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# **Statement of Work for the First Year Contract with Nazarbayev University**

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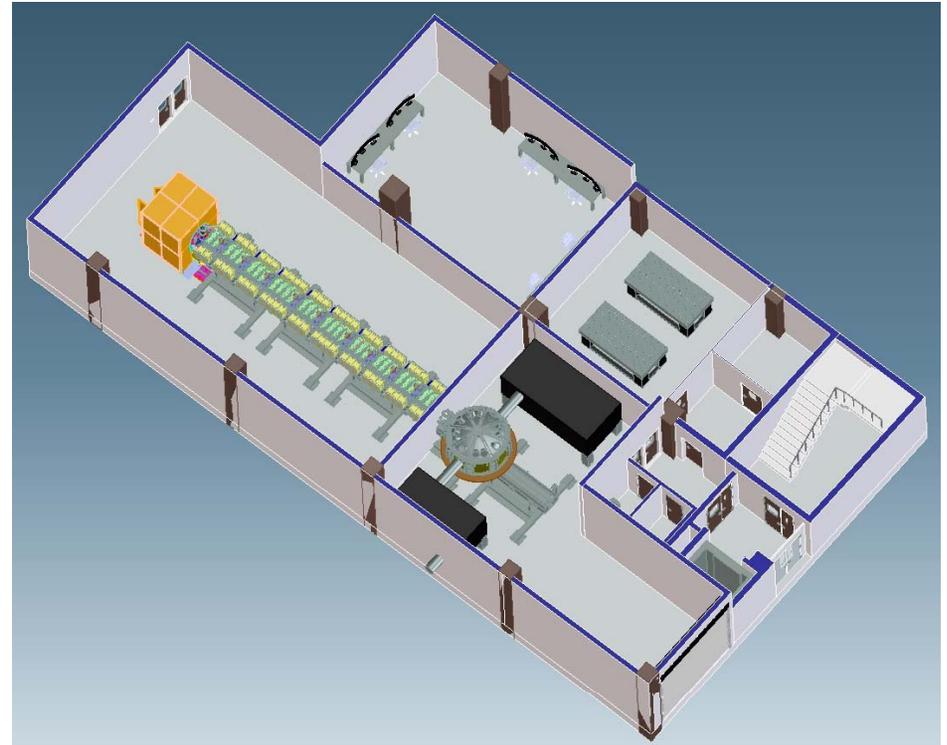
**Lawrence Berkeley National Laboratory**

