Comparisons among various EPICS implementations: - SLS, Bessy-II, KEKB (and JKJ) -

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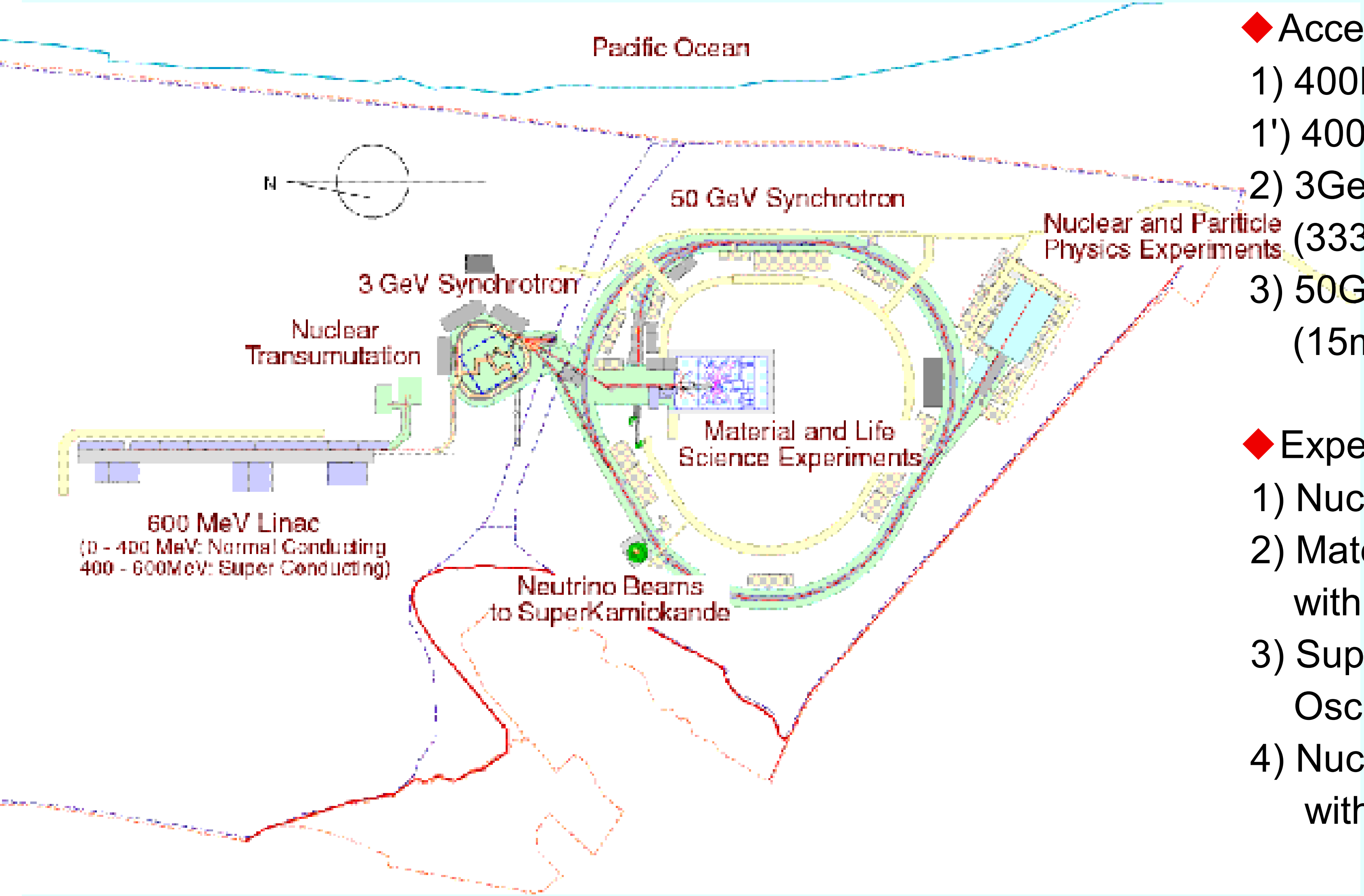
for
Joint Hadron Project Controls Group
EPICS Traversal Group at KEK

- ❖ **JKJ: Joint Hadron Project - status**
- ❖ **Comparison of Epics implementations**
- ❖ **Plan - Implementations for JKJ**

JKJ - JAERI / KEK Joint Hadron Project



◆Accelerators

1) 400MeV Proton Linac

1') 400->600MeV S.C.Linac

2) 3GeV Rapid-Cycle Sync. (333microA, 1MW)

3) 50GeV Synchrotron (15microA,0.75MW)

