MOLLER Laser Table Ground – Requirement Document

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When conducting PV experiments it is vital to prevent electronic cross-talk that could transmit real-time helicity information to the "outside world" (e.g., experiment hall counting house, polarimeter DAQs), including via ground loops, that could produce false raw (detector) asymmetries. In designing the helicity-control board and laser table devices, the following precautions were taken (with many illustrated in Figure 4):

- The helicity-control board is located within an electrically-isolated VME crate at the Injector Service Building, powered by an isolation transformer and floating at 62 VAC.
- The helicity-control board generates two real time helicity signals called *Helicity Flip* and its opposite, *nHelicity Flip*. In this manner, the current drawn by the board does not depend on the helicity state.
- The Pockels cell and so-called IA charge-asymmetry controllers at the injector drive-laser table are the only devices that receive a real-time helicity signal (*Helicity Flip*). The setpoint voltages for these devices pass through a galvanic-isolation card and there are no readbacks of these setpoint voltages. This card uses a precision isolation amplifier (ISO-124) to isolate signals from -10 V to +10 V with a bandwidth of up to 50 kHz.
- The helicity magnets are powered using an independent electrically-isolated VME crate powered by an isolation transformer that receives one of the two real-time helicity signals (*nHelicity Flip*).
- The beam helicity signal is generated by a pseudo-random bit generator, to prevent a correlation between the helicity signal and any other signal at the accelerator or experiment hall.
- The "outside world" receives only a delayed helicity signal (*Delayed Helicity*) so there is no knowledge of real time helicity.

- During the experiment, all helicity-correlated beam asymmetries (position, angle, charge, energy, and size – and thus beam scraping) are minimized so that helicity is the only real time property of the beam that is changing.

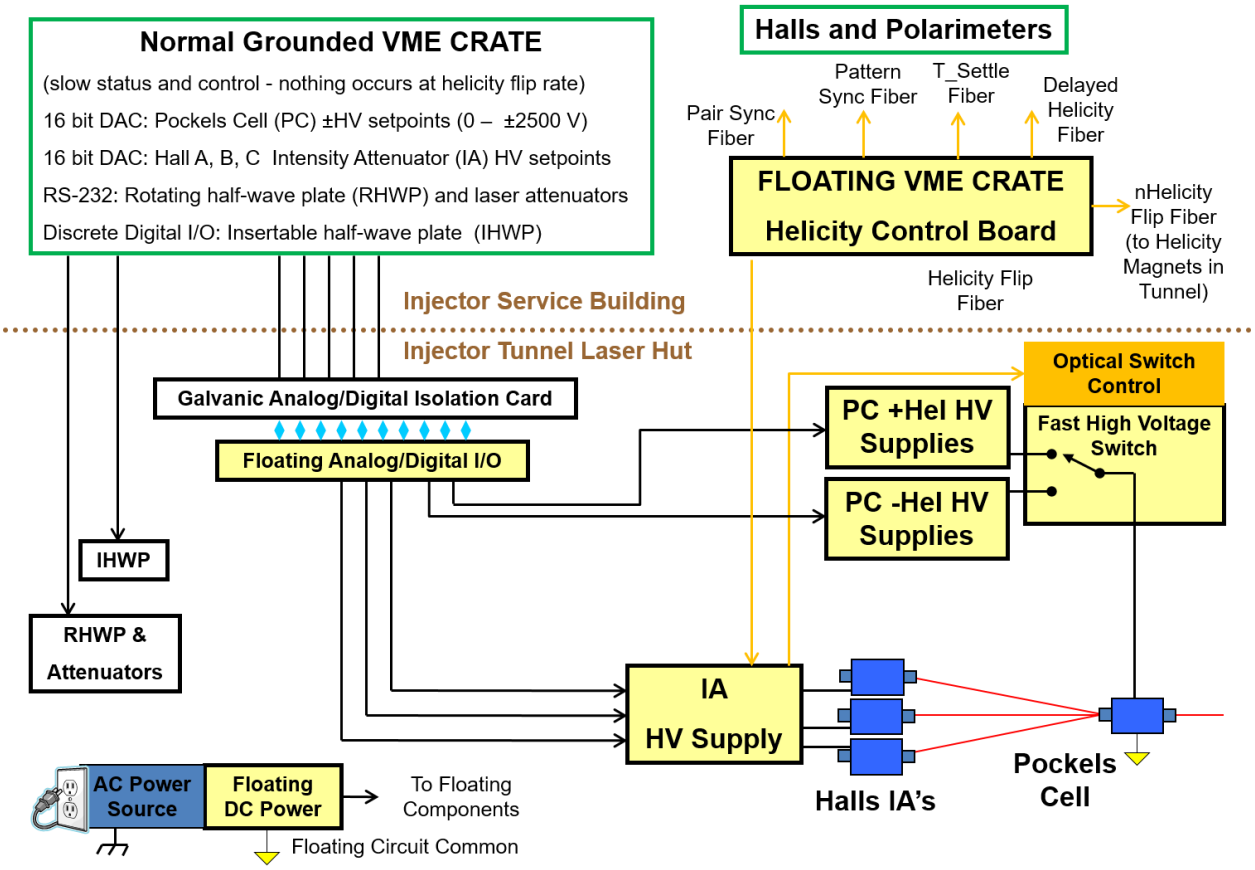

Figure 4: Electrical ground isolation.