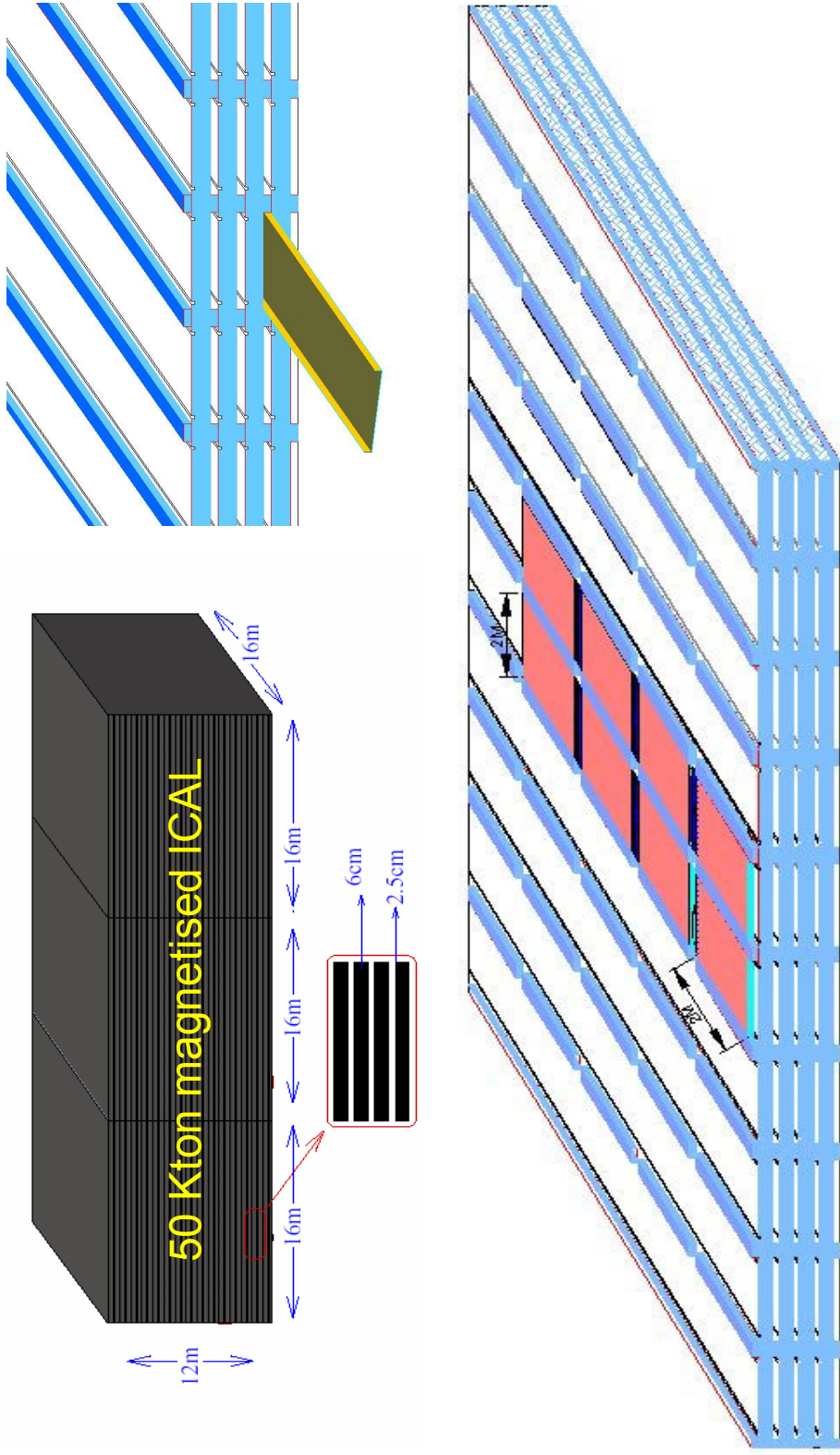


Preliminary results from INO detector R&D programme

B.Satyanarayana, TIFR, Mumbai, INDIA
For INO Collaboration

INO detector concept



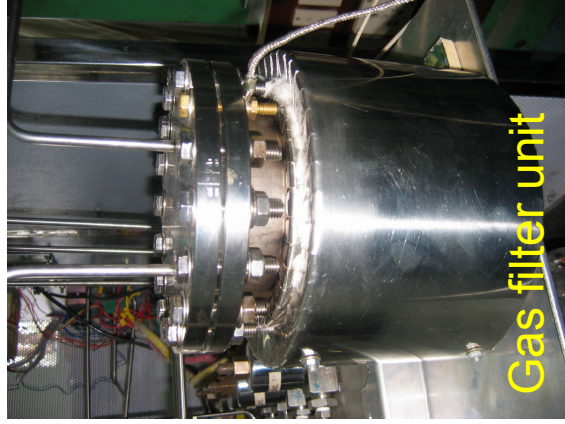
INO detector specifications

Number of modules	3
Module dimensions	16 m X 16 m X 12 m
Detector dimensions	48 m X 16 m X 12 m
Number of layers	140
Iron plate thickness	~6 cm
Gap for RPC trays	2.5 cm
Magnetic field	1.3 Tesla
RPC unit dimensions	2 m X 2 m
Readout strip width	3 cm
Number of RPCs/Road/Layer	8
Number of Roads/Layer/Module	8
Number of RPC units/Layer	192
Total number of RPC units	27000
Number of electronic channels	3.6×10^6

