Coming to ARIS SpecTcl v.30

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Research presentation

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Content

Main purpose is to push aside “debug and heavy” source and settings, easy switch between user and debug settings

- #define directives for “light” source
- pid_values.csv re-organization
- PID fine tuning
- Tof variables and parameters (cpp,cvs) re-organization
- Z-calculation based on dE, dZ - variable
- Ztke revision
- Channel Assign and packets update
- Others

- List of modifications

Directives

It’s recommended to comment the next definitions for the operation version

CAris_pid.h

```
#define _AnalysisZTKE      // Z-calculation based on dE-TKE-Brho without ToF use (Ztke or Ztimeless)
#define _deltaZ            // Fast check of Z-stabilty. Do not use it for gates!
#define _E_CORRECT         // dEnergy correction for dispersion. No matrix and Brho use
#define _AnalysisQint      // A/q and Brho recalculation based on q-integer value
```

CAris_tof.h

```
#define _useDeltaAnalysis  // delta ToF between 34 and 45 ppacs (e.g. db34.ppac0.xy-db45.ppac0.xy) ,
                           // and between db5 detectors (ppac-pin-sci)
```

pid_values.csv re-organization

pid_values.csv → pid_values.csv
tke_sci_values.csv

first symbol in line comments this line

Global tof offset.
It's very flexible to use with tof_average

Flag to use PID fine tuning variables

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	run_start	run_stop	Z_method	tof_mehod	brho_method	Z_slope2	Z_slope	Z_offset	Z_log_beta	tkebox	tof_offset	fine	L34_correct	L45_correct	Q_offset	exp #	notes	
2	#3186	4186	0	96	45	0	7.35	-0.32	1	5	-1.2	0	0	0	0	all		tof96
3	3186	4186	0	94	1	0	7.35	-0.32	1	5	-2.5	0	0	0	0	all		tof94
4	#3186	4186	1	96	45	0	7.22	0	1	5	-1.2	0	0	0	0	all		tof96
5	#3186	4186	1	94	45	0	7.22	0	1	5	-2.5	0	0	0	0	all		tof94
6	#----------																	
7	#3219	4186	0	94	345	0	4.19	0.45	1	5	-1.9	1	0	0	-0.5	70Ni-isomer		tof94
8	#3241	3241	1	94	45	0	7.22	0	1	5	-2.5	0	0	0	0	70Ni-isomer		tof96
9	#3241	3241	1	96	45	0	7.22	0	1	5	-1.3	0	0	0	0.43	70Ni-isomer		tof96
10	#3242	4218	1	94	45	0	7.29	0	1	5	-0.8	0	0	0	0.43	71Cr		db3sci
11	#3219	3240	1	94	45	0	7.29	0	1	5	-0.8	0	0	0	0.43	71Cr		
12	#3189	3218	1	94	45	0	7.29	0	1	5	-0.8	0	0	0	0.43	71Cr		db3sci
13	#3241	3241	0	94	45	0	4.19	1.45	1	5	-1.7	1	0	0	-0.5	70Ni-isomer		tof96
14	#3242	4218	0	94	45	0	4.19	0.05	1	5	-1.2	1	0	0	-0.5	71Cr		db3sci
15	#3219	3240	0	94	45	0	4.19	0.05	1	5	-1.2	1	0	0	-0.5	71Cr		
16	#3189	3218	0	94	45	0	4.19	0.05	1	5	-1.2	1	0	0	-0.5	71Cr		db3sci
17	#3189	3218	1	94	45	-0.1554	6.5667	0	1.2	5	-1.2	1	0	0	-0.5	71Cr		db3sci
18	#3189	4186	0	913	345	0	4.19	0.05	1	5	-1	1	0	0	-0.5	71Cr		db3sci
19	#3188	3188	0	913	34	0	4.19	-0.35	1	5	-1.35	1	0	0	-0.4	78Zn		db3sci
20	#3188	3188	1	94	45	0	7.29	0	1	5	-0.8	0	0	0	0.43	78Zn		like ne

Trajectory reconstruction: Fine tuning

https://lise.frib.msu.edu/work/SpecTcl/ReconstructionFineTuning.pdf

Content : A/q tuning

- Trajectory reconstruction
- A/q tuning
- X/A & X/D
- pid_fine_values.csv
- A/q fine tuning

