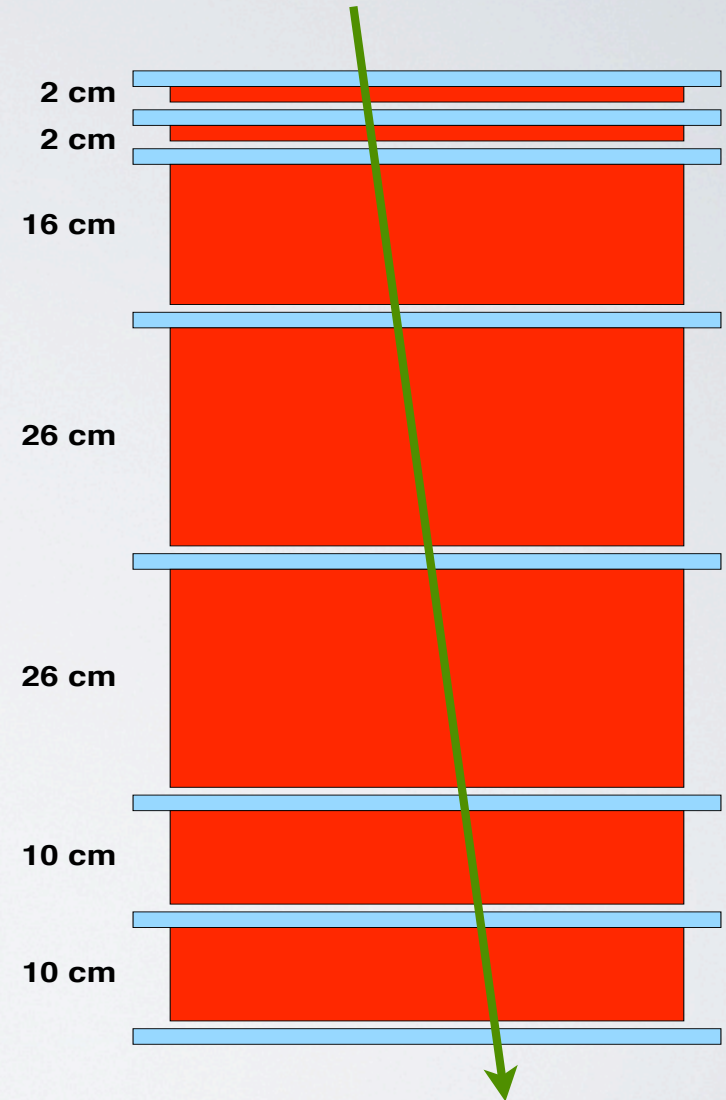# STATUS OF PROTOTYPE PREPARATION

Ferrara Group

OUTLINE

- Modules preparation

  - Scintillators, fibers, PCBs...

  - Pizza Box and assembling

  - Readout configurations

- Preparing the Q.C.

- DAQ system and Online monitor

- Overall status and schedule

- Summary and outlook

2 cm
2 cm
16 cm
26 cm
26 cm
**10 cm**
10 cm

SCINTILLATORS

- Scintillator bars for binary readout arrived in Ferrara a couple of weeks ago; delivered

  - 350 pcs 60cm (for the prototype)

  - 15 pcs 400cm (for final detector R&D)

- We need about 180 bars for the prototype binary readout so we have plenty of spares.

- The scintillators need to be cut to have the same length: either 50cm or 60cm depending on the view (vertical bars must allow the fiber to bend therefore they will be shorter).

- The scintillators have 2 holes: an additional groove will be done with a diamond tool. Procedure tested with good results in terms of surface transparency and rapidity. Tooling ordered.

- 2-cm scintillators will be delivered... April? May?

FIBERS

- All fibers have been delivered:

  - Kuraray (for binary readout): 1800m - $\Phi=1.2$mm

  - Saint Gobain (for time readout): 1000m, $\Phi=1.0$mm and 500m $\Phi=1.2$mm.

- Fiber polishing will be done using a diamond mill (see next slide for tests result). Tooling ordered.

