Risetime analysis: machine calculations

Maximum polarisation during risetime calibration:

$$P_{\max} = P_{\mathrm{ST}} \times \frac{\tau_{\mathrm{ST}}}{\tau_{\mathrm{ST}} + \tau_{\mathrm{dep}}} + P_{\mathrm{kin}}$$

Built-up time during risetime calibration:

$$\tau = \tau_{\mathrm{ST}} \times \frac{\tau_{\mathrm{ST}}}{\tau_{\mathrm{ST}} + \tau_{\mathrm{dep}}}$$

For given machine and machine energy: P_{ST} and τ_{ST} precisely known.

Flat machine (no spin rotators): $P_{\mathrm{kin}} = 0$

$\rightarrow$ relation $P_{\max} = \tau \times \frac{P_{\mathrm{ST}}}{\tau_{\mathrm{ST}}}$ for polarimeter calibration

Non-flat machine: $P_{\mathrm{kin}} \neq 0$ and depends on alignment (i.e. can not be predicted).

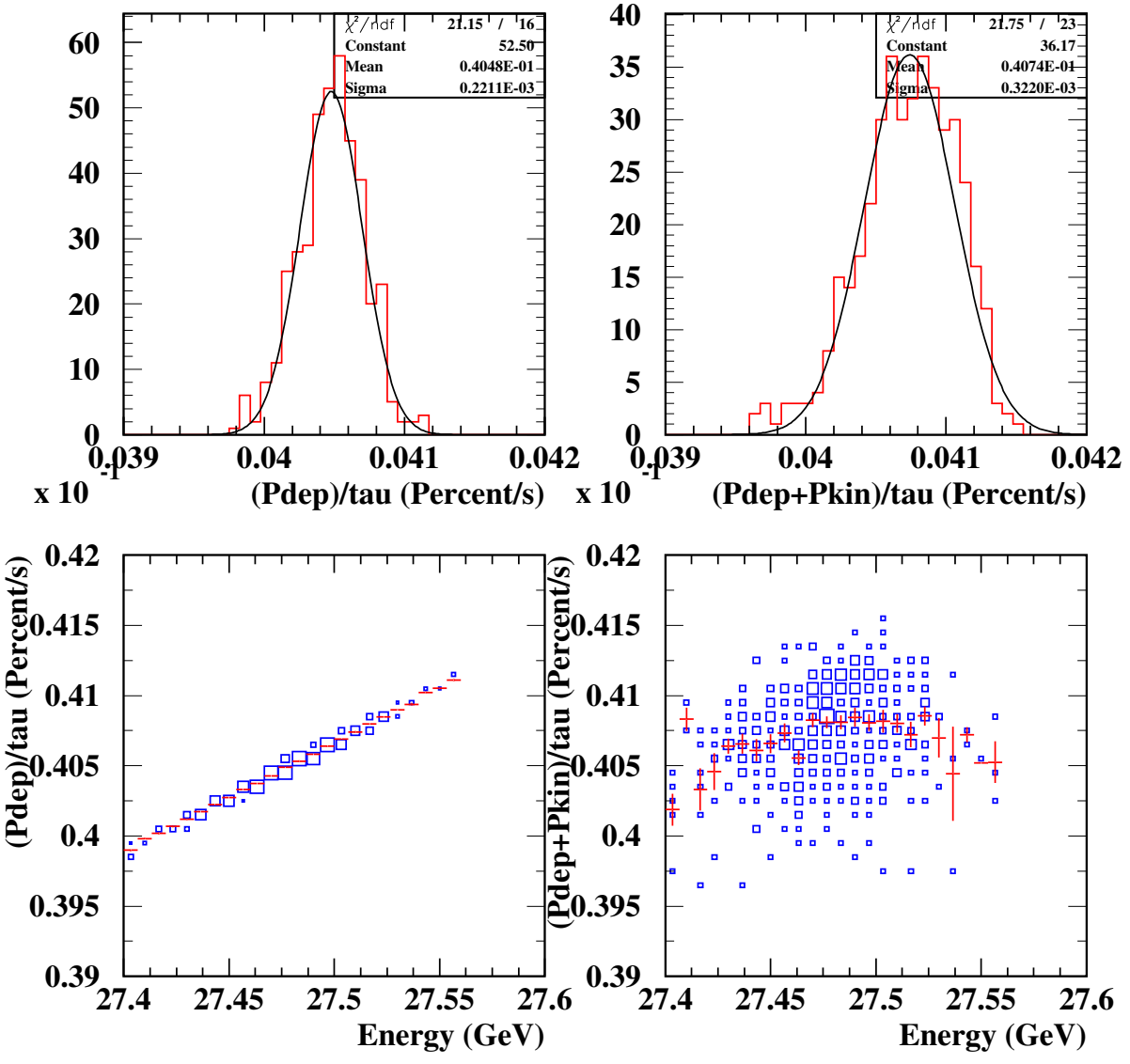
Solution: calculate $P_{\max}$ (including $P_{\mathrm{kin}} = 0$) and τ for a set of machines with random alignment errors. For each machine, scale alignment errors such that $P_{\max}$ equals 58% (observed $P_{\max}$).

Relation $P_{\max} = \tau \times \left[\left\langle \frac{P_{\max}}{\tau} \right\rangle_{\mathrm{random}} \pm \mathrm{RMS}(\frac{P_{\max}}{\tau})\right]$

Caution: machine calculations are 1st order perturbation theory only.

