



# Existing and Planned Accelerator Projects

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## Introduction

### Existing:

- **Cooler Synchrotron (COSY)**
- **Relativistic Heavy Ion Collider (RHIC)**

### Future:

- **Facility for Antiproton and Ion (FAIR)**
- **Polarized Proton-Antiproton Collider (PAX)**

# Applications



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- **Nuclear physics:** Electron/proton/ion accelerators and storage rings (e.g. BNL, GSI, COSY, ELSA)
- **High-energy physics:** Circular and linear collider: (e.g. CERN, DESY, SLAC, FERMILAB)
- **Synchrotron radiation:** Synchrotron light sources: (e.g. APS, ESRF, DESY, ELSA)  
Chemistry, Biology (molecular and cell biology), Physics (basic atomic, condensed matter and surface physics), Engineering (material science)
- **Coherent radiation:** Free electron laser (e.g. DESY, BESSY)
- **Neutron scattering:** spallations neutron sources (e.g. ISIS, SNS)  
Chemistry, Complex Fluids, Crystalline and Disordered Materials, Engineering, Magnetism and Superconductivity, Polymers, Structural Biology
- **Industrial applications:** Ion implantation, material testing, food sterilization, X-ray radiography and lithography
- **Medicine:** radioisotope production, cancer therapy (e.g. GSI, PSI)
- **Power generation:** Initial fusion, reactor fuel breeding

# Criteria for Ring Design



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- **Experimental requirements:** particles, energy range, luminosity, operation modes, ...
- **Injection, accumulation, extraction:** parameters of injected/extracted beams, RF gymnastics, phase space cooling, ...
- **Magnet & RF layout:** types, fields, length, gaps, ...
- **Lattice design:** optical functions, correction elements, diagnostics, ...
- **Magnet tolerances:** dynamic aperture, correction schemes, ...
- **Design of components:** magnet, kicker, RF cavities, power supplies, phase space cooling, vacuum, diagnostics, controls, ...
- **Costing:** magnets, RF, building, supplies, ...

# Cooler Synchrotron (COSY)



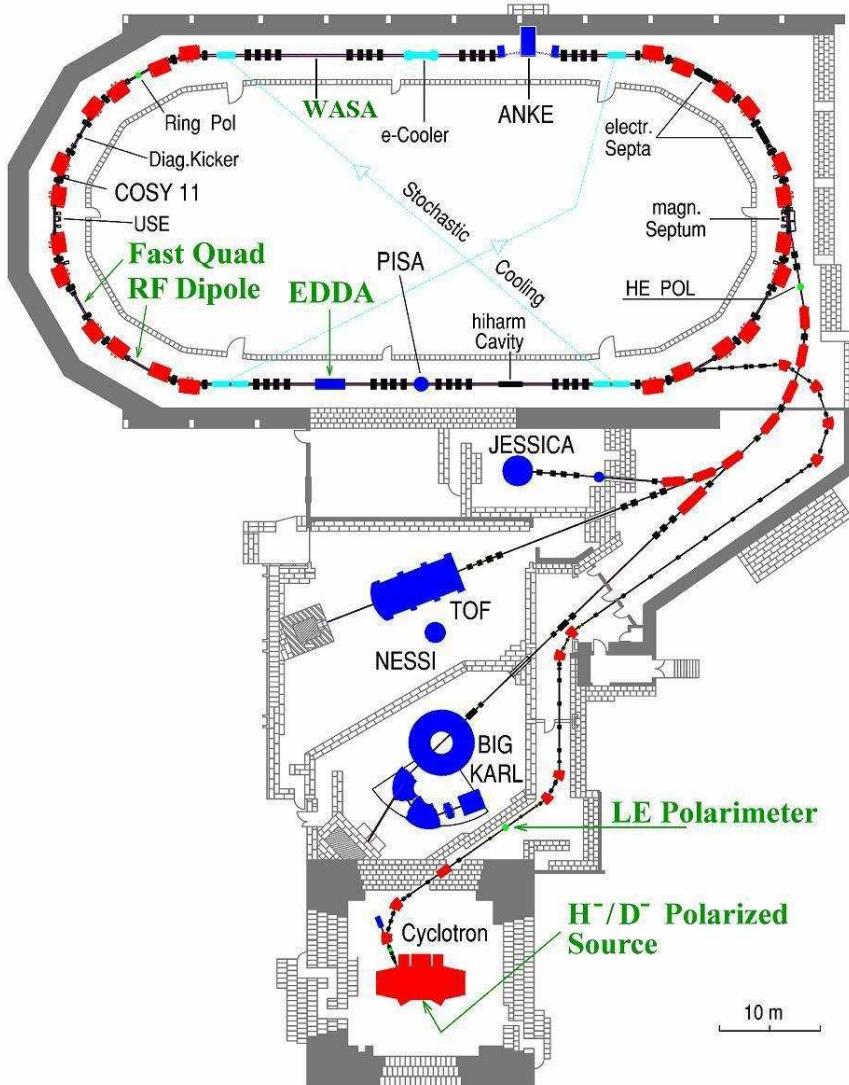
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# COSY Accelerator Facility



