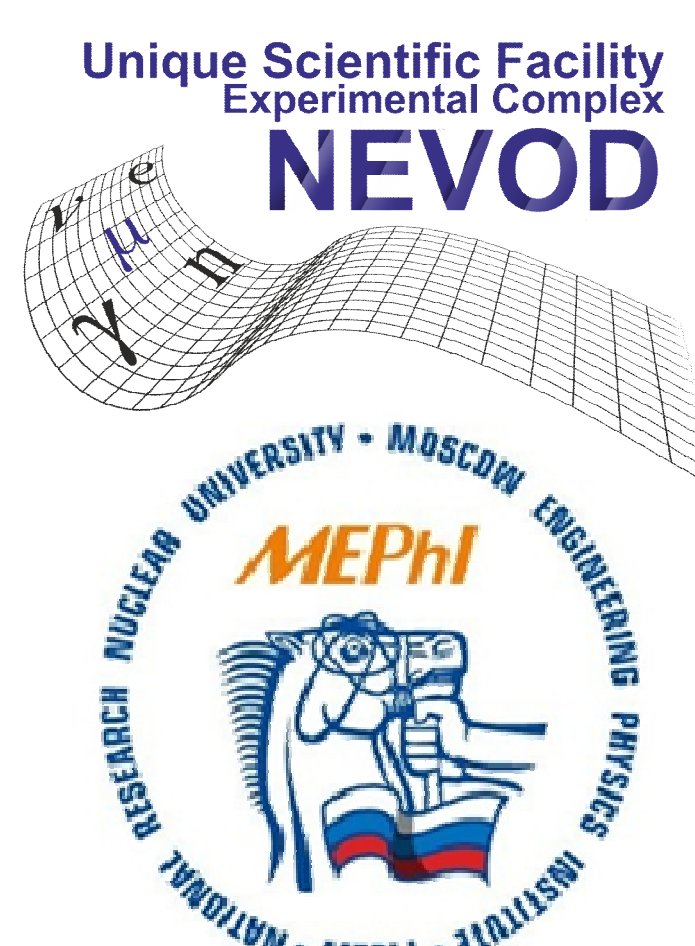




NEVOD - experimental complex for multi-component investigations of cosmic rays and their interactions in the energy range $1 - 10^{10}$ GeV

