Brescia-Pavia group

Researchers mostly working at Brescia State University
and / or associated to Pavia Section of INFN (Italian National Institute of Nuclear Physics)

Main people:

Andrea Bianconi (associate professor, Brescia Un., local spokeperson for this activity)

Luca Venturelli (full professor, Brescia Un.)

Marco Leali (technologist, Brescia Un.)

Evans Craig (post-doc fellowship, Brescia Un.)

Valerio Mascagna (post-doc fellowship, Como Un.)

Plus several collaborators on temporary specific projects coming from engineer groups of our University.

Our background: Collaborations

Obelix (LEAR-CERN)
Finuda (LNF-Italy)
Athena (AD-CERN)
Asacusa (AD-CERN)
Painuc (JINR-Dubna)
Panda (FAIR-GSI)

Our group was lead of collaboration papers, or of small subgroup papers, presenting results that are **still used** about

Antinucleon nuclear-level physics
Antiproton atomic-level physics
Slowing down of antiprotons in solids and (standard or low-pressure) gases
Non-neutral cold plasmas
Mixed matter-antimatter states and processes

and participated as coauthors to studies and results on

Ion and cold plasma trapping and confinement
Anti-Hydrogen formation in stationary conditions (1st done in Athena)
Muon neutrino mass (upper limit from Painuc)

Special results, theory, phenomenology, MC codes

Antiproton interactions with different states of matter:

Available, and presently used, data on antinucleon-proton and antiproton-nucleus annihilations at small energy are Obelix ones, many of them by our group. Most recent in 2017 (from Asacusa data).

Behavior of antiprotons in gases below Bragg's peak is largely Brescia's story (nuclear and electron stopping power, Barkas effect, capture thresholds)

Special analyses

Reflection of an antiproton flux by a solid surface (1st observation, by Brescia group)

Chemical reaction between atoms and antiatoms (1st observation, by Brescia group)

Cold antihydrogen formation: leading Athena result, with Brescia's participation.

Cold plasma physics
Nonequilibrium mixing of antiproton and positron plasmas in presence of strong magnetic field (Brescia-Swansea).

Nuclear Cosmology
Nucleosynthesis in presence of light dark matter exotic components

Nuclear / particle physics:
Color Transparency
2-hadron fragmentation functions (AB co-author of new FF H1-angle)
Drell-Yan (fully inclusive and semi-exclusive) (MC code used by both PANDA and COMPASS, by AB)
Timelike Proton form factors (1^{st} observation periodicity in modulation of the FF)

Nuclear medicine:
Very long term radionuclide contamination in liver

To begin with – our plans for the near future

Need developing acquaintance with CLAS12

Close interaction with Italian Genova CLAS group and with Stefan Diehl (Gießen)

Calibration of forward detectors

(where possible, with publishable analyses)

Photon polarization asymmetry in π^0 quasi-photoproduction.

e + p -> e' + γ* + p -> e' + π^0 + p -> **e' + γ + γ** + p

Inclusive w.r.t. proton recoil

Diffractive forward pion E = 7-10 GeV -> forward decay photons
-> selective check on forward tagger
(gets electron + 2 photons)

Distribution A + B*cos(2 ϕ) -> start with simple determination of B/A from

Asymmetry (P-O) / (P+O) P = cos(2 ϕ) > 0 (“parallel photon polarization”)
O = cos(2 ϕ) < 0 (“orthogonal photon pol.”)
-> limited role of flux and acceptance

Interesting measurement: disagreement between SLAC data (1971) and
Gluex data (2016)

Next: same with η.

Heavier than pion -> less forward photons,
broader angle detectors (Ecal) tested.

In parallel: more “global” but known event with tracks: production of a multi-meson-decay hadron

Simplest possibility: omega

$e + p \rightarrow e' + \gamma^* + p \rightarrow e' + \boldsymbol{\omega} + p \rightarrow e' + \boldsymbol{\pi^+ + \pi^- + \pi^0} + p$

$\omega \rightarrow$ 2 charged + 1 undetected neutral pions

Simple narrow mass spectrum, small background

Neutral pion momentum identified as missing momentum after reconstruction of charged pions and proton tracks.

Proton at 20-80 degrees, pions at 5-30 degrees (extrapolating from simulation of 2 pion production by S.Diehl)

Need matching data from several detector components.