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Ions: (unpol. and pol.) **p** and **d**

Momentum: **0.30 to 3.7 GeV/c for p**  
**0.54 to 3.7 GeV/c for d**

Circumference: **184 m**

Experimental areas: **4 internal**  
**3 external**

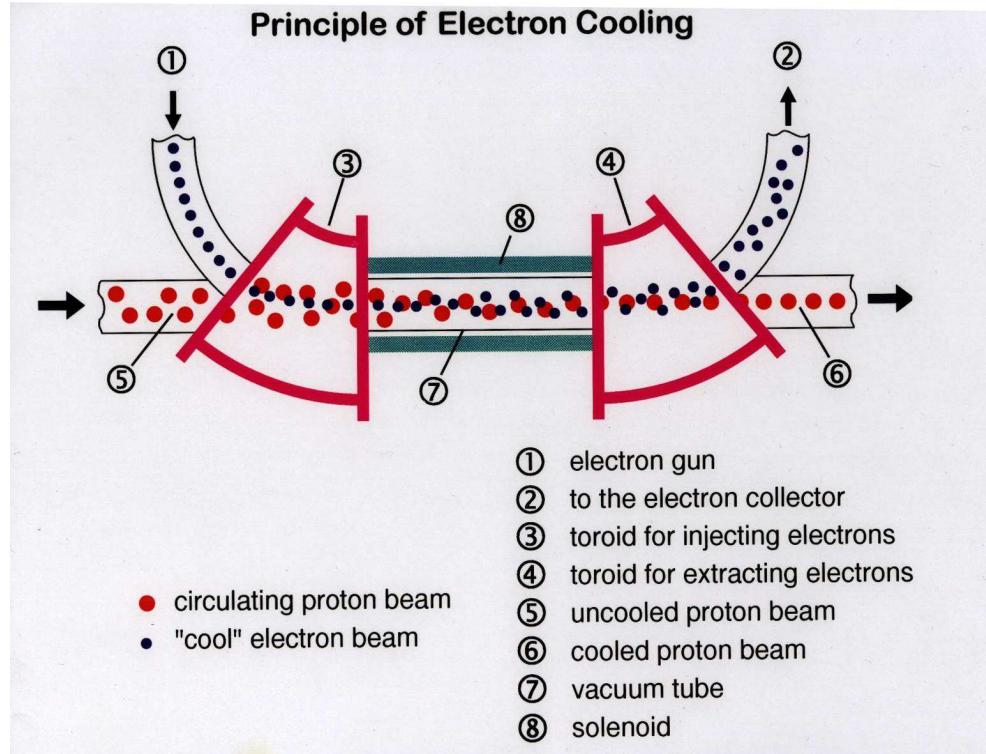
Beam cooling:

- **Electron cooling at injection**  
**beam accumulation**  
**high-brightness beams**
  
