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## Design of cyclotron-based in-vacuum material irradiation beamline at TINT

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A new cyclotron facility has been constructed at Thailand Institute of Nuclear Technology to provide proton beams with energy of 15-30 MeV for radioisotope production and material analysis. Due to requirements of particle induced X-ray emission (PIXE) and particle induced gamma-ray emission (PIGE) techniques that need a low-energy and low-intensity proton beam in range of 2-15 MeV and picoamperes as well as high detection sensitivity, the additional setup including an energy degrader, a collimator, a 30-degree separator magnet, and a slit, is employed for an in-vacuum irradiation beamline. In this work, we study the proton beam trajectory and beamline elements. The energy degrader made of aluminum has shown promising results in decreasing the beam energy while the energy spread of a secondary beam is significantly reduced by the following 30-degree separator magnet. Furthermore, the combination of the collimator and the slit lessens the beam current to proper values. To measure the proton beam current downstream, a copper Faraday cup will be used.

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