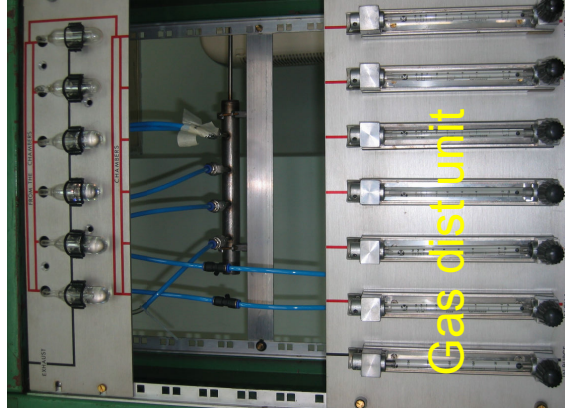
RPC R&D infrastructure at TIFR



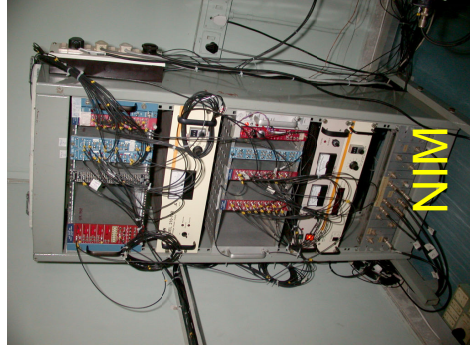
Gas mixing unit



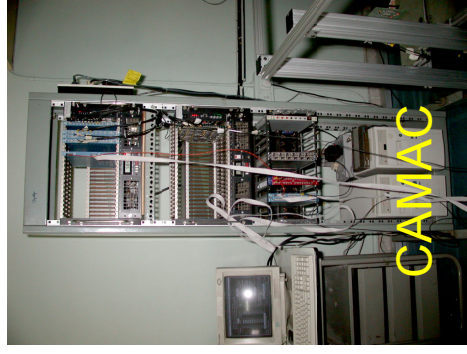
Gas filter unit



Gas dist unit



NIM



CAMAC



Telescope stand

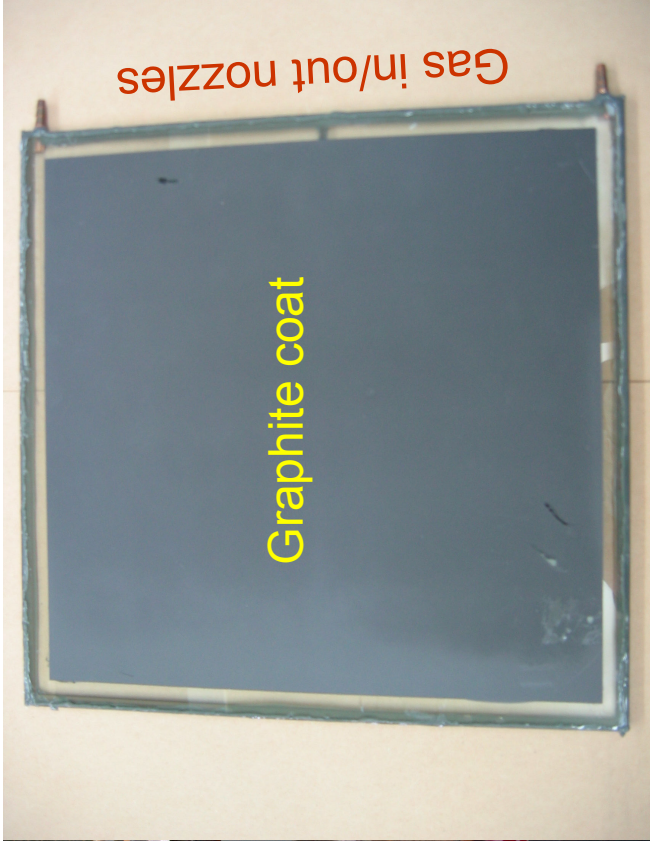


Tools and jigs

Typical TIFR prototype RPC designs



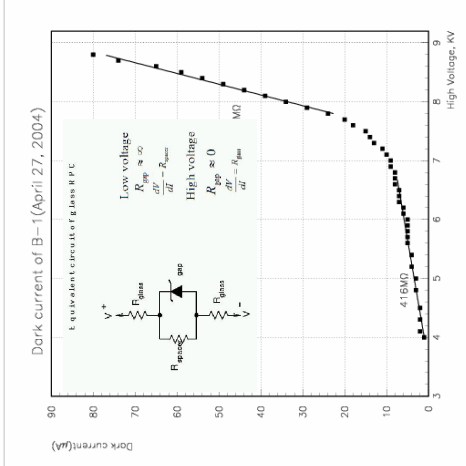
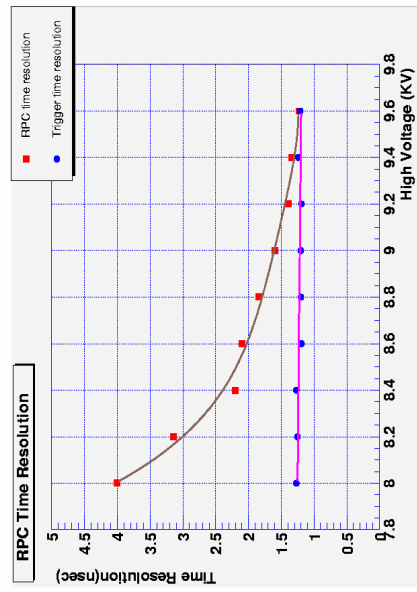
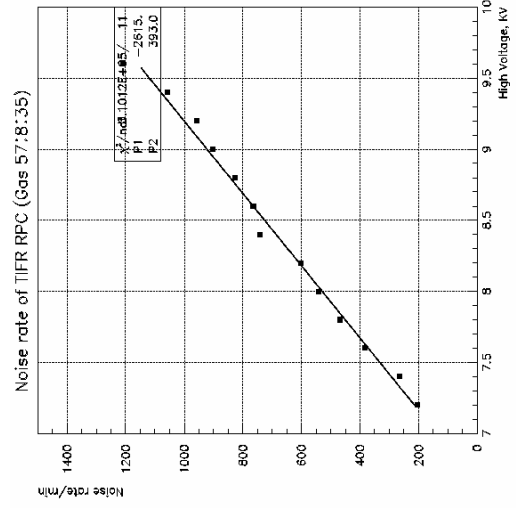
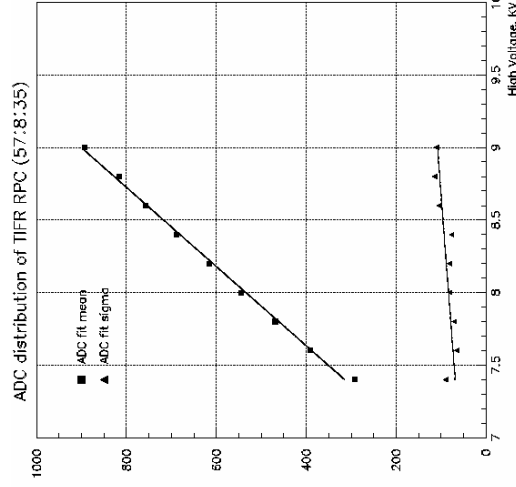
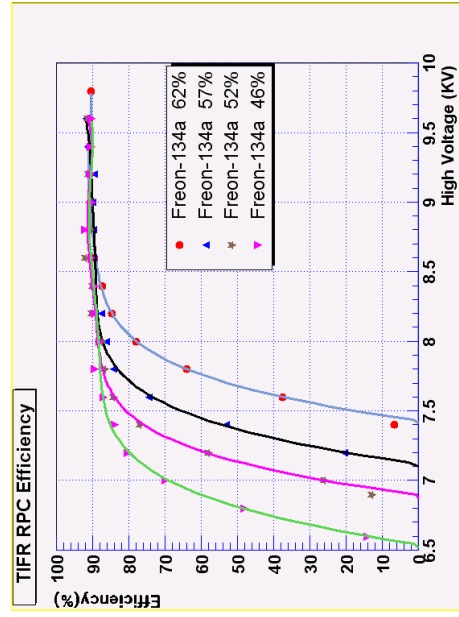
1200 X 900 mm