Making Matrices for ARIS SpecTcl from savesets

Prepared by Shane Watters (07/26/2024)
Updated by Oleg B. Tarasov (04/02/2025)

https://lise.frib.msu.edu/work/SpecTcl/Matrices_for_ARIS_SpecTcl.pdf

ToF parameters re-organization

tof_offsets_seg35.csv → tof_offsets_seg35_ppac.csv (4 x 10)
tof_offsets_seg35_sci.csv (2 x 10)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	run_start	run_stop	p0xy-pin	p0xy-si0	p0xy-si1	p0xy-sci	p0xy-scin	p0xy-scis	p0xy-p0xy	p0xy-p1xy	p0xy-p0a	p0xy-p1a	p1xy-pin	p1xy-si0	p1xy-si1	p1xy-sci	p1xy-scin	p1xy-scis	p1xy-p0xy	p1xy-p1xy	p1xy-p0a	p1xy-p1a	p0a-pin
2	3091	6000	609.65	0	0	0	528.1	518.07	110.8	0	119.32	0	614.27	0	0	0	532.71	522.68	0	112.6	0	124.08	579.21
3	3053	3090	609.65	0	0	0	528.1	518.07	110.8	0	119.32	0	614.27	0	0	0	532.71	522.68	0	112.6	0	124.08	579.21
4	3040	3052	609.65	0	0	0	528.1	518.07	110.11	0	119.32	0	614.27	0	0	0	532.71	522.68	0	113.26	0	124.08	579.21
5	3039	3039	609.65	0	0	0	528.1	518.07	110.11	0	119.32	0	614.27	0	0	0	532.71	522.68	0	113.26	0	124.08	579.21

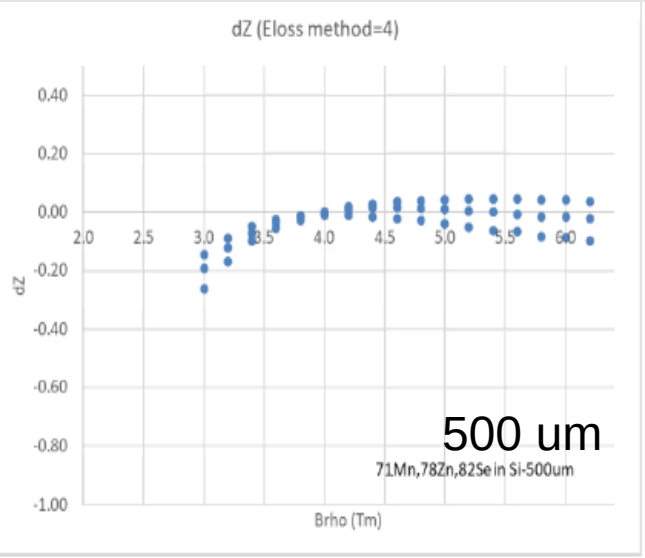
```
// DB3 sciN - db5

    case 20:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5pin;
    case 21:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5si0;
    case 22:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5si1;
    case 23:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5sci;
    case 24:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5scin;
    case 25:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5scis;
    case 26:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5p0_xy;
    case 27:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5p1_xy;
    case 28:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5p0_a;
    case 29:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scin.to_db5p1_a;

// DB3 sciS - db5

    case 30:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5pin;
    case 31:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5si0;
    case 32:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5si1;
    case 33:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5sci;
    case 34:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5scin;
    case 35:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5scis;
    case 36:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5p0_xy;
    case 37:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5p1_xy;
    case 38:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5p0_a;
    case 39:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3scis.to_db5p1_a;
```

