Target Analysis Update for G_E^n Collaboration

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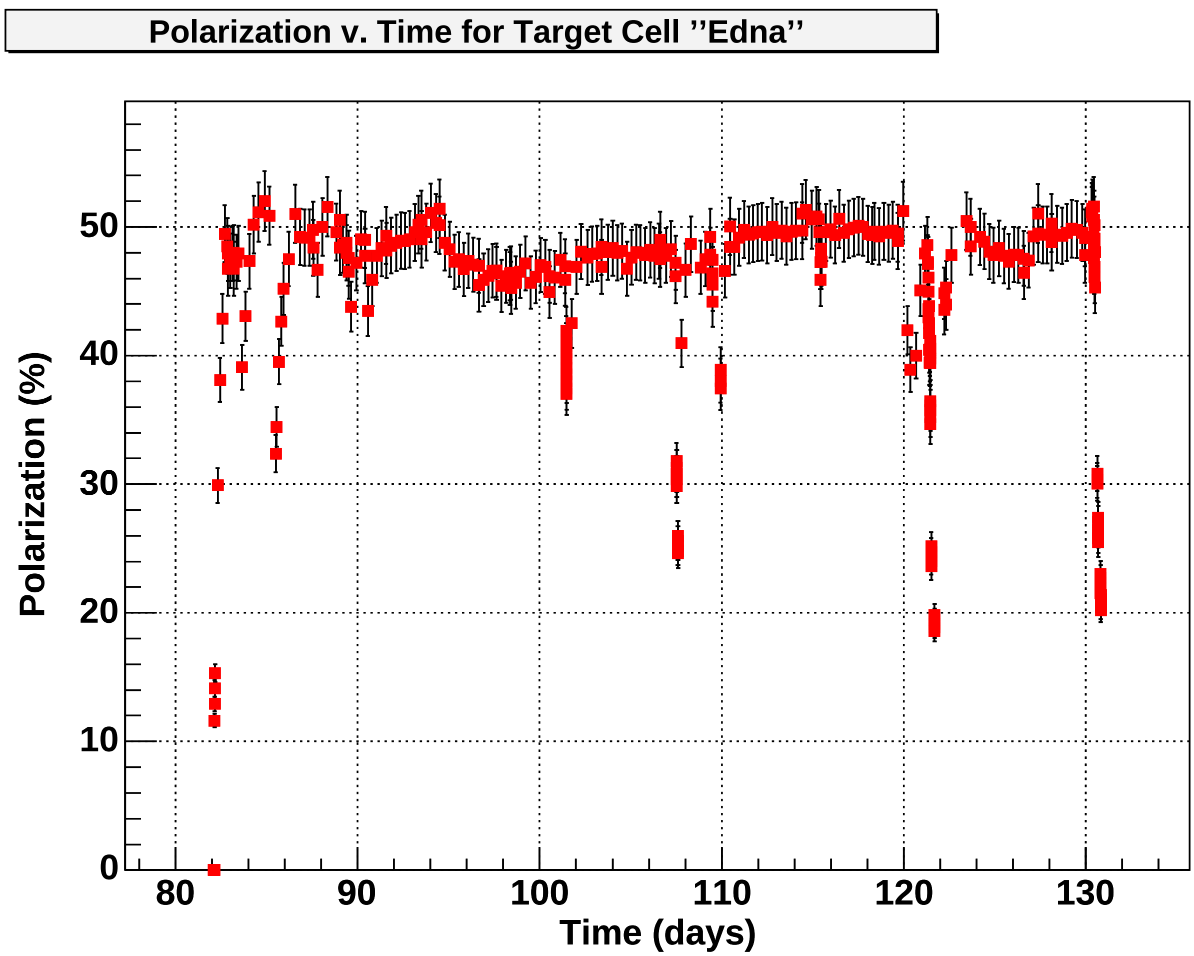
Outline

1. Target Polarization Analysis
   (a) Complete Edna
   (b) Complete Dolly
   (c) Ongoing Barbara
   (d) Pion Asymmetry Cross Check
2. κ_0 Measurements
   (a) What is κ_0
   (b) World Data (and uncertainty)
   (c) Ongoing Measurement
3. Ongoing Projects