**September 29, 2014**

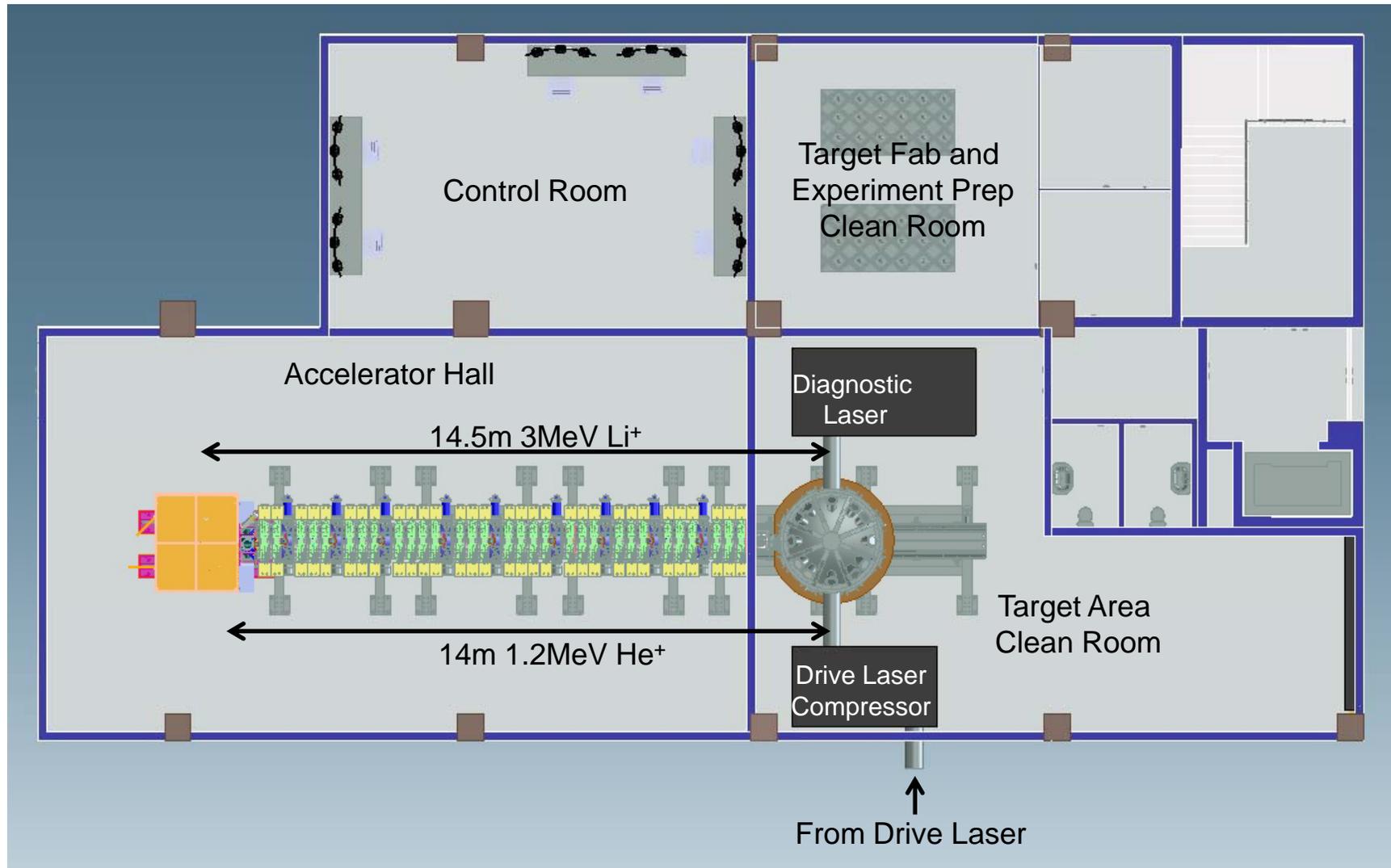
# The Big Picture – Nazarbayev University Research Accelerator facility (NURA) in 5 years

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- **NURA will be a facility to enable physics and engineering research at Nazarbayev University**
  - Accelerator engineering
  - Pulsed power engineering
  - Electrical engineering
  - Mechanical engineering
  - Beam physics
  - Plasma physics
  - Material Science
  - High energy density physics
  - Laser science and engineering
  - Fusion energy science and engineering