400 X 300 mm

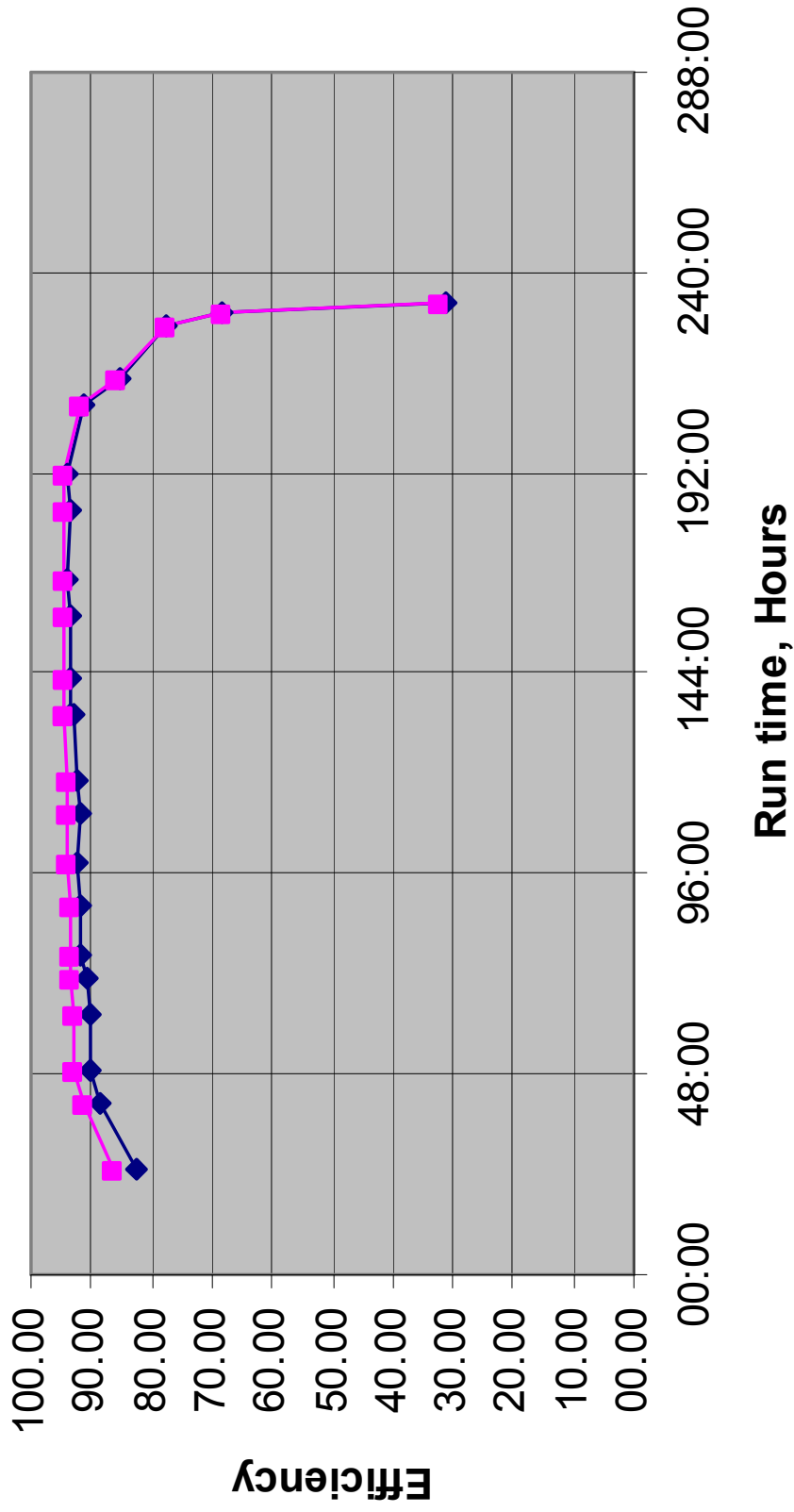
- ❑ 2mm thick local float glass (Modi, Asahi)
- ❑ 2mm single gas gap using Noryl spacers

A few of our first results (Streamer)

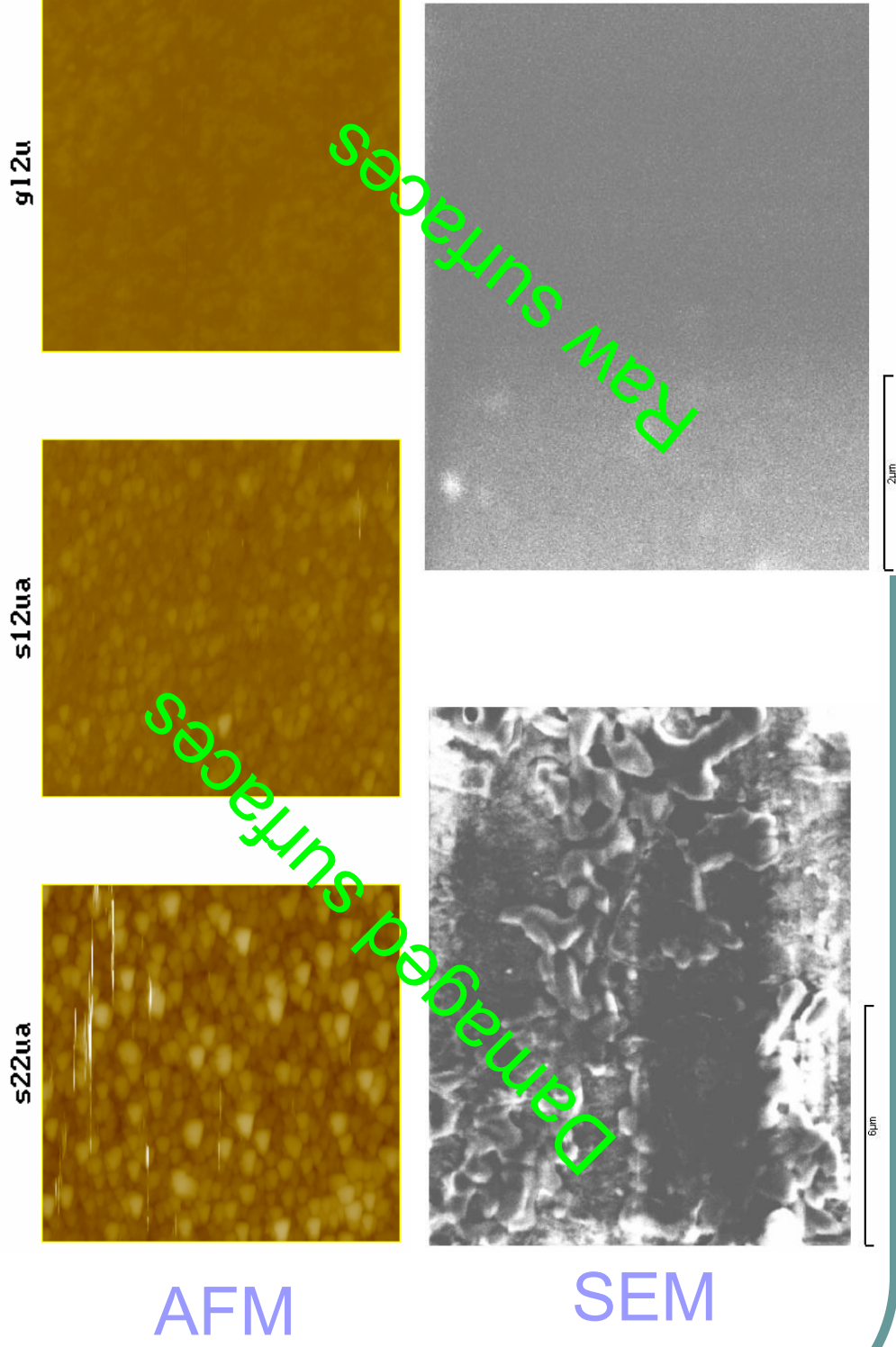


Gas Mixture	Tele window (mm)	Cross talk (%)
62:8:30	10	6.8
62:8:30	15	6.7
62:8:30	20	6.2
57:8:35	20	6.5
52:8:40	20	5.9
46:8:46	20	6.3

