# The INFN Participation to JUNO



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Consiglio di sezione

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## Framework of INFN involvement in JUNO

Main Motivations

Scientific continuity → Neutrino oscillation study and astroparticle program in JUNO natural evolution of the INFN activities in both fields and will represent one of the pillars of the INFN participation to the next round of "gigantic" neutrino oscillation experiments worldwide

Technological continuity  $\rightarrow$  broad expertise acquired in the course of several scientific programs at Gran Sasso in many areas, e.g. scintillator optical properties and purification, electronics, low background techniques, analysis and MC methods, geoneutrino detection; all can be profitably reused within the JUNO project

Specific asset from Gran Sasso to Jiangmen  $\rightarrow$  reuse of the OPERA plastic scintillator tracker (40% INFN funded for PMTs) for the JUNO top muon tracker

Milano, July 8, 2015

# Status of the group

Over the past year strong consolidation of the INFN group in JUNO, following the two years of participation to the activities of the proto-collaboration of the initially interested people. Italian component formally established in June 2014

#### Seven INFN sections

#### Experimental background

Padova	
Milano	
Milano Bicocca	(recent addition)
Ferrara	
Perugia	
Roma3	
Frascati	

Gerda, Opera, Icarus Borexino, DarkSide Cuore Borexino Borexino, DarkSide Argo, DarkSide Opera

### All the groups are deeply connected with Gran Sasso!!

# Approval from the Committee II

First scientific presentation of JUNO in September 2013, also Yifang was present

Second presentation in July 2014, with the presentation of composition and expression of technical interest of the various INFN sections group and the formal request to be approved

In September 2014 formal approval granted by the Committee II

In parallel, supported by the INFN endorsement, we took some roles in the coll.

6 members in the IB (the Milano Bicocca group joined later, formalization next week) 1 member in the EB

- 1 member in the publication committee
- 1 member in the technical board
- 1 co-responsible of a working group (scintillator)
- Deputy spokesperson

## Interests of the groups

Seven INFN sections	Experimental interest
Padova	Electronics of the central detector (included that for the small PMTs system)
Milano	Scintillator optical properties and purification, MC, solar neutrinos, geoneutrinos
Milano Bicocca	Reactor study for flux prediction, low background techniques for scintillator purification
Ferrara	MC, geoneutrino
Perugia	Scintillator optical properties
Roma3	MC and computing
Frascati	Electronics for the Opera tracker used as top tracker

### Each group has defined its area of activity

### To complete the formalization process, INFN meeting with CTS held on July 7

All the groups have participated to the writing of the Yellow Book and CDR

## The global framework

All the mentioned efforts are characterized by a strong cooperative link with the Chinese groups and the European groups

In particular in the European context:

- ✓ Scintillator studies done in cooperation with Munich, Mainz and Russian groups (Dubna, Moscow)
- ✓ Electronics for Central detector in cooperation with Aachen, Paris and Dubna
- ✓ Top tracker in cooperation with Strasbourg

I do not speak of the very successful INFN-IHEP case represented by MC -> Talk of Marco

Frequent working groups meetings at European level together with the Chines collaborators, as well as group meetings in China - scintillator working group at Gran Sasso past October

Fully integrated activities at Collaboration level since the design phase is the concept supporting all our efforts

## Purification

From the general concept described last year to a concrete plan of a pilot plant to be tested at Daya Bay which will guide the final design choice for the JUNO large scale plant

# **Introduction**

From the talk of Paolo Lombardi @ the last proto-collaboration meeting at Kaiping

In Milano we have started a research activity for a possible LAB scintillator purification plant starting from our past long term experience in this field.

The conceptual idea is to adopt, with a proper scaling, the successful purification technique, sequence and construction specifications developed for Borexino experiment @ Gran Sasso .

Borexino plant was designed and constructed by a NJ company (Koch Modular Process System).

We have searched for a reliable European company and we found one in Milano

### Polaris engineering <u>http://www.polarisengineering.com</u>

The company already worked with us for a design upgrade of the cryogenic distillation column at Fermilab for the underground Ar gas purification of DarkSide experiment



Design and supply of separation systems and production units for process industry.