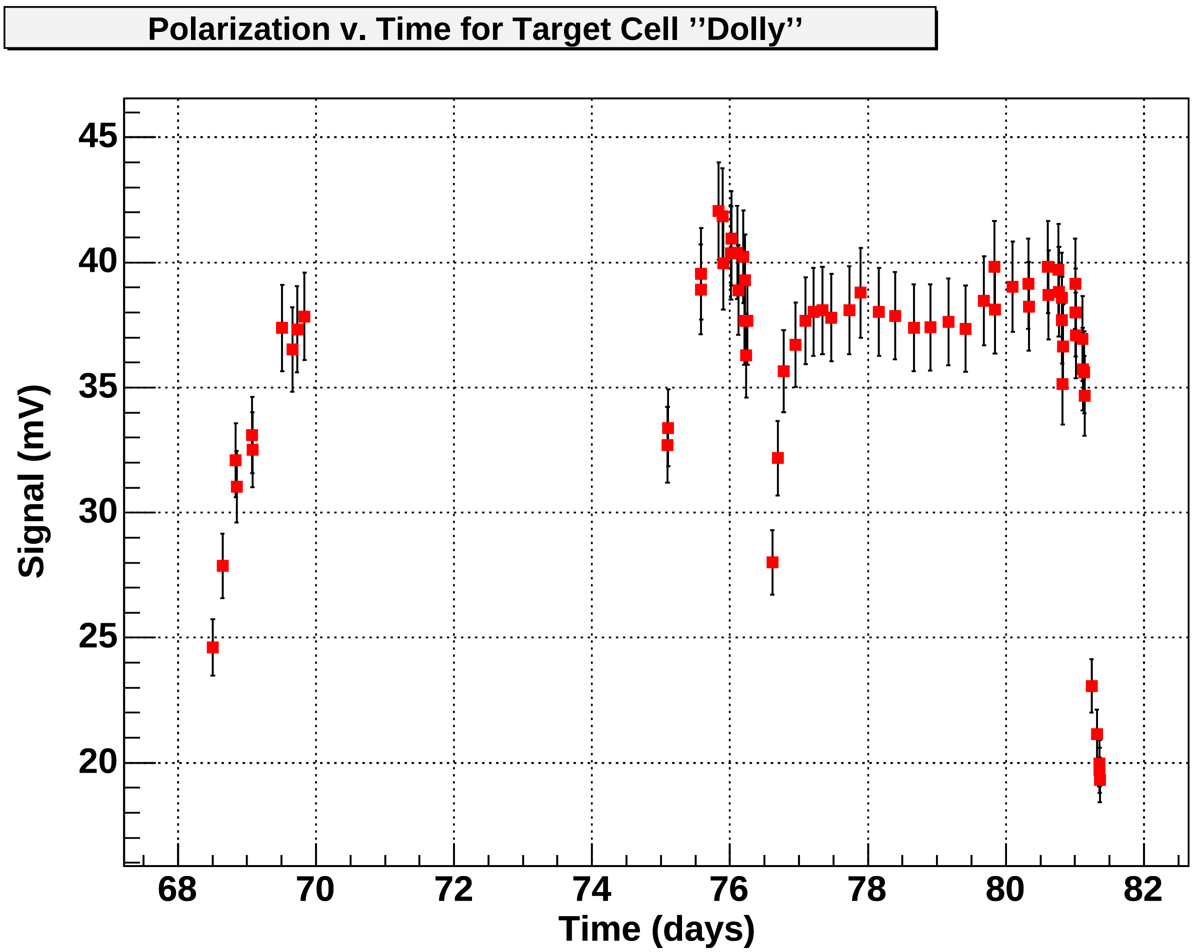
Complete Edna

A little old news, but improved uncertainty



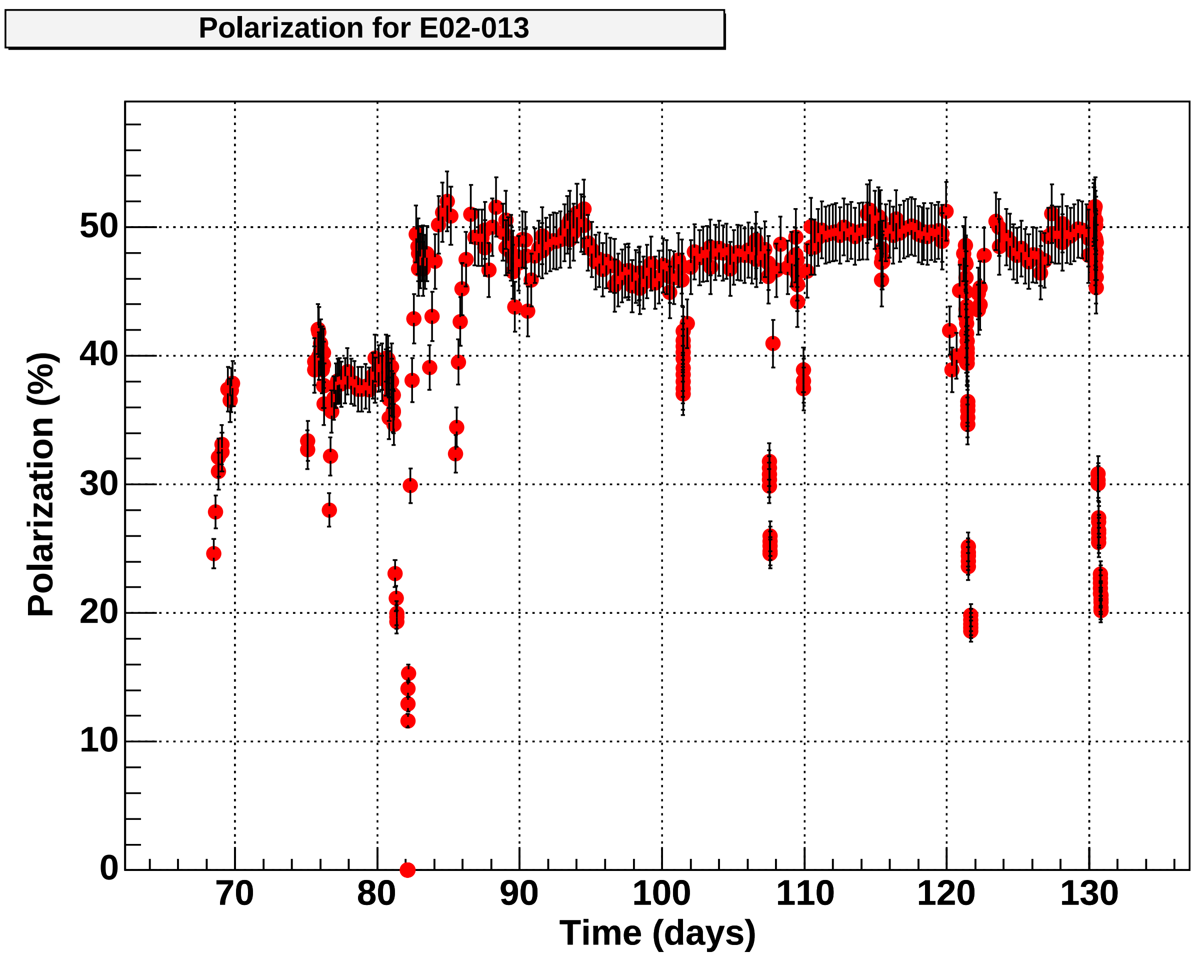
Includes approx. 4% uncertainty due to κ_0

Complete Dolly



Includes approx. 4% uncertainty due to κ_0

State of Polarization



Includes approx. 4% uncertainty due to κ_0

Ongoing Barbara

- Have EPR/NMR calibrations for Barbara
- Logbook notes are confusing at best
- Have very little temperature information

Pion Assymmetry Cross Check

- Use pion asymmetry data to check for the consistancy of the product $P_t \cdot P_b$ and compare to previous plots.
- Use single arm (BigBite) data.
- Have good π^-/e identification
- Simply look at π^- events asymmetry (w/r/t beam helicity)
- **Use of double polarized observable**
- Possibly confirm polarization gradient
- First analyzer project for me

What is κ_0?

