

THE ANTIMATTER EXPERIMENT

Gravity | Interferometry | Spectroscopy



5 laser beams

100 million antiprotons

AEGIS

THE WEIGHT OF ANTIMATTER



1 billion positrons

50 collaborators

AEgIS 2024 – exciting beyond Rydberg levels



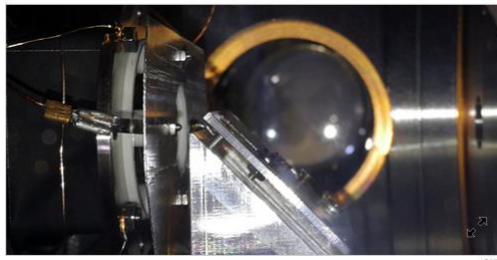
Jan-Feb: “Paper work”

| | | | | | |
|--------------------------|---------------------------------------|----------|-------|------|----------------|
| Mon Jan 22 11:09:22 2024 | COMSOL for field gradient termination | Hardware | Benji | 5905 | see attachment |
|--------------------------|---------------------------------------|----------|-------|------|----------------|

Laser-Cooling Positronium

February 22, 2024 • *Physics* 17, 523

Researchers have managed to cool an atom-like system made of an electron and a positron using a technique commonly used in cold-atom experiments.



AEgIS status report 2022

148th meeting of the SPSC
February 7th, 2023

R. Caravita*
*INFN – TIFPA, Trento (IT)

on behalf of the **AEgIS Collaboration**

Research | [Open access](#) | Published: 15 February 2024

CIRCUS: an autonomous control system for antimatter, atomic and quantum physics experiments

[M. Volponi](#), [S. Huck](#), [R. Caravita](#), [J. Zielinski](#), [G. Kornakov](#), [G. Kasprowicz](#), [D. Nowicka](#), [T. Rauschendorfer](#), [B. Rienäcker](#), [F. Preلز](#), [M. Auzins](#), [B. Bergmann](#), [P. Burian](#), [R. S. Brusa](#), [A. Camper](#), [F. Castell](#), [R. Ciuryło](#), [G. Consolati](#), [M. Doser](#), [L. T. Glöggler](#), [Ł. Graczykowski](#), [M. Grosbart](#), [F. Guatieri](#), [N. Gusakova](#), ...
[N. Zurlo](#) + Show authors

EPJ Quantum Technology 11, Article number: 10 (2024) | [Cite this article](#)

1516 Accesses | 2 Citations | 1 Altmetric | [Metrics](#)

RESEARCH ARTICLE | AUGUST 30 2024

TALOS (Total Automation of LabVIEW Operations for Science): A framework for autonomous control systems for complex experiments

[M. Volponi](#), [J. Zieliński](#), [T. Rauschendorfer](#), [S. Huck](#), [R. Caravita](#), [M. Auzins](#), [B. Bergmann](#), [P. Burian](#), [R. S. Brusa](#), [A. Camper](#), [F. Castelli](#), [G. Cerchiarri](#), [G. Consolati](#), [R. Ciuryło](#), [G. Consolati](#), [M. Doser](#), [K. Eliaszuk](#), [A. Giszczak](#), [L. T. Glöggler](#), [Ł. Graczykowski](#), [M. Grosbart](#), [F. Guatieri](#), [N. Gusakova](#), [F. Gustafsson](#), [S. Haider](#), [M. A. Janik](#), [T. Januszek](#), [G. Kasprowicz](#), [G. Khatri](#), [Ł. Klosowski](#), [G. Kornakov](#), [V. Krumins](#), [L. Lappo](#), [A. Linek](#), [J. Malamant](#), [S. Mariazzi](#), [L. Penasa](#), [V. Petracek](#), [M. Piwiński](#), [S. Pospisil](#), [L. Povolo](#), [F. Preلز](#), [S. A. Rangwala](#), [B. S. Rawat](#), [B. Rienäcker](#), [V. Rodin](#), [O. M. Röhne](#), [H. Sandaker](#), [P. Smolyanskiy](#), [T. Sowiński](#), [D. Tefelski](#), [T. Vafeiadis](#), [C. P. Welsch](#), [T. Wolz](#), [M. Zawada](#), [N. Zurlo](#)

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Rev. Sci. Instrum. 95, 085116 (2024)

