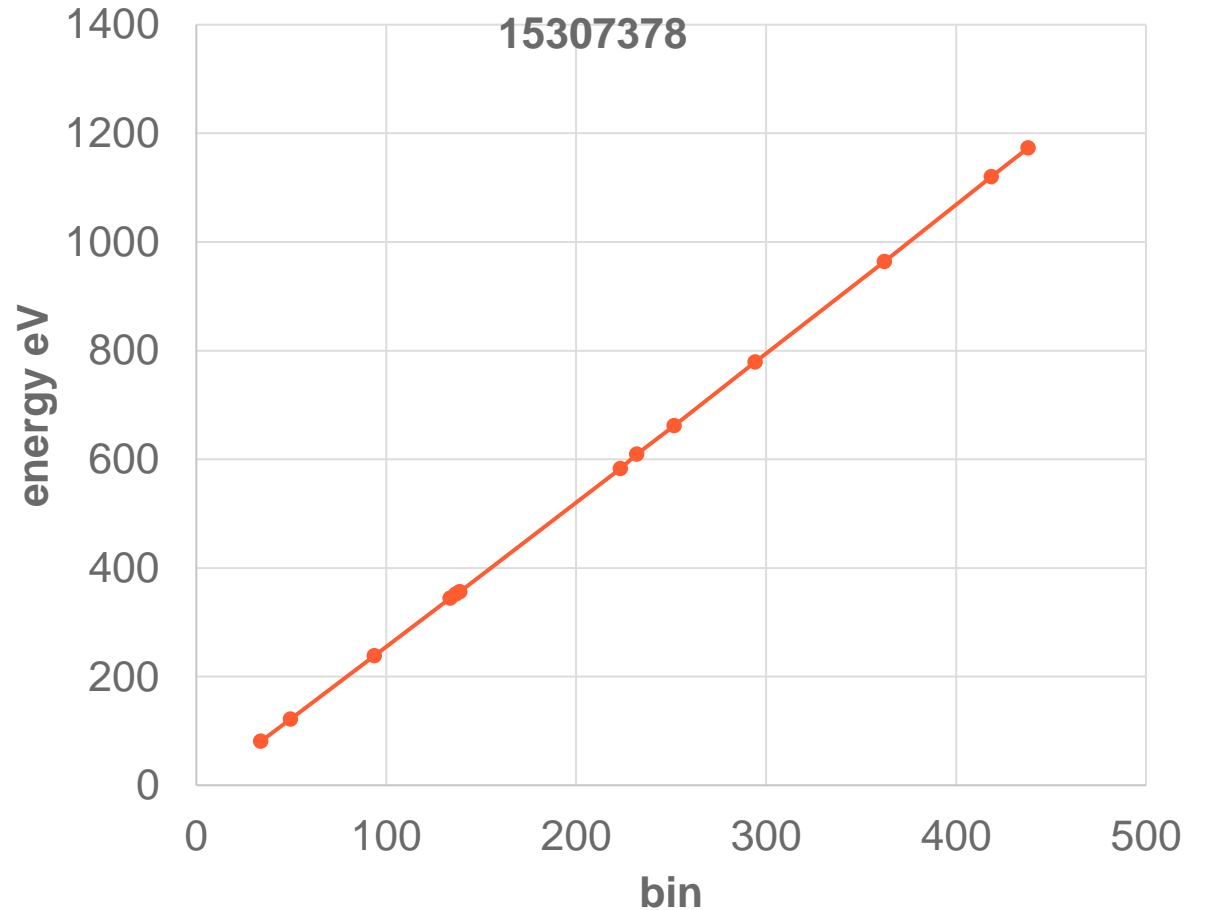
D3S ~30s including alarm



NaI ~30s including alarm

# NaI Calibration

- Injected threats are aligned to individual detector calibration (templates are output by bin not energy)
- Calibration data pairs are contained in the extant structure
  - Top level group “sensor”
  - Second level key “characterization”
  - Sensor serial number, (bin, energy) pairs (~10)
- Some NaI are temperature stabilised (kept at 40 °C)
  - It is not currently clear which, though it is not the majority