- QC need to be setup to measure the deterioration of the diamond mill

- For the Binary readout: only one end read, the other end can be aluminized. Not difficult, but test will be done to establish if there is some advantage.
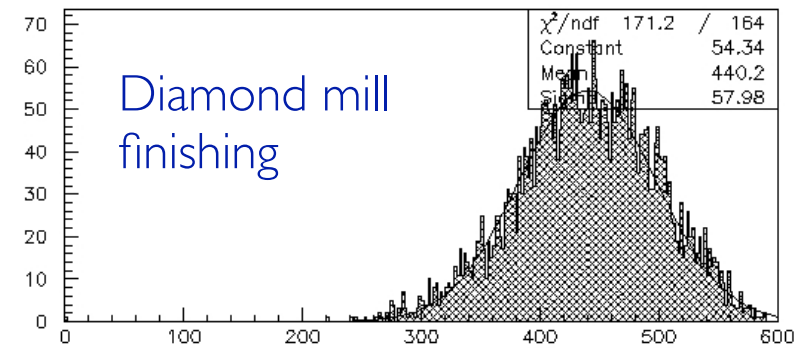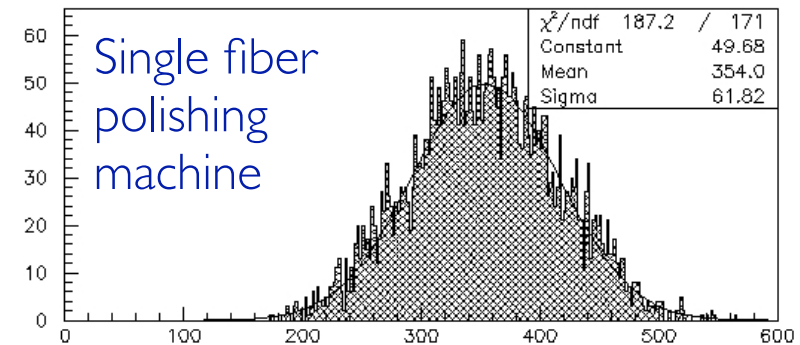
FIBER POLISHING

Fiber 1

Diamond mill finishing
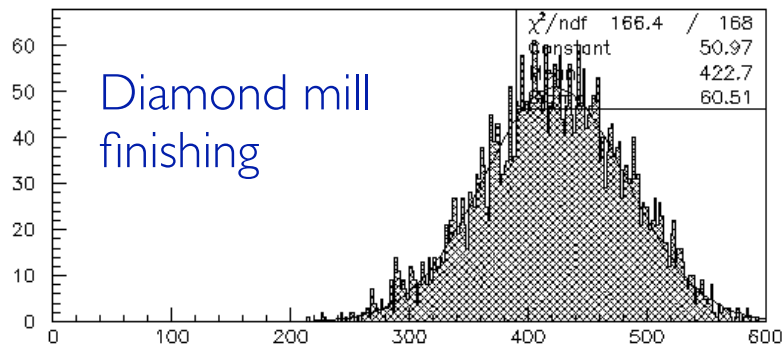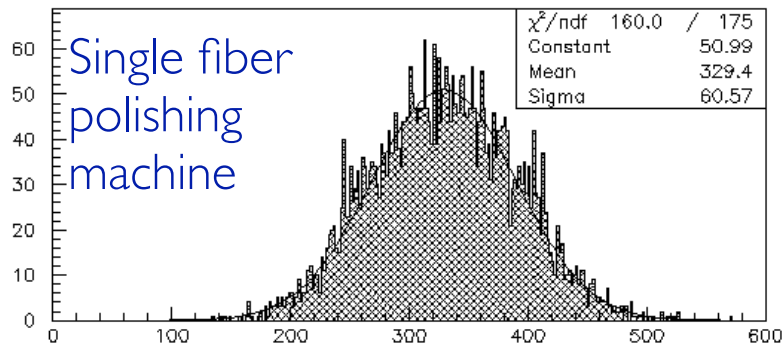
Single fiber polishing machine
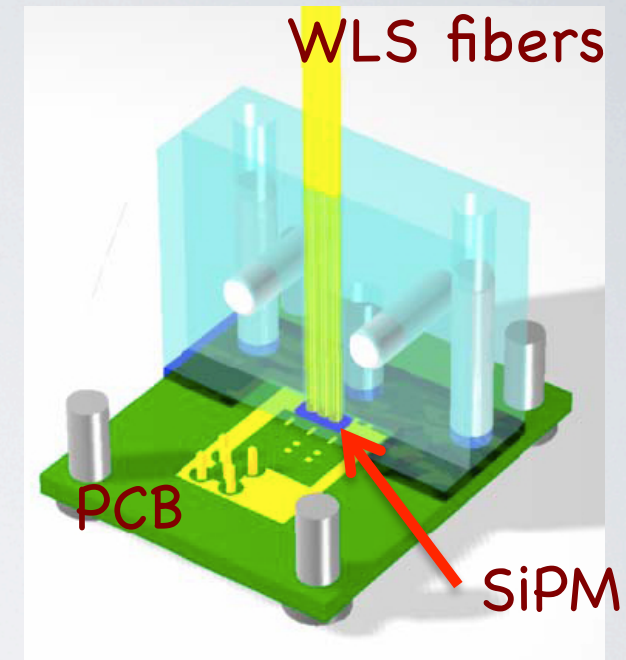
Fiber 2