◆Experiments

1) Nuclear Transmutation

2) Material and Life Science with neutrons/muons

3) Super Kamioka Neutrino Osc. with neutrino beams

4) Nuclear and Particle Phys. with exotic particles

◆High-power Proton-accelerator Complex

◆Under Construction at JAERI-Tokai Site

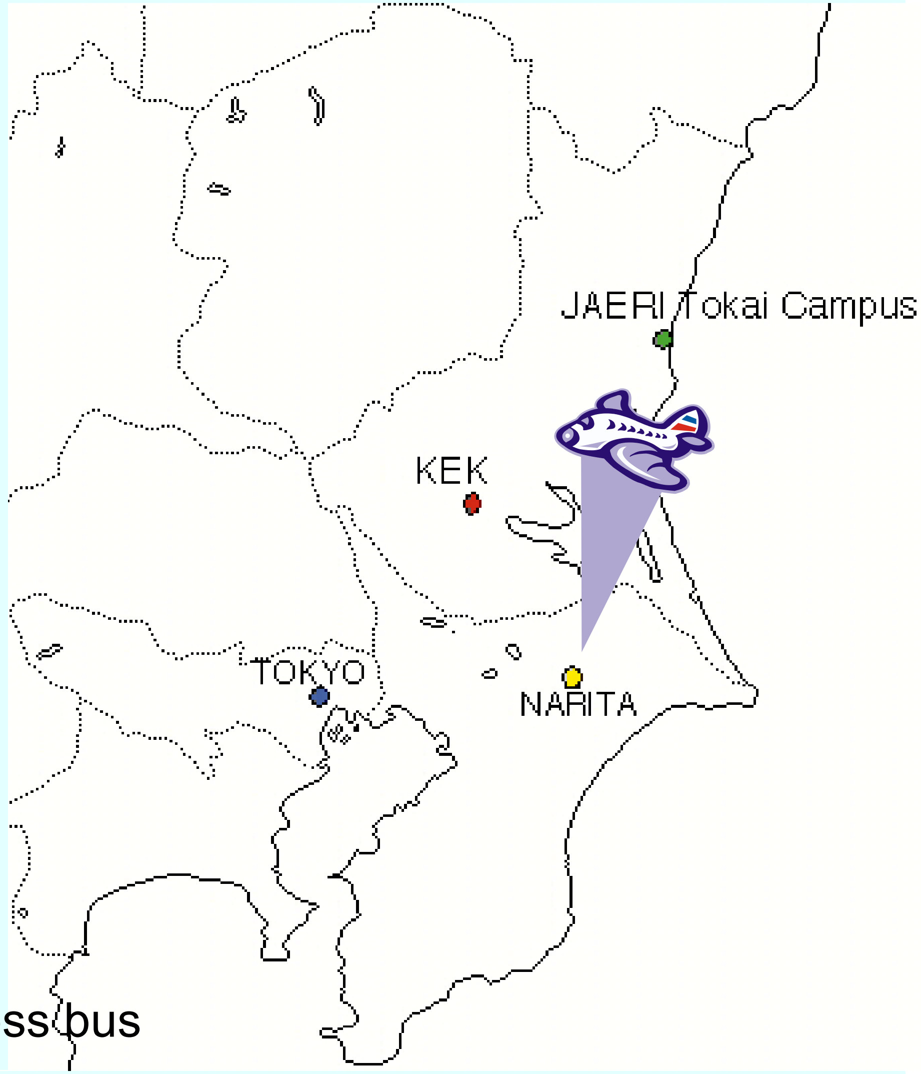
JAERI-Tokai

◆Japan Atomic Energy Research Institute

National Research Institute for Nuclear Reactors

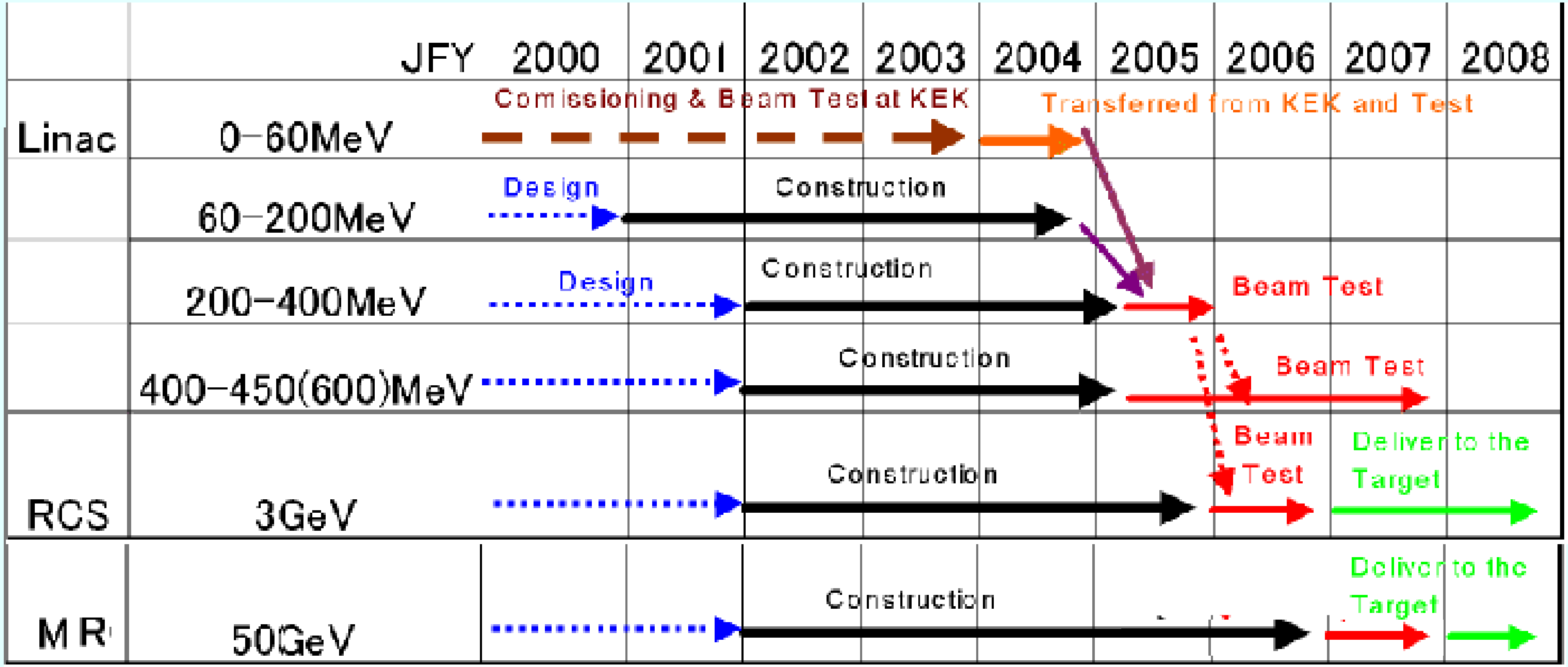
◆JRR-1
The first nuclear reactor in Japan
(1957-1969)

photo from JAERI homepage



◆Location
60km from KEK
# 60-80min by car
130km from Tokyo
# 2-3 hr.s by express bus