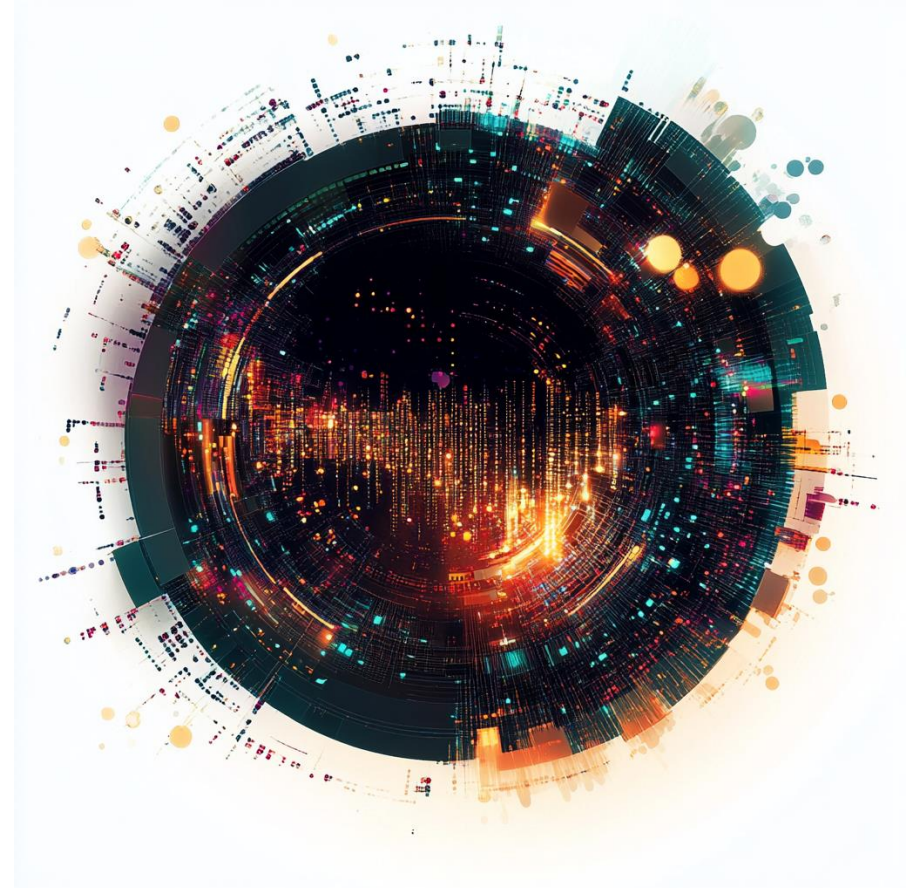


# PFA Discussion

- Assumption of at least as good as 1 in 8 hours (to match SIGMA)
  - Anecdotally need better than one high confidence false alarm every few years (absolutely not 0.05, closer to  $10^{-8}$  for a busy road-based system)
  - SIGMA had no contextual sensors to indicate when a person/vehicle was near a detector
- Approaches
  - Run over all data, define PFA with respect to the number of alarms in blank inject regions
    - This assumes one “test” per “region”
  - Similar to above but include additional background between regions
    - This can account for the potential for multiple “tests” per unit time (e.g. a string of vehicles passing the detector)

# Conclusion/Timescales

- Ground truth hybrid dataset is near completion and will be made available soon\*
  - Facilitates quantitative PD/PFA analysis
  - Can compare to other algorithms if the community is interested\*
- Threat injection pipeline is in place and file generation has started
- File generation needs to be completed and verified (~ weeks)
- Data files need to be transferred to Surrey for upload to sharepoint (~days?)
- End FY is fast approaching
  - Everything is very busy till approximately end March



\*These moves up the priority list as people ask for it to be available