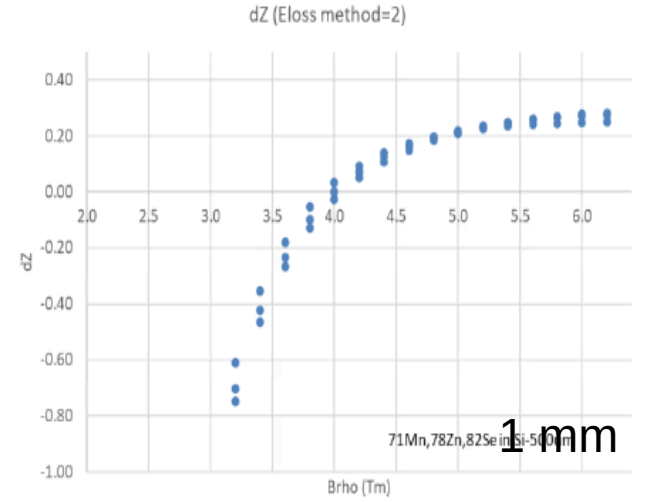
```
// DB3 ppac0 xy - db5

    case 40:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5pin;
    case 41:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5si0;
    case 42:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5si1;
    case 43:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5sci;
    case 44:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5scin;
    case 45:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5scis;
    case 46:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5p0_xy;
    case 47:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5p1_xy;
    case 48:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5p0_a;
    case 49:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_xy.to_db5p1_a;

// DB3 ppac1 xy - db5

    case 50:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5pin;
    case 51:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5si0;
    case 52:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5si1;
    case 53:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5sci;
    case 54:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5scin;
    case 55:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5scis;
    case 56:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5p0_xy;
    case 57:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5p1_xy;
    case 58:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5p0_a;
    case 59:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_xy.to_db5p1_a;
```

```
// DB3 p0_a - db5

    case 60:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5pin;      break;
    case 61:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5si0;      break;
    case 62:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5si1;      break;
    case 63:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5sci;      break;
    case 64:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5scin;     break;
    case 65:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5scis;     break;
    case 66:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5p0_xy;    break;
    case 67:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5p1_xy;    break;
    case 68:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5p0_a;     break;
    case 69:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p0_a.to_db5p1_a;     break;

// DB3 p1_a - db5

    case 70:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5pin;      break;
    case 71:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5si0;      break;
    case 72:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5si1;      break;
    case 73:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5sci;      break;
    case 74:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5scin;     break;
    case 75:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5scis;     break;
    case 76:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5p0_xy;    break;
    case 77:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5p1_xy;    break;
    case 78:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5p0_a;     break;
    case 79:  seg=dbseg_35;  p[0] = &aris.tof.tdc.DB3p1_a.to_db5p1_a;     break;
```

Z-calibration

- v.29 Z-calibration has been based on e-raw signals instead e-calculated assuming zero-offset in order to avoid dependence from dE-calibration
- During last experiments Z-misidentification was observed in several cases after moving far by Brho calibration point
- Z-identification analysis has been performed in this context https://lise.frib.msu.edu/work/SpecTcl/Zcalibr_2025.pdf
- The analysis shown Z-identification is stable (±0.25) for Z=25-34 for Brho=3.5-6.0 Tm with Zigler energy loss model, and for Brho=3.0-6.0 Tm with ATIMA models in the case of 500 um Si-detector. The calibration point was at 4 Tm.
- with 1 mm Si-detector Brho ranges are decreased: Brho=3.7-4.5 Tm with Zigler, Brho 3.6-6.0 Tm with ATIMA. It was concluded that thick dE-detector provides better resolution, but requires second order and log_beta calibrations
- The large positive offset has been reported in dE-calibrations. After that Z-calibration was set on e-calculated values to take into account these offsets. As result: Z-stability for all runs from 3187 up to 3250 (Brho45 ranges 3.3691-4.8114 Tm) reported to be stable. See the next slide.





v.30: After modifying the dE calibration, the Z-calibration must be rechecked for consistency