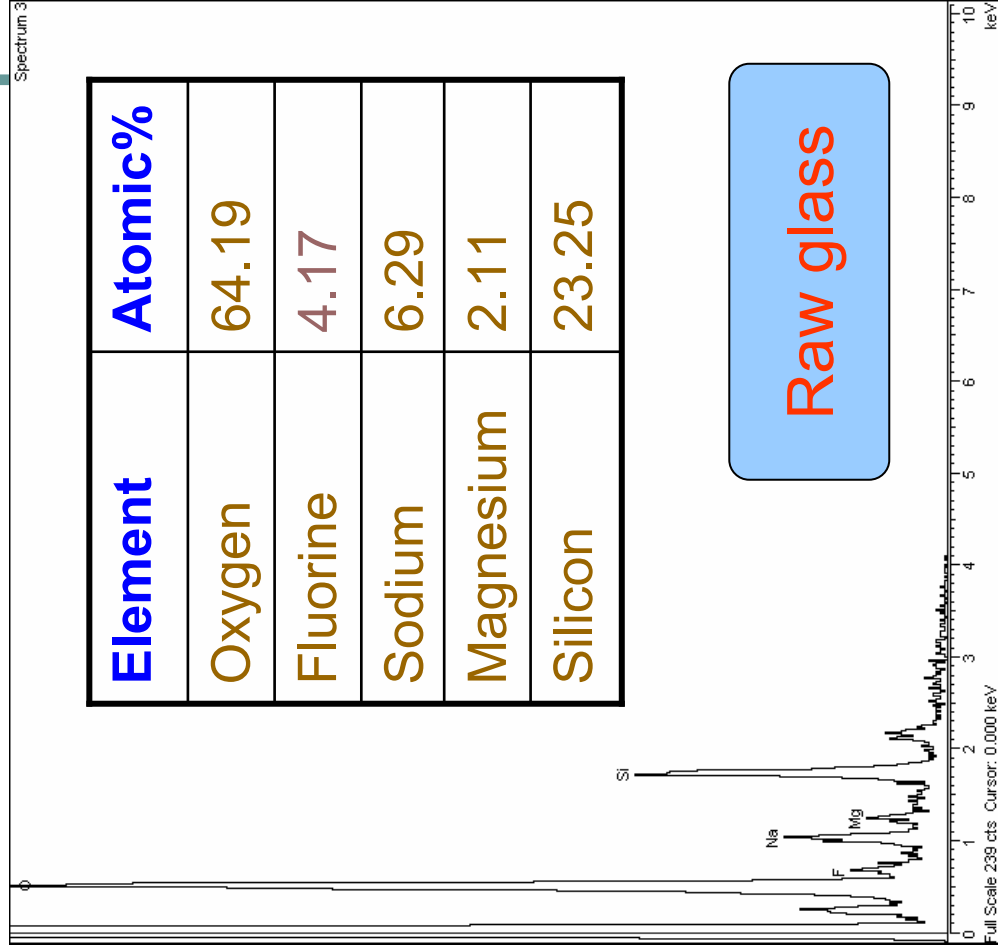
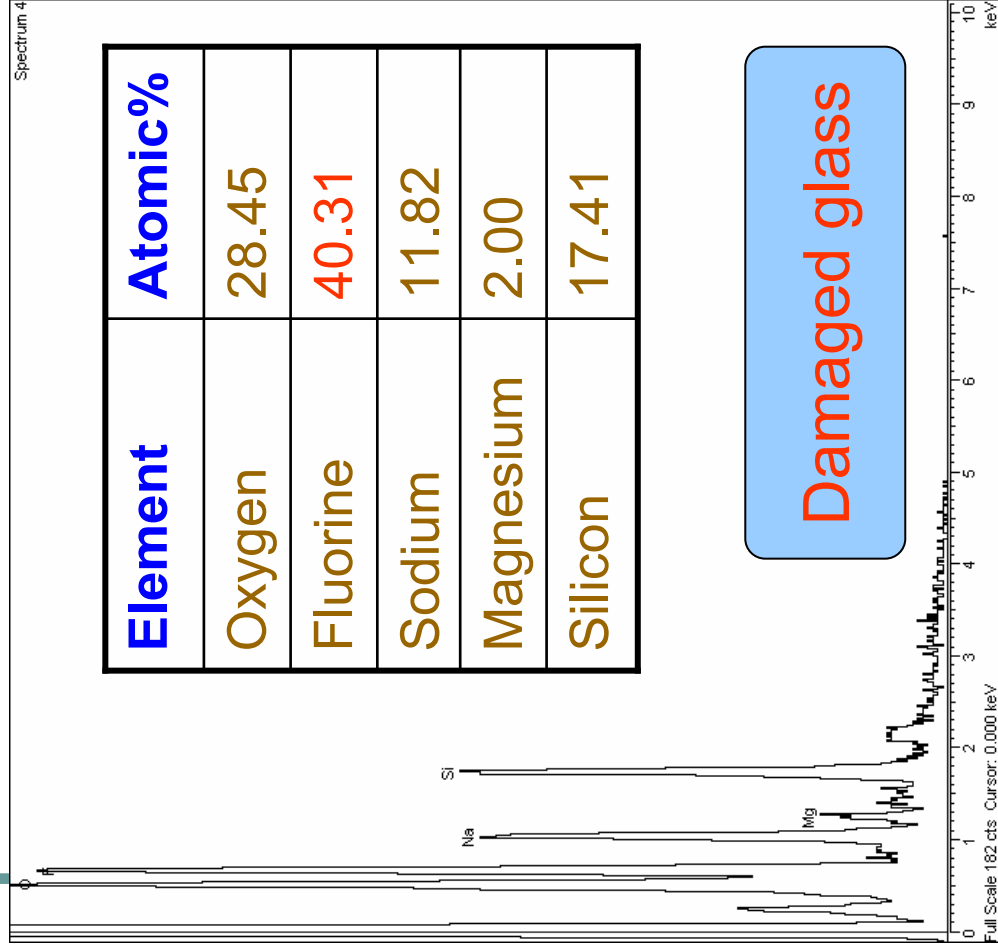
Aging: Efficiency drop of a RPC



