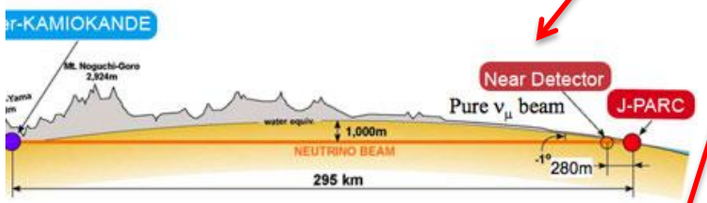
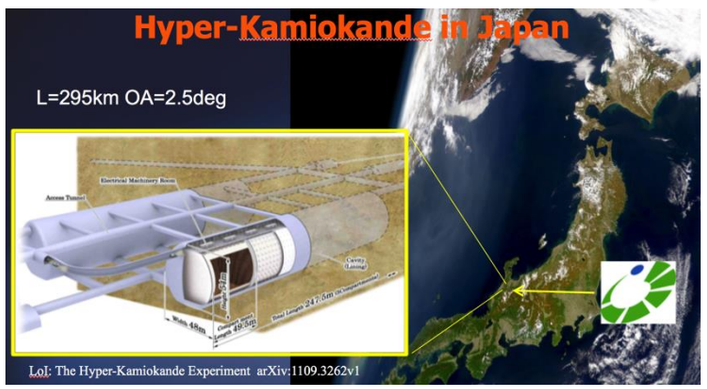
Workshop on Near Detectors based on Gas TPCs

Why at CERN?

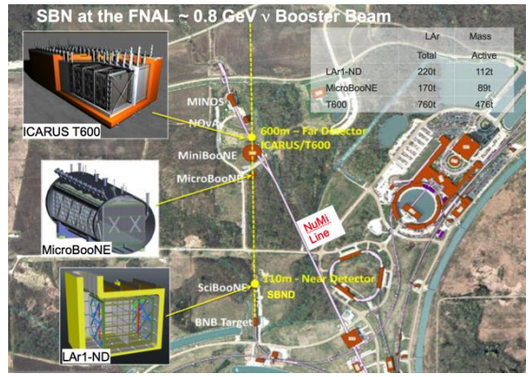
Neutrino Platform at CERN

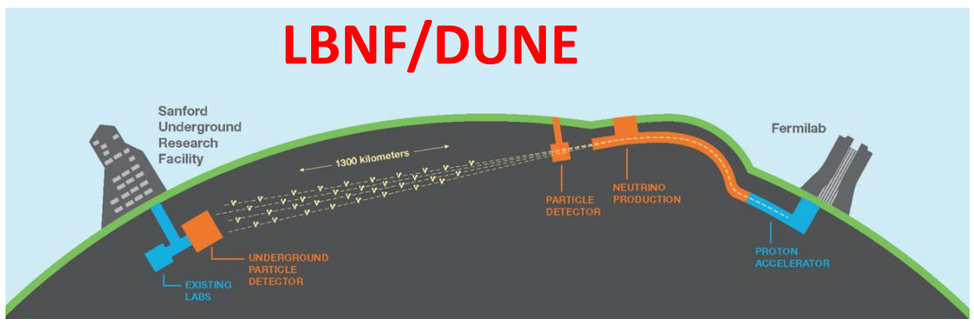


T2K



SBN (short baseline)





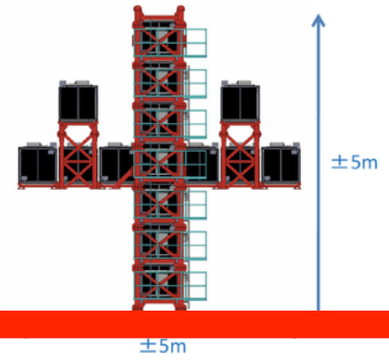
Composition of People

- Primarily people working in Europe involved in TPCs
  - Many T2K TPC people
  - Many general TPC people
- Several Japanese T2K/HK people