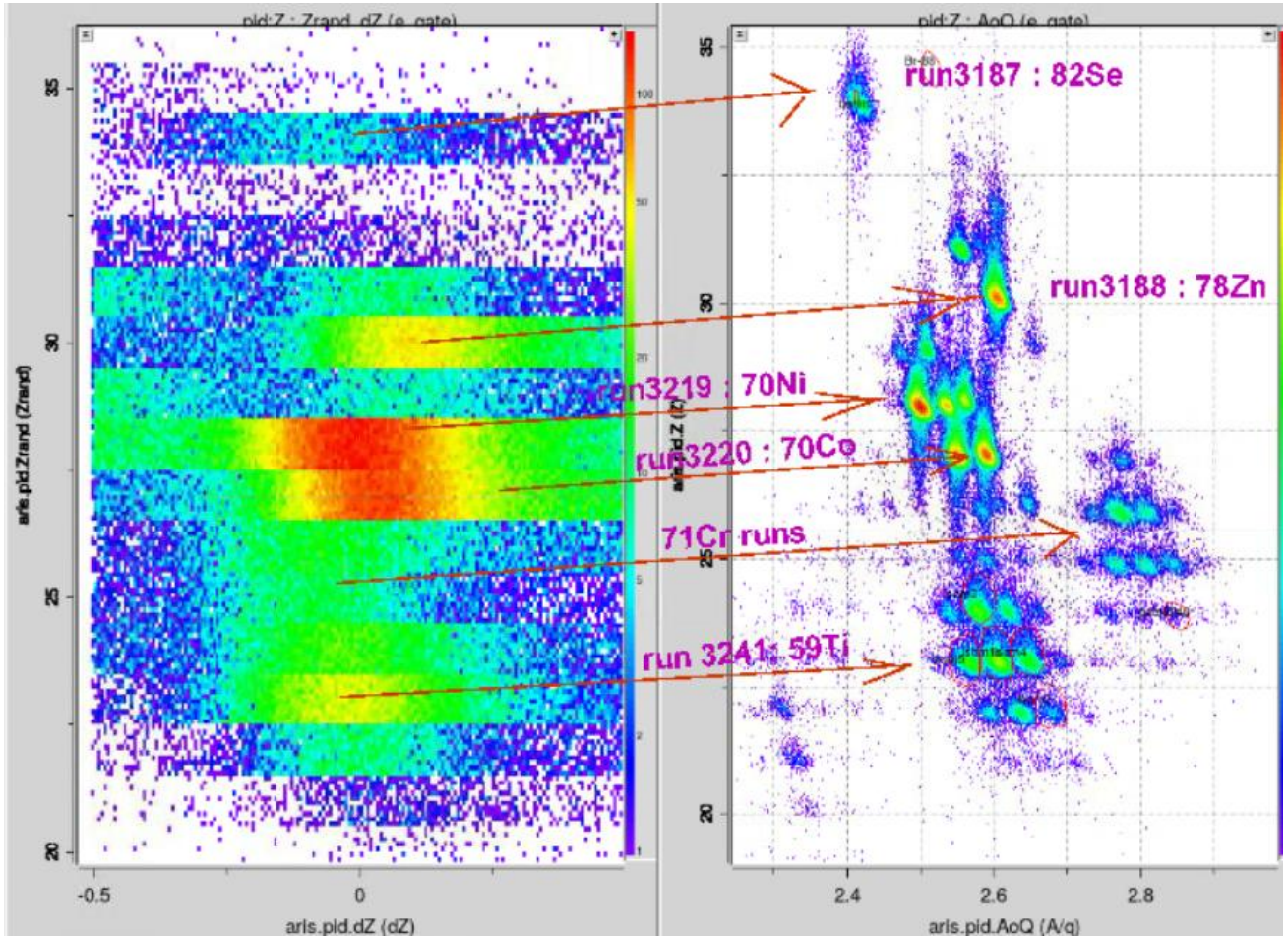
dZ-variable

left plot demonstrates the Z-stability for all runs from 3187 up to 3250 (Brho45 ranges 3.3691-4.8114 Tm)

Fast observation of Z-stability

```
#ifdef _deltaZ
        CTreeParameter Zrand;
        CTreeParameter dZ;
#endif
```

```
#ifdef _deltaZ
if(flag_Z)
{
        int Zint = Z + 0.5;
        dZ = Z - Zint;
        Zrand = Zint + EqualDistr(-0.5, 0.5);
}
else
{
        dZ = 0; dZ.setInvalid();
        Zrand = 0; Zrand.setInvalid();
}
#endif
```



Z-calibration: large positive offset in energy calibration

e1_slope=	0.3033	PIN	
e2_slope=	0.2797	stack0	
e3_slope=	0.4902	stack1	
e4_slope=	0.5408	stack2	
e5_slope=	0.7139	stack3	
e6_slope=	1.0236	stack4	
e7_slope=	0.8650	stack5	
e8_slope=	0.6334	stack6	
			mode_invers
e1_offset=	58.3	PIN	192.18
e2_offset=	76.1	stack0	272.02
e3_offset=	84.9	stack1	173.27
e4_offset=	92.1	stack2	170.26
e5_offset=		stack3	0.00
e6_offset=		stack4	0.00
e7_offset=	0.0	stack5	0.00
e8_offset=	0.0	stack6	0.00
offset_sum=	311.3906		
	all		
chi_dE1_PIN=	0.077		
chi_dE2_stack0=	1.038		
chi_dE3_stack1=	0.960		
chi_dE4_stack2=	0.962		
chi_dE5_stack3=	46.513		
chi_dE6_stack4=	44.295		
chi_dE7_stack5=	18.118		
chi_dE8_stack6=	48.740		
chi_sum=	171.857		

Distance between Z-lines in the 71Cr case is just 30 MeV

In nuclear physics, a **PIN diode detector** used for **energy loss (ΔE) measurement** typically outputs a signal proportional to the ionization caused by the passing ion. When you observe a **large positive offset in energy calibration** (i.e., the baseline of the spectrum is shifted up), it may indicate one or more of the following issues:

1. Electronic Offset / DC Bias
•The most common cause: the preamplifier or shaping amplifier has an **offset voltage** that hasn't been subtracted.
•This can be due to **misconfigured electronics** or **insufficient pole-zero cancellation**.

