# STAR Simulations

Focus:
- optimize design of hardware & electronics,
- data for development of analysis software,
- measurement biases, efficiencies, & backgrounds.

Spans all RHIC beams, all STAR detectors,
and all analyses throughout the lifetime
of the STAR Collaboration.

nml/gxintX11/mct/TAS
*gave way to*
AGI/gstar/g2t/STAF

## Outline:

*AGI Overview and Geometry's*

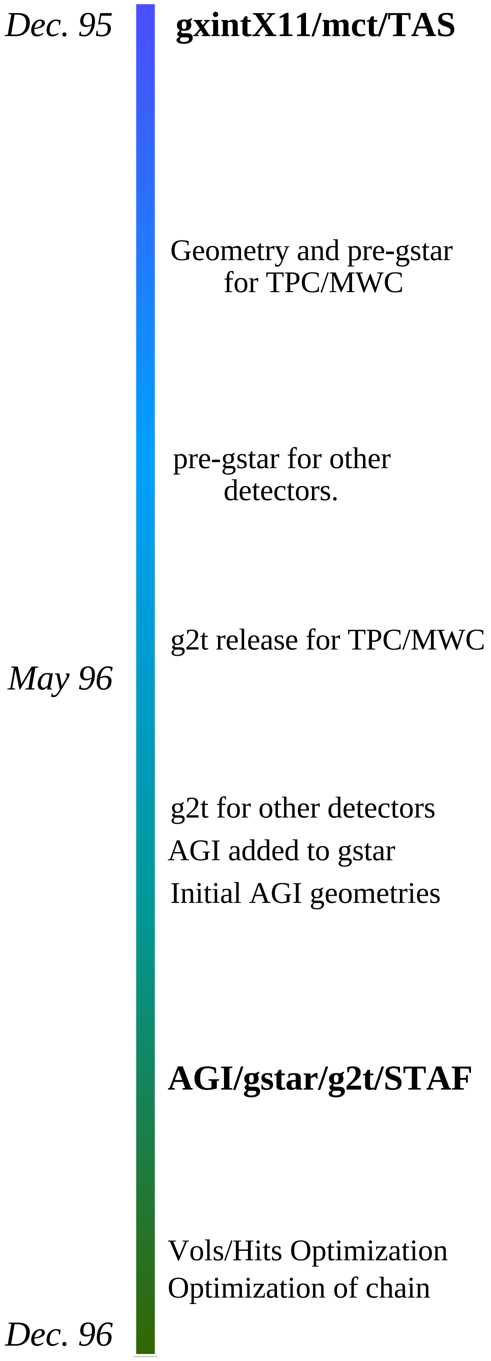
*GSTAR Overview*

*G2T Overview*

*STAF Overview*

*Manpower*

*Plans*


*Dec. 95* **gxintX11/mct/TAS**

Geometry and pre-gstar
for TPC/MWC

pre-gstar for other
detectors.