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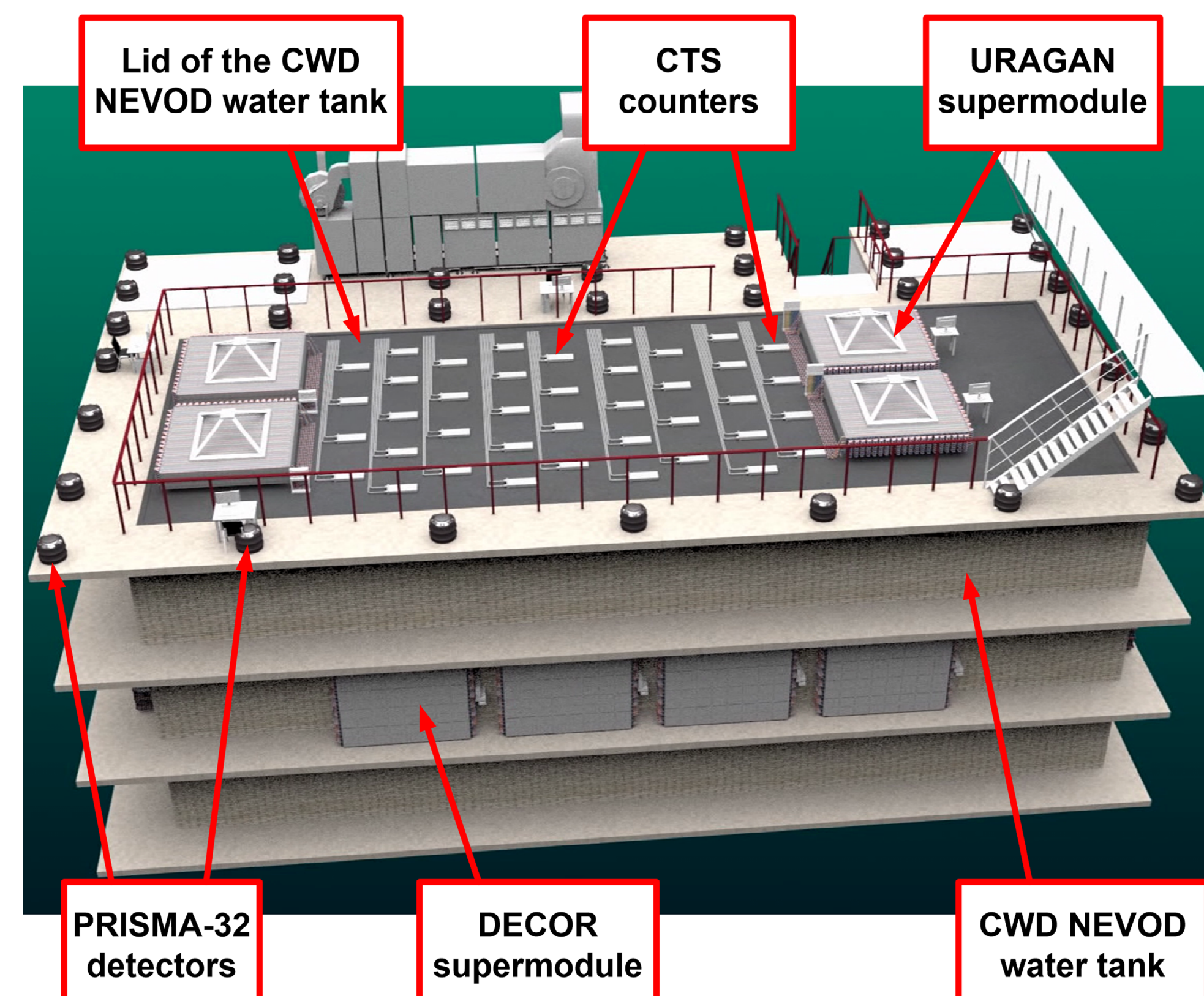
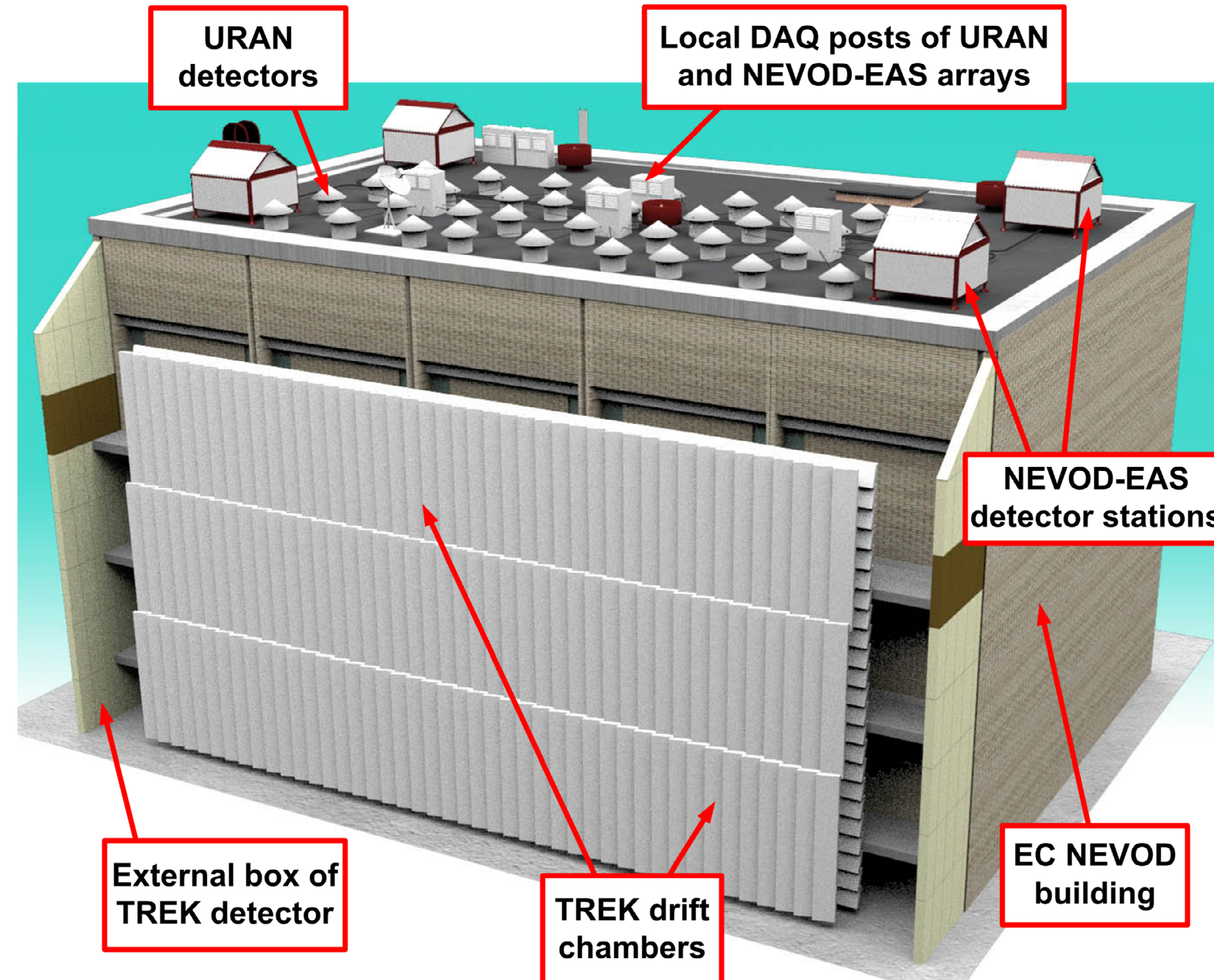
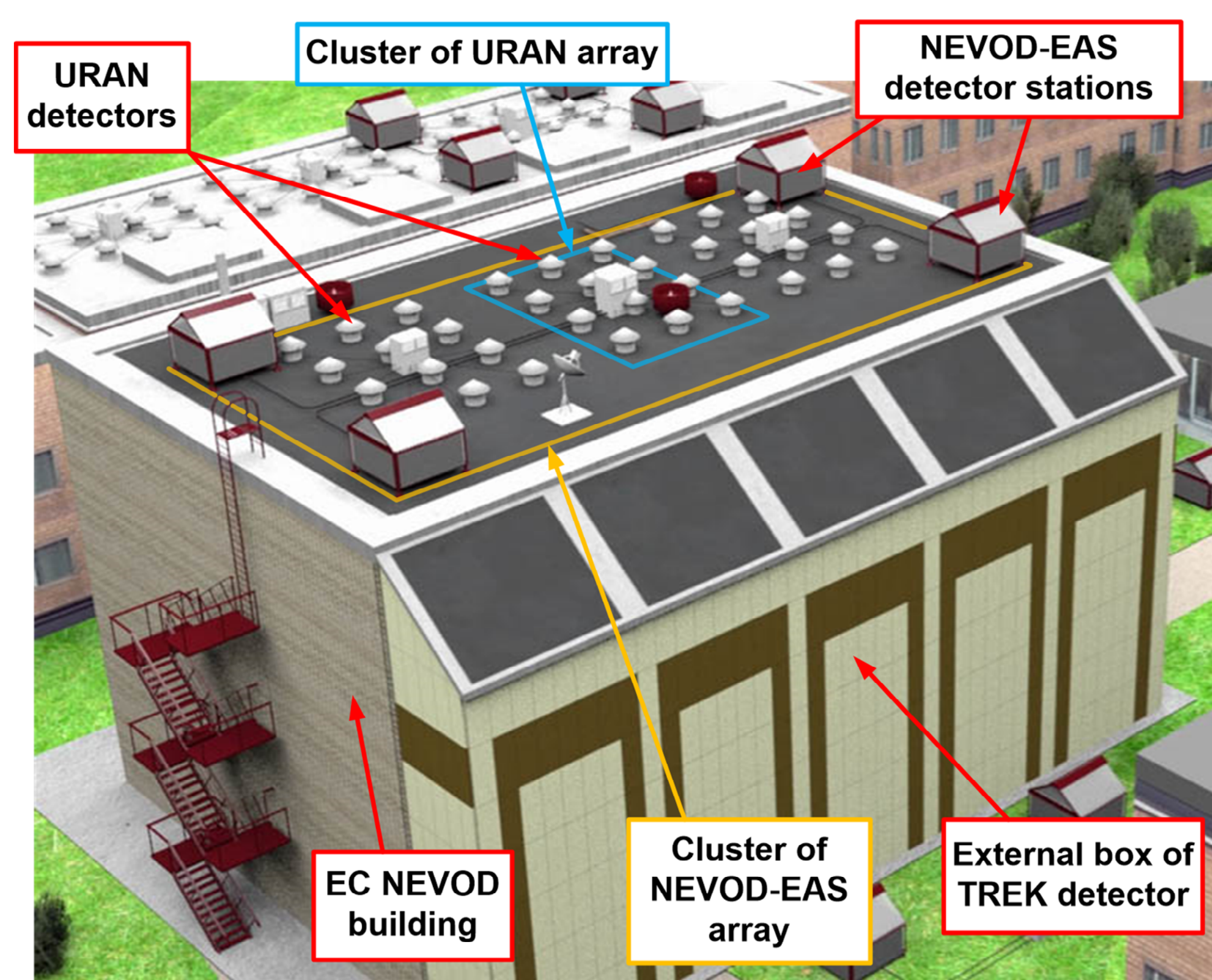
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Experimental complex NEVOD (MEPhI, Russia) includes a number of detectors and installations designed to register various EAS components: electron-photon (CTS, NEVOD-EAS), muon (CWD NEVOD, CTS) and hadron (PRISMA-32, URAN (being created)) components, energy deposit of EAS cores (CWD NEVOD) and muon bundles (DECOR, TREK). All detectors and installations of the complex are combined by the global time synchronization system ensuring 10-nanosecond accuracy of timestamping of registered events to a single time source. This opens wide opportunities for conducting unique multi-component EAS studies.