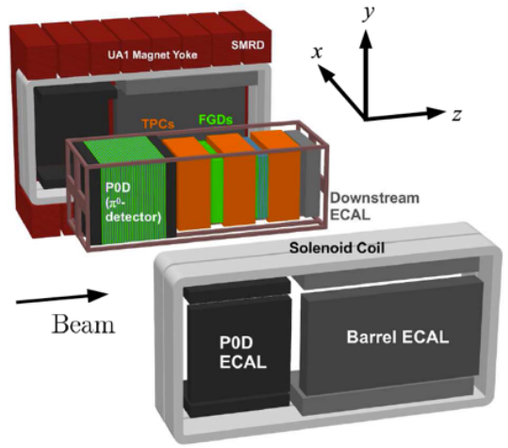
NEAR/INTERMEDIATE DETECTOR STRATEGY FOR HYPER-K

Baseline strategy is to build on the success of the T2K near detector program

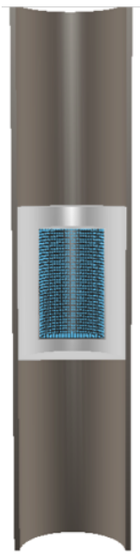
Upgraded(?) INGRID:
- Neutrino event rate monitoring with high statistics
- Precision beam direction measurement



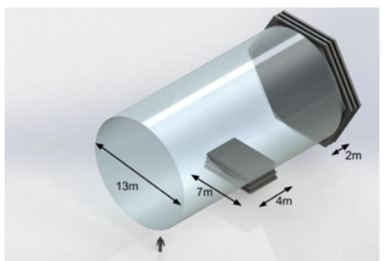
Upgraded ND280:
- Measurement of exclusive hadronic final states+leptonic final states for model building
- Magnetized detector for right-sign/wrong-sign separation



Intermediate Water Cherenkov Detector
- Loaded with Gd for final state neutron detection
- Off-axis spanning to measure energy dependence of interaction rates/final state particle kinematics
- 1-2 km baseline
- Naturally minimizes differences: nuclear target, efficiency and acceptance, unoscillated neutrino spectrum