Diamond mill finishing

Single fiber polishing machine

LED test comparing the light on the ends of the fibers polished with the Diamond mill and the polishing machine (flying diamond cutter)

Fiber 1: diamond/polishing-mach = 422/329 = 1.28
Fiber 2: diamond/polishing-mach = 440/354 = 1.24

FIBER/SIPM COUPLING AND PCB

- PCBs delivered.

- SiPM/fiber coupling connector to be finalized. Quotation already asked, 2 weeks for delivery.

- Need to make the masks to position the SiPM on PCBs.

- QC should be setup to assure the correct placement of the SiPM and the alignment of the fibers w.r.t. the photodetector.

WLS fibers

PCB

SiPM

ASSEMBLING

- Scintillator planes will be assembled in a light-tightened box (a.k.a. Pizza Box) to avoid dealing with single fiber/module light isolation and to give mechanical rigidity to the active layers

- PBCs and Photodetectors will be located inside the Pizza Box to avoid fibers going out.

- Fibers and scintillator machining will be done in the mechanics workshop, while the assembling stage will be done in a clean room.

- Scintillator/fiber coupling will be done by means of a very fluid optical epoxy.

PIZZA BOX (I)

- Pizza box for standard time readout module

Fiber-SiPM coupler

WLS fibers

15
14 Scintillator

Fibers Holder

3
2
1