<https://doi.org/10.1063/5.0196806> Article history

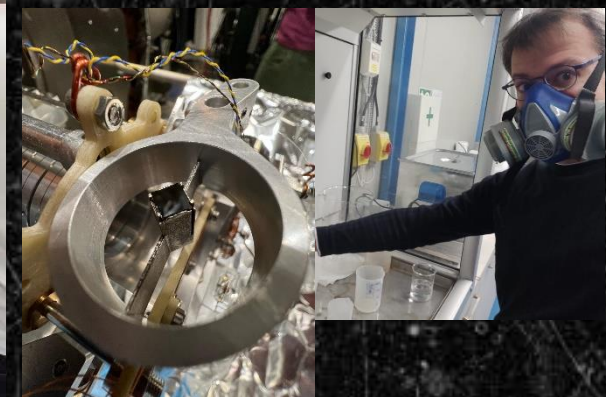


AEgIS 2024 – exciting beyond Rydberg levels



Mar-Apr: “Start-up”

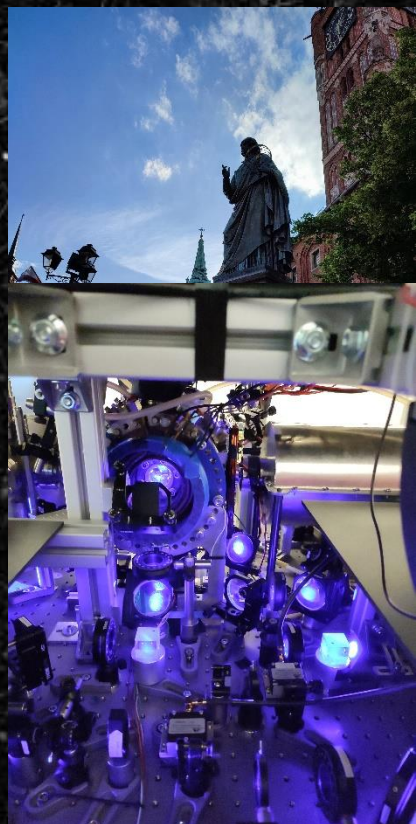
| | | YETS | | | | | | | | | | | | |
|----|---------------|------------------------------------|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--|
| | | Mar-24 | | | | Apr-24 | | | | May-24 | | | | |
| 1 | Team | Task name | 04..10 | 11..17 | 18..24 | 25..31 | 01..07 | 08..14 | 15..21 | 22..28 | 29..05 | 06..12 | 13..19 | |
| 5 | Stefan | WP1: Closure of experiment | [Timeline bar] | | | | | | | | | | | |
| 6 | Stef | Repair and maintenance vacuum-side | [Timeline bar] | | | | | | | | | | | |
| 7 | Rug | Device test protocol | [Timeline bar] | | | | | | | | | | | |
| 8 | Stef | Test of closure | [Timeline bar] | | | | | | | | | | | |
| 9 | Benji | Installation of Ps target | [Timeline bar] | | | | | | | | | | | |
| 10 | Stef | Real closure: 27.03.2024 | [Timeline bar] | | | | | | | | | | | |
| 11 | Stef | Pumping start | [Timeline bar] | | | | | | | | | | | |
| 13 | Stefan | WP2: Pump down and cooling | [Timeline bar] | | | | | | | | | | | |
| 14 | Stef | Roughing turbo pumping | [Timeline bar] | | | | | | | | | | | |
| 15 | Valts | LN | [Timeline bar] | | | | | | | | | | | |
| 16 | Stef | LHe | [Timeline bar] | | | | | | | | | | | |
| 17 | Stef | Magnets ON: 16.4.2024 | [Timeline bar] | | | | | | | | | | | |
| 18 | Gosia | Safety check AEgIS: 16.4.2024 | [Timeline bar] | | | | | | | | | | | |
| 20 | Gosia | WP3: Starship and beamline | [Timeline bar] | | | | | | | | | | | |
| 21 | Gosia/Valts | Installation and test | [Timeline bar] | | | | | | | | | | | |
| 22 | Gosia/Valts | Closure | [Timeline bar] | | | | | | | | | | | |
| 23 | Gosia/Valts | Roughing and pumping | [Timeline bar] | | | | | | | | | | | |
| 24 | Gosia/Valts | Bakeout | [Timeline bar] | | | | | | | | | | | |
| 25 | Gosia | Cabling finished | [Timeline bar] | | | | | | | | | | | |
| 27 | Rug | WP4: Beam preparation | [Timeline bar] | | | | | | | | | | | |
| 28 | Stef | Repair and maintenance external | [Timeline bar] | | | | | | | | | | | |
| 29 | Benji | 1TCMOS camera setup | [Timeline bar] | | | | | | | | | | | |
| 30 | Rug | SC setup + calibration | [Timeline bar] | | | | | | | | | | | |
| 31 | Saiva | Kasli/TALOS start | [Timeline bar] | | | | | | | | | | | |
| 32 | Saiva/Rug | Recabling of electrodes and test | [Timeline bar] | | | | | | | | | | | |
| 33 | Jakub | Talos upgrade | [Timeline bar] | | | | | | | | | | | |



