μSR Data Analysis

"Seeing"

with Software

by

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UBC PHYSICS & ASTRONOMY

TENTATIVE OUTLINE

- Introduction to ***Linux***
  - Workstations & **bnqrexp**
  - Getting set up: **TSI.zip**
  - The **bash** command line
- Overview: *μSR* Data Analysis
  - Data Acquisition & Storage
  - Abstract Descriptions
- First Look with **PHYSICA**
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    - **TO**, **BKGD**, **TIMES** & **NPAC**
    - Asymmetry Spectra
- Second Look with ***μView***
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  - Spectrum Storage
- Web Access & Display
  - MUD Runs Database
  - Using **SPECT** & **FFT**
- Making Fourier Transforms with **MSRFFT**
- Fitting with **MSRFIT**
  - Input File Syntax
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- Fitting with **MUSRFIT**
  - Input File Syntax
  - Associated Procedures
- Plotting Results with ***μView***
- Fitting Results with **XYfit**

Linux

- Hopefully everyone will by now be at least a little familiar with ***Linux***.
- Log in physically on the *Linux* workstations in Hennings 205 and/or remotely on the assigned server at TRIUMF: **bnqrexp.triumf.ca** using the same ID and the same initial password. On the workstation, open a *Terminal* window (by clicking on its icon) and change your password using the command

  ```
  passwd
  ```

- Rename your existing **.bashrc** file to **.bashrc-inst** using the command

  ```
  mv  .bashrc  .bashrc-inst
  ```

  Then copy the file TSI.zip from my directory to your own using the command

  ```
  cd ; cp -a ~jess/TSI.zip  $HOME
  ```

  and extract its contents with the command

  ```
  unzip TSI
  ```

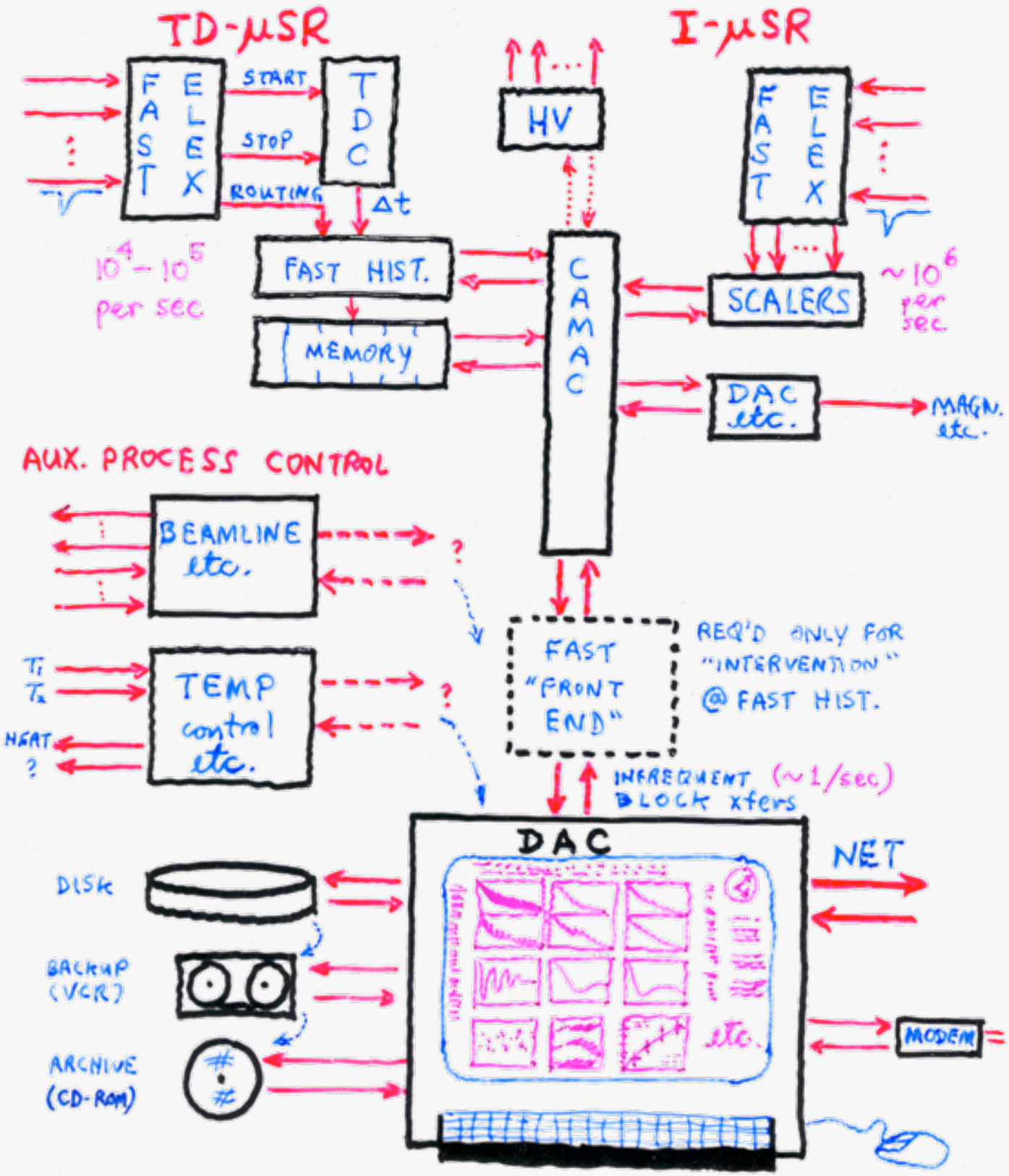
  This will create a new **.bashrc** file, a **.aliases** file, a file **PGPLOT_env.sh** and a **README** file which you can most easily display using the command

  ```
  more ~/README
  ```

