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Absolute Flux Measurements for Swift Atoms

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While a torsion balance in vacuum can easily measure the momentum transfer from a gas beam impinging on a surface attached to the balance, this measurement depends on the accomodation coefficients of the atoms with the surface and the distribution of the recoil. A torsion balance is described for making absolute flux measurements independent of recoil effects. The torsion balance is a conventional taut suspension wire design and the Young modulus of the wire determines the relationship between the displacement and the applied torque. A compensating magnetic field is applied to maintain zero displacement and provide critical damping. The unique feature is to couple the impinging gas beam to the torsion balance via a Wood's horn, i.e. a thin wall tube with a gradual 90° bend. Just as light is trapped in a Wood's horn by specular reflection from the curved surfaces, the gas beam diffuses through the tube. Instead of trapping the beam, the end of the tube is open so that the atoms exit the tube at 90° to their original direction. Therefore, all of the forward momentum of the gas beam is transferred to the torsion balance independent of the angle of reflection from the surfaces inside the tube.