AEgIS 2024 – exciting beyond Rydberg levels



May: Torun Collaboration Meeting



AEgIS 2024 – exciting beyond Rydberg levels



May-Aug: Block I

- OPHANIM tests
- Production of anti-sun region
- **Test Ps in the BBox**
- Test Ps in the 1T (0.2T)
- Test Rydberg Ps
- New positron source
- Electron steering and tests
- Laser calibration and tests
- Pbar manipulations
- Develop and test Hbar script
- Highly-charged ion runs

| | | AEgIS Work Package Plan | | | | | | | | | | | | | | | | | | | | |
|----------------|---|-------------------------|--------|--------|--------|--------|--------|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|----|---|
| | | YETS | | | | | | ELENA Physics | | | | | | | | | | | | | | |
| | | Mar-24 | | Apr-24 | | May-24 | | Jun-24 | | Jul-24 | | Aug-24 | | | | | | | | | | |
| Team | Task name | 04..11 | 17..24 | 25..31 | 01..07 | 08..14 | 15..21 | 22..29 | 30..06 | 12..19 | 20..27 | 28..03 | 10..17 | 24..31 | 01..07 | 08..14 | 15..21 | 22..29 | 30..05 | 11..18 | 19 | |
| Franz | WP5: Franz / Bergi detector | | | | | | | | | | | | | | | | | | | | | |
| Franz | Design and construction at NEPOMUC | | | | | | | | | | | | | | | | | | | | | |
| Franz | Test at CERN with antipotons | | | | | | | | | | ★ | ✓ | | | | | | | | | | |
| Gosia | WP6: Anti-sun region | | | | | | | | | | | | | | | | | | | | | |
| Gosia | Design 1T bellows assembly | | | | | | | | | | | | | | | | | | | | | |
| Gosia | Ordering and production of bellows | | | | | | | | | | | | | | | | | | | | | ★ |
| Benji | Anti-gradient coil design | | | | | | | | | | | | | | | | | | | | | ★ |
| Stefan | Design of the 1T MCP assembly | | | | | | | | | | | | | | | | | | | | | ★ |
| Stefan | Ordering and production 1T MCP ass | | | | | | | | | | | | | | | | | | | | | |
| Stefan | Warmup | | | | | | | | | | | | | | | | | | | | | |
| Stefan/Gosia | Installation | | | | | | | | | | | | | | | | | | | | | |
| Benji | WP7: Ps target test in Bbox | | | | | | | | | | | | | | | | | | | | | |
| Benji | Targets tests on deterioration | | | | | | | | | | | | | | | | | | | | | |
| Benji | Identify best procedure for production | | | | | | | | | | | | | | | | | | | | | ✗ |
| Benji | WP8: Ps tests 1 in 1T | | | | | | | | | | | | | | | | | | | | | |
| Saival/Benji | Identify with electrons the target center | | | | | | | | | | | | | | | | | | | | | |
| Benji | Transport positrons to the target 1T | | | | | | | | | | | | | | | | | | | | | ★ |
| Benji | Compare PMT20 Ps/no Ps | | | | | | | | | | | | | | | | | | | | | |
| Benji | Ps T and B dependence | | | | | | | | | | | | | | | | | | | | | ★ |
| Benji/Rug | Ps photoionization PMT20 / MCP | | | | | | | | | | | | | | | | | | | | | |
| Valts | Rydberg Ps n=30 | | | | | | | | | | | | | | | | | | | | | |
| Benji | Installation of new positron source | | | | | | | | | | | | | | | | | | | | | ✓ |
| Rug | WP9: Electron and pbars startup | | | | | | | | | | | | | | | | | | | | | |
| Saiva | Electrons in ST | | | | | | | | | | | | | | | | | | | | | |
| Saival/Rug | Electron steering and optimization | | | | | | | | | | | | | | | | | | | | | ★ |
| Rug | Startup: Pbar basic procedures | | | | | | | | | | | | | | | | | | | | | ★ |
| Tassilo | Pbar optimization | | | | | | | | | | | | | | | | | | | | | |
| Rug | Electron catching and cooling | | | | | | | | | | | | | | | | | | | | | ★ |
| Rug | Pbar parabolic transport to 1T + timing | | | | | | | | | | | | | | | | | | | | | |
| Rug | WP10: EKSPALA setup | | | | | | | | | | | | | | | | | | | | | |
| Lisa | Cleaning and maintenance | | | | | | | | | | | | | | | | | | | | | |
| Lisa | Induction of Ahmad | | | | | | | | | | | | | | | | | | | | | |
| Rug/Valts | Sensible upgrades (n=40, flashlamp) | | | | | | | | | | | | | | | | | | | | | ★ |
| Valts | Check of uServices and Scripting | | | | | | | | | | | | | | | | | | | | | ★ |
| Valts | Calibrations (Rydberg and check 205) | | | | | | | | | | | | | | | | | | | | | ★ |
| Valts/Benji | Timing and position alignment | | | | | | | | | | | | | | | | | | | | | ★ |
| Fredrik | WP11: HCI | | | | | | | | | | | | | | | | | | | | | |
| Fred | Experiment preparation / Script | | | | | | | | | | | | | | | | | | | | | |
| Stef | Installation Leak Valve | | | | | | | | | | | | | | | | | | | | | |
| Stef | Gas injection and tests | | | | | | | | | | | | | | | | | | | | | |
| Fred | Measurement | | | | | | | | | | | | | | | | | | | | | ✓ |