  Be sure you understand the meaning (in **bash**) of symbols like "**;**", "~", "/" and "$".
- You are now ready to invoke applications using the command line.

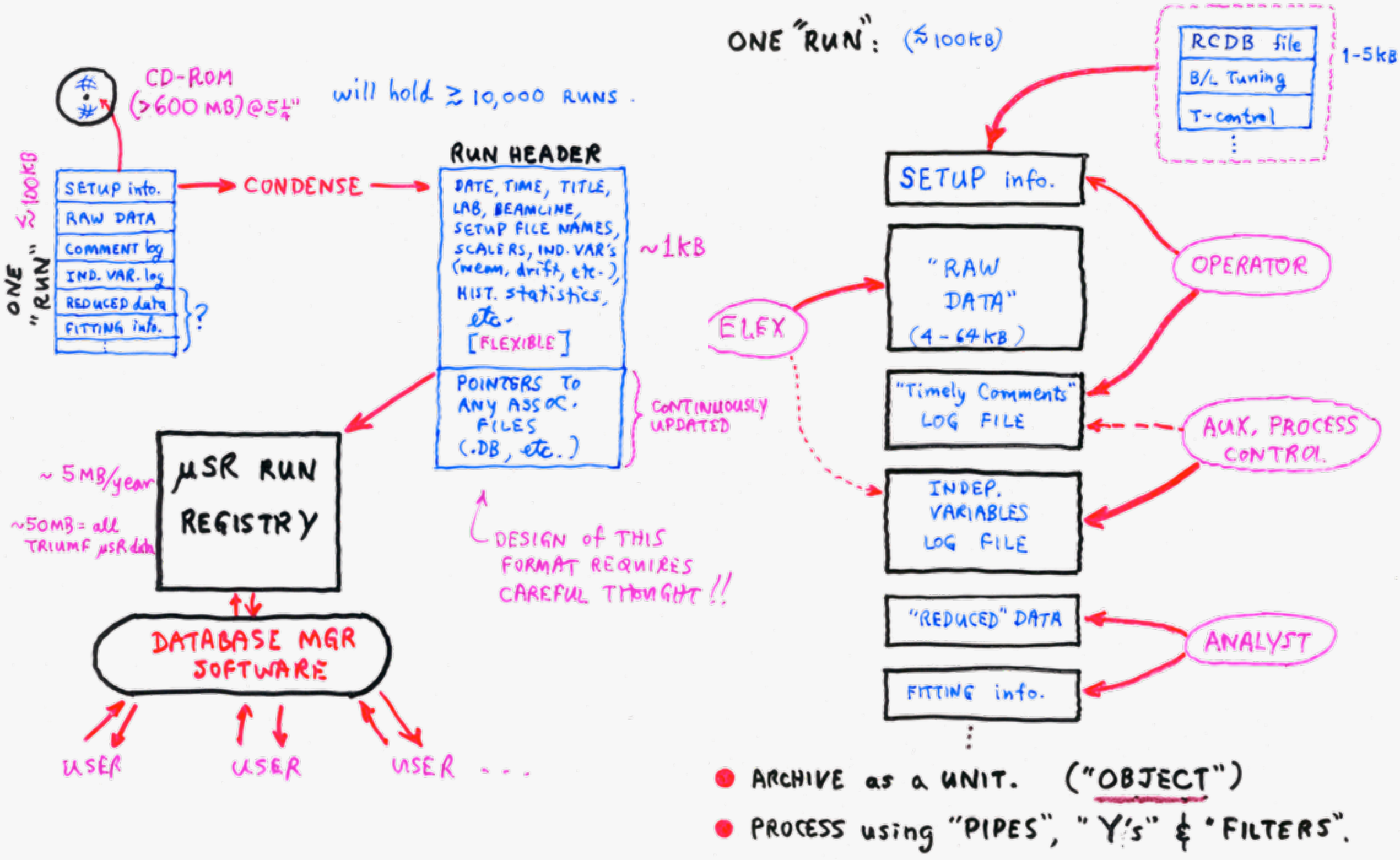
μSR Data Acquisition

ca. 1990



μSR Data Architecture

ca. 1990



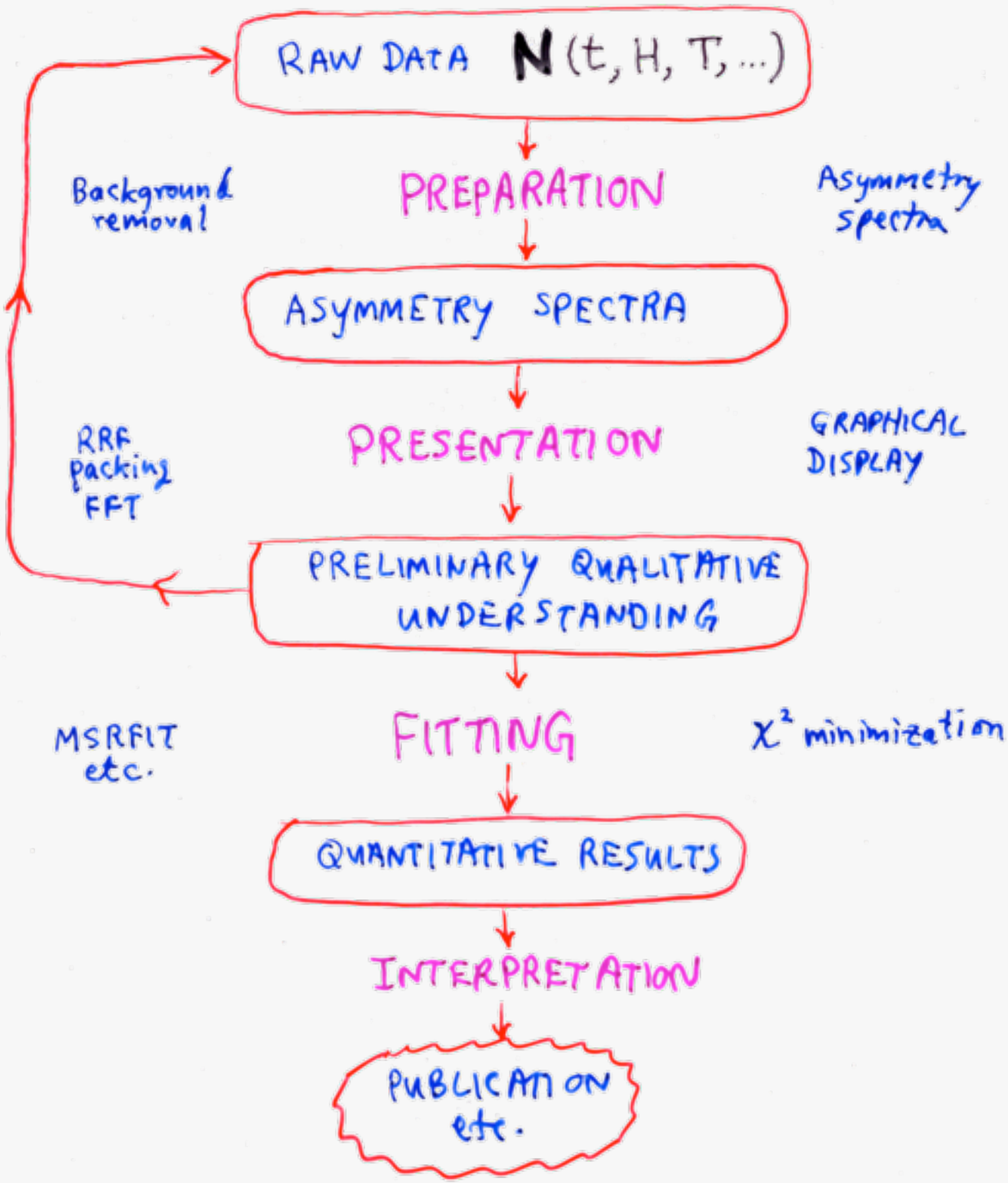
DATA ANALYSIS in μSR:

WHY SO IMPORTANT?

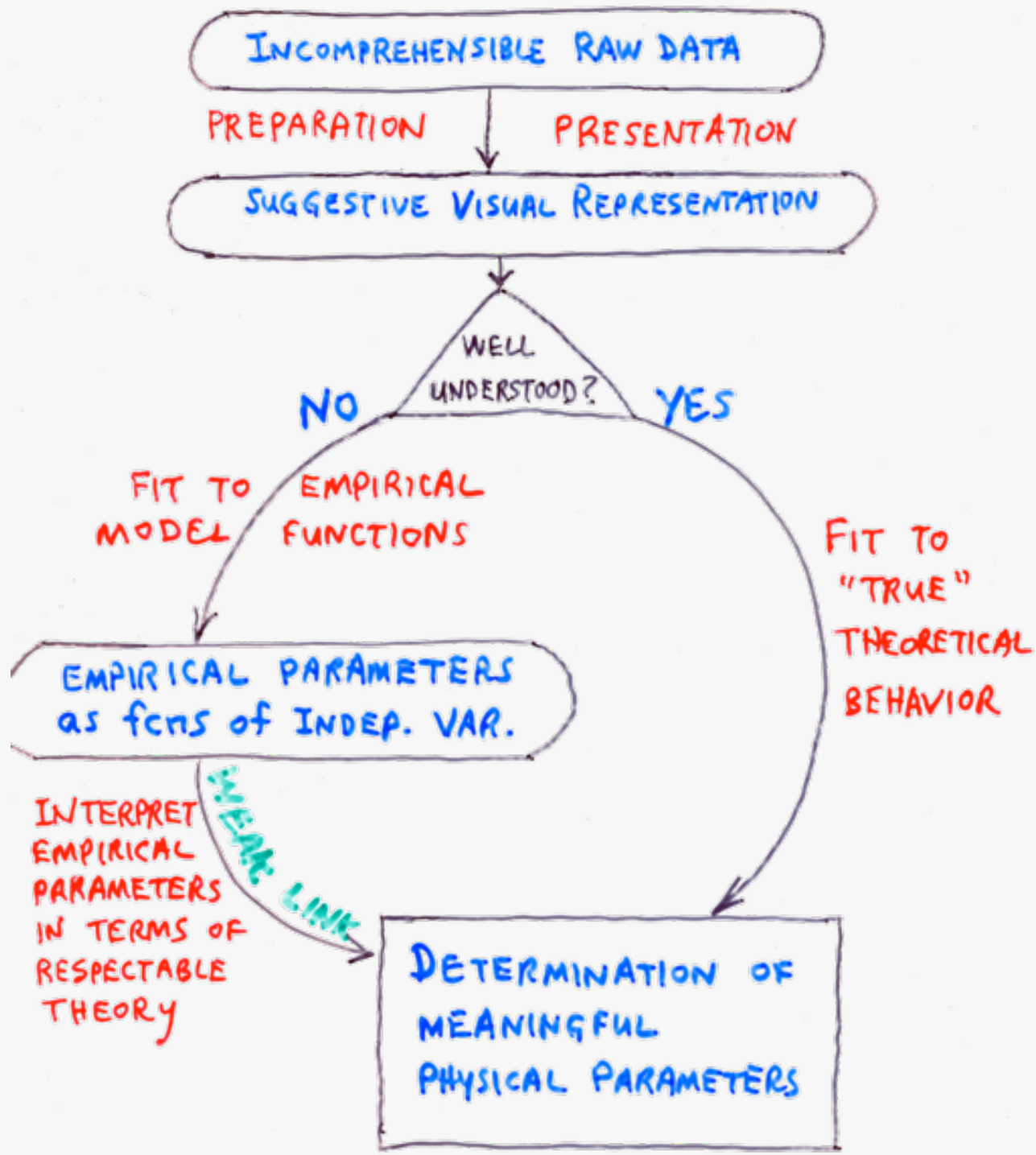
Because

- Beam time comes in blocks of at least a few days @ 24 hr/day.
- Beam time costs the taxpayers a MINIMUM of $1000/hr.
- ∴ You won't get another look at the present system for months, if ever!
- "INSTANTANEOUS FEEDBACK" is POSSIBLE and therefore MANDATORY.

