Yerevan Physics Institute had an electron synchrotron (ARUS) with energy of up to 6 GeV, which was put in operation in 1967.

During 1968-1991 years the Yerevan synchrotron operated productively and many scientific results have been obtained in the energies range up to 4.5 GeV.

Since 1991 because of an economic crisis in Armenia the accelerator has been stopped. However, its maintenance continues till now and short-time experiments are periodically performed.

The YerPhI experimental physics program includes following researches: study of
- properties and structure of baryons (nucleons and nucleon resonances)
- few nucleon systems properties
- excited nuclear systems properties
- nuclear matter in short distance
- electron interaction with crystals and methodical studies
- material science
Division activities and international collaborations

- LUE – 75 (Electron Linear Accelerator Facility)

Experimental Physics Division
http://epd.yerphi.am/EPD.htm
Division activities and international collaborations

- **LUE – 75** (Electron Linear Accelerator Facility)
- **Cyclotron C18/18**

General view of **CYCLONE C18/18**
Division activities and international collaborations

- **LUE – 75** (Electron Linear Accelerator Facility)
- **Cyclotron C18/18**
- **Underground Laboratory** (Avan salt mine)

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Division activities and international collaborations

- **LUE – 75** (Electron Linear Accelerator Facility)
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- **JLAB (Hall A, B, C, D)**
- **HESS, CTA**
LUE – 75, Cyclotron, ELI-NP, material science

**LUE - 75**

- LUE-75 provides electrons with energy 10-75 MeV in the large limits of beam currents $10^{-18}$-$10^{-5}$ A
- Assembly of 3x3 CsI crystals for the calorimeter foreseen for Mu2e experiment were successfully calibrated (Dubna - AANL collaboration).

**Cyclotron C18/18**

- Study of excitation functions
- ICR measurements
- Neutron beam formation on Cyclotron C18: study of astrophysical reactions, radiation resistance of materials.

**Material Science**

- Synthesis and characterization of new carboxymethylated chitosan (application particularly in radiation medicine).

**Radio-Frequency Photo Multiplier Tube**

- LPMWPC – low background, high time resolution (~450 ps), high coordinate resolution (~1mm) highly efficient non-destructing nuclear fragment detector.
  - To be used for:
    - Studying Hole-like states 15.1 MeV in $^{16}$O in Yerevan Cyclotron and ELI-NP facility;
    - Measure $^{16}$O($\gamma$,α)$^{12}$C cross section at HIγS with a LPMWPC based Active Target;
    - Studying decay pion spectroscopy of light hypernuclei at electron- and proton-beam facilities.

**Low Pressure Multi-Wire Proportional Chamber**

- RF PMT – picosecond resolution timing detector with THz bandwidth
  - Applications include:
    - High Energy Physics (bunch length detection, TOF measurements, particle ID)
    - Medical Imaging (PET, DOT, Fluorescence Lifetime Imaging)
Future plans:

- Search for rare modes of $^{252}$Cf nuclei fission:
  - Measurement of the yields of short-living ($T_{1/2} < 1$ min) isotopes
  - Measurement of the yields of long-living isotopes
  - Measurement of the yields of a number of fission products with $88 \leq A \leq 158$
  - Measurement of isomeric ratios
  - Search for cluster radioactivity
  - Search for the ternary fission
- Investigation of photonuclear reactions on LINAC.
- Nuclear astrophysics tasks:
  - a) Investigation of (p,$\gamma$) and (p,n) reaction in ROI of astrophysics
  - b) Supernova “archeology”
- Investigation of (p,$\alpha$) reactions
- High energy (>150 GeV) cosmic muons monitoring
- R&D for searching for Dark Matter
- Applied tasks: dating of archaeological samples, earthquake forecast, ecological tasks.

**About the Laboratory**

The laboratory is placed in the Avan salt mine, which is located in precincts of Yerevan, at the depth of 650 m w.e. (meters of water equivalent). The low-background conditions allow to investigate rare processes and could be used for fundamental, as well as for applied tasks. The fig.1 demonstrates the low-background conditions in our laboratory.

**Very High Energy Gamma-Ray Astrophysics with H.E.S.S.**

H.E.S.S. is a system of Imaging Atmospheric Cherenkov Telescopes that investigates cosmic gamma rays in the energy range from 10s of GeV to 10s of TeV. H.E.S.S. observatory is located in Namibia, near the Gamsberg mountain, and consist of 5 telescopes. First 4 telescopes (Phase I) were operational since 2004 and 5 telescopes (Phase II) – since 2012.