Scintillators: 20x40x600 mm, 15 bars, only Horizontal
WLS fibers: 3 per scint. bar = 45, L = 4.0m, Saint-Gobain BCF92, φ= 1.0mm
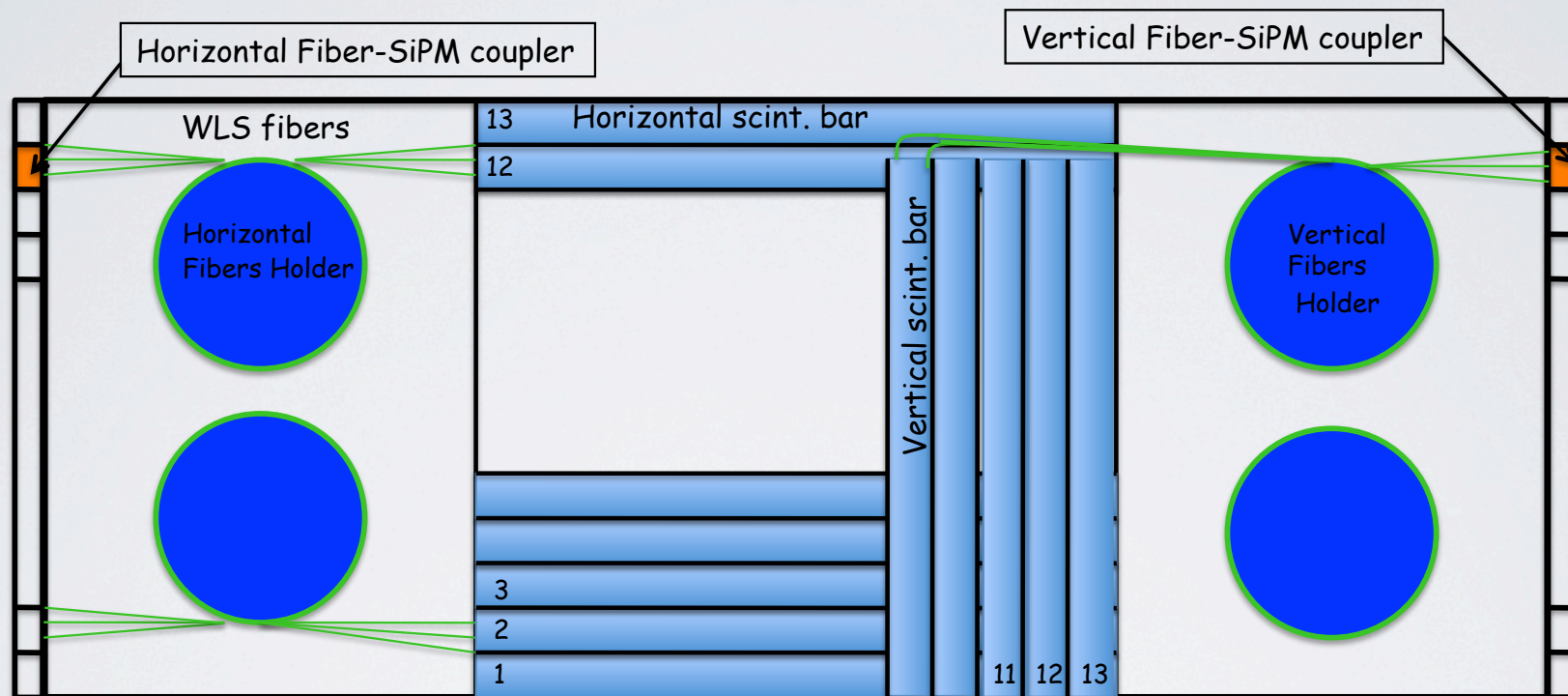SiPM: 1.2x3.2 mm^2 on both fibers ends
Fibers-SiPM couplers: 30, 3 adjacent 1mm fibers

PIZZA BOX (II)

- Pizza box for standard binary readout module

Horizontal Scintillators: $10 \times 45 \times 600$ mm^3, 13 bars, L=600mm

Vertical Scintillators: $10 \times 45 \times 500$ mm^3, 13 bars, L=500mm

WLS fibers: 3 per scint. bar = 90, L = 4.0m, Kuraray Y11(300), φ= 1.2mm

SiPM: 1.4×3.8 mm^2 only on one fibers end

Fibers-SiPM couplers: 30, 3 adjacent 1.2mm fibers

READOUT CONFIGURATION

- 4 Time readout standard modules: fibers=bicron φ=1mm, sensors=1.2x3.2 mm^2

- 1 Time readout special module: fibers=kuraray φ=1.2mm, sensors=1.4x3.8 mm^2

- 1 Time readout special module: fibers=kuraray φ=1.2mm, sensors=round φ=1.4mm

- 4 Binary Readout standard modules: fibers Kuraray 1.2mm, sensors=1.4x3.8mm^2

- 1 Binary readout special module: fibers Kuraray 1.2mm, round φ=1.4mm

FIBERS LENGTH CONFIGURATION

For Time readout (total length 400 cm - SiPM on both sides)
  50cm   - 350cm
  200cm - 200cm   -> the spare module will have this configuration
  100cm - 300cm
  150cm - 250cm

To have measurements every 50 cm.

