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On the formation of molecules containing positronium

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Even though the existence of 33 molecules containing positronium has been predicted using various methods [1], so far only the simplest of them (PsH) has been observed experimentally in vacuum, with that discovery dating back more than 30 years [2]. We aim to confirm the previous result [2], and additionally observe further molecules such as PsO and PsF, as well as measure their binding energy with a resolution of ~50 meV.

To achieve this, we have built a new positron beamline consisting of a ^{22}Na source, positron trap, and high-resolution mass spectrometer. The Surko-type buffer gas trap will create bunches of positrons with a low energy spread and a diameter of approximately 1-2 mm.

The observation of molecular bound states will follow the method developed by Schrader et al. [2]; molecules containing positronium are produced in collisions between the pulsed positron beam and an effusive gas jet target [4]. The signature ions that are created in this process are detected in a time-of-flight spectrometer using a microchannel plate (MCP) detector. A strong magnetic field is applied within the spectrometer to prevent mixing of the parallel and perpendicular energy components of the positron beam, thus ensuring the required low energy spread is maintained.

This poster will describe the positron beam, trap, and ion spectrometer of the newly constructed beamline and show first characterization results.

References

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