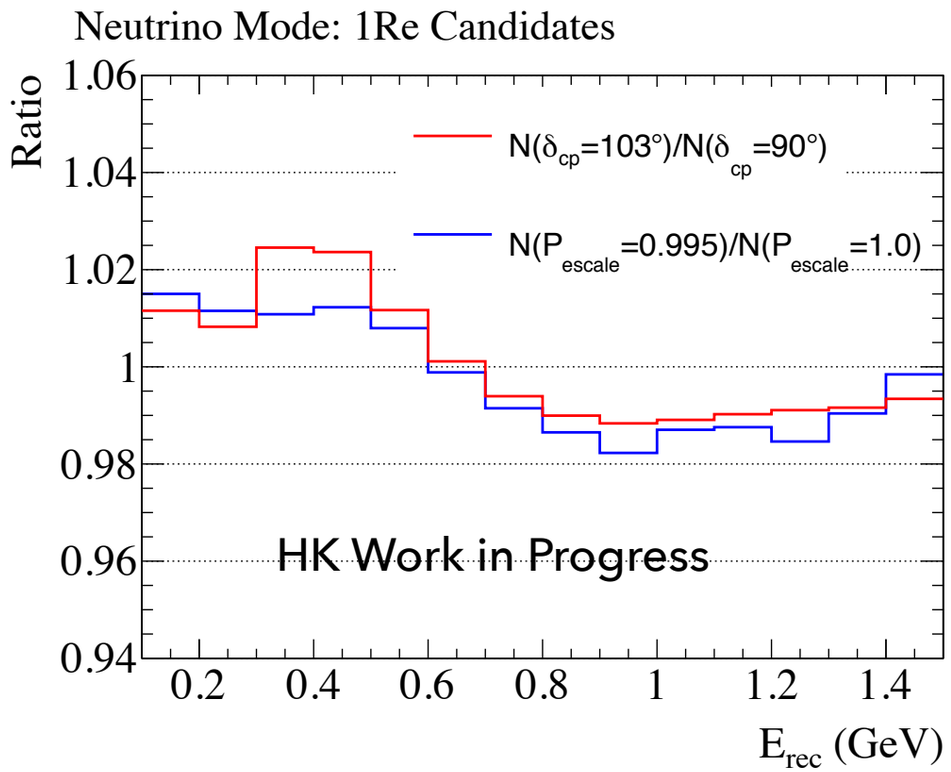


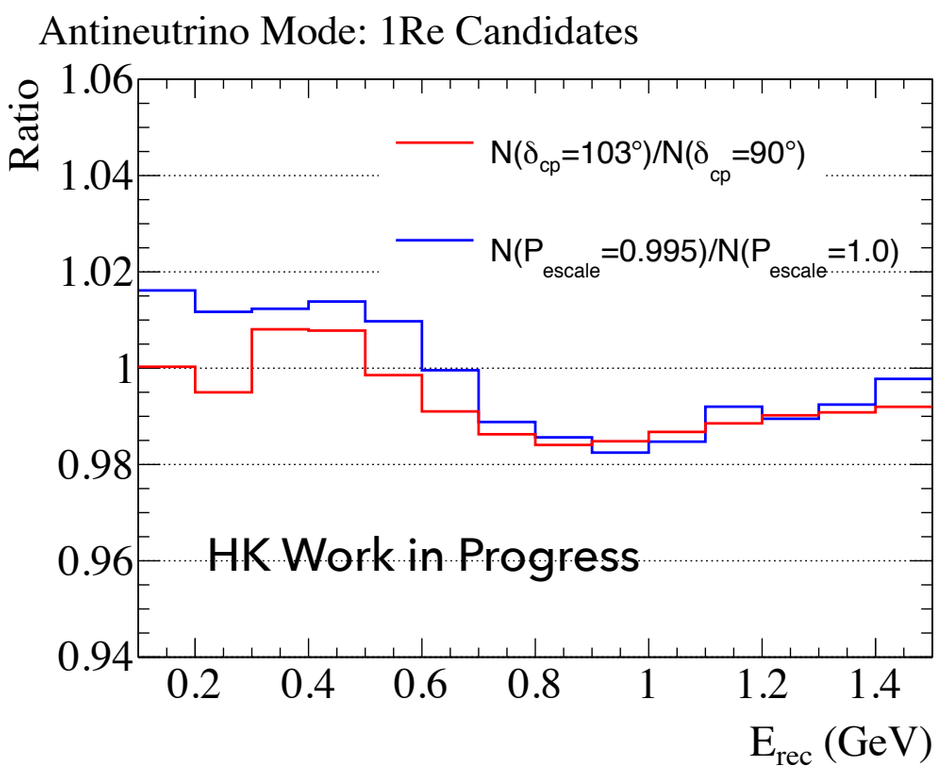
Merging of NuPRISM and TITUS efforts



M. Hartz

SPECTRUM SHAPE UNCERTAINTY, CP PHASE PRECISION





A 13 degree shift in δ_{cp} near maximal CP violation is roughly equivalent to a 0.5% change in the energy scale

Systematic sources that can shift the peak reconstructed energy:

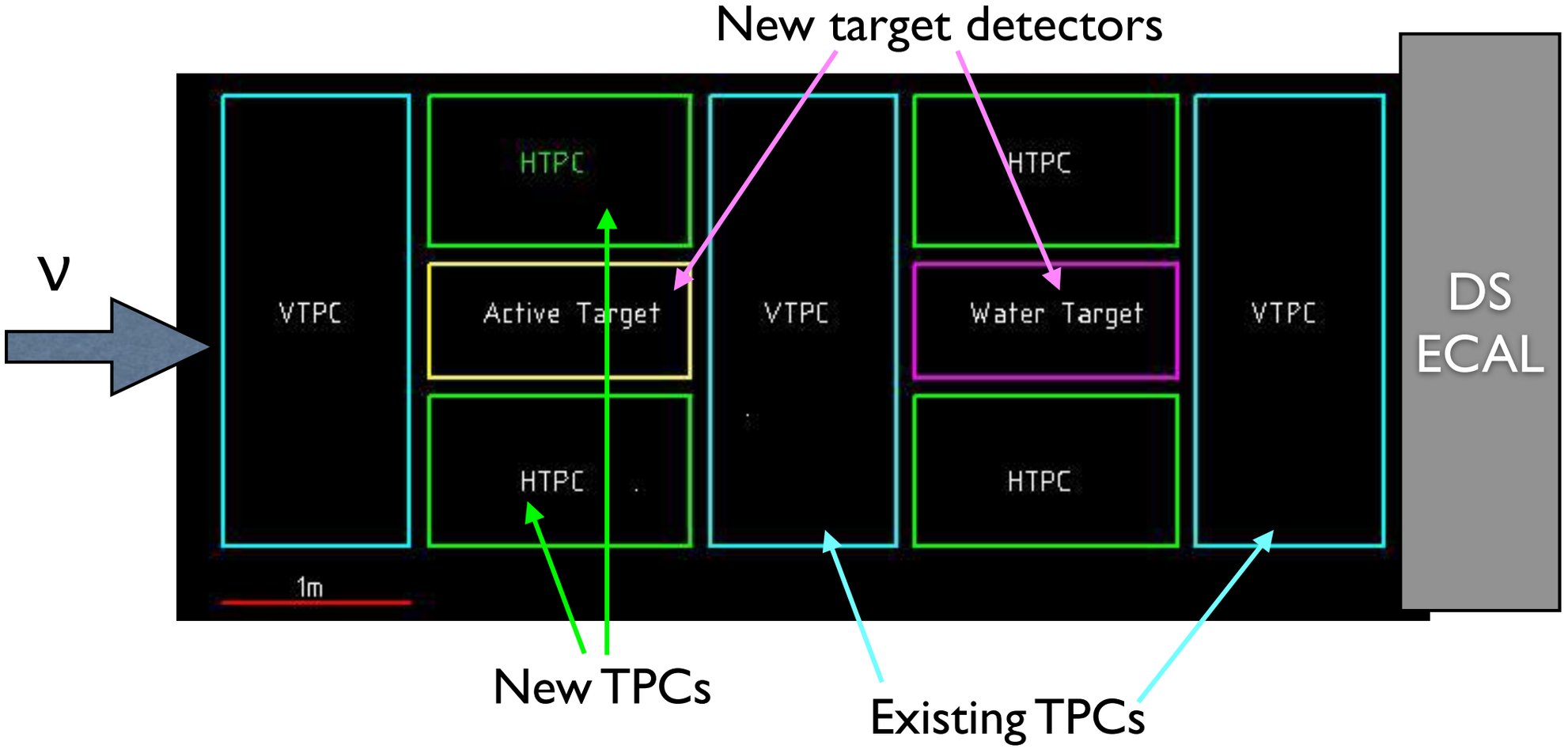
- **Beam direction**
- **Effective binding energy in the nuclear model**
- **Modeling of non-CCQE interactions**
- Modeling of far detector