JKJ - Schedule



- ◆ "60MeV" Proton Linac at KEK

  construction at KEK (Tsukuba site), will be moved to Tokai in 2004

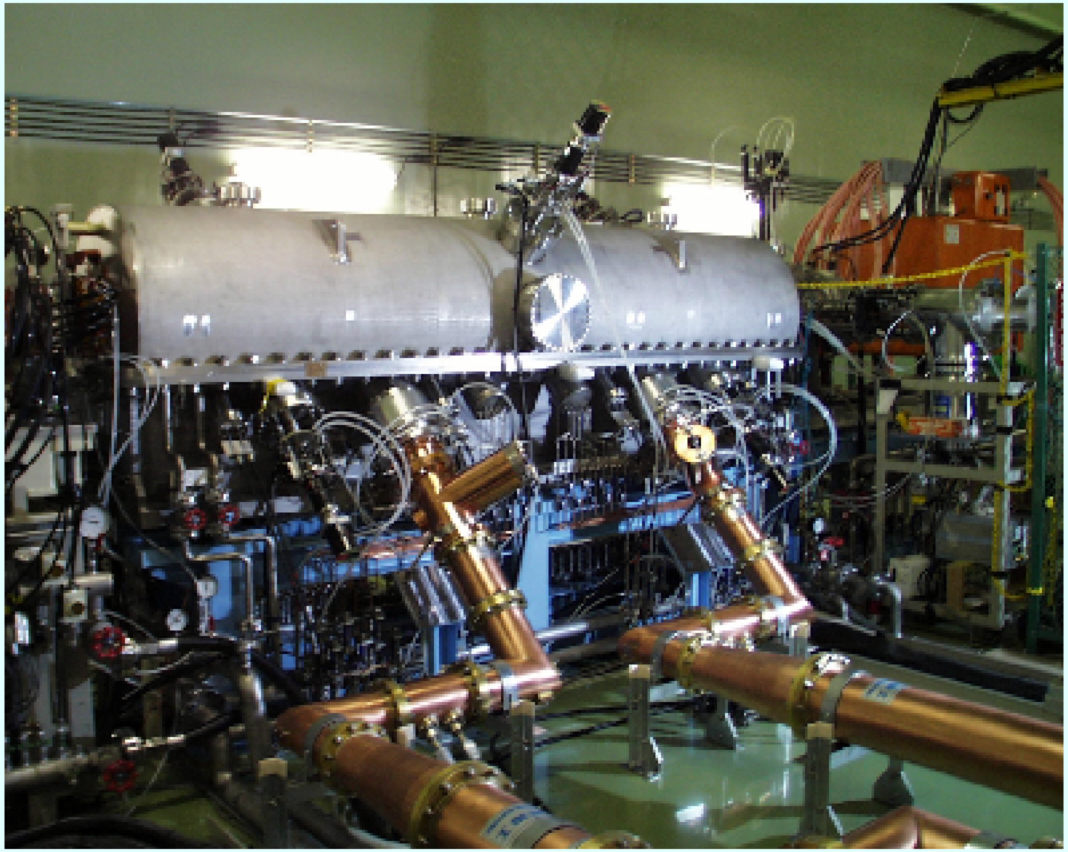
  beam study of Ion Source->RFQ (up to 3 MeV) in June-July of 2002

  prototype control system by EPICS toolkit has been developed

JKJ - Accelerator Status of Aug.2002

- ◆Linac at KEK-Tsukuba (up to 3MeV)
(RFQ and part of the IonSource)

photo by y.kondo



- ◆Linac at JAERI-Tokai

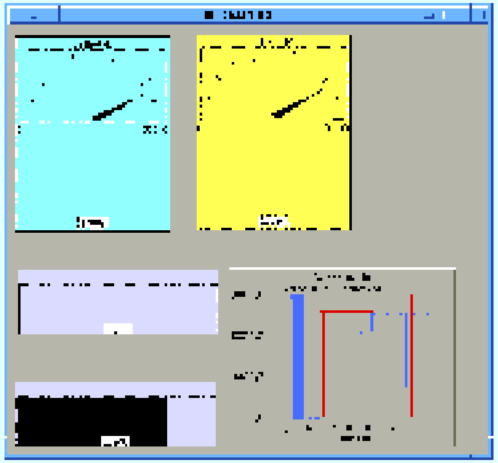
- ◆3GeV Ring at JAERI-Tokai

JKJ Control System - Status

◆ at KEK-Tsukuba

o small EPICS-based prototype (1 HP + 6 VMEs)
monitoring part of the 60MeV Linac since Nov.01
test - channel archiver with ~10 records

o EPICS device support for network devices - OK
# use Ethernet as a field-bus
a) PLC (Yokogawa FA-M3)
b) Measurement Station (Yokogawa WE7000)
c) DTL-Q Power-supply (dedicated Ethernet Controller)



ion-source monitor (Yokogawa PLC)

◆ at JAERI-Tokai

o another small EPICS-based prototype (1 HP + a few VMEs)

o EPICS device support for made-in-Japan VME modules - OK
Advanet standard io-modules (ai,ao,di,do,step-moter)

