The PANDA Experiment:

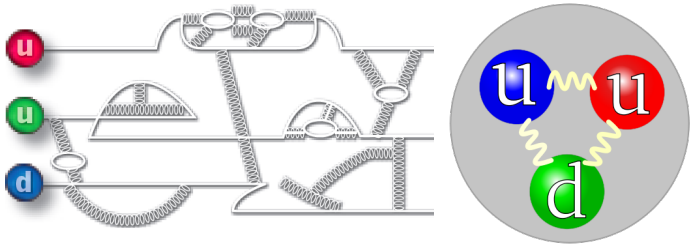
Exploring the first level of complexity in matter

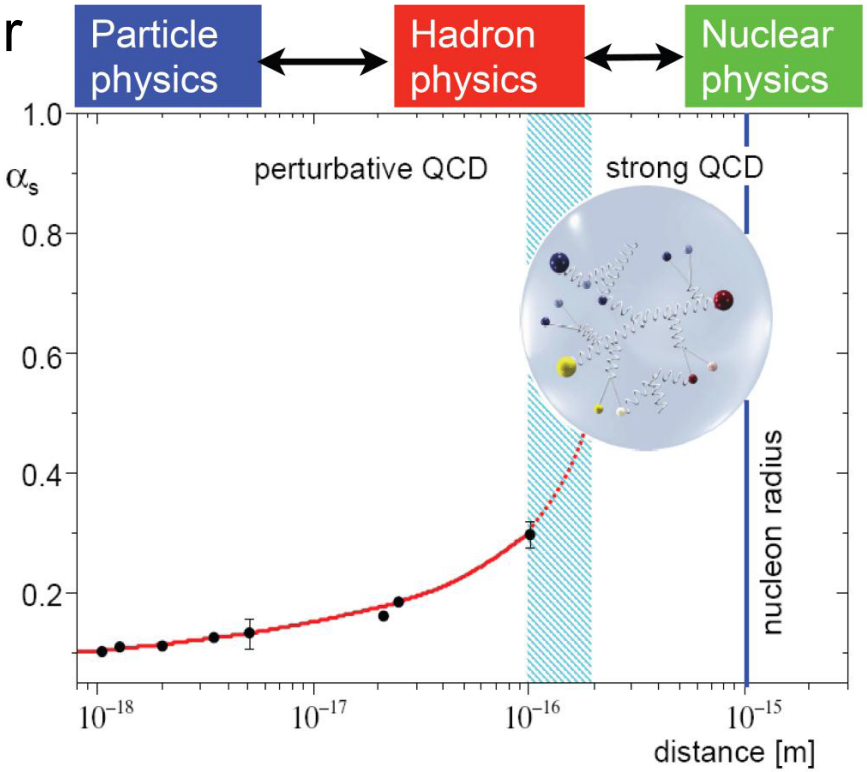
a primer for our new friends&members

J. Ritman Juelich Research Center

Hadron Physics with PANDA

- QCD well understood at high Q^2. Effective DoF at low Q^2.
- Study of the *strong interaction* in the transition region between perturbative QCD and nuclear phenomena
- Emergence of phenomena that are hard to predict from QCD:
  e.g. confinement, nature of hadrons, hadronic masses…





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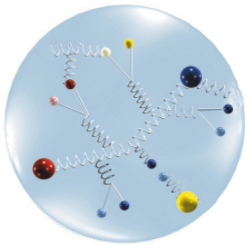
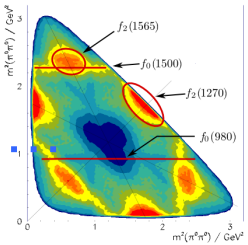
How Do We Study the Hadrons?

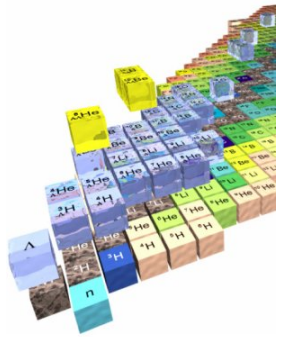
- Hadron Structure: hard (virtual) photons, typically accessed via leptons, allow us to measure the constituents
  - Generalized parton distribution
  - Drell-Yan processes
  - Time-like form factor of the proton



- Hadron Spectroscopy: Excitation spectrum accesses rare quark/gluon configurations
  - Search for glueballs, hybrids, molecules, tetraquarks ...
  - Baryon spectroscopy
  - In-medium effects