Detectors of the Experimental complex (EC) NEVOD

NEVOD-DECOR-CTS

Cherenkov water detector (CWD) NEVOD:

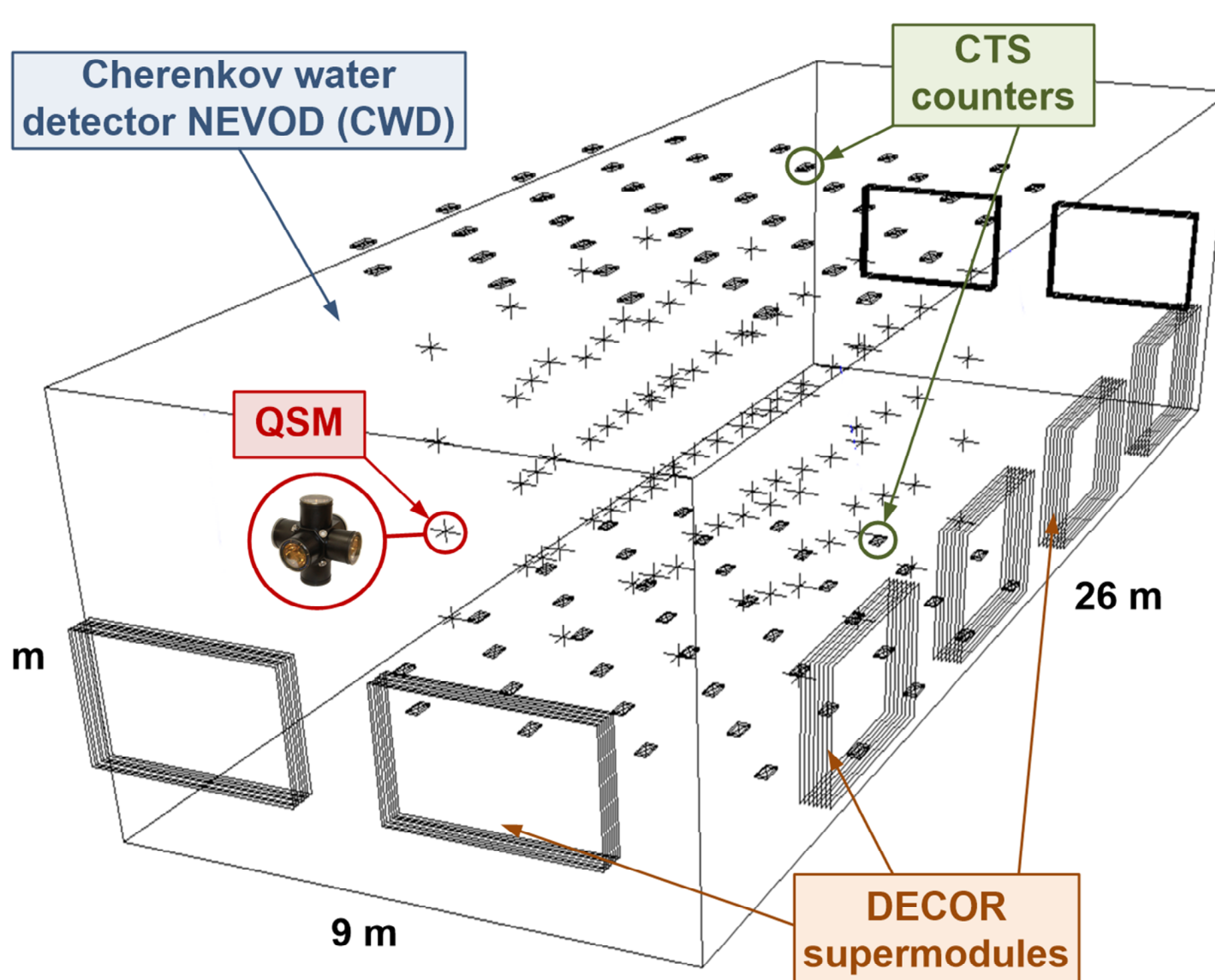
- 91 quasi-spherical optical modules (QSM) deployed in nodes of regular spatial lattice within a volume of 2000 m³;
- wide dynamic range ($1 \div 10^5$ ph.e.);
- measures energy deposit of muon bundles, EAS cores, and cascades generated by single muons in the water volume.

Calibration telescope system (CTS):

- 80 scintillation counters ($40 \times 20 \times 2$ cm³) deployed on the top and bottom of CWD tank;
- calibrates QSMs for various distances from muon tracks and Cherenkov light directions;
- separates EAS electron-photon and muon components, measures their local density spectra in ranges $10^{14} \div 10^{15}$ eV and $10^{16} \div 10^{18}$ eV, correspondingly.

Coordinate-tracking detector DECOR:

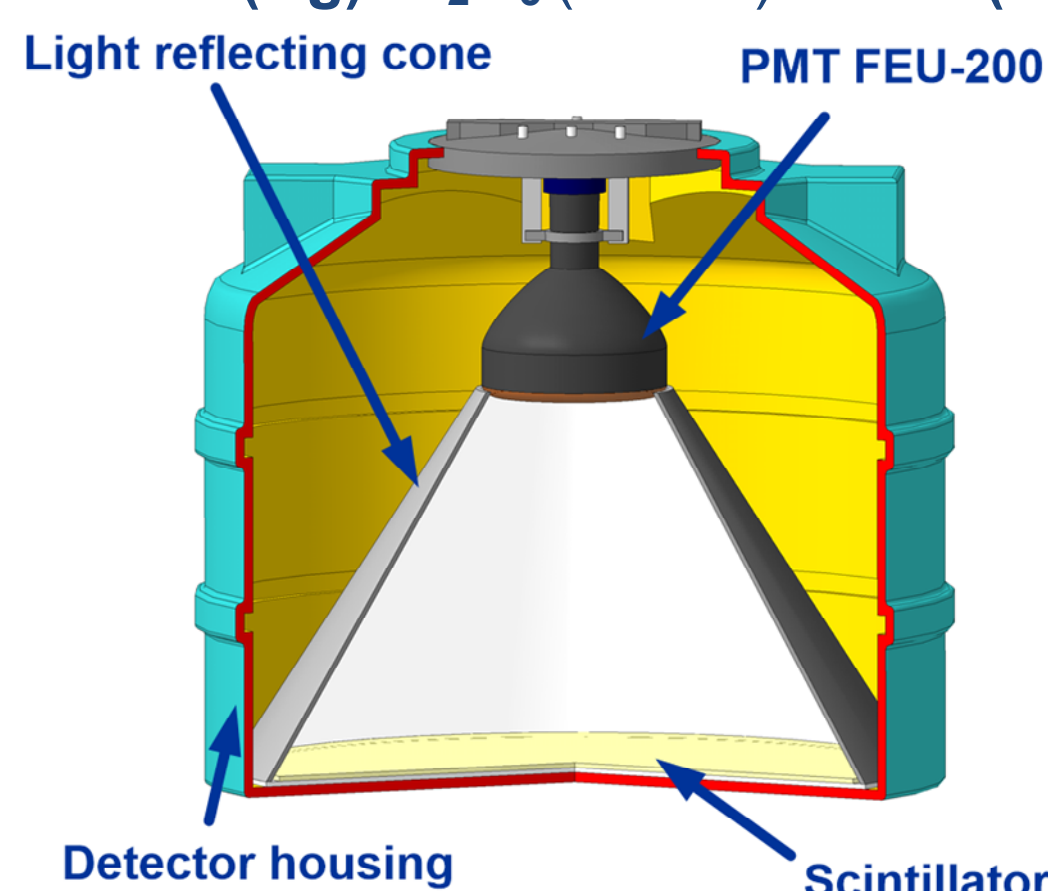
- 8 vertically arranged supermodules with a total area of ~ 70 m²;
- good spatial (< 1 cm) and angular (0.7°) accuracies;
- reconstructs arrival direction, multiplicity and density of muons in bundles of inclined EAS (up to $\theta = 90^\circ$).