2. Incorrect Pedestal Subtraction
•In digital signal processing (like with ADCs), the **pedestal** (baseline ADC value with no signal) needs to be subtracted. If it's not done correctly, the energy values will appear artificially high.

3. Leakage Current or Dark Current
•**PIN diodes** may have **leakage current**, especially if **not cooled** or if the diode is **damaged**. This adds to the baseline and can shift all measured energies up.

4. Calibration Error
•If the **calibration point (e.g., from alpha sources or known particles)** is off (e.g., only high-energy points were used), the extrapolated calibration line might overshoot low-energy values, resulting in a positive offset.

5. Pile-up Effects or Noise
•Pile-up of multiple signals may result in artificially higher signals being interpreted as higher energy.

Diagnostic Steps:
•Check **baseline without beam**: what is the offset?
•Verify **electronic zero** with a pulser.
•Compare with a **known source (e.g., 241Am alpha particles)**.
•Recheck **gain and offset settings** in the electronics.
•Measure **leakage current** on the detector bias line.

Ztke revision

Based on:

$$dE \approx \frac{AZ^2}{E},$$

$$E = k(Bx)^2 \frac{q^2}{A},$$

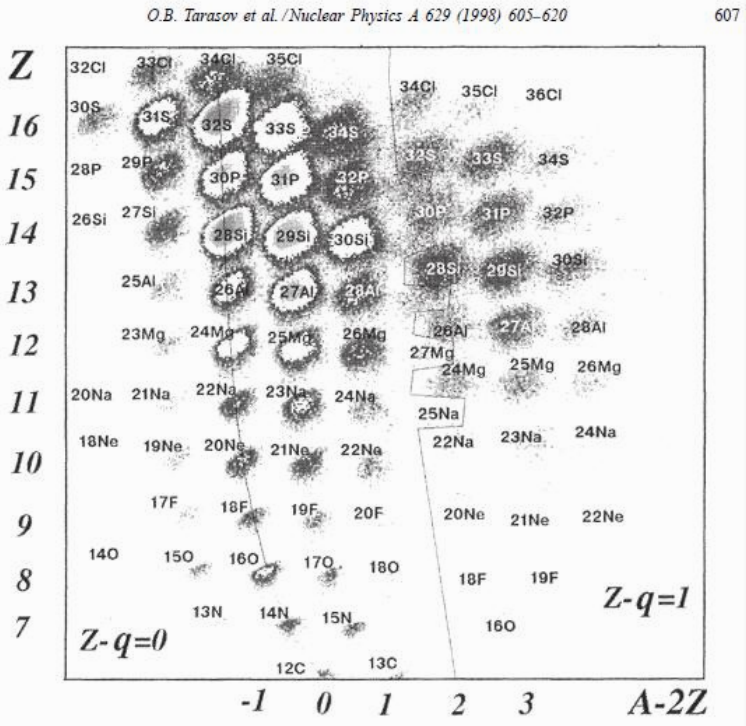
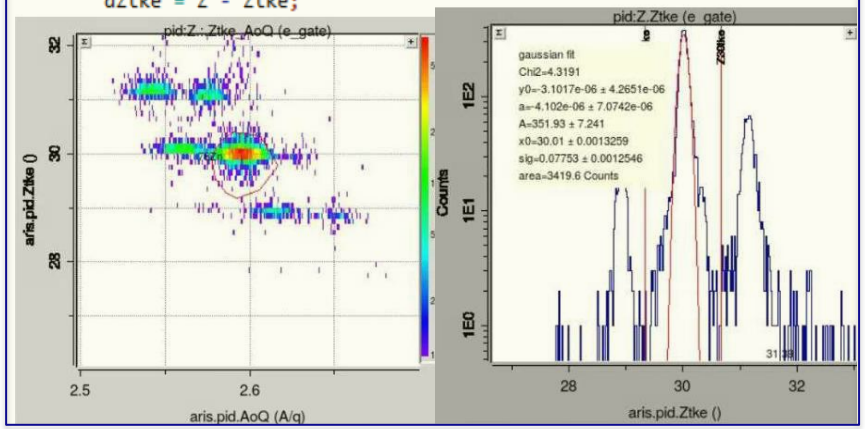