g2t release for TPC/MWC

*May 96*

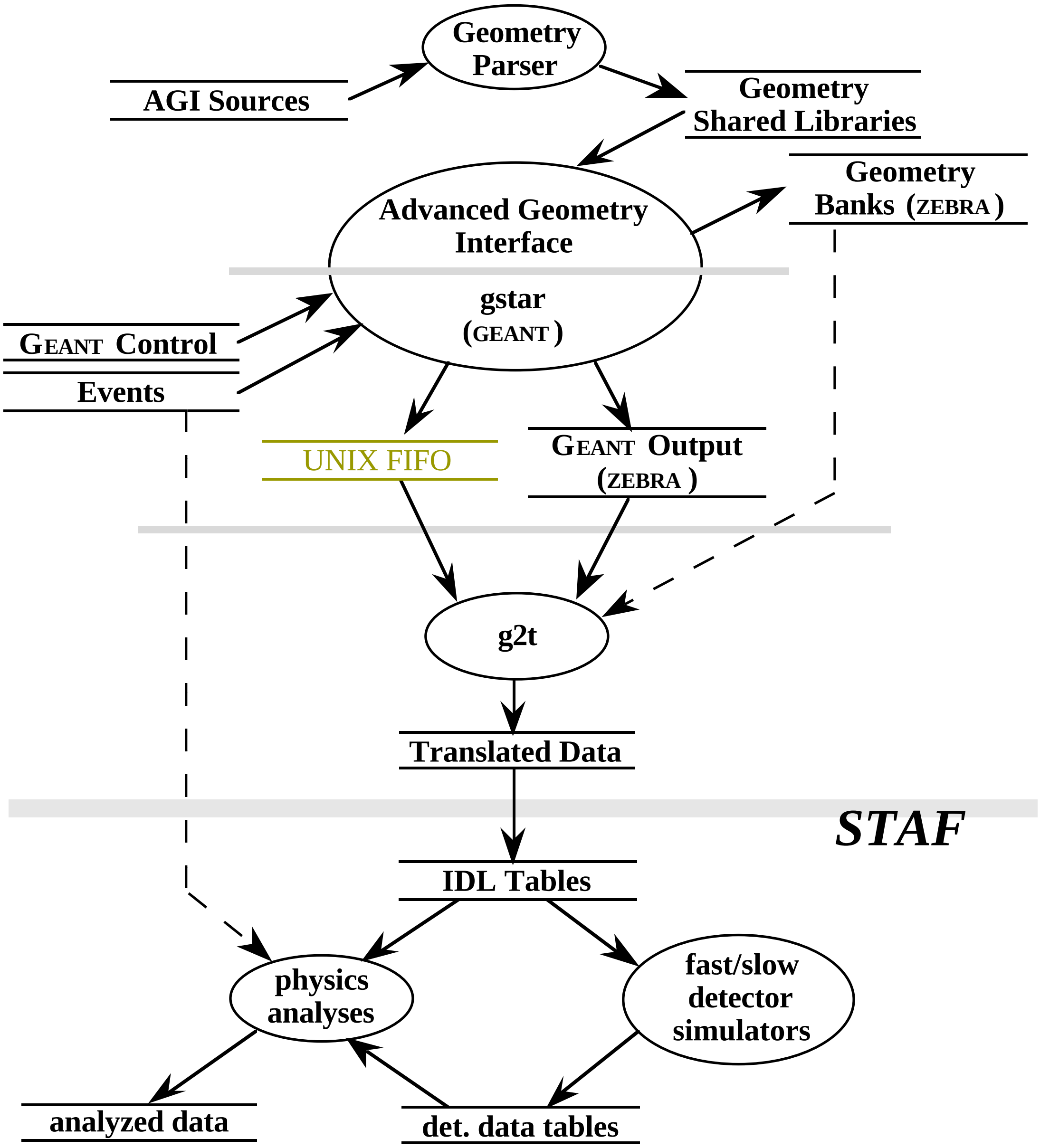
g2t for other detectors
AGI added to gstar
Initial AGI geometries

**AGI/gstar/g2t/STAF**

Vols/Hits Optimization
Optimization of chain

*Dec. 96*

# The Modern STAR Simulations Chain



○ Computation *(e.g.,* STAF PAM, subroutine, ...)

═ Data store *(e.g.,* file, tape, database, ...)

→ Existing Data Path

⇢ Planned Data Path

## *AGI Overview*

AGI is a “geometry parser” (a Fortran pre-processor) producing SL geometry files, and a set of routines linked into the gstar executable.

(Pavel Nevski)

- Geant Volumes *(shapes, positions, divisions, rotations, materials, attributes)*
- Hits Information *(sensitive media, hits words, resolutions, origins)*

```
module   VPDDGEO  is the Vertex Position Detector of STAR
Author   Z.Milosevich, P.Nevski
Created  27 March 1996

CONTENT   VPDD,VRNG,VSEC,VDET,VCNV,VRAD,VSUP,VPMT,VXST
Structure VPDG { Version, Rmin, Rmax, Length, Position,
                 PMTradi, PMTwall, PMTleng, .... }


Block VPDD   is the Vertex Position Detector assembly
     Material  Air
     Medium    Standard
     Attribute VPDD   Seen=0  colo=5
     Shape     TUBE   Rmin=vpdg_Rmin  Rmax=vpdg_Rmax,
                      Dz=vpdg_Length/2
     Rcurrent = vpdg_Rmin
     Do iLayer = 1,2
        Create   VRNG
        Position VRNG
        Rcurrent = Rcurrent + vpdl_DrLayer
     enddo
Endblock

HITS CSUP     eta:0.05:(0,1)     y:1:(-13,13),
     xx:16:H(-300,300) yy:16:(-300,300) zz:16:(-350,350),
     px:16:(-100,100)  py:16:(-100,100) pz:16:(-100,100),
     Slen:16:(0,1.e4)  Tof:16:(0,1.e-6) Step:16:(0,100),
     none:16           Birk:0:(0,10)
```