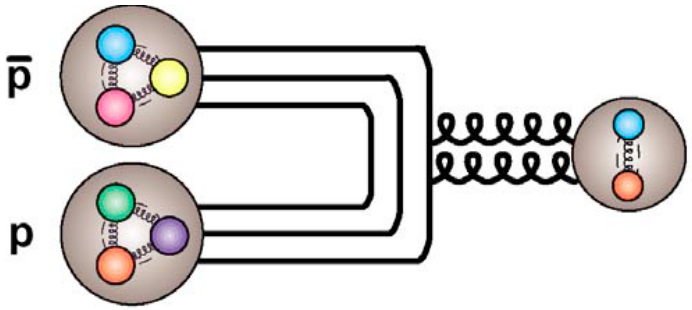


- Hadron Interactions: Pion/Kaon reactions, as well as Hyperons and Hypernuclei provide information about the strong force
  - Double hypernuclei



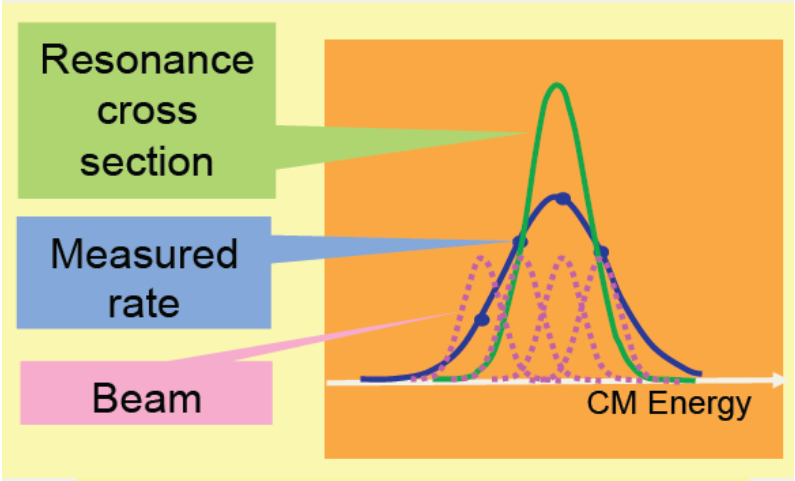
Why Use Antiprotons?

antiProton ANnihilation at DArmstadt

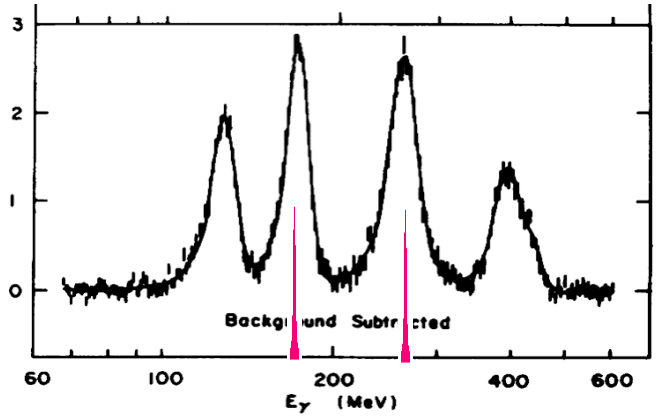


- Annihilation: gluon rich environment
- Formation reactions possible

- Unprecedented resolution via Resonance scans
  → precision limited by beam!