- **Stochastic cooling above 1.5 GeV/c**  
**luminosity preservation**

# Electron Cooling



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**Elektronen energy:**

- **24.5 - 100 kV**

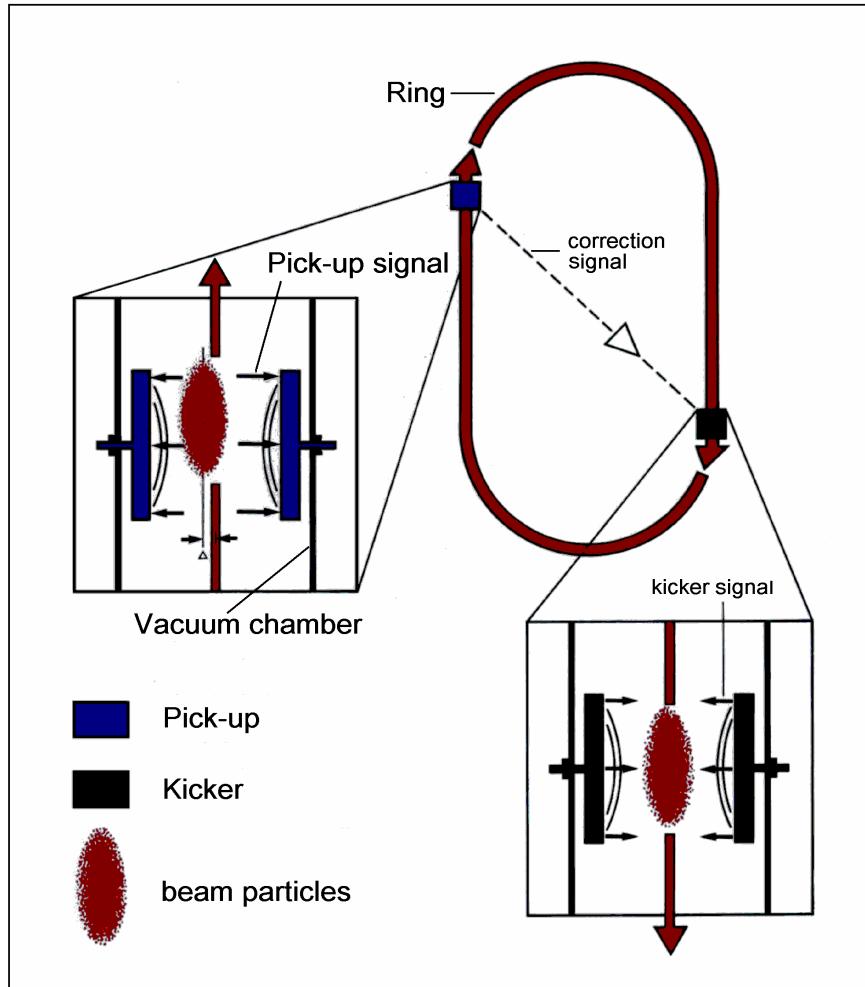
**Elektronen current:**

- **0.2 - 3 A**

# Stochastic Cooling



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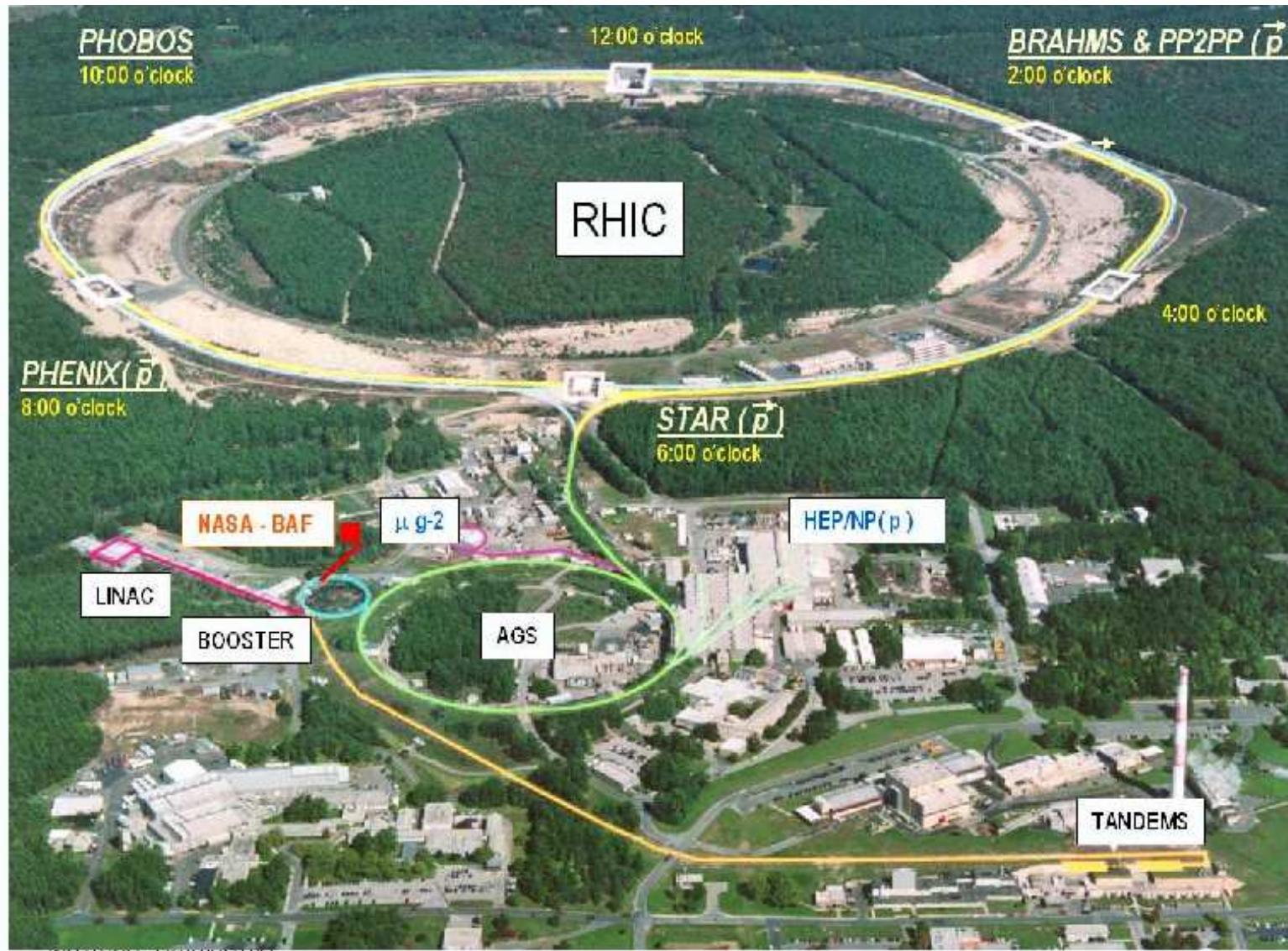