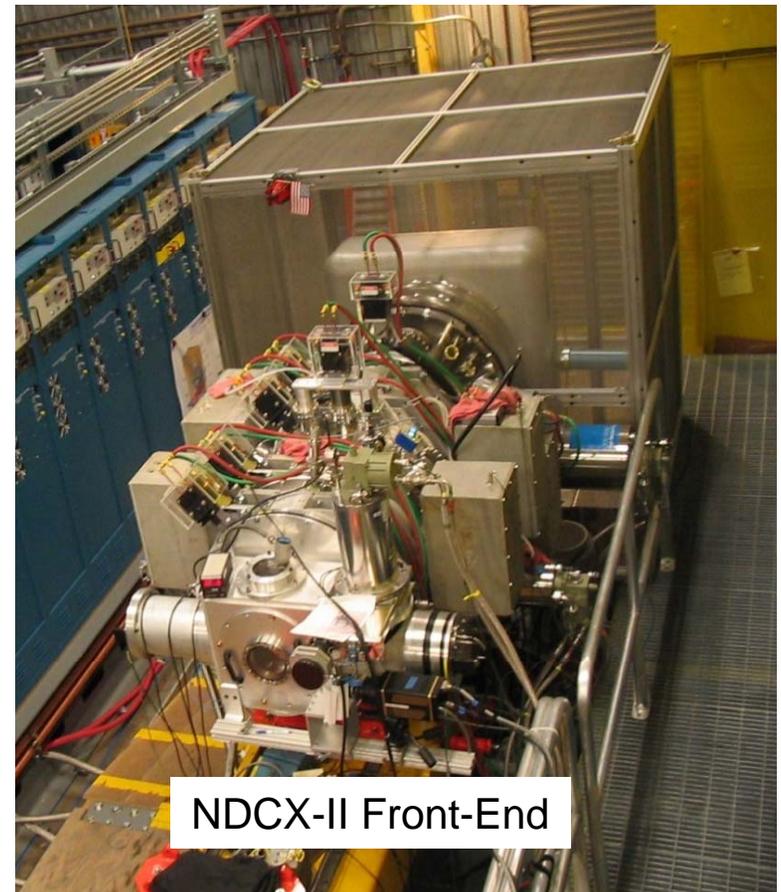
# NURA facility layout



# Multi-year Proposal

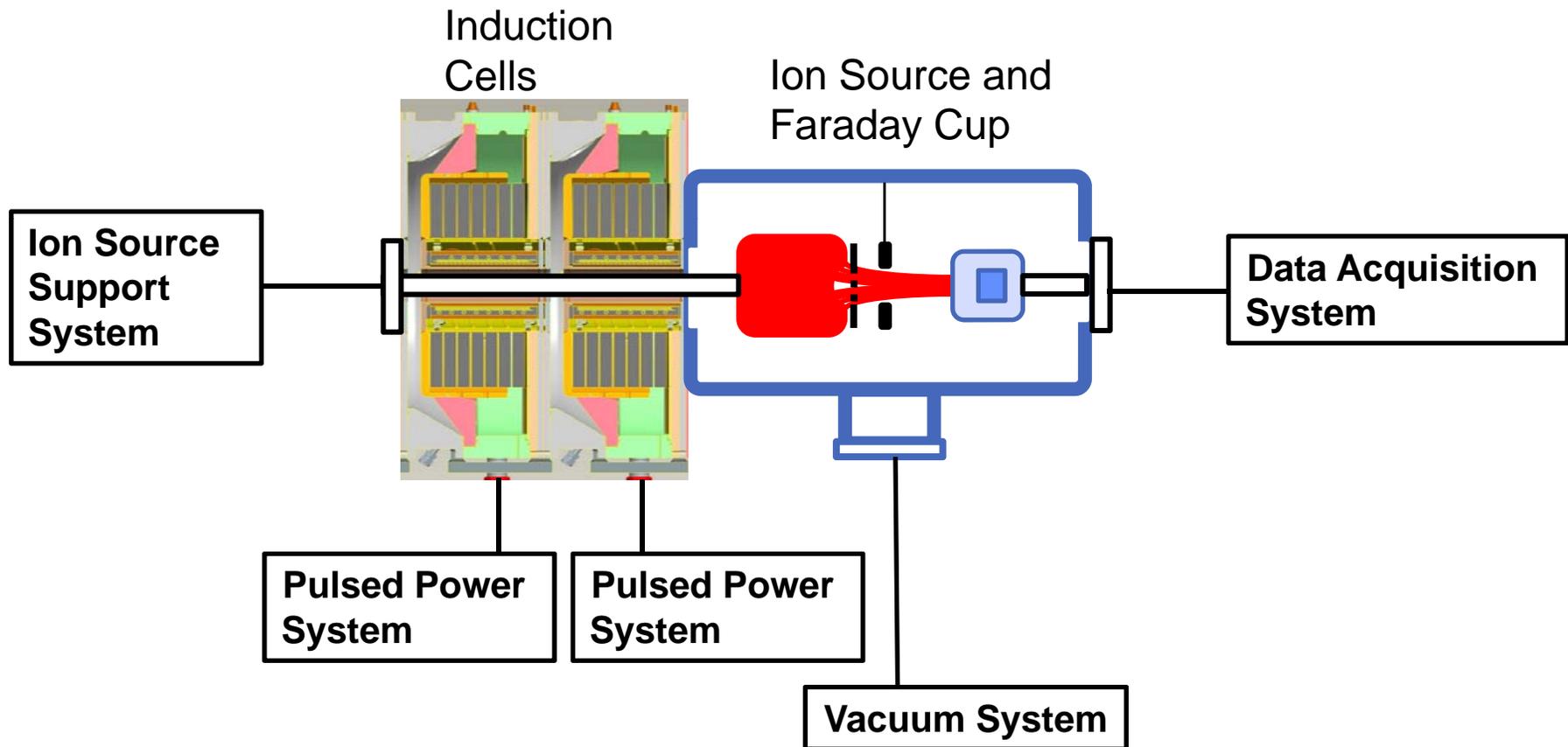
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- **Phase 1: Induction cell and ion source test stand**
- **Phase 2: Injector**
- **Phase 3: Induction cells and pulsed power systems**
- **Phase 4: Integration and commissioning of NURA front-end at NU**
- **Additional phases to be determined**
  - **More cells and pulsed power systems for higher beam energy**
  - **Neutralized drift compression section**
  - **Target chamber**
  - **Diagnostics**



