Notes on Helicity Conventions

The helicity of the beam was flipped at a rate of 30 Hz in a pseudorandom manner during e91-011. The beam helicity is flipped by changing the voltage on the Pockel Cell at the source. The signal which flips the sign is also sent to the counting houses. So for each event the state of the helicity signal is recorded in the espace variable *spec_h.fpp.helicity.helicity* which can have the value -1, 0, 1, or 2. -1 (1) is when the pulse is low (high). 0 is a blank off period of about 500 μsec for the transition between plus and minus helicity. 2 is when the state of helicity is undetermined by software(hopefully this almost never happens). Naturally one would like it to be that -1 means negative helicity and +1 means positive helicity. But in practice the meanings change because the half-plate position is changed (this did nto happen during e91-011), the beam spin rotation through the accelerator is such that it is near 180 degrees relative to its angle at the injector (though in this case we try to work things so the Moller measurement would tell us the the beam has a negative helicity) and unfortunately it seems that the each of the two polarized source guns has the Pockel Cell connected in a way which gives the opposite convention for each gun.

With the ^{1}H($\vec{e}, e\vec{p}$) elastic scattering the sign of the outgoing polarization is known. For electron scattered to beam left the transverse polarization of the proton is negative and the longitudinal polarization is positive, therefore the sign of the beam helicity relative to the helicity signal can be determined. Also from the Moller polarimeter the sign of the beam helicity relative to the helicity signal can be determined. It ends up that Moller used the opposite helicity convention then what is used for the FPP. Of course with the elastic radiative tail at $\theta_{cm} = 90°$ the beam helicity can be determined independent of the Moller. To get the correct signs of the the outgoing proton polarizations in the elastic scattering the following convention was used. The value of -1 for *spec_h.fpp.helicity.helicity* was a plus beam helicity and sign of the beam for the plus helicity was taken from Moller. This is the convention used to get the polarization for the pion production data and therefore the sign of the polarization is correct.