- Frequency range: **1-3 GHz**  
**2 bands**
- RF power: **500 W**  
**per plane**

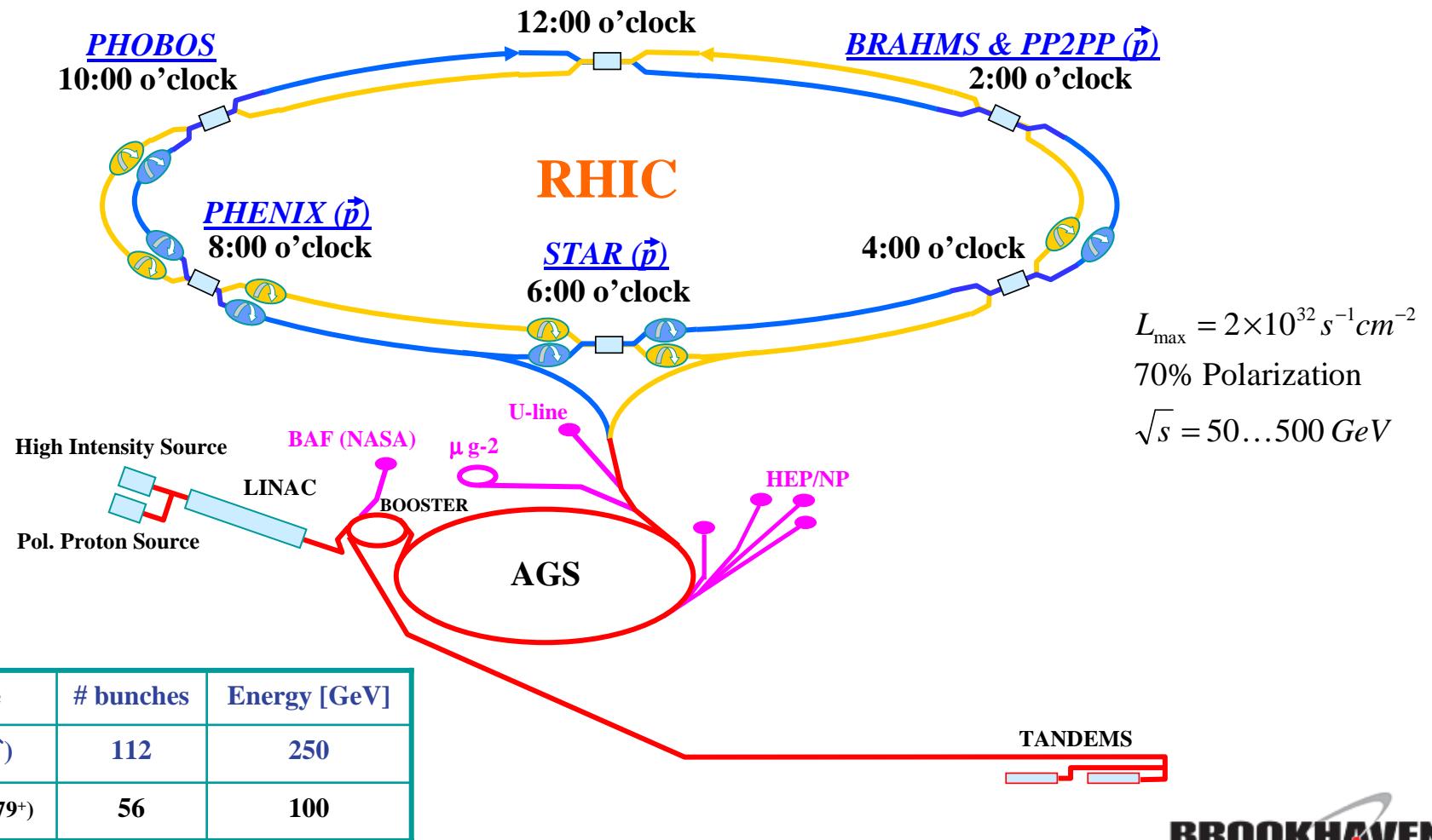
# Relativistic Heavy Ion Collider (RHIC)