# Year One Contract – Induction Cell and Ion Source Test Stand

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## **Year One Contract (Phase I of the multi-year proposal)**

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- **Scope: ion source and pulsed power test stand would be built and tested at LBNL and then shipped to NU**
- **This is the natural first step to provide a platform to characterize ion sources and gain operational experience with induction cells and pulsed power systems that will be used in NURA**
- **Participation from NU technical and scientific staff at LBNL**
- **Preliminary Budget: 900k\$**
  - **LBNL labor: 485k\$**
  - **Hardware: 415k\$**
- **Schedule: 1 year (starting mid 2015)**
- **Open questions:**
  - **How is the contract initiated and approved?**
  - **How is the hardware shipped and transferred to NU?**

## **Benefits to NU and LBNL**

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- **Benefits to NU**
  - **Develop an engineering capability**
  - **Provide a research facility for physics and engineering**
  - **In a position to make unique contributions in the fields of high energy density physics, material science, and fusion energy science**
- **Benefits to LBNL**
  - **Develop a collaborator in ion source and diagnostic development**
  - **Develop a collaborator in HEDP, material science, and fusion science**
  - **Complimentary facility to NDCX-II (operations, experiments, upgrades, etc.)**

# **Year One Scope – LBNL Hardware and Software**

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- **2 induction cells and support hardware**
- **2 pulsed power systems and support hardware**
- **Vacuum vessel and support hardware**
- **Vacuum system (pumps, valves, etc.)**
- **Control racks**
  - **Vacuum control system**
  - **Timing system**
  - **Data acquisition system**
  - **Data archiving system**
  - **Power supply control system**
  - **Safety interlock system**

## **Year One Scope – NU Hardware and Software**

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- **Ion source and specific ion source support systems**
- **Beam diagnostics (Faraday cup, scintillator, etc.)**
- **Pressurized air system**
- **LCW system**
- **Crane and lifting hardware**
- **Primary AC power**
- **Oil handling system**
- **Installation costs at NU**

## **500k\$ Contract Scenario in case there are funding limitations the first year would require descoping by reducing the cells and pulsed power systems by half**

- **Remove 1 cell and 1 pulsed power system**
- **Remove corresponding elements of the control systems**
  
- **Preliminary Budget: 500k\$**
  - **LBNL labor: 245k\$**
  - **Hardware: 255k\$**
  
- **Ion source voltage would be limited to 0.0175 V-s**
  
- **Additional cells and pulsed power systems could always be added as a follow-on activity to increase capability of the ion source test stand**