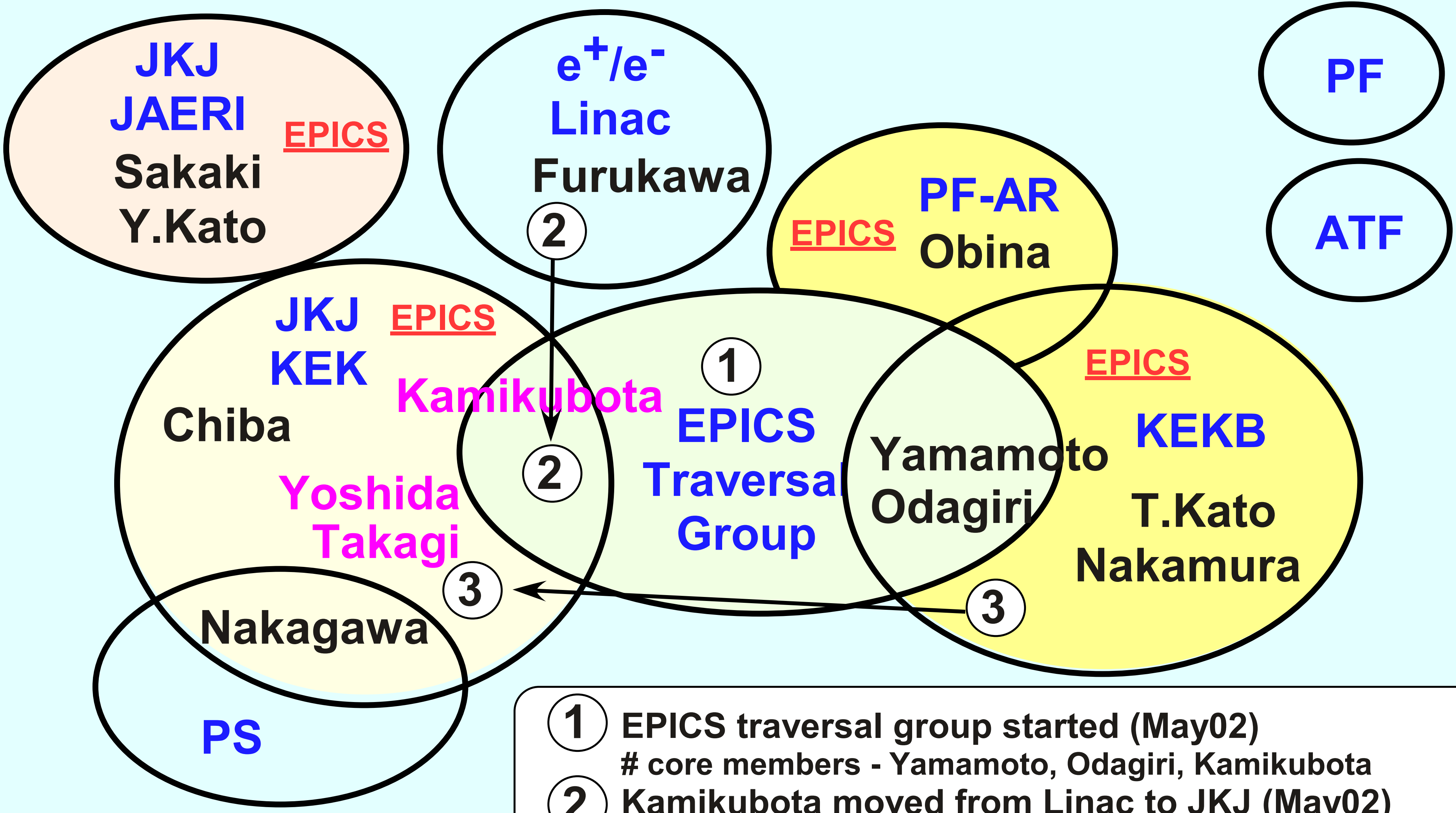
o test - Java GUI with JCA (Java channel access)

◆ Now we are ready to :

o merge two EPICS prototype systems

o develop a new EPICS system for the real JKJ accelerators

JKJ Control System - Control Staff Relationship



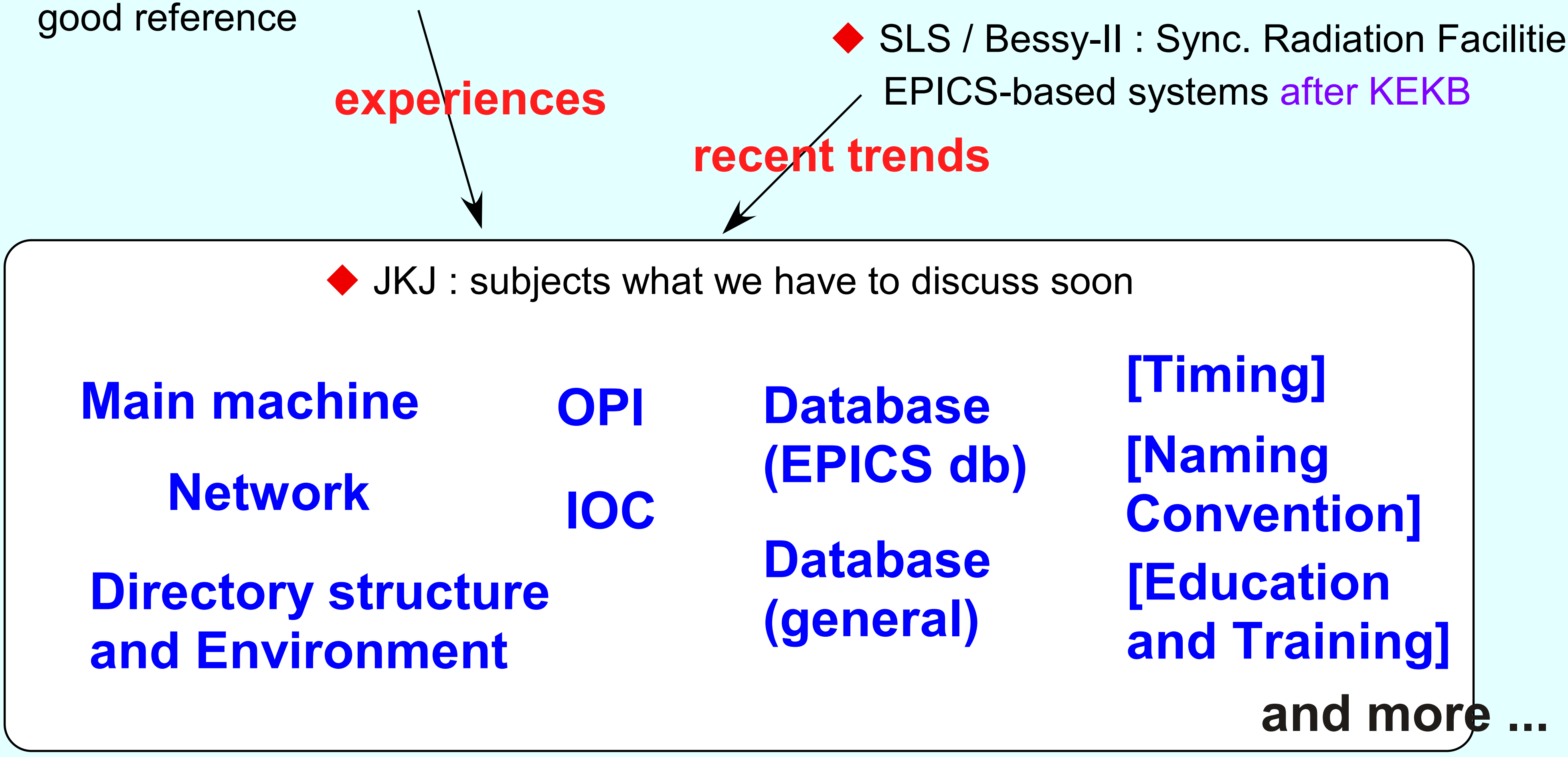
1. EPICS traversal group started (May02)
   # core members - Yamamoto, Odagiri, Kamikubota
2. Kamikubota moved from Linac to JKJ (May02)
3. 2 staffs (company) moved from KEKB to JKJ (Apr.02)