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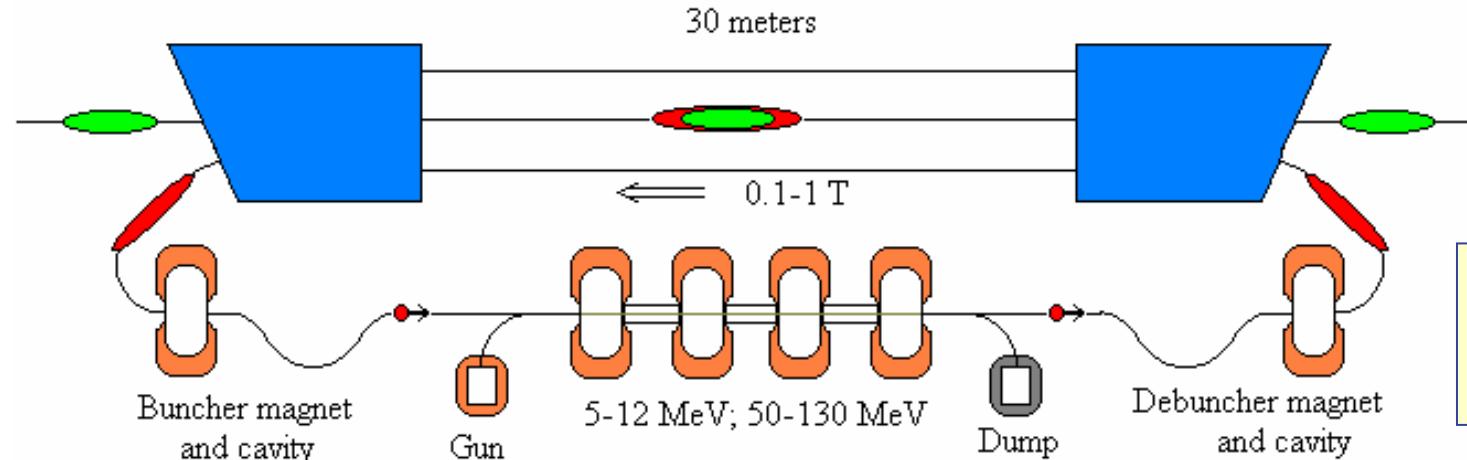
# RHIC Accelerator Complex