## Plus’s compared to previous namelist approach:

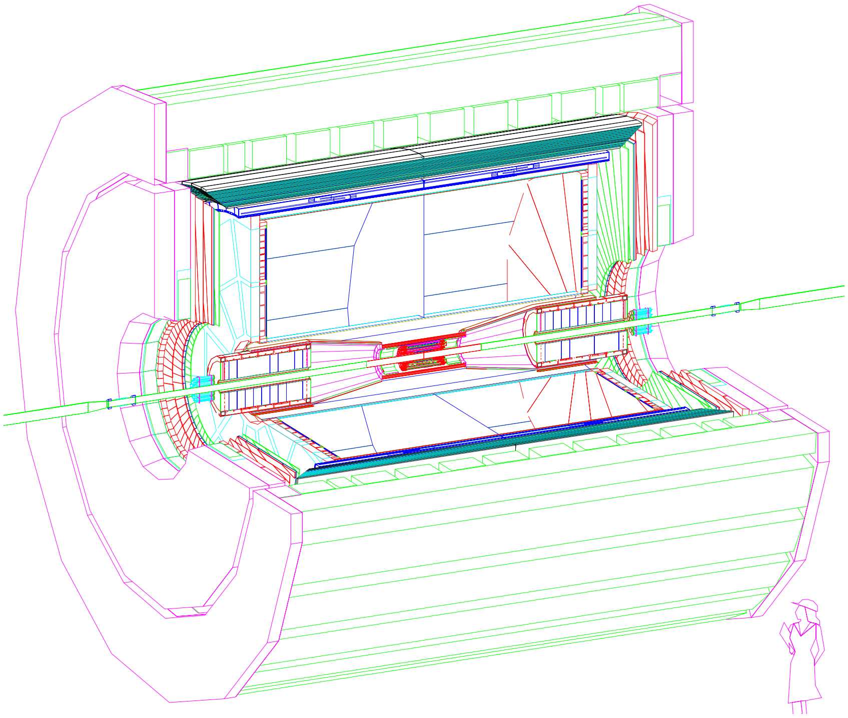
- Easier to read, easier to write...
- Inheritance keeps the sources simple...
- Internal consistency checks leave less for the user to worry about...
- Fully documenting...
- Hits flags, eliminates need to detector-specific GUSTEP routines...
- software subdivisions, powerful for sub-dividing w/o large CPU costs...

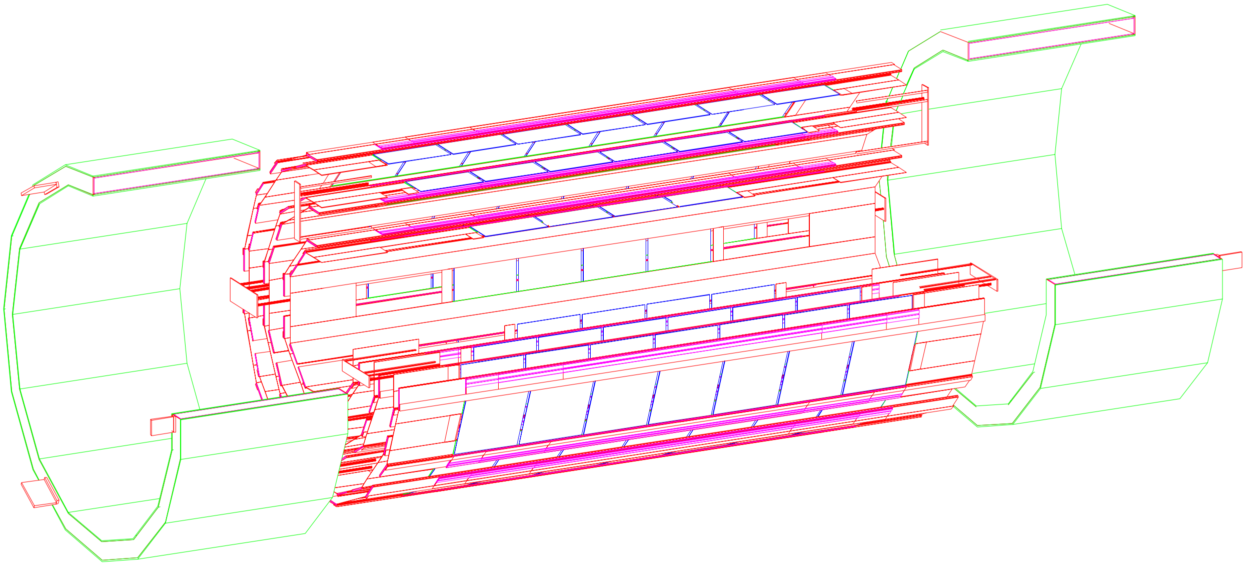
- All eleven AGI source files for STAR available.
- Each detector definition has been fine-tuned by the sub-system groups.
- g2t updated to correctly handle the refined geometry’s.