μSR Data Analysis: Abstract



Empiricism

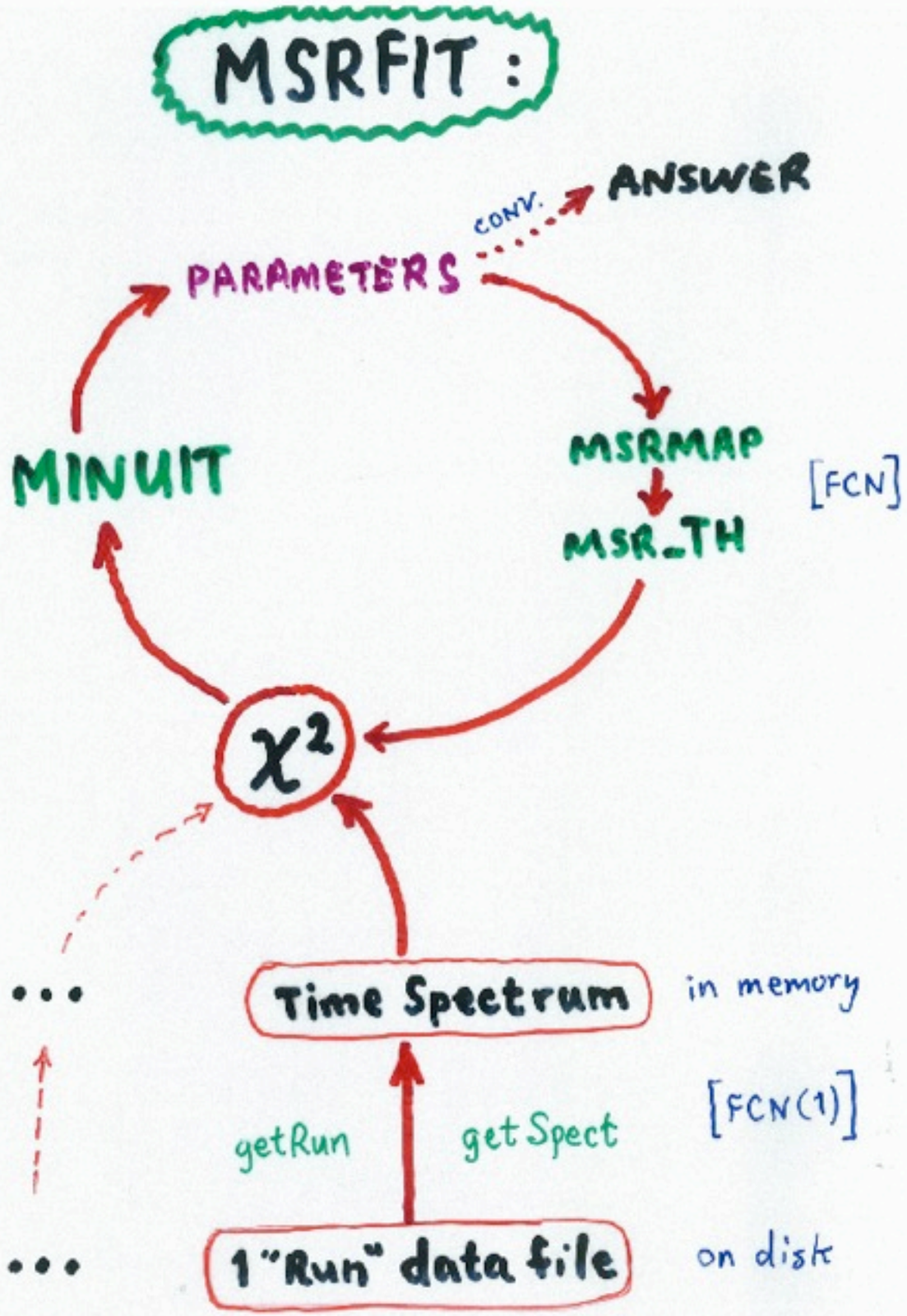


PHYSICA *DEMO*

μView demo

Constructing *SPECTRA* from `*.msr` (MUD) files

MUD Web Tools demo



MSRFIT Input / Initial guess FILE:

TITLE ...