Comparison of EPICS Implementations - motivation

◆ N.Kamikubota and J.Chiba visited SLS (Swiss) and Bessy-II (Berlin) in July 2002
hint to choose ‘standard EPICS tools/environment’ for new JKJ Control System

◆ KEKB : B-factory rings (8GeV e- and 3.5GeV e+) since 1998
good reference

◆ SLS / Bessy-II : Sync. Radiation Facilities
EPICS-based systems after KEKB



experiences

recent trends

◆ JKJ : subjects what we have to discuss soon

Main machine

Network

Directory structure and Environment

OPI

IOC

Database (EPICS db)

Database (general)

[Timing]

[Naming Convention]

[Education and Training]

and more ...

Comparison of EPICS Implementations - **Main machine**

- SLS
  - Console - Linux
  - Main - (Sun?)
  - Servers - Linux
  - Personal - Linux
- Bessy-II
  - Console - HP 11
  - Main - HP 10.20
  - Servers - HP
  - Personal - Linux
- KEKB
  - Console - Macintosh
  - Main - HP10.20 & 11
  - Servers - HP, Compaq and Linux
  - Personal - Macintosh

- Linux has become the most common platform for software development
- SLS uses Linux intensively for various purposes
  - OPI consoles are PCs with 2/4 displays
  - Linux File servers (at least 6 Rack-mount PCs [DELL Power Edge])
  - Oracle Database server on Linux (DELL PowerEdge)
  - IOC boot servers (each for 12 sectors, keep copies of the main IOC server)
  - gcc to compile EPICS ioc-core (note: VxWorks license problem is unclear)

Comparison of EPICS Implementations - **Network**

- SLS
  100BaseTX switches
  Nortel 350-24T
  (14x100Mbps,1x1Gbps)
  star topology

- Bessy-II
  100Mbps switch
  10Mbps optic switches
  Cisco product
  star topology

- KEKB
  100Mbps FDDI and 10Mbps switches
  DEChub
  ring topology

- <I think> Differences come from when the netwrok system was introduced

- Recent trend - use 100BaseTX switches with start-topology links
  if possible - use GbE at the center, use opitic-fibar cables

Comparison of EPICS Implementations - OPI

- SLS
  Console -
  Linux with 2/4displays
  # Matrox video card
  MEDM@Linux
  Launcher - Tcl/Tk

- Bessy-II
  Console - HP 11
  DM2K@HPUX
  Launcher - Tcl/Tk

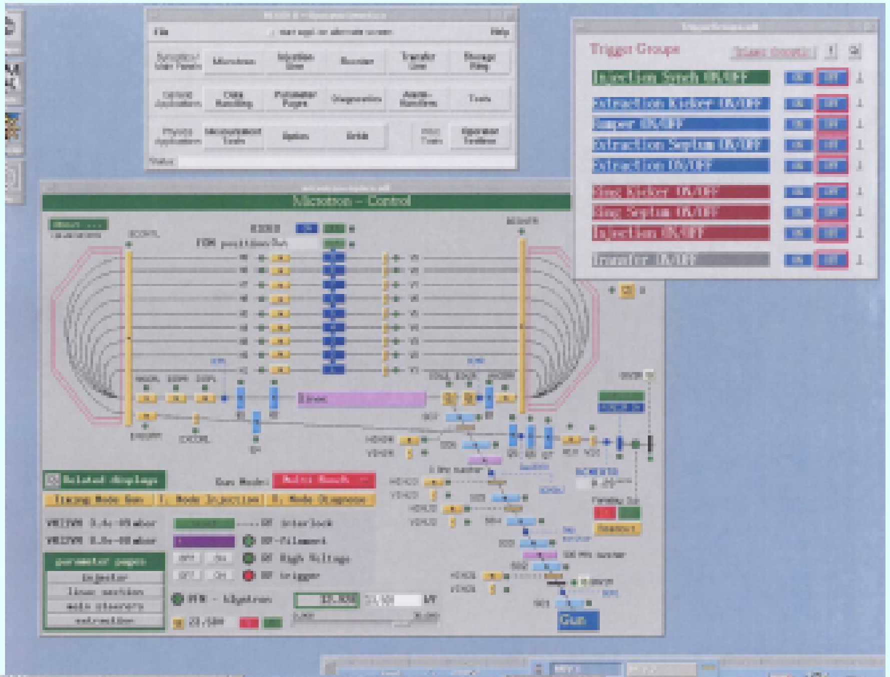
- KEKB
  Console -
  Macintosh with multi-displays
  + X-server software
  MEDM and Python
  Launcher - SAD script