PRISMA-32 and URAN air-shower arrays

PRISMA-32 and URAN air-shower arrays are aimed at studying of cosmic rays in the "knee" region ($\sim 3 \times 10^{15}$ eV) by means of the detection of neutrons produced in interactions of EAS particles with nuclei of atmosphere or matter near the facility. In these arrays, delayed thermal neutrons generated by EAS hadronic component are detected over the entire area using special electron-neutron-detectors (en-detectors).

en-detectors register EAS electromagnetic (e) and hadronic (through thermal neutrons) (n) components using inorganic scintillators $\text{ZnS(Ag)} + \text{B}_2\text{O}_3$ (URAN) or $\text{ZnS(Ag)} + {}^6\text{LiF}$ (PRISMA-32).



- ${}^{10}\text{B} + n \rightarrow {}^7\text{Li} + \alpha + 2.79 \text{ MeV}$ (93%)
 ${}^{10}\text{B} + n \rightarrow {}^7\text{Li} + \alpha + 2.31 \text{ MeV}$ (7%)
 ${}^7\text{Li}^* \rightarrow {}^7\text{Li} + \gamma + 482 \text{ keV}$
- ${}^6\text{Li} + n \rightarrow {}^3\text{H} + \alpha + 4.8 \text{ MeV}$

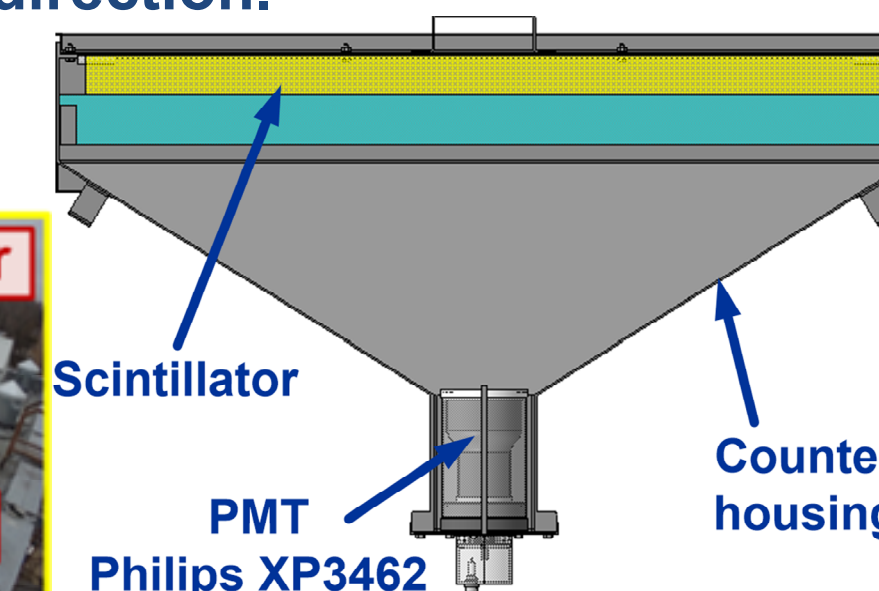
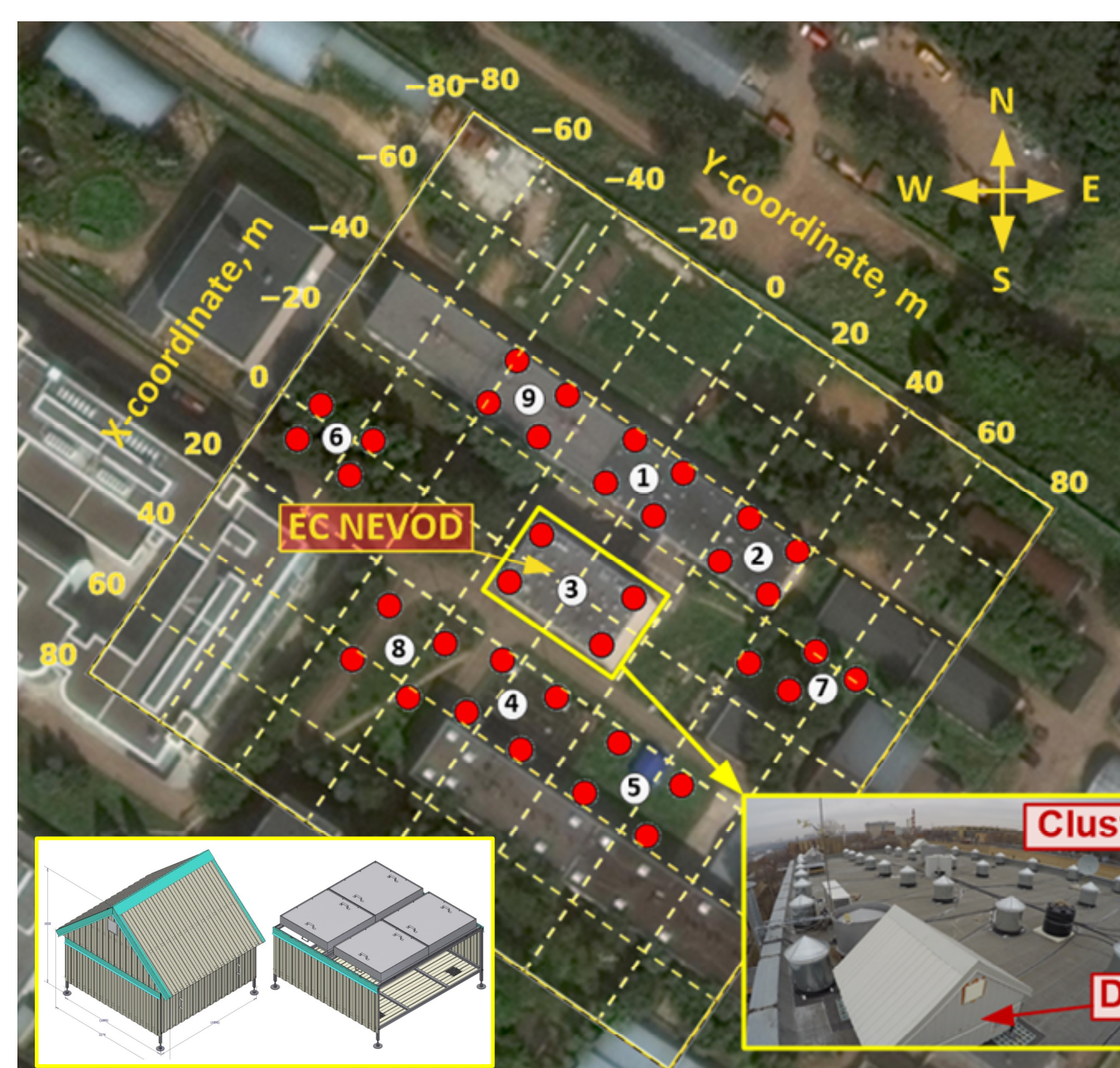
URAN air-shower array includes 6 independent clusters of 12 en-detectors in each deployed over the area of 10^3 m² on the roofs of the laboratory buildings of the Experimental complex NEVOD.

PRISMA-32 air-shower array includes 2 clusters of 16 en-detectors in each deployed over the area of ~ 250 m² inside the laboratory building of the Experimental complex NEVOD. Clusters are integrated into the NEVOD-DECOR-CTS triggering system.

NEVOD-EAS air-shower array

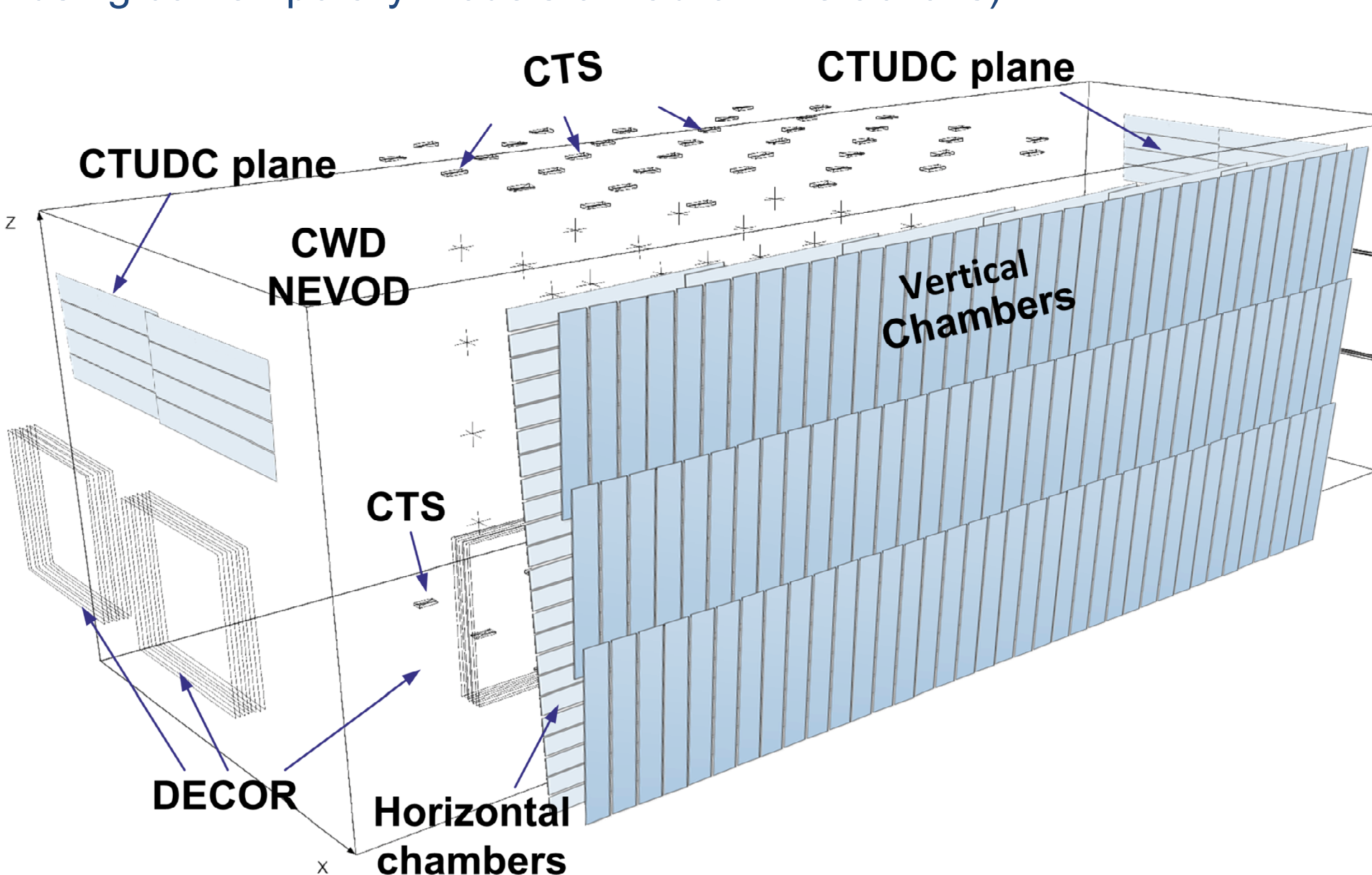
NEVOD-EAS air-shower array:

- 9 independent clusters (15×15 m²) of detector stations (DS) deployed over the area of 10^4 m² around the EC NEVOD;
- cluster includes 4 DS with area of 2.56 m² and a dynamic range $0.3 \div 10^4$ particles/m²;
- detects EAS electron-photon component in range $10^{15} \div 10^{17}$ eV and reconstructs EAS size, axis position and arrival direction.



Coordinate-tracking detector TREK

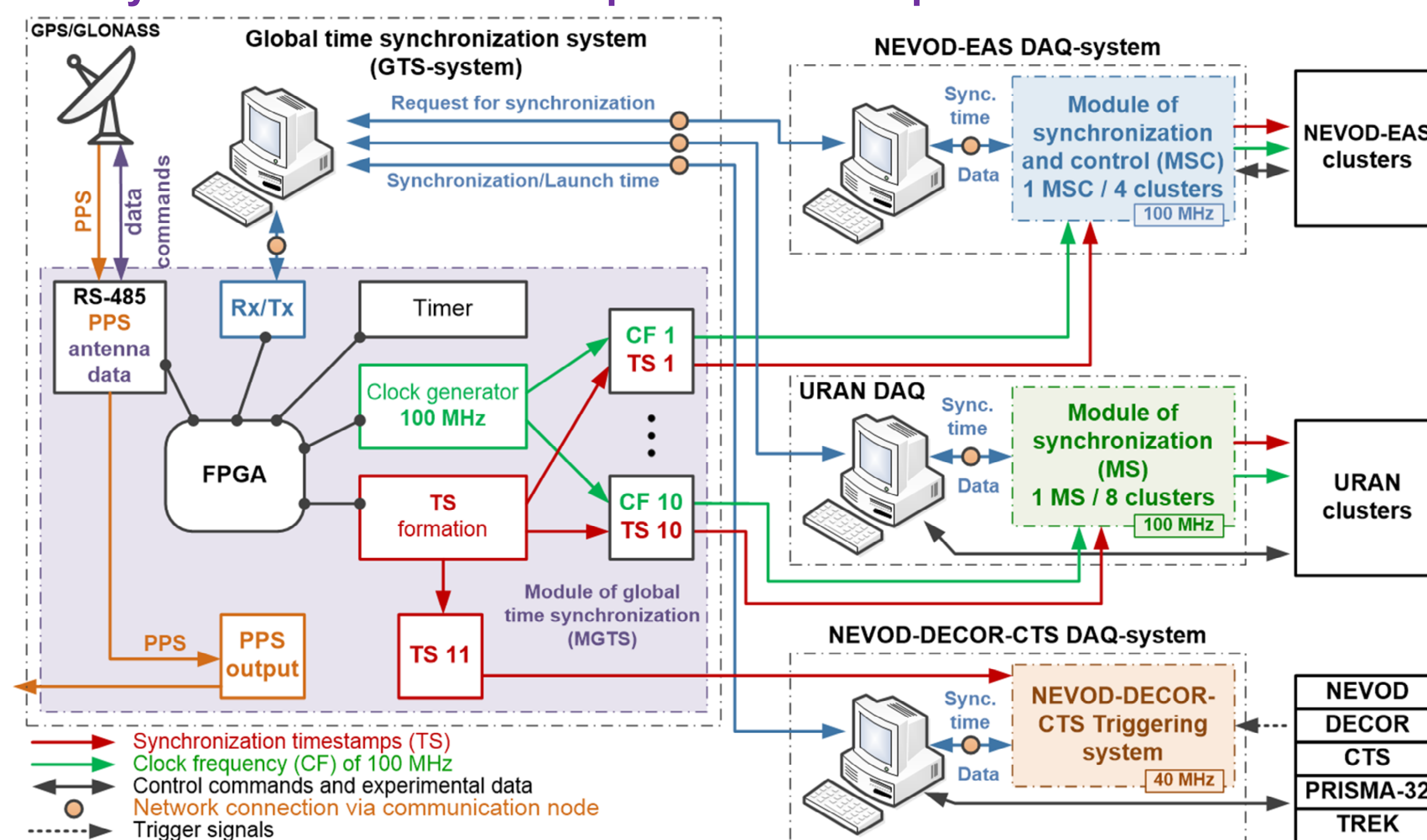
Large-scale coordinate-tracking detector TREK is aimed at studying of "muon puzzle" (the excess of events with a high multiplicity of muons in comparison with results of simulation obtained using contemporary models of hadron interactions).