Should be addressed with near detector measurements

T2K ND280 Upgrade

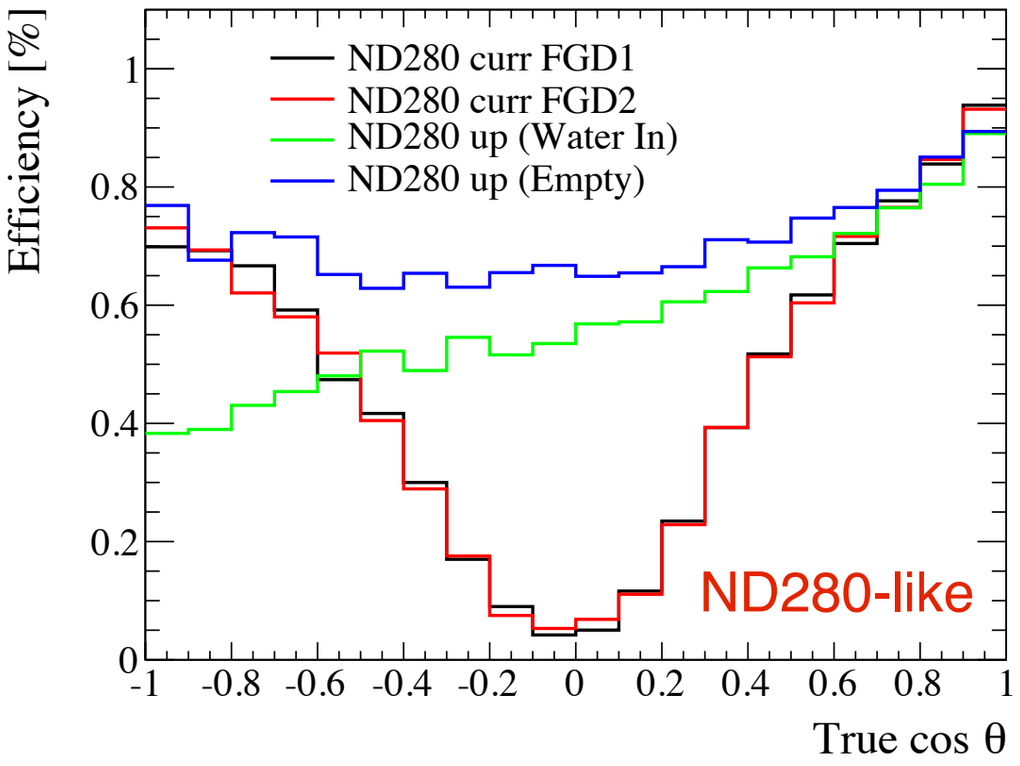
The "reference design"

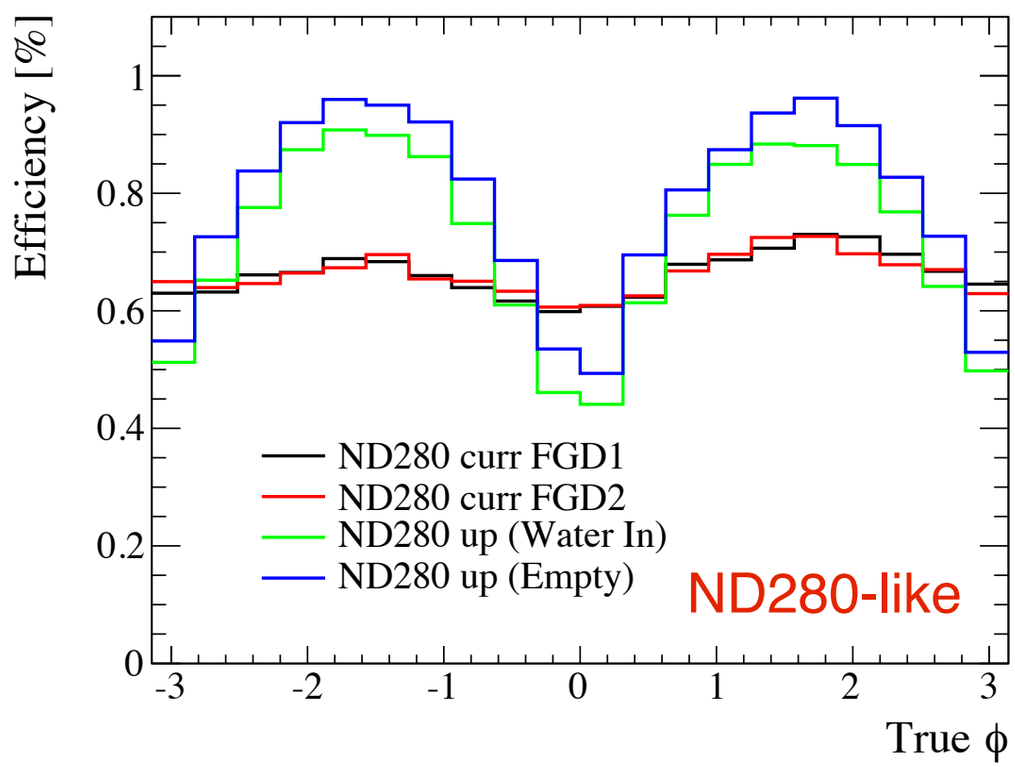
Inside calorimeter and magnet (seen from side)