TeVCat sky map of H.E.S.S.- discovered gamma ray sources, as of April 2019 (111 from total 222).

AANL in CMS (LHC)

**General activity:**
- MC simulations / Data analysis
- Calibration (hadron calorimeter, CASTOR)
- Jet energy scale calibration
- Detector performance / control system
- Data quality / certification
- CMS upgrade
- Triggers
- DiMuon analysis
- Diffractive processes

**Main ongoing physical analysis:**
- $H \rightarrow bb$ decay search in Vector boson fusion (VBF) Higgs production process.

**Summary:**
- Over 700 collaboration papers
- Over 20 non collaboration papers
- 2 PhD thesis
- Over 10 master and bachelor degree thesis.

AANL-ATLAS team activities

- Simulation and analysis of physics data for validation of the ATLAS TileCal Phase-II upgrade
- Maintenance, development and testing of the TileCal front-end electronics
- Development of the offline system to Monitor DCS and DQ data for the Phase II upgrade
- ATLAS NSW (New Small Whell) upgrade
- Trigger Data Acquisition System. Detector Operations.

AANL-ALICE Collaboration

- Design, R&D study, construction and installation of the elements for ALICE setup
- Developments and upgrades for the computing environment of ALICE
- Design, simulation studies, R&D, construction and installation of Geometry Monitoring System (GMS) for ALICE Dimuon Forward Spectrometer
- Data analysis.
AANL (YerPhI) group has been part of the collaboration since 1990

Experimental Hall-A

High Resolution Spectrometer Pair, (HRS) and specialized large installation experiments

- Real Compton Scattering
- Measurement of Neutron Electric Form Factor GEN at High Q^2
- Polarization transfer in Wide Angle Compton Scattering

- 12 GeV upgrade

- Super BigBite Spectrometer
- GEP5 - Large Acceptance Proton Form Factor Ratio Measurements at 13 and 15 (GeV/c)^2 using Recoil Polarization Method GEP
- GMN - Precision Measurement of the Neutron Magnetic Form Factor up to Q^2=18.0 (GeV/c)^2 by the Ratio Method
- Transversity - Target Single-Spin Asymmetries in Semi-Inclusive Pion and Kaon Electroproduction on a Transversity Polarized 3He Target using Super BigBite and BigBite in Hall A
- GEN2 - Measurement of the Neutron Electro – magnetic Form Factor Ratio \( G_E^N/G_M^N \) at High \( Q^2 \)
Experimental Hall-B

*(CEBAF Large Acceptance Spectrometer)*

**CLAS12 – 4π scattering angle, high luminosity, large acceptance**

- NN Short Range Correlations
- Deuteron Wave Function
- Timeline Compton Scattering
- Electromagnetic Calorimeter (EC) construction

- **12 GeV upgrade**

- Heavy Photon Search experiment *(HPS)*
- Preshower Calorimeter construction *(PCAL)*
- High Treshold Cherenkov Counter *(HTCC)*
- Slow Control System for *HPS*
Experimental
Hall-C

Super High Momentum Spectrometer
(SHMS)
at high luminosity and forward angles

- HMS and SOS electromagnetic calorimeters
- HMS Aerogel detector
- SHMS electromagnetic calorimeter (SHMS)
- PMT’s gain monitoring system for the calorimeters and Neutron Detector
- Co-spokesperson in “Meson Duality” experiment

- 12 GeV upgrade
  - Measurement of the Ratio $R = \sigma_L / \sigma_T$ in Semi-Inclusive Deep-Inelastic Scattering
  - Transverse Momentum Dependence of Semi-Inclusive Pion Production
  - Measurement of Semi-Inclusive $\pi^0$ Production as Validation of Factorization
AANL (YerPhI) group has been part of the collaboration since 1990

12 GeV upgrade

- **GlueX** detector system construction
- Design, development and implementation of controls system within the EPICS framework of the **GlueX** detectors
- Voltage controls of FDC, CDC, TOF, TAGH, TAGM PSC, BCAL, ST, PS detectors
- Motion (motorized) controls of Goniometer, Beam Profiler, Collimator, Compton Calorimeter, TPOL, Amorphous Radiator, Microscope, PS Converter
- Tagger electron harp scan program
- Photon harp scan
- **GlueX** experiment participation

**Experimental Hall-D**

9 GeV tagged polarized photons and a 4π hermetic detector

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