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# DayaBay LAB purification test

Proposal for a complete test in one of the near DB detector of all the purification plants foreseen for JUNO.

Purification plants involved:

- Allumina columns
- Distillation column
- Stripping column

- Distillator unit of our pertinence
- Fluors (PPO and bis-MSB) mixing
- Water extraction

### Some drawings: DB Lab5



JUNO Padova Meeting March 31<sup>st</sup> 2015

### 3D drawing of the first (distillation) sub-unit



JUNO Padova Meeting March 31<sup>st</sup> 2015

3D drawing of the second (stripping) sub-unit



JUNO Padova Meeting March 31<sup>st</sup> 2015

Tender for the first sub-unit (distillation column) funded, bid completed and approved -> Polaris Engineering

Perfectly in line with a delivery to Daya Bay in the Fall

For the second sub-unit (stripping column) funding just awarded, bid procedure started

Delivery probably in the spring

Total funding for the test about 650 Keuros

The funding for the final system will come extra-Comm II

The laboratory measurements with which we have started this work continue with also the addition of distillation tests at laboratory scale

# **Introduction**

Several activities are already ongoing on LAB characterization either in Milano and in Perugia:

- Scintillator measurements on various samples (suppliers and cocktails)
  - Optical measurements in Perugia (emission spectrum, absorbance, attenuation length, light decay time under laser excitation, distillation)
  - Decay Time and pulse shape measurements in Milano under beta, alpha and proton recoil by neutron interaction on various samples (suppliers and cocktails)
  - Charge spectrum measurements under beta, alpha and proton recoil by neutron interaction on various samples (suppliers and cocktails)
- Procurement of LAB from European suppliers and check of the properties to compare with the LAB from China (CEPSA, HELM and SASOL).
- Conceptual definition of the distillation column and of the associate N<sub>2</sub> stripping column for scintillator purification by the company "Polaris-engineering".
- Engineering of a distillation pilot plant for realistic purification tests (flow rate~100 l/h).

an, JUNO meeting

## Contribution in the yellow book and CDR

- Physics cases: Solar neutrinos, geoneutrinos with specific responsibility in the writing and editing of the respective chapters

- MC

- Purification

### Richieste fondi JUNO a Milano

1.	Inventariabile:				
	a. Scheda digitalizzatore laboratorio scint. AGILENT M9210A	8 keuro			
	b. Computer laboratorio scintillatori	1 keuro			
	c. Computer e 2 monitor slow controllo impianto pilota	3 keuro			
	d. Fisher-Rosemount HART 275 Communicator	1 keuro			
	e. Leak detector per test impianti pilota e finali	20 keuro			
	f. Bombola elio con accessori per leak check	1 keuro	34		
2.	Costruzione apparati				
	a. 1000 litri LAB per test impianto pilota	3 keuro			
	b. Spare VCR, Swagelok e pneumatica, ect	7 keuro	10		
3.	Consumo:				
	a. Attrezz. meccanica FACOM con carrello JET.8GM3 JET.C4GM3	10 keuro			
4.	Trasporti:				
	a. materiali Daya Bay (Leak D., attrezzi, valvole)	8 keuro			
5.	Missioni:				
	a. Test purificazione LAB a Daya Bay (3 mesi x 2 persone)	35 keuro			
	b. Meeting in Cina (4 persone x 2 meeting)	16 keuro			
	c. Meeting in Europa (4 persone x 2 meeting)	8 Keuro			
	d. Meeting in Italia (4 persone x 4 meeting)	8 keuro			
	e. Viaggi x il deputy Spokeperson e rappresentante naz.	10 keuro	78		

#### Gruppo

E. Meroni 40%
P. Lombardi 50%
G. Ranucci 60%
V. Antonelli 50%
M. Grassi 100%
R. Ford 100%
Assegno Ric. Tecnologico 100%

A. Brigatti 20%S. Parmeggiano 20%P. Saggese 20%

Conclusion

The vast potential physics reach of JUNO - MH determination and beyond - makes the experiment very attractive for Italian INFN groups

The perspectives for an INFN participation of significant impact are very promising, solidly grounded on previous expertise and well positioned in a larger European framework