AGI routines & Parser are stable.

The detector definitions are quite realistic.

|  |  |
|---|---|
|  | CAVE |
|  | MAGP |
|  | MFLD |
|  | PIPE |
|  | VPDD |
|  | SVTT |
| (TPC,MWC) | TPCE |
| (CTB,TOF) | BTOF |
| (BEMC,BSMD) | CALB |
| (EEMC,ESMD) | ECAL |
|  | FTPC |



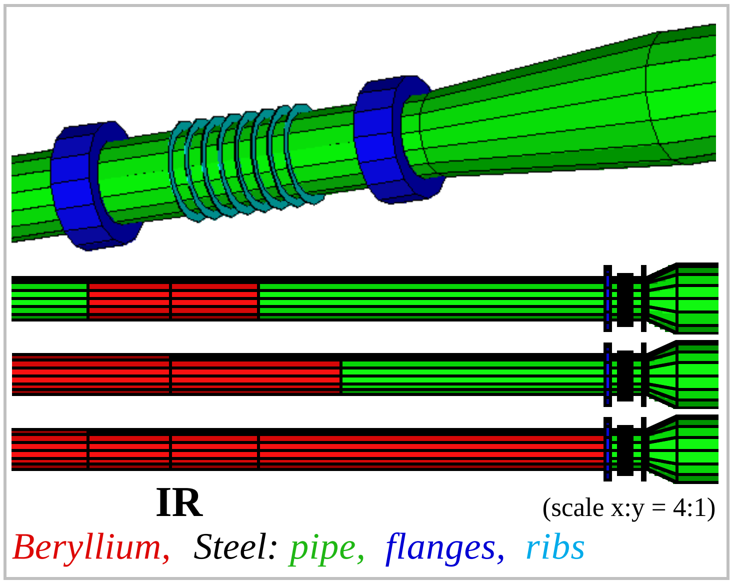


- Beam pipe is only system with fundamental open design issues.

SVT, TPC, and FTPC groups presently collaborating on the study of three different beam pipe designs...

- length of Beryllium section
- Steel vs. Aluminum

Studying $N_{hits}$ and performance
*(i.e. tracking eff., momentum res.)*



- Trivial to load only particular sets of detectors for specific studies.

- Volume hierarchy optimized for present level of detail.

## AGI/Geometry Joblist:

- For specific studies, some of these definitions are *too realistic*.
  investigate pro's and con's of cruder definitions...
  patch geometry's...

- Continue studies of effects related to the various GEANT parameters.
  thresholds, cut-off's, step-sizes, ...

- Geometry database.
  - synchronize latest CADD drawings and simulations definitions.
  - provide information describing hardware configuration to PAMs.

*near-term workaround is revising g2t to translate /DETM information to STAF tables*

## Gstar Overview

- GEANT implementation, based on NA49 code...
- prepared to keep pace with STAR and STAR software...
- command-line control of AGI, stacking, kinematics cuts, ...

First "full" release for IRIX during Summer 1996.

*One central Au+Au (VENUS) event, RSGI00, all detectors on, all physics on.*

| | ***time*** | ***output*** |
|---|---|---|
| **Simulation (perm. stacking)** | ~15 hours | ~500 MB |
| **Simulation (temp. stacking)** | ~4 hours | ~40 MB |
| **Experimental Data** | ~0.01 sec | ~16 MB |

Permanent stacking to understand det. response & shake out system.