+scintillator planes around TPCs for timing

ND280 upgrade performance





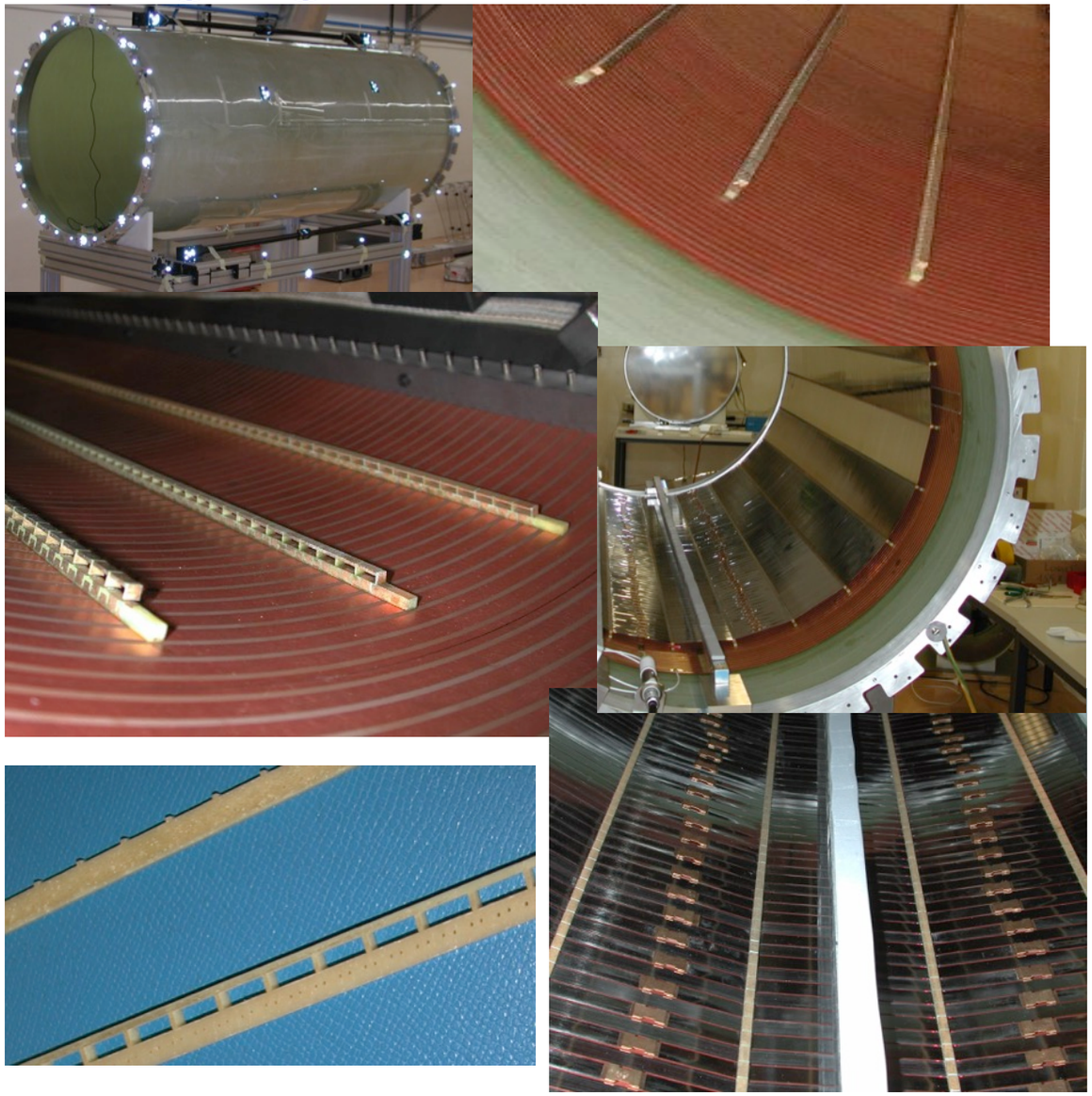
- Horizontal targets and new TPCs can measure very well the high angle region both for Water-in and Water-out WAGASCI targets
- At cosΘ~0 the efficiency is improved to >50% for water-in, ~70% for water-out
- Also momentum threshold is lower with the new configuration
- With 60 cm thickness target we do not loose much in efficiency

