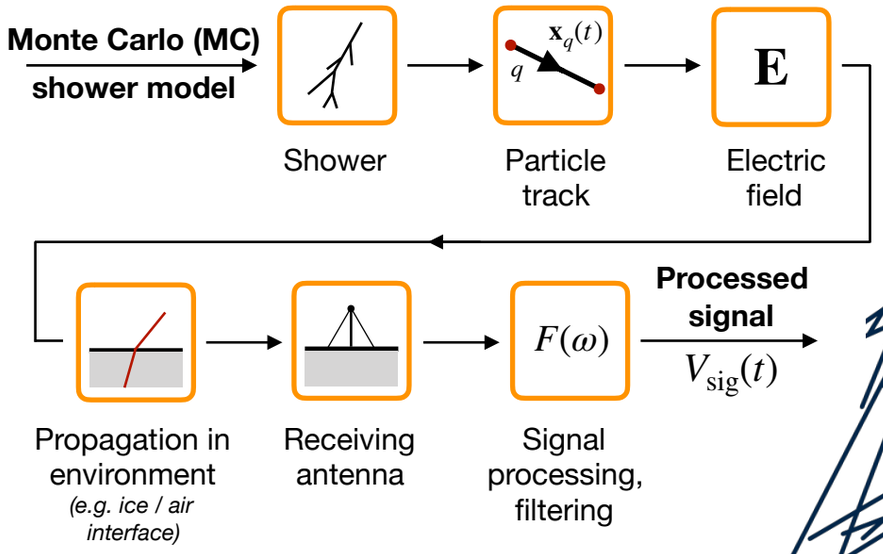
A reciprocal look at air shower radio emissions

Philipp Windischhofer (Oxford), Werner Riegler (CERN)

philipp.windischhofer@physics.ox.ac.uk

① Conventional, "shower-centric" computation of radio signature

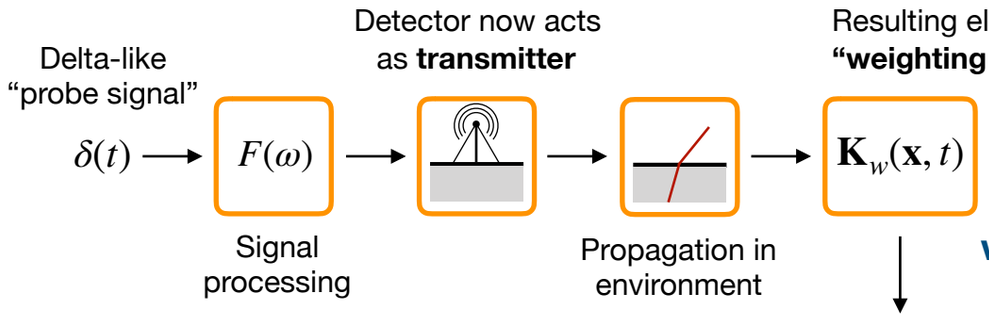


Available in general-purpose simulators
(e.g. REAS: "endpoint formalism")
or experiment-specific codes

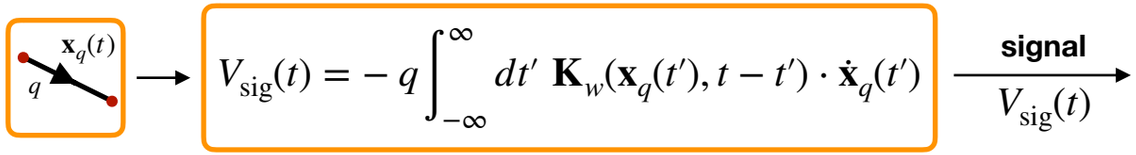
Calculation needs to be redone for each shower in the same environment!

② An alternative method:
exploit *reciprocity relations* of electrodynamics

Swap roles of transmitter (shower) **and receiver** (detector)**:**



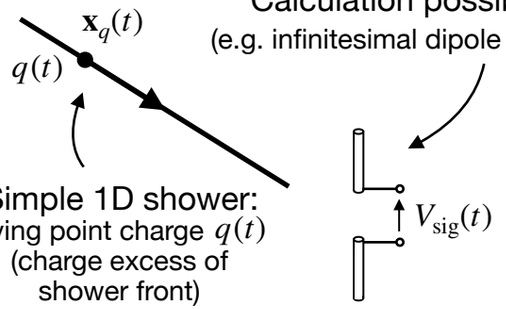
Compute *(and store)* **weighting field once …**



… get processed signal efficiently by convolution with particle trajectory
(weighting field = Green's function for environment)

③ A "detector-centric" view of air showers

Calculation possible analytically for simple detectors (e.g. infinitesimal dipole antenna) and simple shower models



Automatically includes all electrodynamic effects:
Askaryan radiation, Coulomb field, ion trail, …

More information

For real-world detectors: compute weighting field with Maxwell solver, convolve numerically with MC shower

UNIVERSITY OF OXFORD
DEPARTMENT OF PHYSICS