*Output file sizes and CPU-times as large as they can be.*

Temporary stacking for production runs.

*Output file sizes similar to those from previous nml/gxintX11/mct, although geometry's are now much more detailed.*

*However, CPU-times above still prohibit long production runs.*

→ Port to other platforms!

makes more CPU available, much will be faster than RSGI00

- Port to Solaris completed Oct. '96
  *(PDSF at LBNL-NERSC, Institutional machines).*
- Difficult port to AIX (statically bound geometry) in Nov. '96
  *(RHIC-SP1 farm, RIBM0X, Institutional machines).*
- dynamic geometry binding under AIX in progress... (Janet Seyboth *et al.* )

RHIC SP-1 farm alone increases available CPU by a factor of ten.

## Gstar Joblist:

- Port to new Pentium Pro farm at BNL... (another large increase in CPU)
- Continue studies of geant parameter space... (modest speed increases)
- Streamline event input...
- Continue optimization of "shower track" mechanism...
- Implement detector-dependent stacking and other tools...

## *g2t Overview*

- C program that translates gstar’s ZEBRA output to STAF’s XDF input.
- can take input piped from gstar through a FIFO (ZEBRA data not saved).
- stable, and generally fast.

### Status:

- up and stable for TPCE, SVTT, CALB, FTPC, VPDD, CTB/TOF
- ECAL and BTOF available shortly.

### g2t Joblist:

- complete addition of ECAL and BTOF...
- translate Geometry banks (/DETM) for STAF input...
- allow <11 words for each hit... *(not an AGI limitation, modest file size savings)*
- port to other platforms... *(generally easier than porting gstar)*

## *STAF Overview*

All of the detector simulators (“fast”, “slow”,...) are STAF modules.

| | **Type:** | **Name:** | **Output:** | **Status:** |
|---|---|---|---|---|
| SVT | fast | `srs` | space points w/ det. resolution & merging | Available |
| | slow | `srs` | signals and zero-suppressed fake data | Porting now |
| TPC | fast | `tfs` | space points w/ det. resolution and diffusion | Available |
| | slow | `tss` | pixels w/ det. resolution and noise | Available |
| FTPC | fast | `ffs` | space points w/ det. resolution and diffusion | Available |
| | slow | `fss` | fake ADC data from pads | Available |
| EMC | fast | `efs` | parameterized showers w/ fluctuations | Not written |
| | med | `N/A` | geant showers | Available |
| | slow | `ess` | geant showers+light propagation and SMD response | Not written |
| CTB/TOF | fast | `cts` | ADC and TDC fake data | Available |