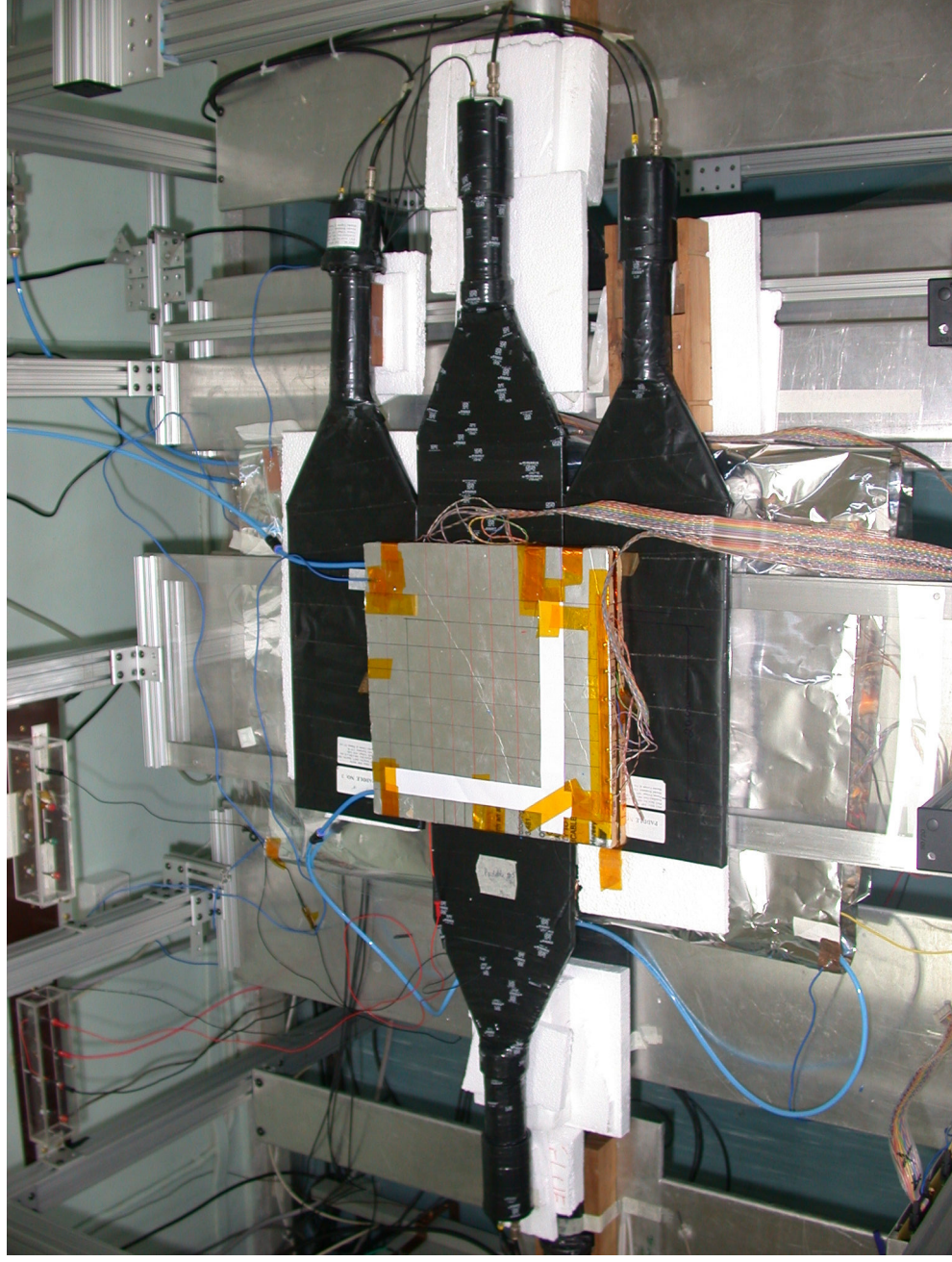
Aging: AFM and SEM scans



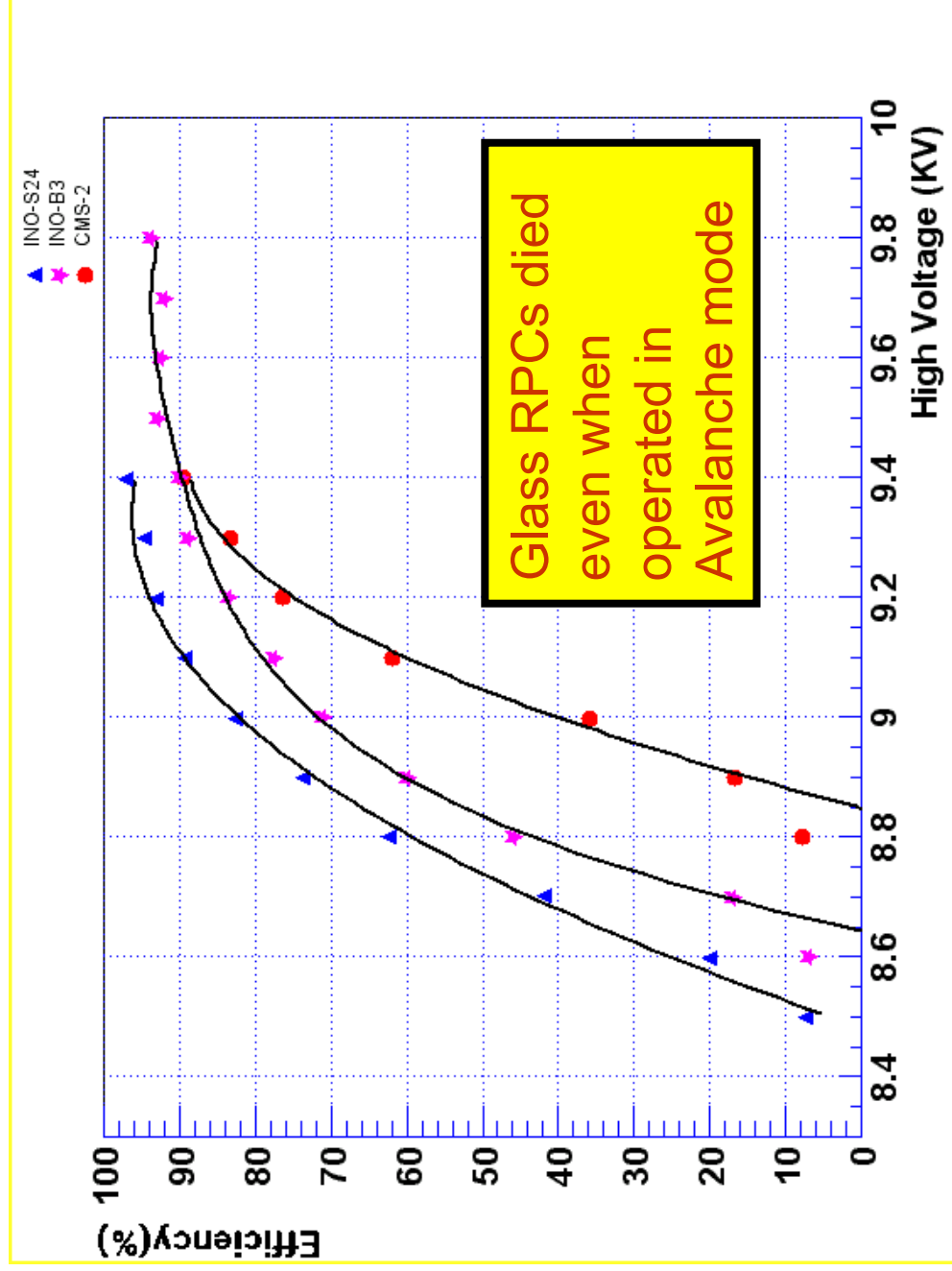
Aging: Element analysis



CMS & TIFR RPCs under test



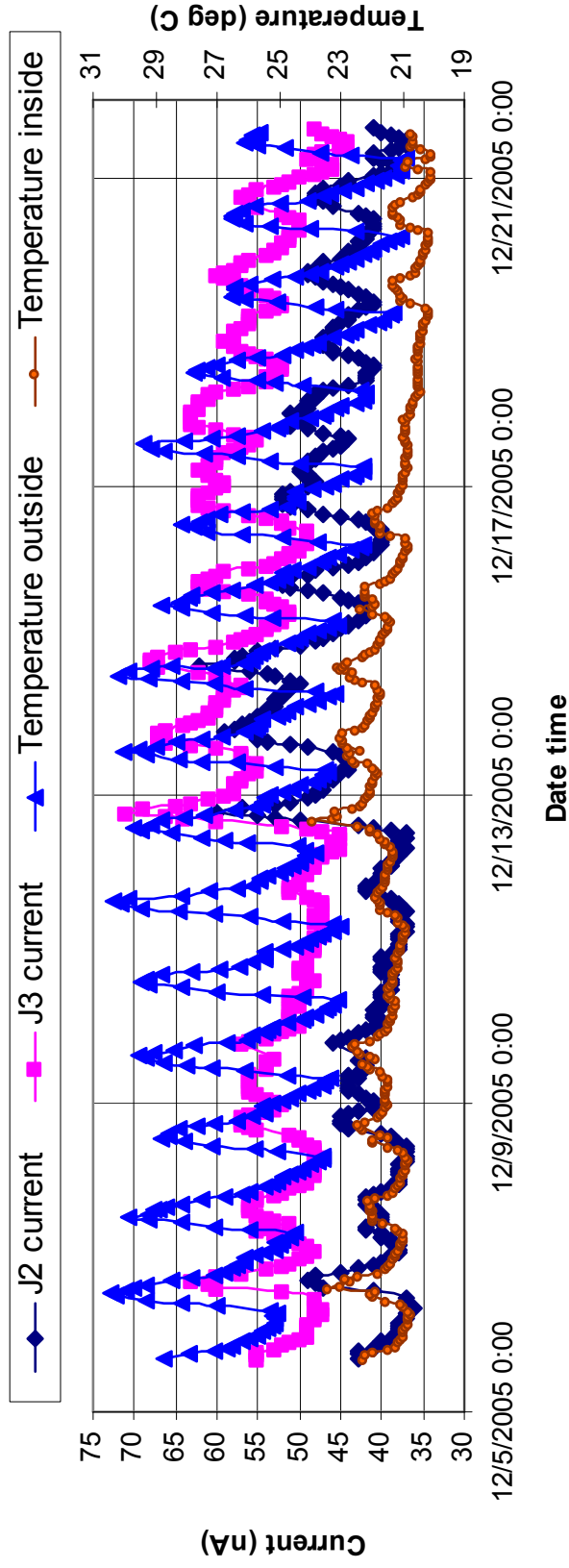
Efficiency comparison (Avalanche)