1	NAME1	x_i	δx_i	x_{min}	x_{max}
2	NAME2	y_i	δy_i	y_{min}	y_{max}
3	NAME3	z_i	δz_i	z_{min}	z_{max}
⋮					

(term. w/ blank line) } MINUIT Parameters

<FILENAME> (where to put the results)

MULTIPLE "SIGNALS" allowed up to 32 (?)

SIGNAL $j_1, j_2, j_3, \cdots, j_{10}$ "SIGNAL" MAPPING onto MINUIT parameters by number

SIGNAL $j'_1, j'_2, j'_3, \cdots j'_{10}$

⋮

MULTIPLE SPECTRA allowed up to 20 (?)

SPECTRUM $i_1, i_2, i_3, i_4, \cdots, i_{10}$
<DATA FILE>
SPTYP 2
HIST 1,2
TIME 0, 9, 50
} getSpect commands (term. w/ blank line)

SPECTRUM $i'_1, i'_2, i'_3, \cdots, i'_{10}$
<DATA FILE>
PREV ("do like previous spectrum, above.")
(term. w/ blank line)
(term. with 2nd blank line)

MINIMIZE
MINOS
⋮
END/EXIT
} MINUIT commands (for Batch mode; otherwise ignored.)

SYNTAX of SIGNAL command:

```
SIGNAL kph, kas, kfr, krl, khp, ko1, ko2 ... ko5
   expression1
   expression2
   :                } if needed ("200-series" mappings)
   TABLE filename (if needed)
```

kph etc are ± INTEGERS. If $|k_i|<100$ then it refers to MINUIT parameter # $|k_i|$.

If $100<|k_i|<200$ then it is an "INDIRECT" MAPPING, used for MULTI-SPECTRUM ("global") fits. Use SPECTRUM parameter # $|k_i-100|$ for this variable, each spectrum.

If $|k_i|>200$ then it is an "explicit expression" mapping. Set this variable equal to the corresponding expression (in terms of MINUIT parameters BY NAME and any other defined constants, like PI).

TYPE of SIGNAL is encoded in the SIGNS of the MAPPING integers. E.g.

SIGNAL 1, 2, 3, 4, 5 means to fit to

$$P_2 \exp[-(P_4 t)^{P_5}]\cos\left(2\pi P_3 t + P_1 \tfrac{\pi}{180}\right)$$

where P_i is the i^{th} MINUIT parameter

SIGNAL 0, 1, 0, −4, 5 means to fit to $P_1 G_{zz}(t,\Delta,\nu)$
KDGZF.TBL where $\Delta = P_4$ and $\nu = P_5$
using the ZF relaxation function stored in KDGZF.TBL

∃ MANY, MANY, MORE CRYPTIC "MAPPINGS"
— see MSRMAP.FOR
& MSR_TH.FOR

SYNTAX of SPECTRUM Command:

```
SPECTRUM kNM, kBG, kRP, kRA, kLT, kI1, kI2, kI3, kI4, kI5
   expression1
   expression2      } if needed ("200-series" mappings)
<DATA Filename>
   getSpect commands
   :                } instructions on what data to read in and HOW.
   [term. w/ blank line]
```

kNM = MINUIT parameter # giving N_0 for SPEC_TYP = 0
α for " = 2

[for multiple spectra, all type 0, a NEGATIVE kNM on any but the FIRST spectrum means "relative to spectrum 1":]

kBG: unused for spec_typ = 2; FRACTIONAL BACKGROUND for = 0.

kRP: (never used for spectrum 1): RELATIVE PHASE [deg.] wrt. spectrum 1.

kRA: (" " " " "): RELATIVE ASYMMETRY wrt. spect. 1.

kLT: (rarely used) LIFETIME of MUON or (kLT<1) t=0 MISALIGNMENT

kT1 - kT10: INDIRECT SIGNAL PARAMETERS (which see)

μView demo

Plotting *RESULTS* from `*.db` or `*.csv` files

`XYfit` *DEMO* (?)

C'est fini!