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Multiple Scattering and Volume Capture of Charged Particles in Bent Crystals

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Recent results [1] on incoherent multiple scattering for charged particles passing through bent crystals in planar orientation are surveyed. Regions in the crystal bending radius vs. particle energy (R , E) plane are determined, where:

- i- the number of bent atomic planes crossed by the particle within the intrinsic volume reflection region of extent $\sim R\theta_c$ is greater than 1;
- ii- the influence of thermal spread $u(T)$ of atomic nuclei in the crystallographic planes on the interplanar potential is negligible;
- iii- multiple scattering angles acquired in the intrinsic volume reflection region are small compared to the Lindhard's critical angle θ_c ;
- iv- the volume capture probability is small.

Intersection of those regions gives optimal conditions for beam steering by volume reflection.

The estimates for volume capture indicate that it must occur predominantly as a result of scattering in the bent plane closest to the radial reflection point. Thereat, the volume capture probability obeys the scaling law [1]

$$P_{\text{capt}} \propto \frac{R}{u^{1/2}(T)E^{3/2}}.$$

References

- [1] M.V. Bondarenko, Phys. Rev. ST-AB 15 (2012) 032802.

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