# RHIC Electron Cooler



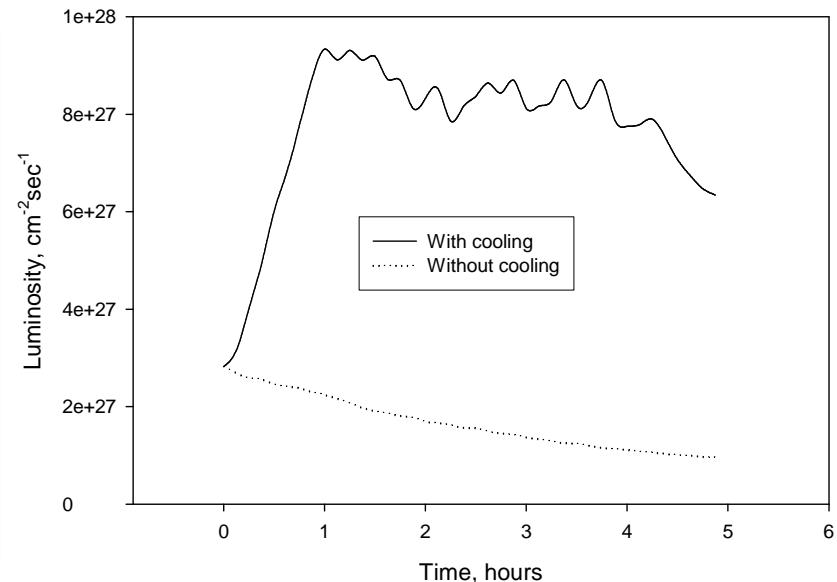
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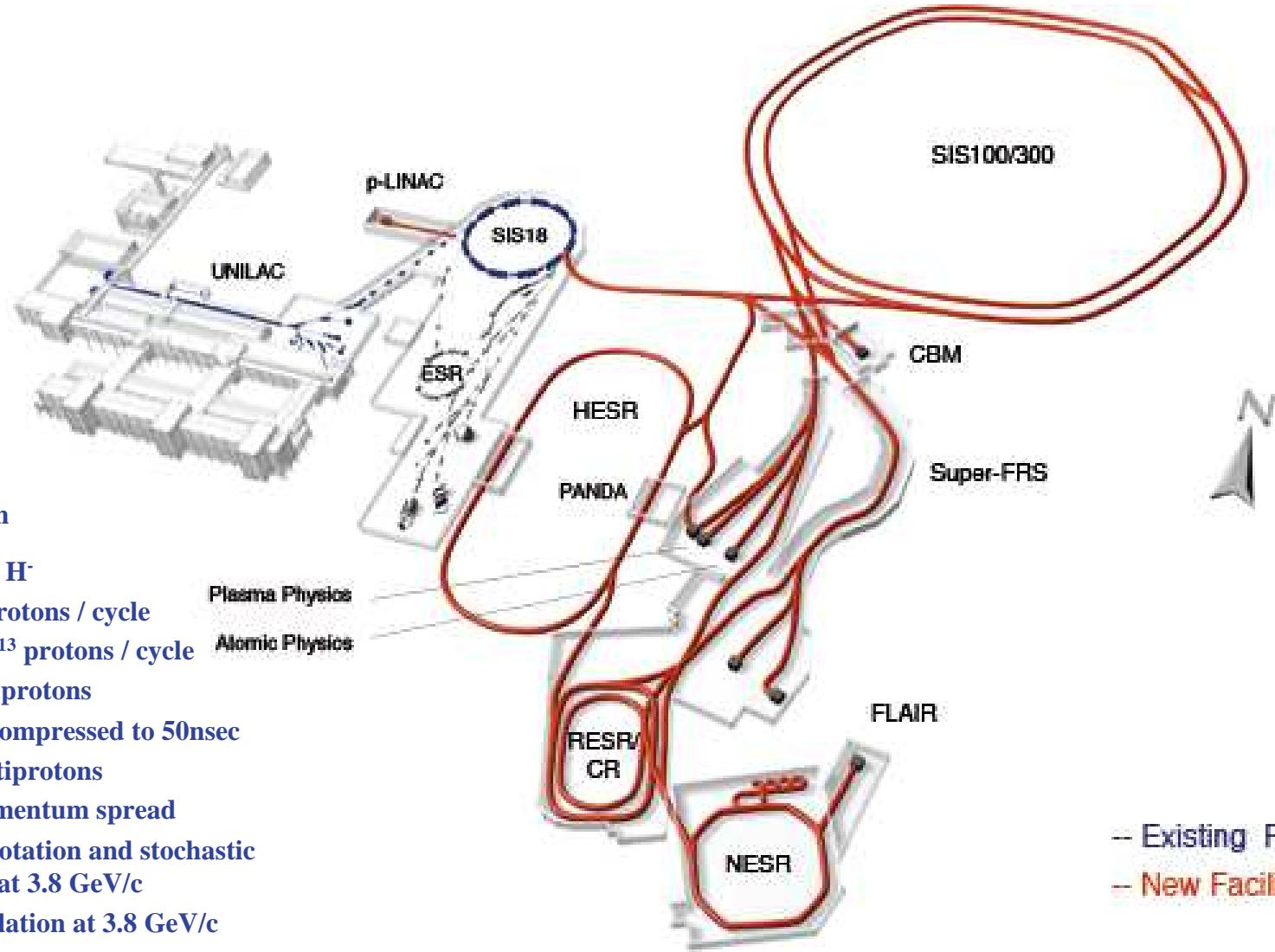
electron energy:  
**130 MV**