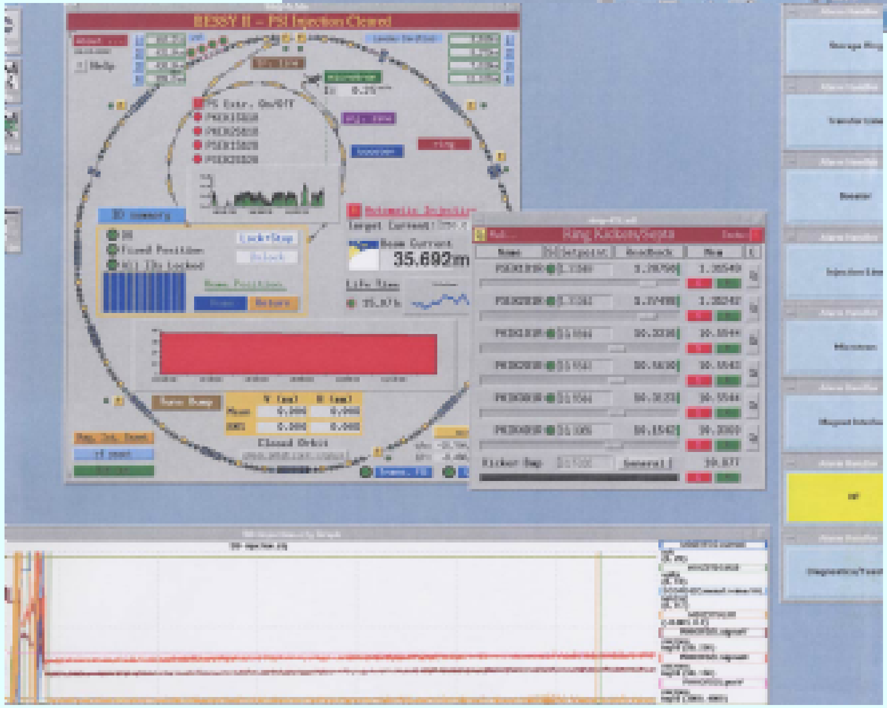
- Is EDM a future promising Display Manager ?
  for me it is not clear yet ..

- Linux with multiple displays seems good for consoles

- SLS
  console displays

- Bessy-II
  screenshot





Comparison of EPICS Implementations - IOC

- SLS
  VME64X and Hytec standard modules
  # noise tolerance, hot-swap, backplane cabling
  PowerPC CPU (Motorola2306)
  Policy - all the signals should come to VME

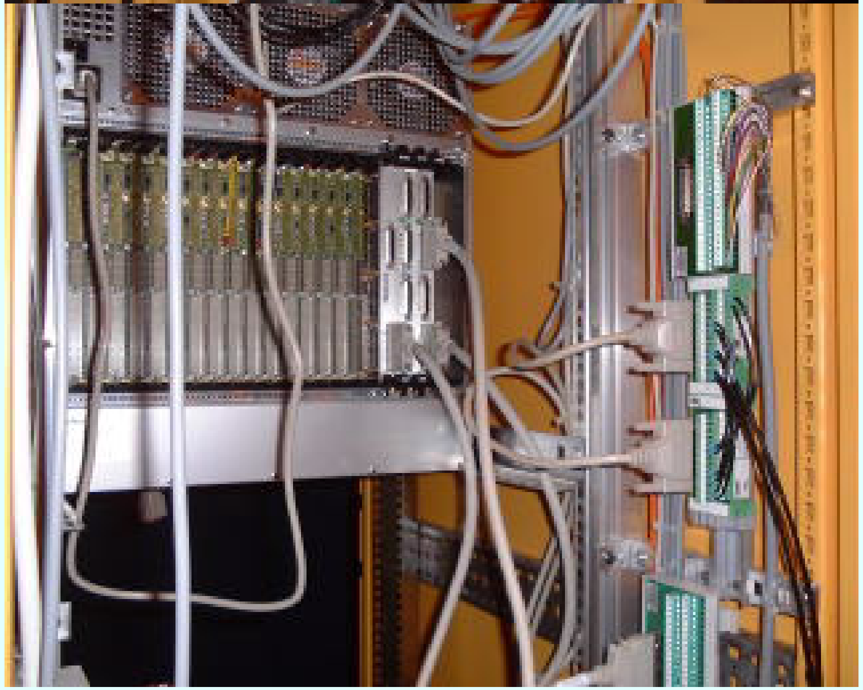
- KEKB
  CAMAC modules
  # ARCnet/VME for power-supplies
  PowerPC CPU (Force6750)

- Bessy-II
  use CAN - a CAN line has 25-50 CAN adapters: 40m - 1Mbps (typical case)
  MC68K CPU (Motorola162)
  Policy - all the signals should come to CAN adapter

- simple policy is preferable - it makes everything simple & maintenance easy
- CPU - PowerPC is popular
- Both SLS/Bessy have remote reset lines of CPUs by CAN-bus

- SLS - typical VME crate for vacuum (analog IO modules)

Rack systems for control



VME64X - backplane cabling

◆ Unique and Excellent ! at SLS

Self-study system of EPICS
with basic VME modules
(di, do, ai, ao, step-moter)

# People from companies
can study with this system

Text is here -
http//www.sls.psi.ch/controls/help/tutorials/epics/index.html

- Bessy-II - typical VME crate

Remote reset lines by CANbus

CAN-bus chains for small power-supplies

CAN control cards

◆ Unique and Excellent ! at BESSY-II

Aftrenoon tea party everyday !

