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Direct detection of charged particles with SiPMs

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Recent studies demonstrated that SiPMs are highly suited in directly detecting charged particles(ref.1-2).The reason is traced back to the abundant production of Cherenkov photons when a MIP passes through the SiPM's protection layer.This leads to a significant increase in the firing SPADs number,resulting in:
1. efficiency close to 100%
2. excellent timing performance, reaching 20-30 ps or less
3. high noise-rejection capability, thanks to the large signals.
To build upon these findings,we propose four directions for further development:
- better quantify the number of photons produced with different resin thickness and material
- determine the optimal SPAD/SiPM dimensions to improve timing performances
- improve SIPM radiation tolerance, in synergy with other DRD4 projects
- develop a custom FEE for timing
This research can pave the way for SiPM applications in space and HEP for direct charge particles in TOF, and new RICH-TOF combined systems.

[1]F.Carnesecchi,et al.,JoI-17(P06007)(2022) https://doi.org/https://dx.doi.org/10.1088/1748-0221/17/06/P06007
[2]F.Carnesecchi,et al.,EPJ-Plus-138,337(2023) https://link.springer.com/article/10.1140/epjp/s13360-023-03923-4

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