Machine calculations: results

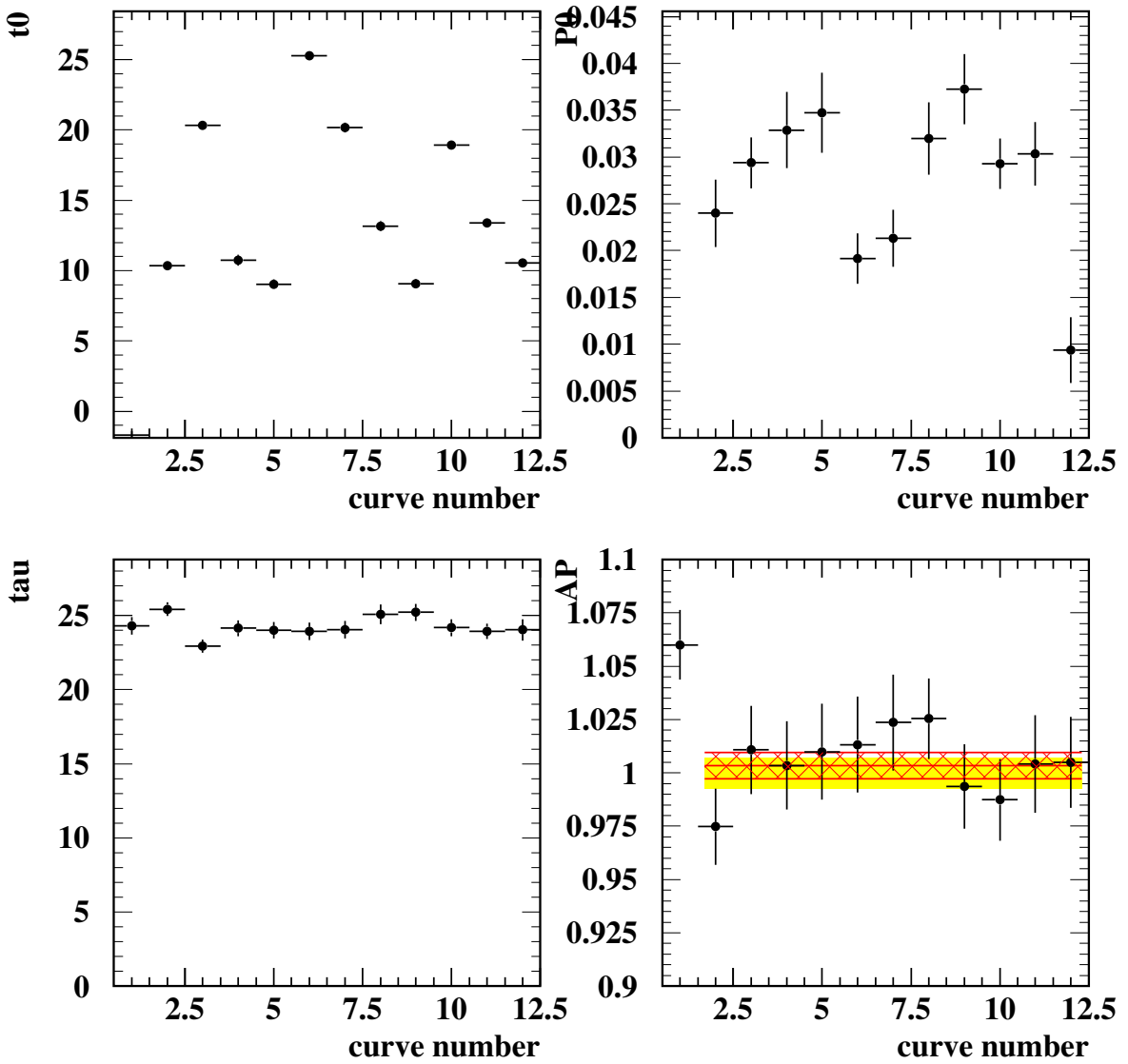
. . . using the program SLICK (Author Desmond Barber, HERA configuration prepared by D. Barber and M. Vogt).



- $\frac{P_{\mathrm{dep}}}{\tau} = \frac{P_{\mathrm{ST}}}{\tau_{\mathrm{ST}}}$ depends on Machine energy (approx $\frac{2.5\%}{100\,\mathrm{MeV}}$). Confirmed by independent calculation of D. Barber
- $P_{\mathrm{max}} = P_{\mathrm{dep}} + P_{\mathrm{kin}}$ shows larger spread, correlation to energy completely washed out.

Result: $\left\langle \frac{P_{\mathrm{max}}}{\tau} \right\rangle = (0.0408 \pm 0.0003) \frac{\%}{\mathrm{s}}$ in first order perturbation theory, calculated for $P_{\mathrm{max}} = 58\%$.

Risetime analysis



hatched: statistical precision

yellow: theory error

- First risetime curve not usable (starting polarisation not measured)
- Using new calibration constant, average analysing power is well compatible with one

Result: $\mathrm{AP} = 1.0033 \pm 0.0062_{\mathrm{stat}} \pm 0.0075_{\mathrm{theor}}$

valid for beam conditions and -energy during RT calibration, in lowest order perturbation theory.