Fig. 1. Identification matrix $(A-2Z, Z)$ of the products of the $^{32}S(14.5\ MeV/A)+C$ reaction obtained at a magnetic field $B = 0.7975$ T. The left solid line passes through the completely stripped nuclei with zero isotopic spin. The right curve discriminates between regions of nuclei with charge $q = Z$ and $q = Z-1$.

CTreeVariable dEpower_Ztke;

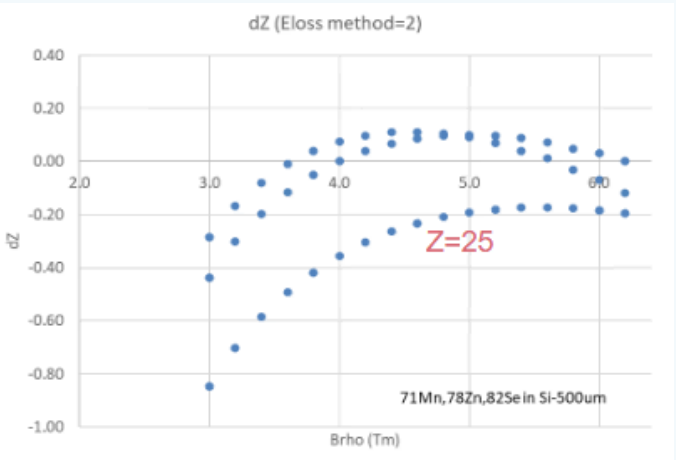
```
#ifdef  _AnalysisZTKE

    if (TKE.isValid() && brho.isValid() && e_reduced > 0)
    {
    double v = pow(e_reduced,dEpower_Ztke)* TKE / brho;
    Ztke = Ztke_slope2*v + Ztke_slope*sqrt(v) + Ztke_offset;
    Ptke = lightSpeed * Ztke * brho;
    Atke = (Ptke*Ptke/TKE - TKE) / amu / 2.;
    if(Ztke < 0.1) Ztke = 0.5;
    AoZtke = Atke / Ztke;
    }
//---------------------------
    if(Q.isValid() && Ztke.isValid())
    {
    ZmQtke = Ztke - Q;
    AoQtke = Atke / Q;
    }

//---------------------------
    if(Z.isValid() && Ztke.isVali
    {
    dZtke = Z - Ztke;
```

Fantastic Z-resolution 0.077!



- Z-identification analysis https://lise.frib.msu.edu/work/SpecTcl/Zcalibr_2025.pdf →
- Z-tke:
  - excellent resolution for local region. It can be used for cleaning and time shift verification.
  - it requires second order and dE_power calibrations.

Eloss_methoc	Result	dE_power	Result @ 0.5
0	0.240	0.670	0.867
1	0.232	0.672	0.882
2	0.177	0.697	0.937
4	0.186	0.694	0.926



Channel Assign and packets update

Upcoming changes to the channel/module mapping:

- Vectors be used will hold the name of the signals and modules
  - Number of signals can easily scale with number of channels in an event of upgrades to modules
  - The location in the vector stack is the slot number (for module) or channel number (signal)
  - i.e in module slot 10, bank1[1] = db1 ppac0 l signal = 2nd channel in the module
- Two banks are defined to simply the counting and will reflect physically what each signal means in the ribbon cable to the modules
- Same names to be used in an event of a reconfiguration
- Simplifying if/else cases for the configuration for easier readability/addition
- Run numbers within the function allows for backwards compatibility

```
// future upgrade to clean up mapping below
int channel = ch& 0x3F-1;
std::vector<std::string> TDC1_config = mapTDC1(runno);
//cout<<std::hex<<ch<< "=ch "<<std::dec<<channel<<endl;
//if(channel<32)
  {
    // cout<<TDC1_config[channel]<<endl;
    if(TDC1_config[channel] == "ARIS_DB1_PPAC0_L_CH") map_ppacT(aris.db[1].ppac[0].l, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC0_R_CH") map_ppacT(aris.db[1].ppac[0].r, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC0_U_CH") map_ppacT(aris.db[1].ppac[0].u, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC0_D_CH") map_ppacT(aris.db[1].ppac[0].d, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC0_A_CH") map_ppacT(aris.db[1].ppac[0].a, data);

    else if(TDC1_config[channel] == "ARIS_DB1_PPAC1_L_CH") map_ppacT(aris.db[1].ppac[1].l, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC1_R_CH") map_ppacT(aris.db[1].ppac[1].r, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC1_U_CH") map_ppacT(aris.db[1].ppac[1].u, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC1_D_CH") map_ppacT(aris.db[1].ppac[1].d, data);
    else if(TDC1_config[channel] == "ARIS_DB1_PPAC1_A_CH") map_ppacT(aris.db[1].ppac[1].a, data);

    else if(TDC1_config[channel] == "ARIS_DB3_PPAC0_L_CH") map_ppacT(aris.db[3].ppac[0].l, data);
    else if(TDC1_config[channel] == "ARIS_DB3_PPAC0_R_CH") map_ppacT(aris.db[3].ppac[0].r, data);
    else if(TDC1_config[channel] == "ARIS_DB3_PPAC0_U_CH") map_ppacT(aris.db[3].ppac[0].u, data);
    else if(TDC1_config[channel] == "ARIS_DB3_PPAC0_D_CH") map_ppacT(aris.db[3].ppac[0].d, data);
    else if(TDC1_config[channel] == "ARIS_DB3_PPAC0_A_CH") map_ppacT(aris.db[3].ppac[0].a, data);
```

Call to map channel number to detector

Mapping value to correct channel

```
std::vector<std::string> mapmodules(int Run) {
  std::vector<std::string> modulelist, left, right;
  //need to verify mapping of old config
  //vme starts with 1
  //ARR06
  if(Run<1000)
    {
      left = {"TDC1","","","","",
              "","","","",""};
      right = {"","","","","",
               "","ADC1","","","",
               ""};
    }
  else
    {
      left = {"","","","","",
             "","","","","TDC1"};
      if(Run<1586)
        right = {"TDC2","TDC3","","","",
                 "QDC1","", "ADC1","","ADC2",
                     ""};
      else
        right = {"","TDC2","","TDC3","",
                  "TDC4","","QDC1","","ADC1",
                  "ADC2"};
    }
    modulelist = left;
    modulelist.insert(modulelist.end(), right.begin(), right.end());
    return modulelist;
}
  //WWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWWW
//mapping channels
std::vector<std::string> mapTDC1(int Run) {
  std::vector<std::string> TDC, bank1, bank2;

  if(Run<=2932)
    {
    }
  else if(Run<=3178)
    {
    }
  else if(Run(<=3180)
  else
    {
      bank1 = {"", "ARIS_DB1_PPAC0_L_CH", "ARIS_DB1_PPAC1_L_CH","ARIS_DB1_PPAC0_R_CH",
               "ARIS_DB1_PPAC1_R_CH","","ARIS_DB1_PPAC0_U_CH","",
               "ARIS_DB1_PPAC1_U_CH","ARIS_DB1_PPAC0_D_CH","ARIS_DB1_PPAC1_D_CH","",
               "ARIS_DB1_PPAC0_A_CH","","ARIS_DB1_PPAC1_A_CH",""};
      bank2 = {
               "ARIS_DB3_PPAC0_U_CH","ARIS_DB3_PPAC1_L_CH","ARIS_DB3_PPAC1_L_CH","ARIS_DB3_PPAC1_U_CH",
               "ARIS_DB3_PPAC0_D_CH", "ARIS_DB3_PPAC1_R_CH","ARIS_DB4_PPAC0_L_CH","ARIS_DB3_PPAC0_A_CH",
               "ARIS_DB4_PPAC0_A_CH","ARIS_DB3_PPAC1_A_CH","ARIS_DB3_PPAC0_R_CH","ARIS_DB4_PPAC0_D_CH",
               "ARIS_DB4_PPAC0_R_CH","","ARIS_DB3_PPAC1_D_CH","ARIS_DB4_PPAC0_U_CH"};
```

