Lepta - Facility for Fundamental and Applied Research

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1. LEPTA Facility

- collector
- kicker
- septum
- e-gun
- positron trap

Helical quadrupole

cooling section

Q-Ps

10E4 o-Ps per sec

Ps detector

22Na

10E6 e+ per sec

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2. Positron Injector

1 - positron source $^{22}\text{Na}$, 2 - radioactive protection shield, 3 - vacuum valve,
4 - vacuum chamber for pumping out and diagnostic tools, 5 - positron trap,
6 - vacuum isolator, 7 - positron vacuum channel,
8 - vacuum “shutter” (fast valve), 9 - ion pump, 10 - turbo pump, 11 - He vessel.

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Introduction

• The purpose of the project LEPTA is to create in the JINR new basic installation for investigations in the field of Positronium Physics

• The parameters of Positronium and its constituents: electron and positron must be known
Objectives and Aims

• To study the accumulation process
• To study the circulation of electron beam
Equipment Description
Experiment Description

• Find resonance of RW frequency vs pressure of buffer gas
• Lifetime of the beam with RW, and without RW
• Beam size with RW and without, when continuously inject or when we use one pulse injection of electrons
• Using long trap and the normal trap
• Finally we measure life time in the ring
2. Positron Trap

Pressure, Torr

Area 1

Area 2

Area 3

10^{-3}

10^{-4}

10^{-6}

eU

e^+

N_2

N_2

z

I

II

III

IV

V

VI

VII

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2. Positron Trap

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The “Rotating Wall” (RW)

Each electrode is placed under combination of AC and DC potentials (Fig. a, b, c). AC potentials of sector electrodes are shifted by 90° each to other.

The first experiment: Mg+ (Laboratory Univ. of California at San Diego) X-P. Huang et al., PRL. 78, 875 (1997).
Obtained Results for RW resonance frequency

Long trap

Normal trap

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Obtained Results for life time

\[ \text{Life Time} \]

\[ y = 0,1399e^{-0,014x} \]

\[ y = 0,072e^{-0,032x} \]

<table>
<thead>
<tr>
<th>RW</th>
<th>Life time, s</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>31.25</td>
</tr>
<tr>
<td>On (25 kHz)</td>
<td>71.43</td>
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</tbody>
</table>

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Obtained Results for beam size

Continuous injection

One-pulse injection
Life time of electron beam in the Ring

Pick Up station 1
Helical quadrupole
Pick Up station 2
Kicker
Septum
e-gun
Collector
Cooling section
Life time of electron beam in the Ring

LongTor1_ShortTor1
ShortTor1_Straight
Straight_ShortTor2
ShortTor2_LongTor2

Without Correction Coils   With Correction Coils
Life time of electron beam in the Ring

Life time measurement

<table>
<thead>
<tr>
<th>Cor_coils</th>
<th>Life time, ms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>2.4</td>
</tr>
<tr>
<td>On (44 A)</td>
<td>4.3</td>
</tr>
</tbody>
</table>

\[ y = 83,393e^{-0.412x} \]

\[ y = 76,024e^{0.237x} \]
Conclusion/ Discussions

- We found that the RW increases the efficiency of particle accumulation and lifetime.
- It explains the observed effects of compression and prolonged containment of particle bunch in the trap.
- The application of correction coils helps us to reduce inhomogeneity hence big lifetime.
Thanks for your attention!
Спасибо за внимание!