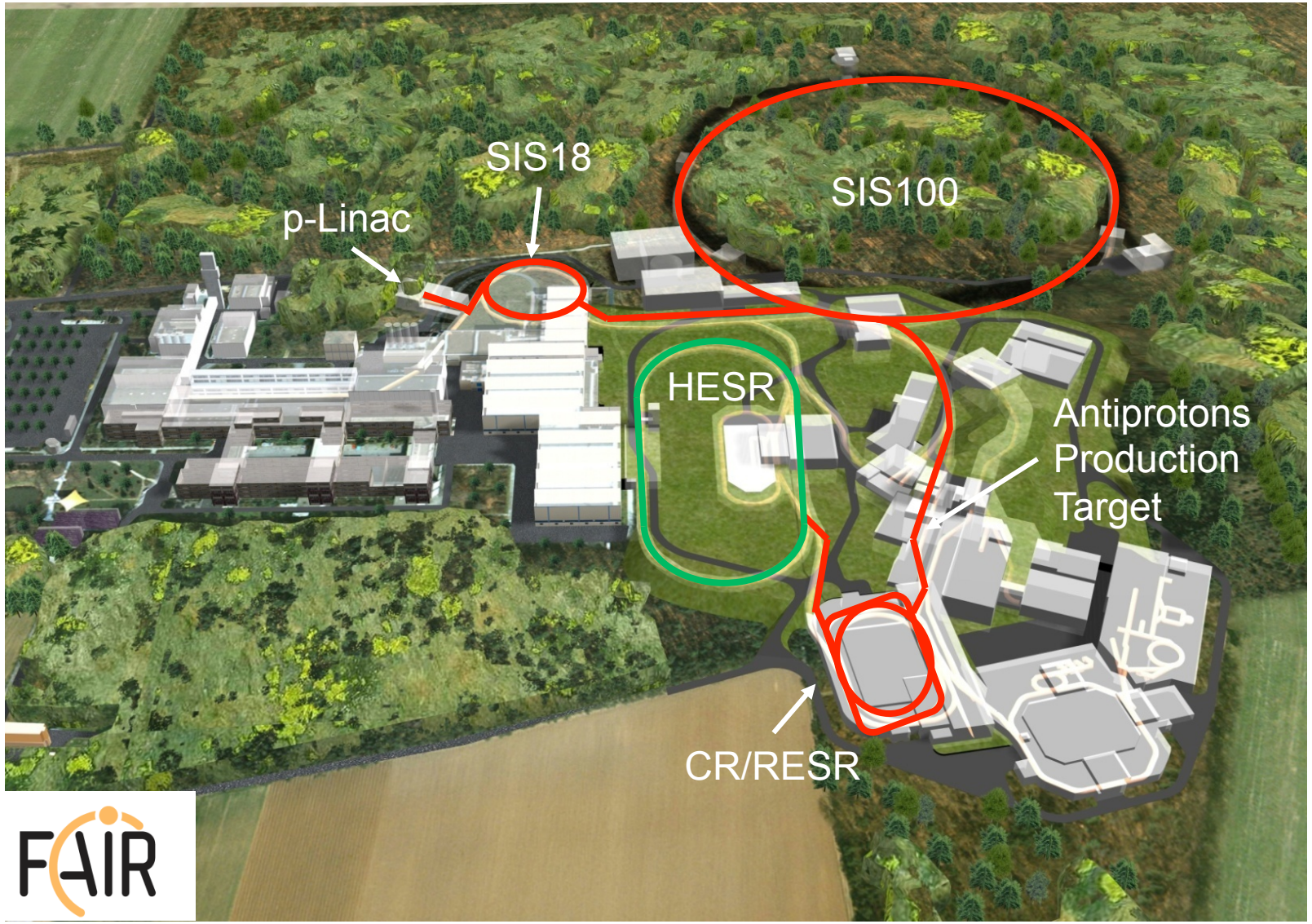


- Example: X(3872)
  PDG: $\Gamma < 1.2$ MeV
  HESR: $\Gamma \sim 0.05$ MeV

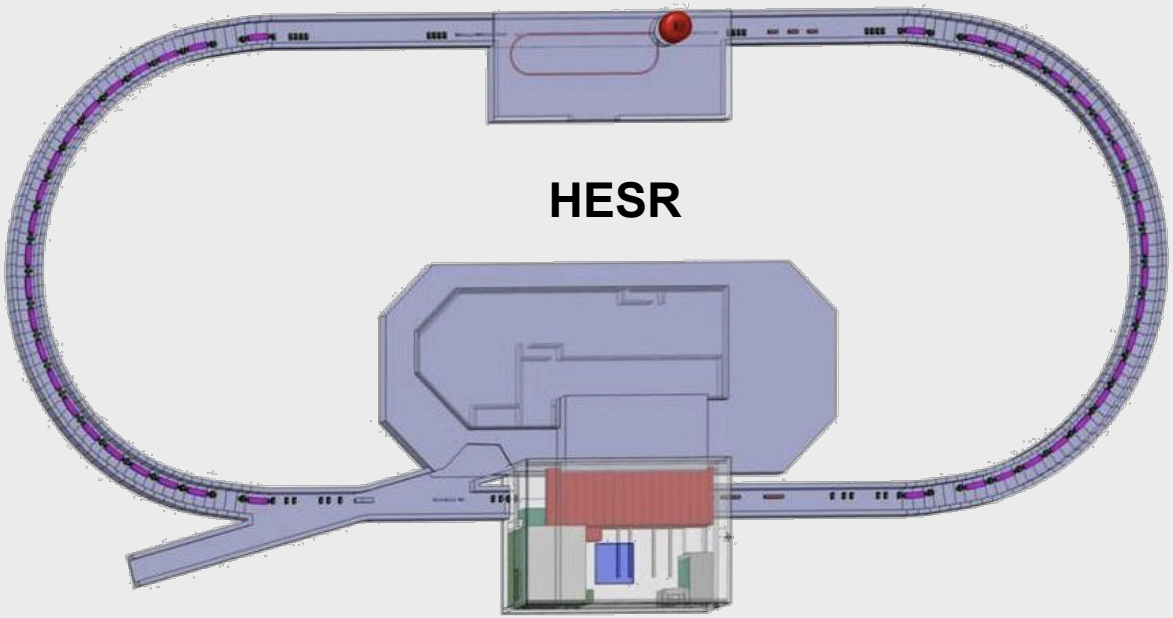


E760@Fermilab

Facility for Antiproton and Ion Research



HESR with PANDA and Electron Cooler



10^{10} - 10^{11} Antiprotons stored

Thick target $4 \cdot 10^{15}$ cm^{-2}

$\Delta p/p \leq 4 \cdot 10^{-5}$

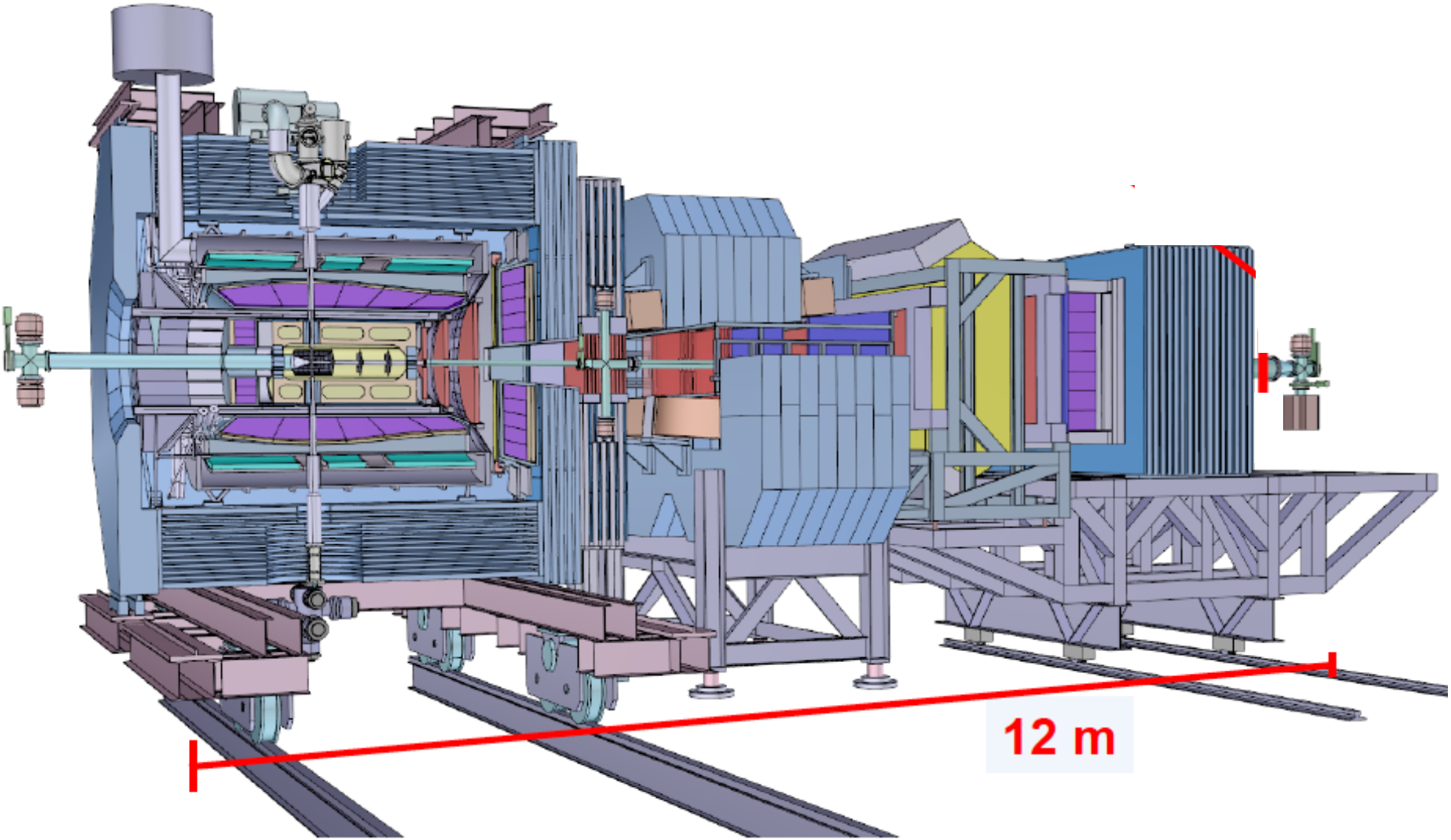
Lumi up to $2 \cdot 10^{32}$ $cm^{-2}s^{-1}$

Phase space cooling

beam life time: > 30 min

HESR	
575 m	Circumference
1.5 – 15 GeV/c	Momentum
up to 9 GeV/c	Electron Cooling
Full range	Stochastic Cooling

The PANDA Detector



The PANDA Collaboration

517 Members from

67 Institutes

18 Countries

Australia, Austria, Belarus, China, France, Germany, India, Italy, Poland, Romania, Russia, Spain, Sweden, Switzerland, Thailand, The Netherlands, USA, UK

PANDA Management

- Collaboration Board makes the decisions
- Plus some elected members for coordination

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Let the Meeting Begin