Others

29.6 calc beta for ARIS timing calibration

```
//WWWWWWWWWWWWWWWWWWWWWWW
class ARIStiming
{
friend class ARIStimingCalib;
friend class ARIStimingTDC;

public:

    CTreeParameter t;
    CTreeParameter length;
    CTreeParameter beta;

.......
    void Calibrate();
    void calcBeta();
};
//WWWWWWWWWWWWWWWWWWWWWWW
void ARIStimingTDC::Calibrate()
{
........

    calcBeta();
}
//WWWWWWWWWWWWWWWWWWWWWWW
void ARIStiming::calcBeta()
// can be called from CAris_pid_LenToF with updated length
{
    bool flag=false;

    if(t.isValid() && length.isValid())
     if( t > 0 && length > 0)
        {
        beta = length / t / lightSpeed;
        if (beta > 0. &&  beta < 1.)   flag = true;
        }
        if(!flag)
    {       beta=0.;        beta.setInvalid();    }
}
```

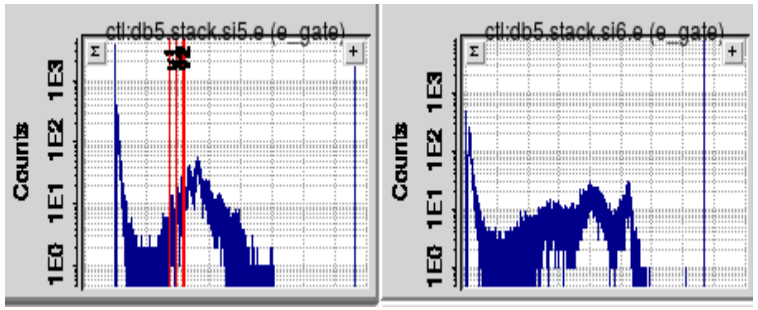
29.10 db3-db4 and db4-db5 special insert for length corrections (CAris_pid_LenToF.cpp)

```
//=========================================================  special inserts to check dL   begin
ARIStiming *p0 = &aris.tof.tdc.DB34p0_xy.to_db4p0_xy;
if(p0->t.isValid() && p0->length.isValid() && p0->t > 10)
 if(aris.Dip34.deltaL.isValid() && aris.pid.length34_correct_use!=0)
    {
    p0->length += aris.Dip34.deltaL * aris.pid.length34_correct_use;
    p0->calcBeta();
    }
p0 =&aris.tof.tdc.DB4p0_xy.to_db5p0_xy;
if(p0->t.isValid() && p0->length.isValid() && p0->t > 10)
 if(aris.Dip45.deltaL.isValid() && aris.pid.length45_correct_use!=0)
    {
    p0->length += aris.Dip45.deltaL * aris.pid.length45_correct_use;
    p0->calcBeta();
    }
//=========================================================  special inserts to check dL   end
```

29.4 upper threshold for PINs (temporary)

```
void ARISpin::Calibrate()
{
    bool flag = false;

    if(e>0.)
      e+= + EqualDistr(0,1);

    if (e>e_threshold && e < 7600) // Oleg inserted temporary v.29.4
      {
            ……
```

Eliminate these events for TKE



List of modifications

// 29.26 revision of tof.csv and tof.tcl
// 29.25 update Aq-fine tuning parameters (cpp-source, csv)
// 29.24 new parameters dZ and Zrand
// 29.23 Z-calculation based on dE instead e_raw
// 29.22 new variable tke_offset
// 29.21 new ToF values 04/09/25
// 29.20 Channel Assign and packets by Elaine 04/09/25
// 29.19 Channel Assign and packets by Elaine 04/08/25
// 29.18 A/q - vertical dispersion @ db5// 29.17 New variable dEpower_Ztke for Ztke calculations
// 29.16 Channel Assign and packets by Elaine
// 29.15 new dZtke parameter --> Z - Ztke, additional modifications with Ztke
// 29.14 new ZmQtke parameter --> Ztke - Q
// 29.13 purging all user #define blocks in pid.h and tof.h
// 29.12 brho from Qint
// 29.11 deltaTOF moved to #define
// 29.10 db3-db4 and db4-db5 special insert for length corrections
// 29.9 brho_method == 345 --> AoQ *= (1.+ AoQ_dP_factor*(aris.Dip34.deltaP+aris.Dip45.deltaP)/200.);
// 29.8 ARIS_PID class revision
// 29.7 ARIS_PID class : useFineTuning
// 29.6 calc beta for ARIStiming calibration
// 29.5 using db4.ppac[0].y for A/q correction
// 29.4 upper threshold for PINs
// 29.3 new timing signals and t_offset for global timing
// 29.2 new AoQ corrections for aris.db[3].b and aris.db[5].b;
// 29.1 optics cpp-file was changed.