## R&D issues:

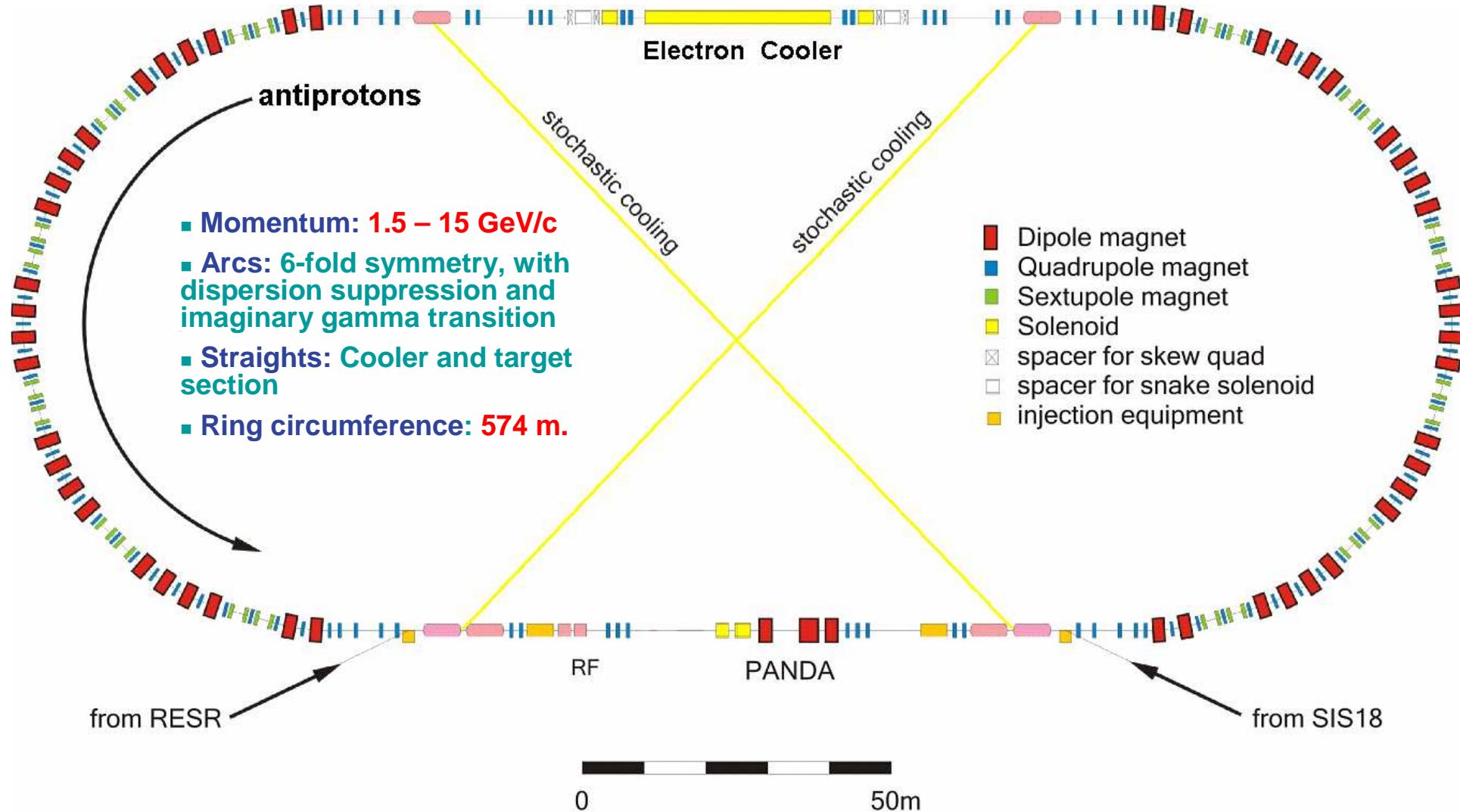
- demonstrate high-brightness, high-current CW photo cathode electron gun
- demonstrate high precision (10 ppm) solenoid for 30 m cooling section.
- full simulation (space charge, non-linearities, wake fields, beam stability) of magnetized electron beam transported from cathode to dump