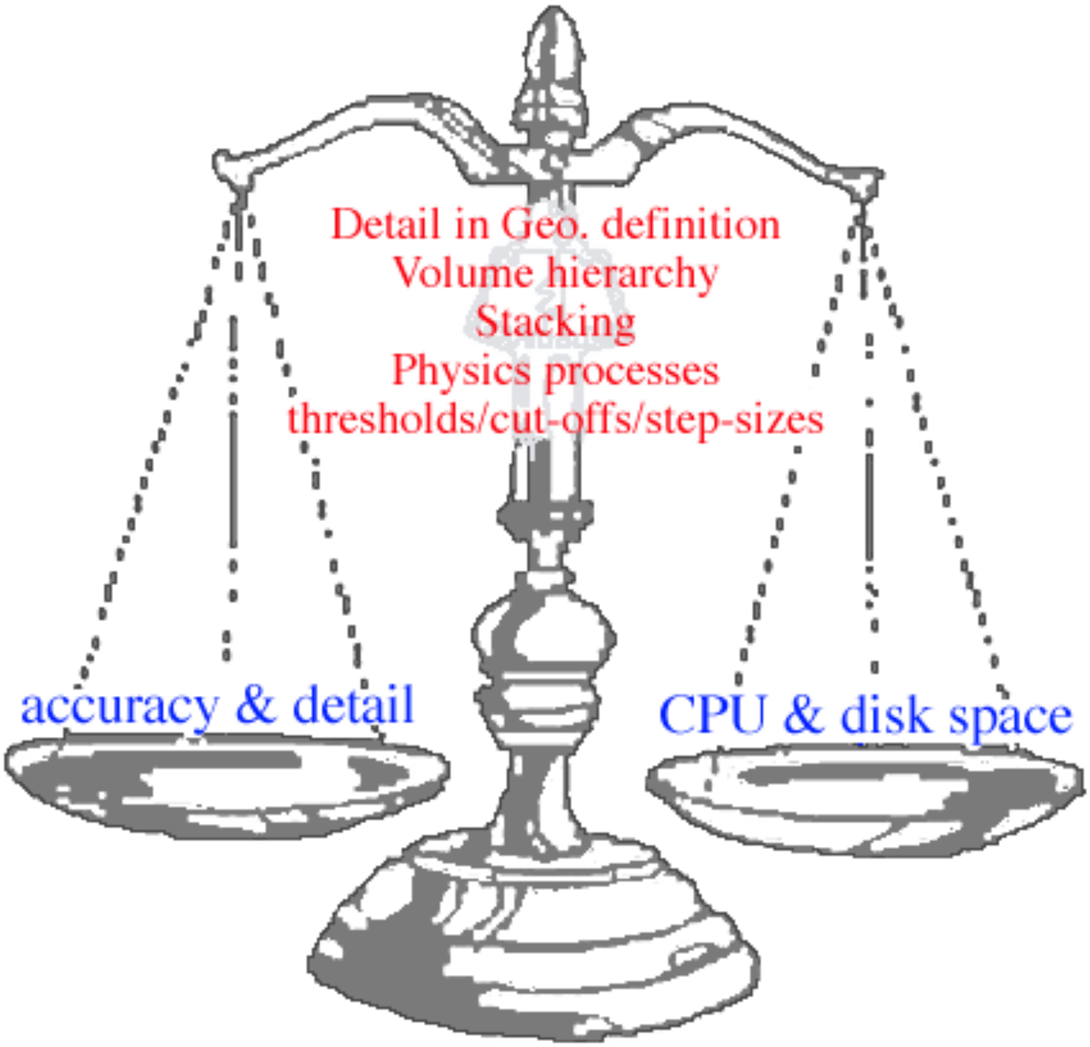
### STAF Joblist:

- complete ports to STAF...
- make `efs` available...
- accept Geometry information via g2t, or from Geometry database...
- port detector simulation PAMs to other platforms...
- accept events directly from event generators...

Chain is up and running...

*(even for central Au+Au with all STAR subsystems on, all physics on, and permanent stacking).*

Still working to understand the parameter spaces...



## *Manpower*

A STAR-wide census (The "STAR Software Survey") was performed.
Goal was to answer the following questions:

- Who is working on STAR off-line software? (SAS & SOFI)
- What topics are people working on?
- What is *not* being worked on (enough)?
- Where is the group going?

### Numeric Section

- Name, institution, sub-system, local computing hardware
- Skills: *24 categories, each rated on a scale from 0 - 10.*
- Present Efforts: *18 categories, each rated on a scale from 0 - 10.*
- Future Efforts: *18 categories, each rated on a scale from 0 - 10.*

Categories:

*UNIX, Fortran90, C, C++, Shell scripts, Makefiles,*
Star library and CVS, Geant infrastructure,
Geant geometry, Running Geant, Analysis shell infrastructure,
Detector response software, Running detector response software,
Event reconstruction modules, Running event reconstruction modules,
Physics analysis modules, Running physics analysis modules,
GUI tools, Event visualization,
Database programming, Using databases,
System management, Organizing data and DSTs,
Other (WWW, Event generators, etc.).

### Text Section

- what are you doing? with whom? when will this be done?
- is there enough manpower on this? what is the priority?
- what else are you interested in? is this interest guided by the focus of an institution or subsystem?
- what efforts are dangerously undermanned? how do these affect you?

## *Highlights from the Survey data*

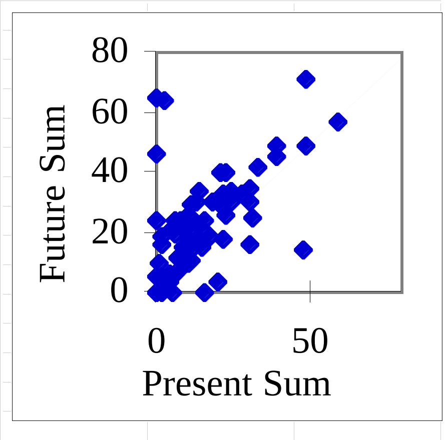
◊ 71 respondents, 21 institutions, all platforms, all subsystems.