TREK detector:

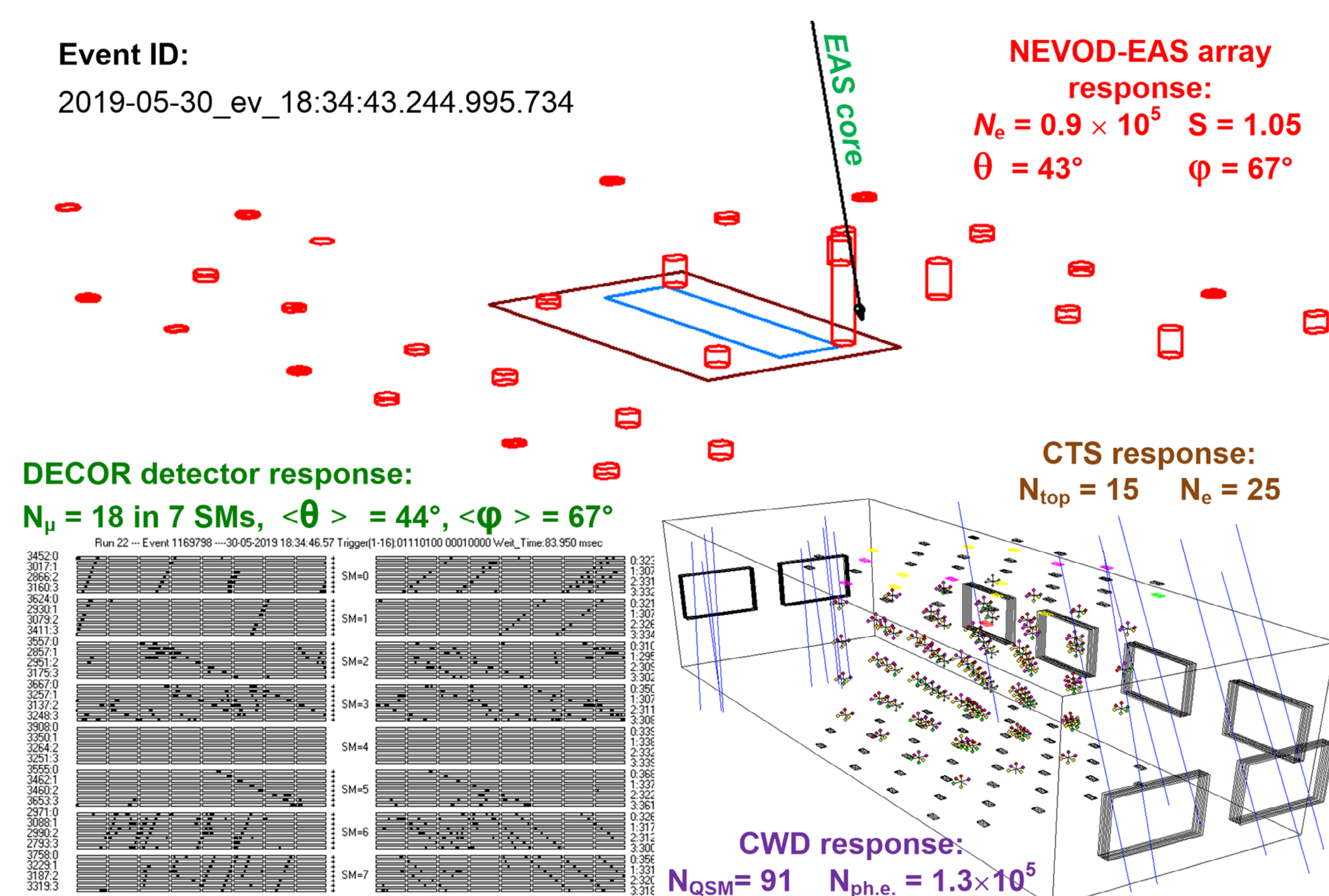
- 264 drift chambers with effective area of 1.85 m²;
- total area of 250 m²;
- high coordinate (1 mm), angular (1.7°) accuracies, and 2-track ($3-4$ mm) resolution;
- will determine multiplicity and arrival direction of muon bundles passing through the CWD NEVOD water tank.

Synchronization of the Experimental complex NEVOD detectors



Joint event in EC NEVOD detectors

Event ID:
2019-05-30_ev_18:34:43.244.995.734



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