# Facility for Antiproton and Ion Research (FAIR)



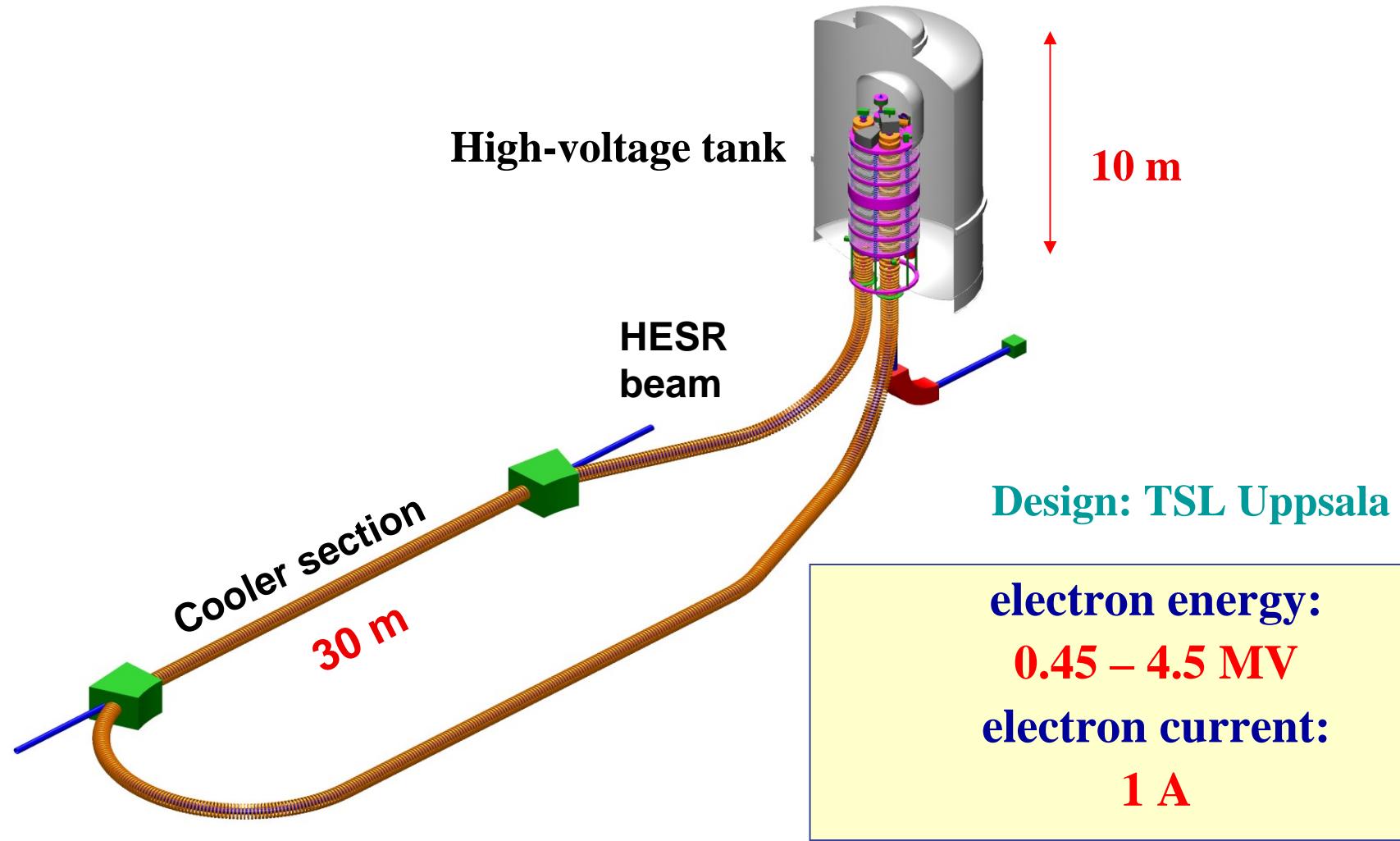
# High-Energy Storage Ring (HESR)



# HESR Electron Cooler



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# HESR Spin Accelerator Facility