Comparison of EPICS Implementations - Directory structure and Environment

- Directory structure - no mention in the EPICS toolkit, but typically ...
  1) EPICS source (base,extensions) and HOSTARCH binaries
  2) Operation (sources for applications/configrations)
  3) Development (test versions of applications/configrations)

CVS controlled

- Implementations

	SLS	Bessy-II	KEKB	JKJ@KEK	JKJ@JAERI
EPICS source	/prod /dev - test with different EPICS versions	/opt/epics	/cont/epics	/jhf/epics	/control/epics
Operation	/prod	/opt/OPI /opt/IOC	# not simple		
Development	/work	/home ?	# not simple		

- Standardization of Dir./Env. is in progress for JKJ
  # based on KEKB experiences
  # by EPICS traversal group

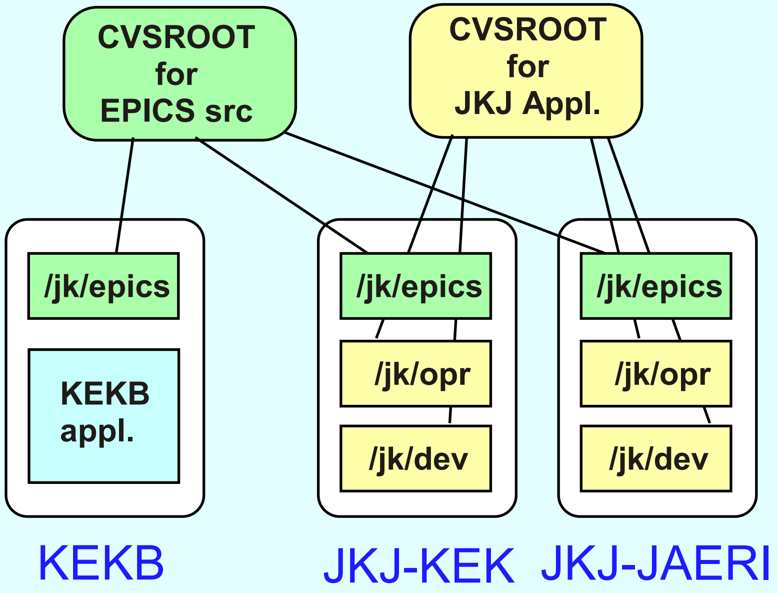
◆ Proposed “Standard” Directory Structure

```
/$(JKROOT)/epics -+              # EPICS source
          +- R3.13.4 -+- base/, extensions/,
          |          +- bin/<ARCH>, lib/<ARCH>     etc.
          +- R3.13.6
          +- R3.14.1

/$(JKROOT)/opr ---+              # Operation - CVS controlled area
          +- config/ --- ar/, restart/, etc/   etc.
          +- device_app/         # IOC-level applications
          +- operation_app/      # Applications for operation

/$(JKROOT)/dev                   # Development - CVS controlled area
                                 # same directories as “opr”

/$(JKROOT)/local -+              # free software
          +- lib/, bin/          # link to $(JKMISC)
          +- share/
          +- src --- GNU/, SAD/, Python/, PostgresSQL/, etc.

/opt -------------+              # commercial software
          +- CapFAST/, Tornado/, Oracle/, etc.

/$(JKMISC) -------+              # platform dependent binaries
          +- <ARCH> -+           # hp700 | Linux | ...
                     +- bin/, lib/, etc.
/$(JKLOG) --------+-             # various operation log
          +- bootlog/, ioclog/, orbit/, Archiver/, restart/, etc.

/scratch                         # work area for large files
```

◆ for JKJ

JKROOT = jk, JKMISC = jkmisc, JKLOG = jklog

EPICS source also controlled by CVS



◆ for JKJ

EPICS traveral group is now trying to complete “standardization“

◆ Environment - other ideas

o Control network is isolated from the laboratory network [SLS, BESSY-II]
no router, but share file servers
effective to avoid unnecessary broadcast, virus, attacks from outside, ...
=> ideal for management, but sometimes inconvenient

o Use resources of Computer Center [SLS]
control network is operated/maintained by Computer Center
=> experts are often inevitable for management of recent network systems
linux support (kick-start floppy for installation, etc.)
“/home” served by Main FileServer of Computer Center
=> user can use his/her “/home” at any PC (both Linux and Windows)

o Study and Simulation [KEKB]
SAD is widely used and very successful at KEKB - and free ..
# Matlab / Mathematica - commercial tools

Comparison of EPICS Implementations - Database (EPICS db)

- SLS

  VisualDCT -

  Java 1.2 based

  # editor was used before

- Bessy-II

  CapFast to make templates

  editor to modify templates

- KEKB

  CapFast to make templates

  editor to modify templates

- VisualDCT

  developed by IJS/Slovenia (cosylab)

  executable files are downloadable from SLS - free !