For Binary readout (reading on one side - two independent views)
     X   Y
  40 cm + 80 cm
  300cm + 260cm   -> the spare module will have this configuration
  120cm + 220cm
  140cm + 180cm

Measurements at 40, 80, 120, 140, 180, 220, 260, 300 cm.

PLANNING THE Q.C.

- Visual inspection of SiPM just after the bonding in Perugia.

- SiPM characterization: gain, threshold, noise (I-V curves done at IRST).

- LED irradiation through WLS fibers for a fine check of the photodetector positioning.

- Test on polished fibers to check the damage of the diamond tool.

- Single Pizza Box cosmic test to check the readout chain.

ASSEMBLING PROCEDURE

Scintillator modules

- Work on single pieces: fibers, scintillators

- Then assemble everything together in the clean room:

  - Position fibers inside the holes and glue them.

  - Block the fibers into the connectors (alignment is critical).

- Assemble the scintillator plane inside the Pizza Box - roll the fiber bundles on the fibers holder

SiPM

- Visual inspection of the SiPM after bonding

- Test SiPM position on the PBC with LED on a fiber setup.

- Characterize SiPM and choose the ones with similar performances.

Finalizing the modules

- Mount the PCBs inside the Pizza box

- Attach the fiber connector on the PCBs

- Close the box and test it with cosmics

- If OK then close the Pizza Box with black tape to assure the light tightens

DAQ SYSTEM & ONLINE

BIRO (TCP/IP)

TDC (TCP/IP)

BIRO (TCP/IP *on port xxxx*)
TDC   (TCP/IP *on port yyyy*)
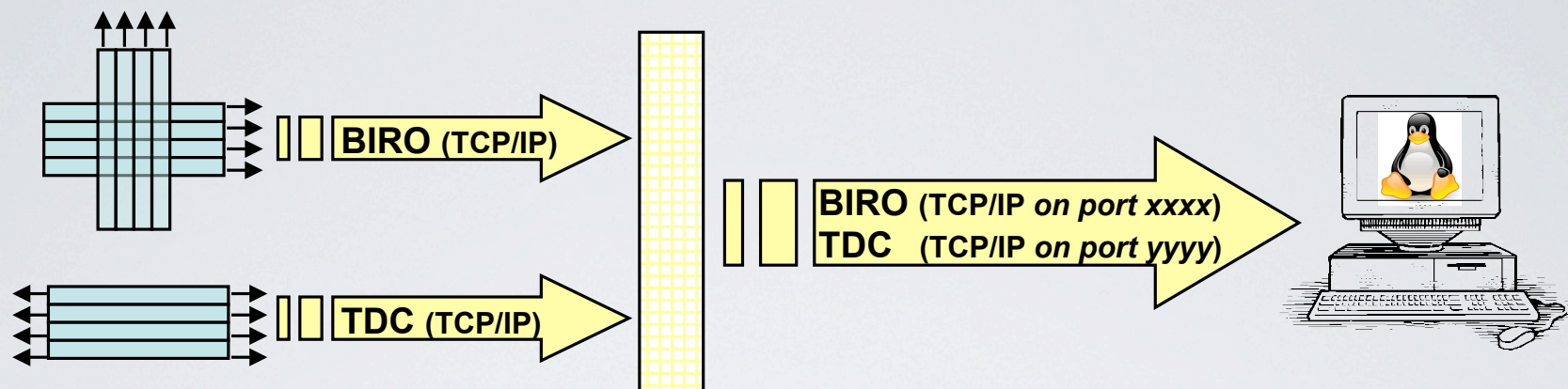
<u>DAQ</u>

➢Interface C++ (realized with Qt development tools)

✓ Receives events via TCP/IP
✓ Preprocess events
✓ Store RAW and preprocessed events in files

<u>ONLINE Monitoring</u>

➢ Interface C++ (realized with Qt development tools)
➢ Analysis code Root integrated in Qt

✓ Read stored events by DAQ
✓ Decode event strings
✓ Produce appropriate rootuples
✓ Produce histo about hits occupancy and time distribution