AEgIS 2024 – exciting beyond Rydberg levels



Aug-Oct: Upgrade (Big thanks to all!!)

- Installation of new 1T MCP
- New anti-bellows assembly
- New thermalization
- New bake-out equipment
- Hedgehog detectors
- Starship setup for extraction
- New Ps target
- Fixing of minor problems
- ...

| | | Physics | | | | | | | | | | | | | | | |
|--------------|------------------------------------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | Aug-24 | | | | | Sep-24 | | | | Oct-24 | | | | Nov-24 | | |
| Team | Task name | 29..04 | 05..11 | 12..18 | 19..25 | 26..01 | 02..08 | 09..15 | 16..22 | 23..29 | 30..06 | 07..13 | 14..20 | 21..27 | 28..03 | 04..10 | 11..17 |
| Gosia | WP12: Upgrade of experiment | | | | | | | | | | | | | | | | |
| Stef | 1T MCP assembly | | | | | | | | | | | | | | | | |
| Gosia | Anti-bellows assembly | | | | | | | | | | | | | | | | |
| Gosia | Hedgehog detectors | | | | | | | | | | | | | | | | |
| Benji/Sandra | Installation of new Ps target | | | | | | | | | | | | | | | | |
| Gosia | Closure: 04.10.2024 | | | | | | | | | | | | | | | | |
| Stef | Pumping start | | | | | | | | | | | | | | | | |
| Gosia | WP13: Pump down and cooling | | | | | | | | | | | | | | | | |
| Stef | Vacuum 1T/5T | | | | | | | | | | | | | | | | |
| Gosia/Valts | Vacuum Hedgehog/Beamline | | | | | | | | | | | | | | | | |
| Gosia | LN: 09.10.2024 | | | | | | | | | | | | | | | | |
| Valts | LHe | | | | | | | | | | | | | | | | |
| Gosia | Magnets ON: 18.4.2024 | | | | | | | | | | | | | | | | |



AEgIS 2024 – exciting beyond Rydberg levels



Oct-Dec: Block II

- Rapid beam preparation
- Fixing of 1000 little problems (1T CMOS, electron steering ...)
- Ps tests in the BBox: 20% Ps!
- Ps tests in 1T: 10% Ps
- Rydberg Ps excitation & diagnostic
- Antihydrogen production (Beam?)
- Backwards extraction of pbars
- HCl: improve understanding for paper
- OPHANIM tests
- Ps* spectroscopy for Valts PhD
- **Ps Doppler & Timing Scan in 1T**
- Laser and detector calibrations
- Bonus: Ps tests at 0.2T