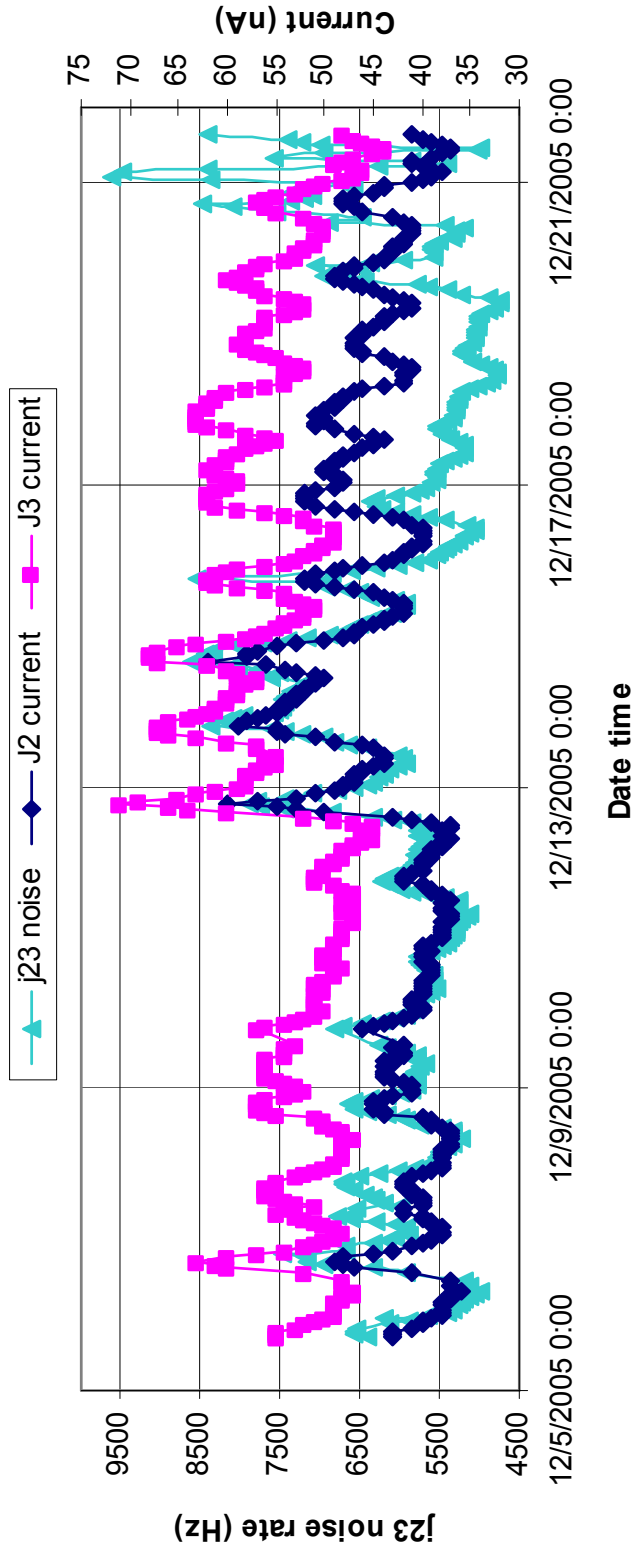
Long term study of two RPCs

- Two RPCs (J2 and J3) made out of Japanese glass
- Readout by common pickup panel
- Operated in avalanche mode (R134a: 95.5% and the rest Iso-Butane) at 9.3KV
- Round the clock monitoring of RPC and ambient (T, RH and P) parameters
- In the system for more than 5 months
- Chamber currents, noise rate, combined efficiencies etc are stable