  available at any platform where Java1.2 (or later) works

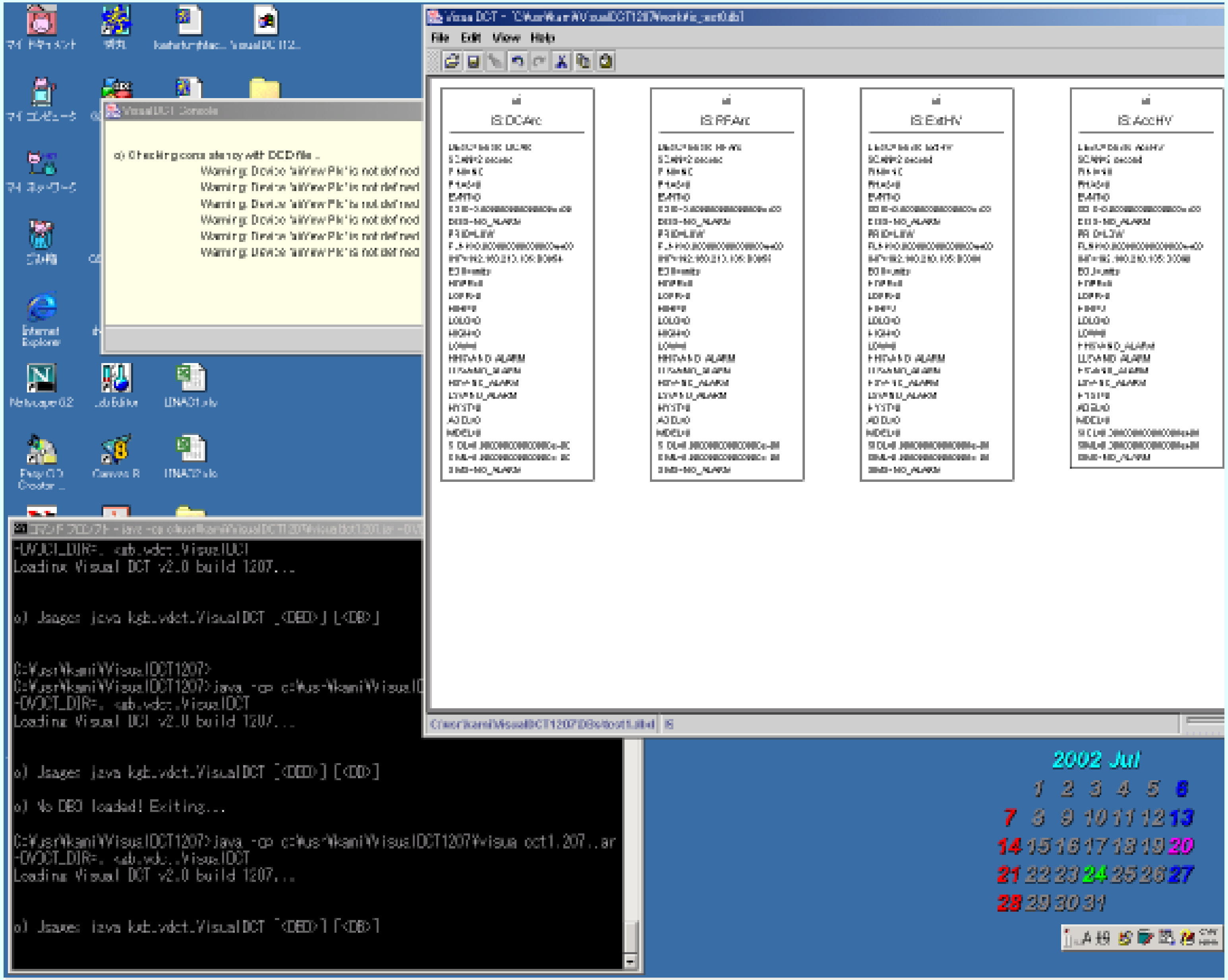
- VisualDCT looks promising for EPICS db management

  Evaluation study started by JKJ staffs

VDCT(executable) is here -

http//www.sls.psi.ch/controls/software/VisualDCT/visual_dct_demo.html

- VDCT runs at a Windows PC (sample db file of the KEK 60MeV proton Linac)



```
o) Checking consistency with DBD file...
        Warning: Device 'aiViewPic' is not defined
        Warning: Device 'aiViewPic' is not defined
        Warning: Device 'aiViewPic' is not defined
        Warning: Device 'aiViewPic' is not defined
        Warning: Device 'aiViewPic' is not defined
        Warning: Device 'aiViewPic' is not defined
```

```
-DVDCT_DIR=. kek.vdct.VisualDCT
Loading Visual DCT v2.0 build 1207...


o) Usage: java kek.vdct.VisualDCT [<DBD>] [<DB>]


C:¥usr¥kami¥VisualDCT1207>
C:¥usr¥kami¥VisualDCT1207>java -cp c:¥usr¥kami¥VisualD
-DVDCT_DIR=. kek.vdct.VisualDCT
Loading Visual DCT v2.0 build 1207...


o) Usage: java kek.vdct.VisualDCT [<DBD>] [<DB>]

o) No DBD loaded! Exiting...

C:¥usr¥kami¥VisualDCT1207>java -cp c:¥usr¥kami¥VisualDCT1207¥visualdct1207.jar
-DVDCT_DIR=. kek.vdct.VisualDCT
Loading Visual DCT v2.0 build 1207...


o) Usage: java kek.vdct.VisualDCT [<DBD>] [<DB>]
```

Comparison of EPICS Implementations - **Database (general)**

- SLS

  Oracle8i on Linux

  Web/jdbc/cdev API

  Archiver:

  Oracle

  Web interface

- Bessy-II

  Oracle @HP

  Archiver:

  channel archiver

  -> use Oracle for retrieval

  # retrieval is slow when datasize is large

  # Archive by Oracle has studied at SLAC

- KEKB

  Oracle @HP

  Archiver:

  KB-log (homemade tool)

  -> channel archiver

- Oracle is standard, but expensive - SLS uses Linux license (much cheaper)
- Archiver - channel archiver looks fine, but ..

  Bessy-II reported that retrieval is slow for large data

Plan - implementations for JKJ

Main machine

Use Linux PCs/Servers as many as possible
but Main machine (with Tornado license) is HPUX ..

Network

100BaseTX switches for local devices
GbE for the center
optic cables with star-topology

Directory structure and Environment

Follow the standards recommended
by EPICS traversal group

OPI

Use Linux/Windows consoles with multiple displays
MEDM/DM2k (or EDM)

IOC

Network-based devices (PLC, WE7000, Ethernet controller)
VME modules for standard io
CPU - Power PC

Database (EPICS db)	Use VisualDCT @ Linux Evaluation in progress
Database (general)	Oracle ? PostgreSql ? - not decided yet Linux server ? Archiver: start with channel archiver
Timing	not studied well ... now we started discussion in the Timing group
Naming Convention	we are just discussing - conclusion will come soon ..
Education and Training	by EPICS traversal group Lecture at KEK/JAERI for beginners Japanese translation of manuals in progress

Thank you

for your attension

portrait by my son