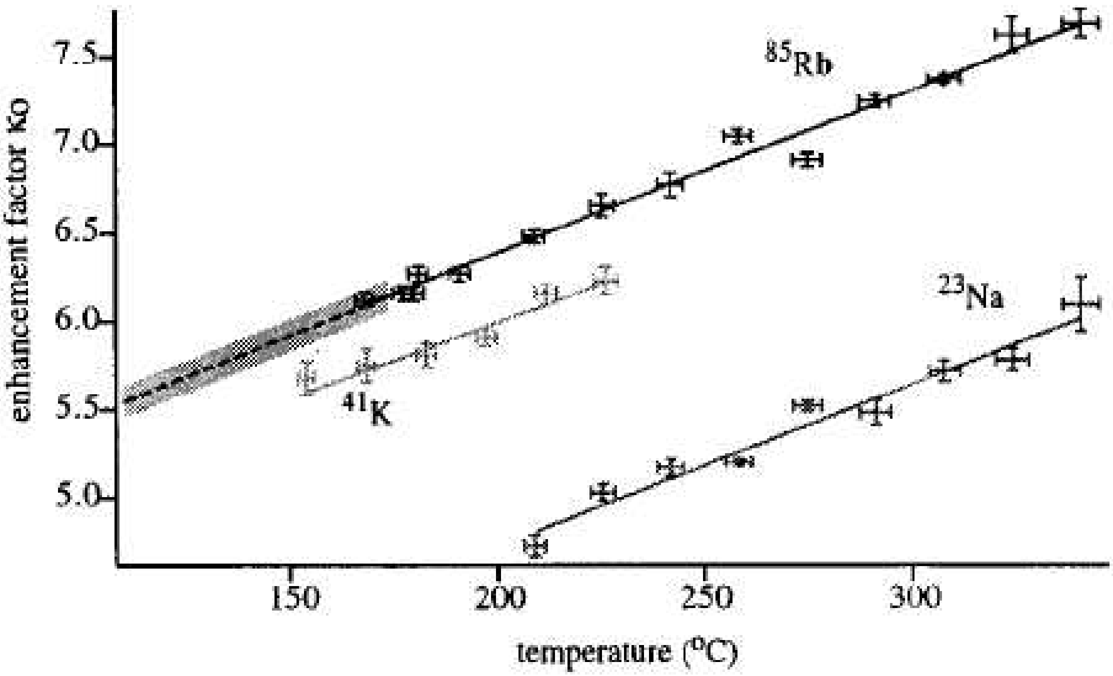
κ_0 is a constant in the equation used to extract polarization from the EPR frequency shift:

$$\Delta\nu_{\mathrm{EPR}} = \frac{8\pi}{3}\frac{d\nu_{\mathrm{EPR}}(F,M)}{dB}\kappa_0\mu_{He}n_{He}P_{He}$$

From M.V. Romalis and G.D. Cates, Phys Rev A, **58** 4 (1998):

"κ_0 is a dimensionless constant that depends on temperature, but not polarization or the polarization of ^{3}He...Note that if we ignored all Rb-^{3}He and used only the classical magnetic shift for a sphere...then we would get $\kappa_0 = 1$. So, the value $\kappa_0 \approx 6$ can be thought of as an enhancement due to the attraction of the Rb electron wave function to the ^{3}He nucleus."

World Data



Babcock *et al*, Phys Rev A **71**, 013414 (2005)

Current Uncertainty

$$\kappa_0(T) = \kappa_0(T_{\text{ref}}) + \kappa_0'(T - T_{\text{ref}})$$

Pair	κ_0 (T_{ref})	κ_0'
KHe	5.99 ± 0.11 (200° C)	0.0086 ± 0.0020
RbHe	6.15 ± 0.09 (175° C)	0.00916 ± 0.00026

Babcock *et al*, Phys Rev A **71**, 013414 (2005)

What does that mean for E02-013

At our temperatures (T $\approx 285^\circ$ C)

Metal	κ_0	σ_κ	σ_κ/κ_0
K	6.72	0.28	4.2%
Rb	7.18	0.11	1.5%

This is, by far, the largest uncertainty.

If $\sigma_\kappa = 0$, then our total polarimetry uncertainty would be $< 2\%$.

Improving κ_0

- Uncertainty for K comes primarily from extrapolation
- Based on Babcock paper, but with different cells
- Can measure the ratio: $\frac{\kappa_0^K}{\kappa_0^{Rb}}$
- Possibly reduce uncertainty in κ_0^{Rb}
- **Any** improvement helps E02-013
- Temperature is largest uncertainty – but will be improved.

Measurement currently underway at William & Mary

Ongoing Projects

1. Finish κ_0 measurement
2. Make YOUR corrections to Edna paper
3. Finish Barbara calibration
4. Expand Edna paper to larger technote/NIM paper
5. Pion Asymmetry measurement (include in NIM?)
6. Target Geometry Document
7. DNP talk