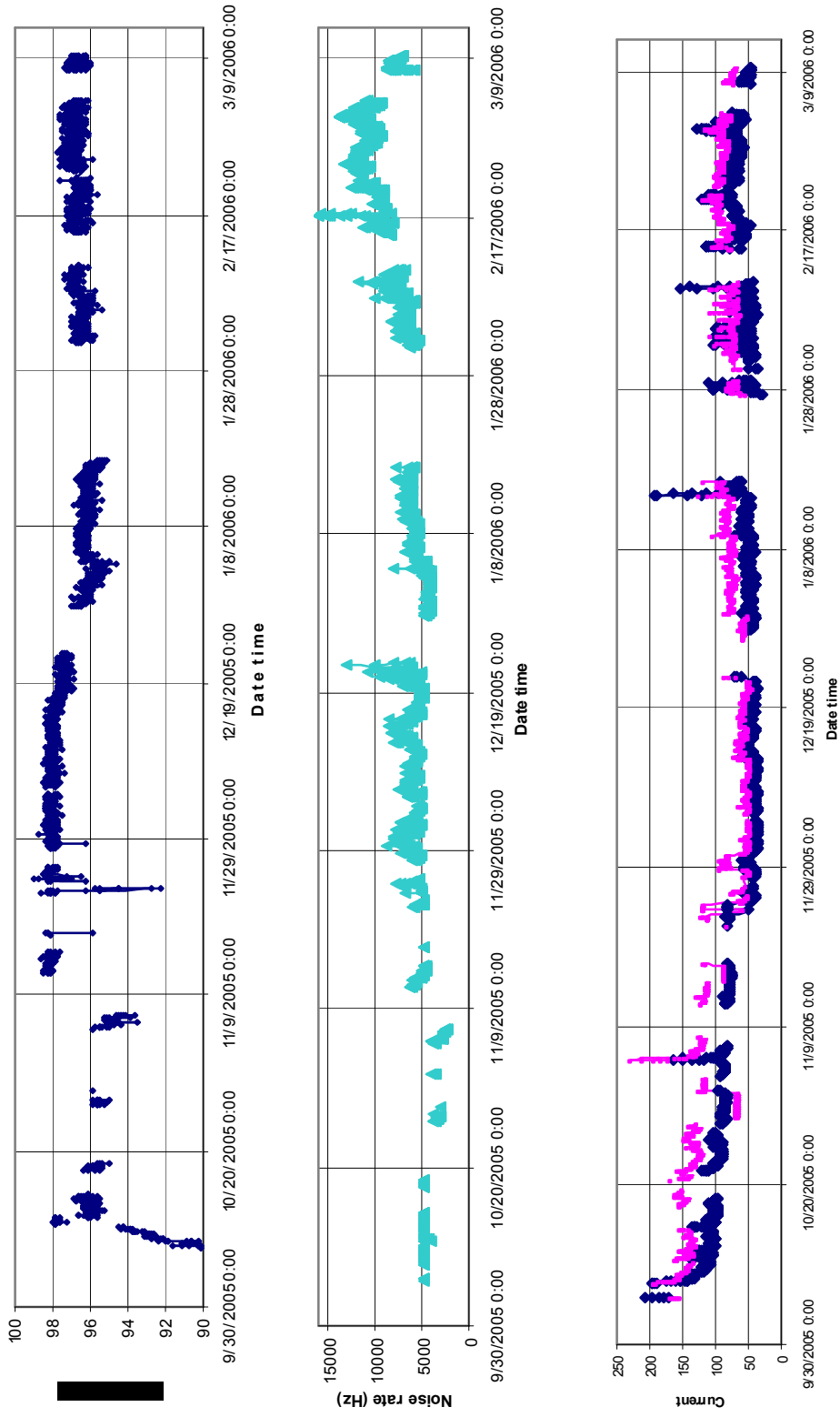
J2+J3 currents Vs Temperature



J2+J3 Noise Vs Currents



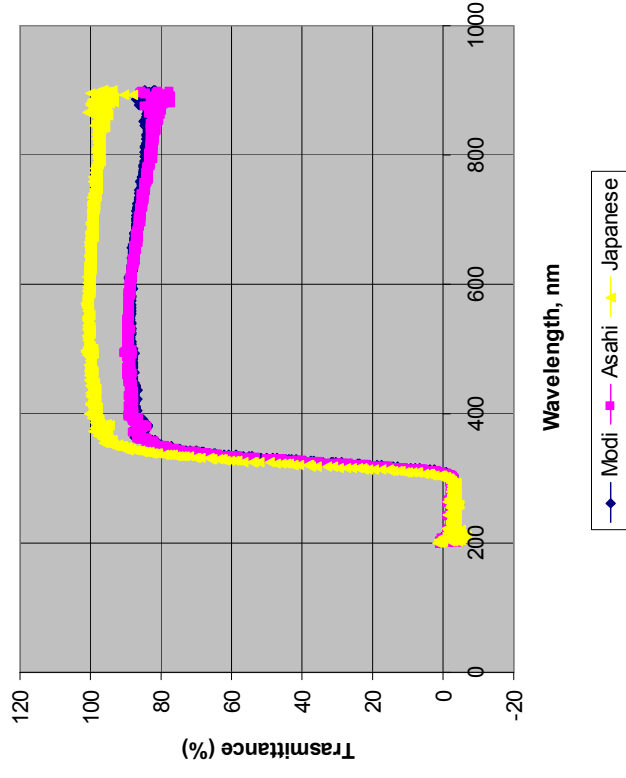
Long term stability of RPCs



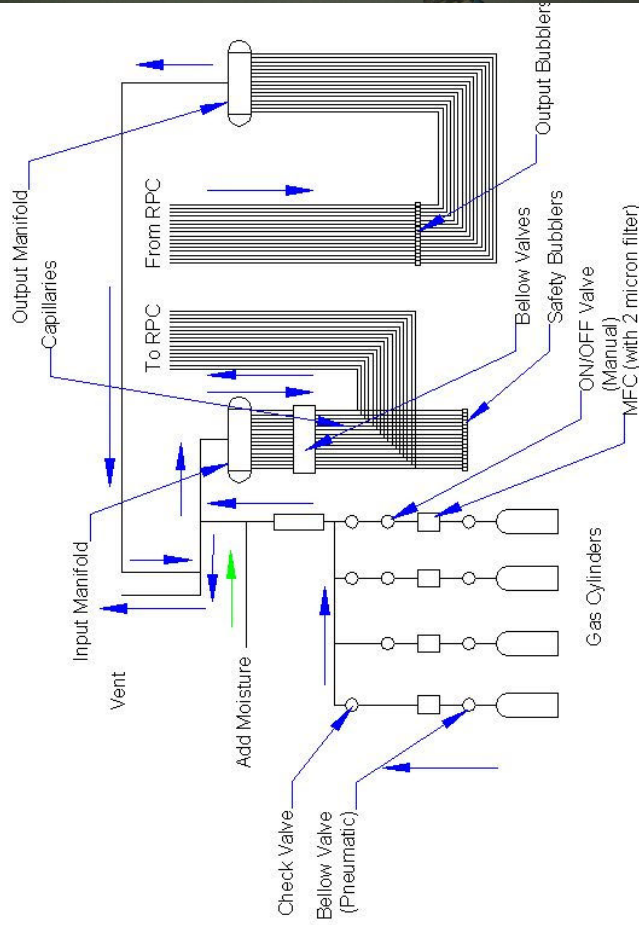
What is special in glass?

- Glass surface quality and element analysis comparison didn't show appreciable differences
- Transmittance tests showed marginal differences between Japanese and local glasses
- Tests to continue till we find the significant differences

Transmittance test



New gas system



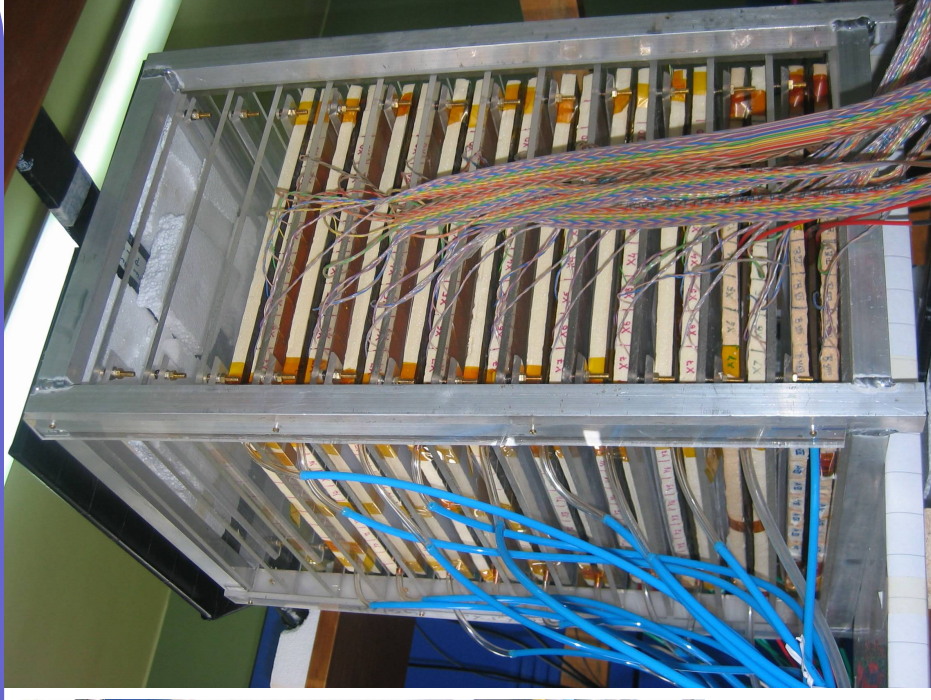
New gas system features

- ❖ 16 pneumatically controlled outputs
- ❖ Molecular sieve based input filter columns
- ❖ Nippon Tylan made model FC-760 MFCs
- ❖ Parker made fine filters on the mixed gas
- ❖ On-line moisture readout on mixed gas
- ❖ Output flow control by SS 0.3mm capillaries
- ❖ Bleeder bubblers for RPC protection
- ❖ Facility to add controlled moisture into the mixture
- ❖ Computer interface for control and monitoring