DAQ SYSTEM
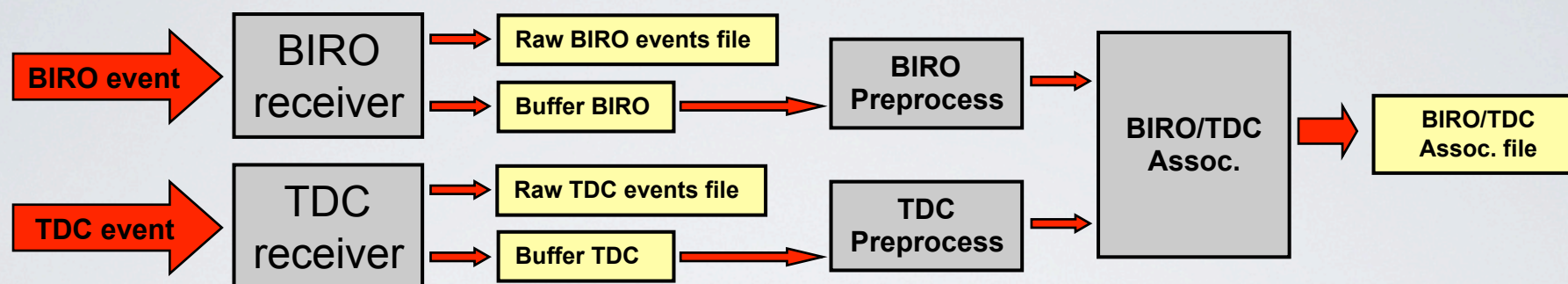
BIRO and TDC receiver via TCP/IP on different port:
- ✓ store raw events on file
- ✓ send string event to buffer for preprocessing
- ✓ send info to Trigger/BIRO/TDC online monitoring

BIRO and TDC preprocessing:
- ✓ check integrity of event string
- ✓ send string event to buffer for preprocessing
- ✓ send preprocessing info to online monitor

BIRO and TDC association:
- ✓ put together BIRO and TDC string of the same event
- ✓ store complete event in a file
- ✓ send assoc. info to online monitor

DAQ USER INTERFACE

M. Andreotti

OVERALL ORDER STATUS

- All fibers (Kuraray and Saint-Gobain) have been delivered:

  - Kuraray 1800m-φ=1.2mm

  - Saint-Gobain 1000m-φ=1.0mm, 500m-φ=1.2mm

- Scintillators (10mm) delivered: 350pcs-60cm, 15pcs-400cm, Scintillators (20mm) expected (april?).

- Tooling for fibers polishing and scintillator machining (additional groove) ordered.

- PCBs (SiPM holders) just arrived.

- Given the PCBs real dimensions, finalize the mechanics of the SiPM-fibers couplers and place the order (quotation already asked) should take $\approx$2weeks to get the pieces.

- Make the masks to position SiPM on PCBs.

- First Pizza box delivered, needs some additional work.

- Glue ordered, expected soon.

TENTATIVE SCHEDULE

Addressed
Need action
Critical
Too far

	Mar	Apr	May	Jun	Jul	Aug
setup the clean room and infrastructure						
machine the scintillators						
fiber cut and polishing						
prepare pizza boxes						
BiRO module assembling and test						
QC infrastructure preparation						
DAQ system and online monitor						
Offline reconstruction code						
Time readout module delivery and assembling						
SiPM delivery: bonding and QC						
SiPM characterization						
Electronics design, construction/test and integration						
Cosmic test in Ferrara						
Cosmic test in Legnaro						
Shipping						
FNAL beam test						

SUMMARY AND OUTLOOK

- All the relevant activities have started.

- Successfully addressed some key item like fiber polishing and SiPM/fiber coupling.

- The main tasks are covered except, perhaps, the Q.C. infrastructure preparation that need to be addressed soon.

- The schedule is very tight and driven by the SiPM delivery (sometime in May?). After that SiPMs need to be bonded, characterized and the readout chain tested: it's important to have a careful planning of these activities.