◊ Good information on the expertise and plans of the SAS participants to draw from as necessary.

◊ Projected overall ~50% increase in available manpower in near future.

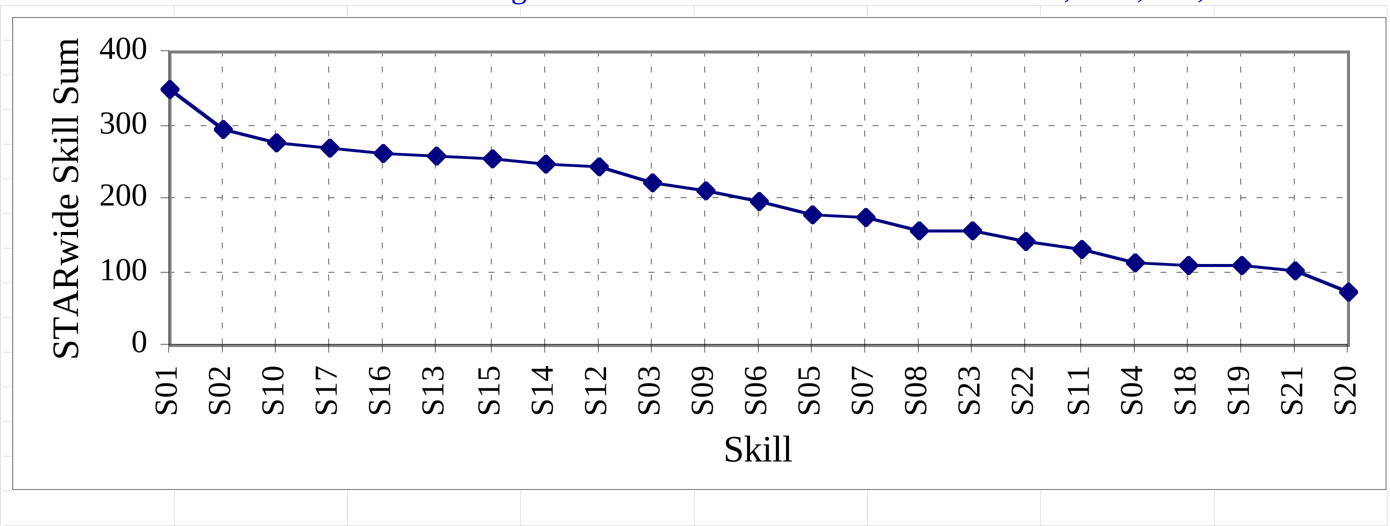
*maintain current to-do lists for members to choose from.*

*focus on providing the software tools and the documentation that make it easy to get started.*



◊ Indications of acute shortages and possible future bottlenecks:

- One critical area was “gstar infrastructure”. Recently remedied as Pavel Nevski has accepted a position at BNL with STAR...
- The group is overall most skilled in PAMs and GEANT...
- The group is overall least skilled at C++, GUI tools, visualization, & using and programming databases...



UNIX and Fortran

PAMs and geant

starlib, shell, infrastructure, C

C++, GUI, Vis, databases

## *Plans*

Keep current the documentation and lists of open tasks...

Continue to exercise and optimize the chain with an eye towards *"large"* CPU-efficient runs, database access, data set libraries,...

Continue study of the relationships:
geometry detail/CPU time/output size/accuracy
GEANT parameters/CPU time/output size/accuracy

Make improvements to g2t:
complete addition of last two detectors
allow variable sizes of hits vectors
translate geometry banks for STAF input
port to other platforms

Make improvements to gstar:
port to Pentium Pro farm
continue study of "shower track" mechanism
standardize event input

Make improvements to Simulations/STAF Interface:
complete ports of detector simulators to STAF
port detector simulators to other platforms
accept geometry information and pass to detector simulators
accept events directly from event generators

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Develop geometry database and paths to AGI and STAF...

Develop paths between detector simulators and calibrations database...

Study viability of specific analysis algorithms in gstar...

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*Another renovation of this magnitude*
*is not foreseen...*