New RPC laboratory at TIFR

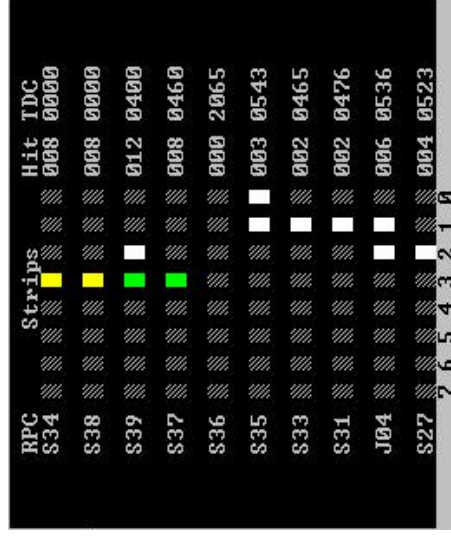
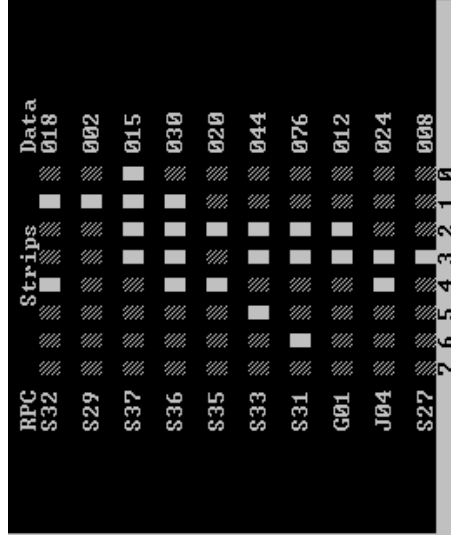
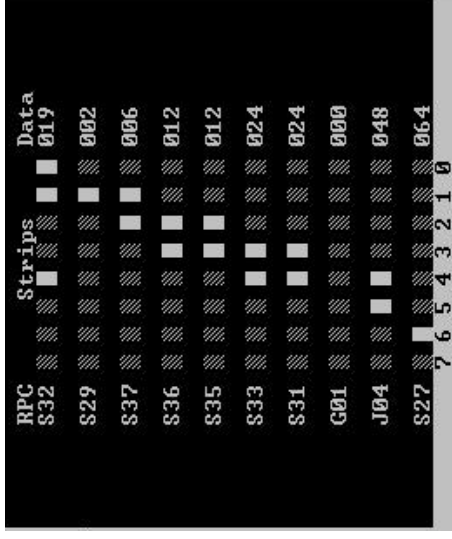
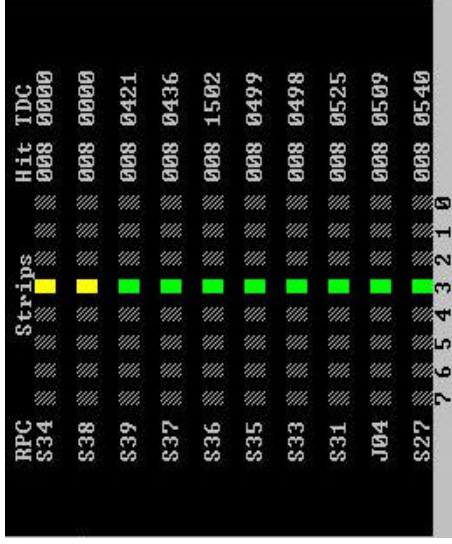


- Streamer mode (R134a=62%, Argon=30% and the rest Iso-Butane)
- Recording hits, timing, noise rates etc



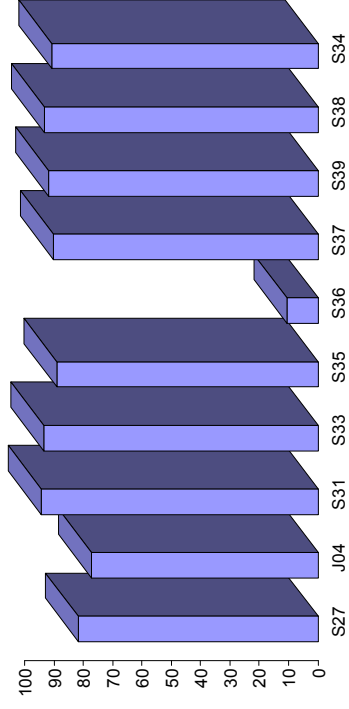
Stack of 10 RPCs

Some interesting events tracked

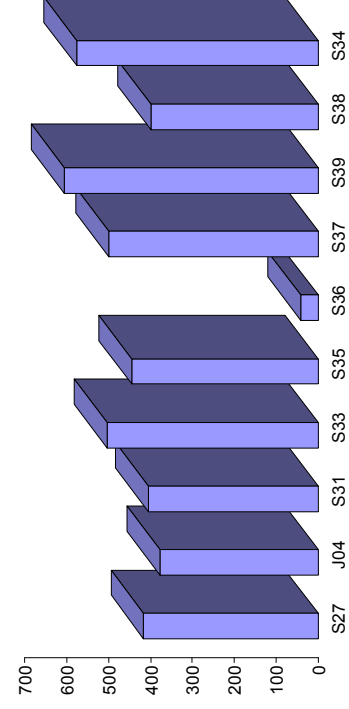


Some extracted parameters

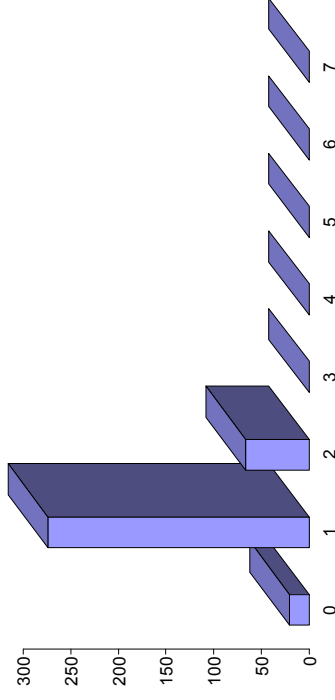
RPC efficiencies



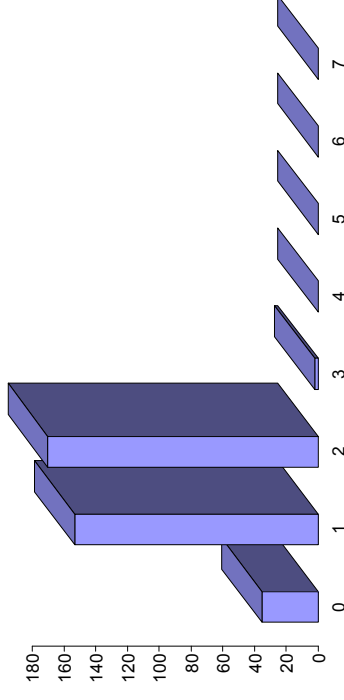
Total hits of RPCs



Strip hit distribution of S-31

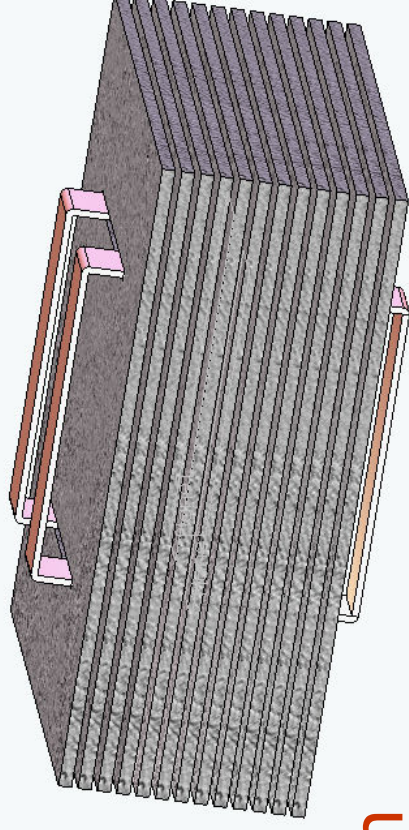


Strip hit distribution of S-37



Scheme of INO prototype detector

- 12, 1m² RPC layers
- 6cm thick magnetised iron plates
- About 1000 readout channels
- RPC and scintillation paddle triggers
- Hit and timing information



Summary and outlook

- ❑ Two RPC laboratories are operational at TIFR
- ❑ Built and operated dozens of small and medium sized chambers
- ❑ RPC operating parameters measured
- ❑ Met with the aging problem – Is the glass the reason?
- ❑ RPCs made with Japanese glass are surviving
- ❑ Glass characterisation studies in progress
- ❑ Plan to make many RPCs with 1 m² Japanese glass
- ❑ Long term studies of small chambers to continue
- ❑ Tracking with RPC stacks with X-Y readout
- ❑ Building of INO prototype detector is the top priority
- ❑ Issues of large scale production

References

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3. India-based Neutrino Observatory, Interim Project Reports 1 & 2, INO/2005/01, May 2005
4. VIII Workshop on Resistive Plate Chambers and related Detectors, Korea University, Seoul, Korea, October 10-12, 2005
5. WIN05, Delphi, Greece, June 6-11, 2005
6. NUFACT05, Frascati, Italy, June 21-26, 2005
7. DAE-BRNS 50th Symposium on Nuclear Physics, Bhabha Atomic Research Centre, Mumbai, December 12-16, 2005