Technical Talks

- Field cages
- Readout
- Electronics
- Calibration
- Scintillators for TOF

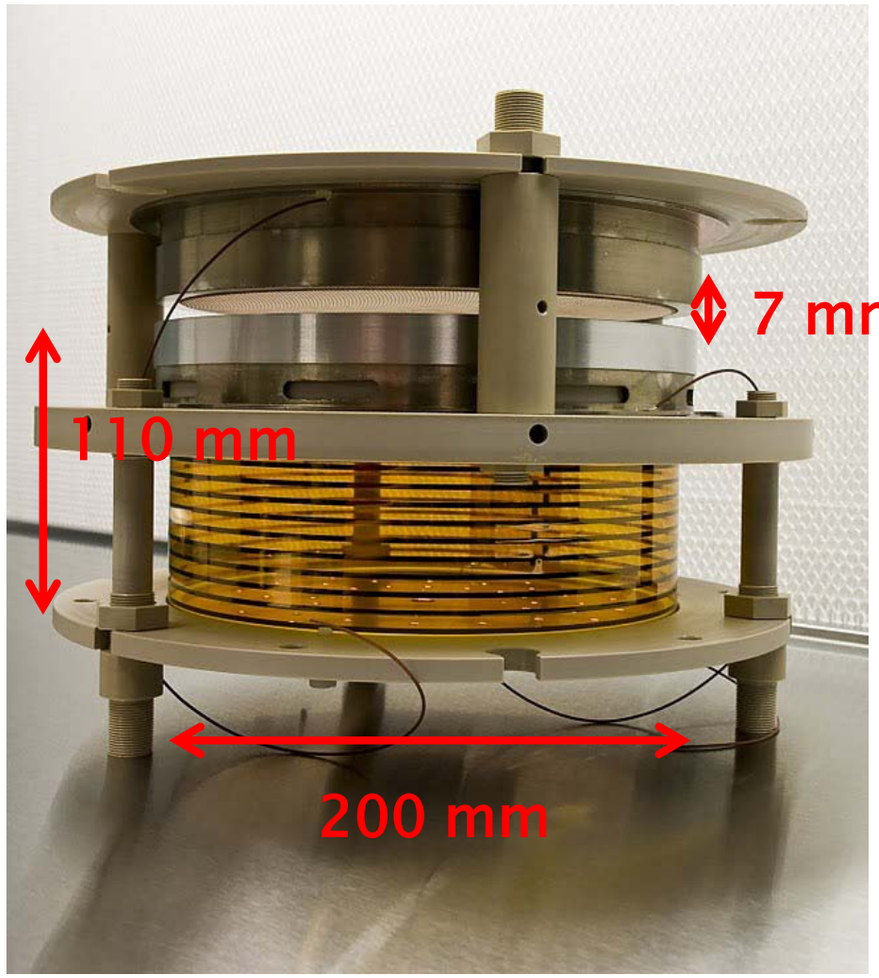
Field Cage

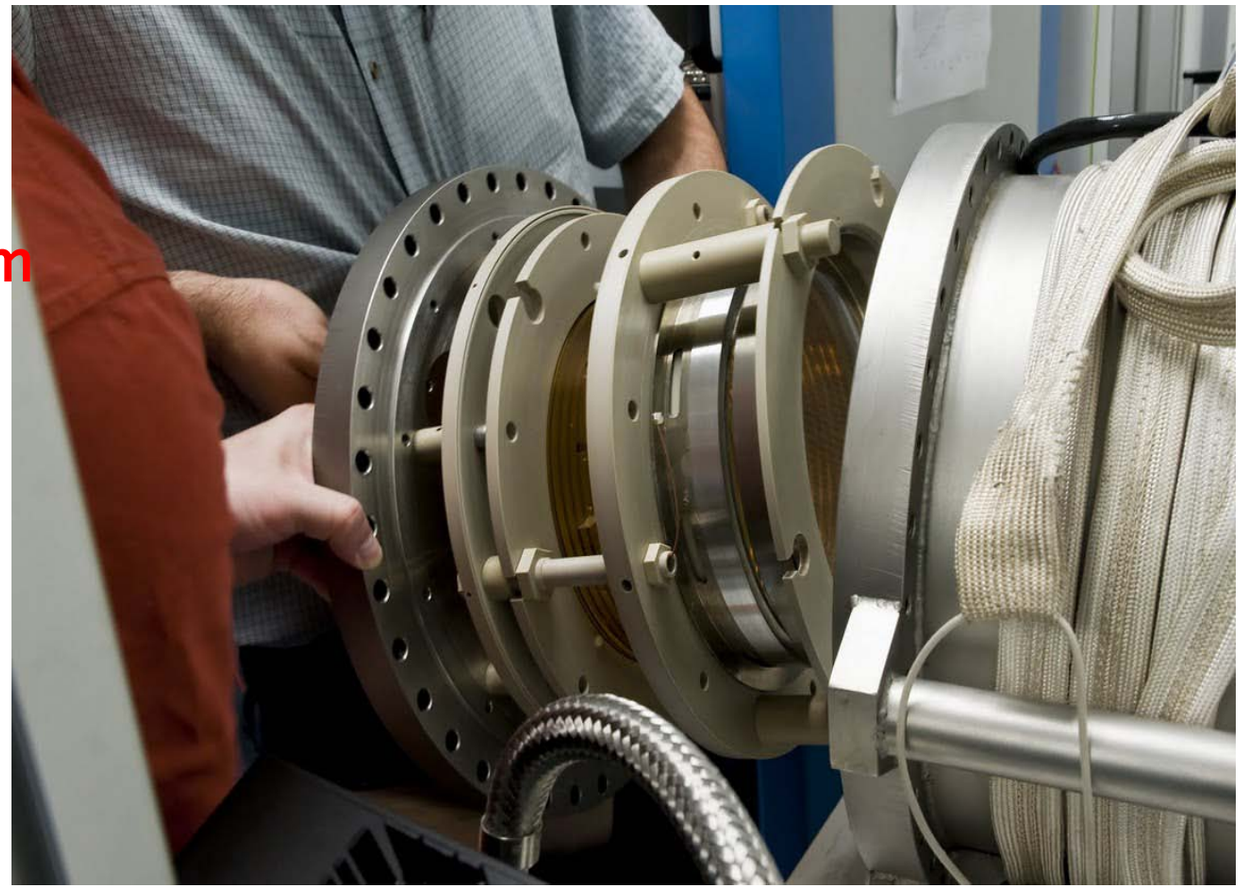
merging the 2 concepts: HARP field cage



- Ar/CH4 90/10
- operated at 110V/cm but capable of up to 35kV
- 1.5m drift
- 8mm Stesalit cylinder (65% glass fiber / epoxy)
- Cu strips glued to Stesalit
- voltage divider with holes for Mylar strips
- staggered strips
- **extremely compact: < 2cm total thickness dead space**
- **uniform material layer → better for simulation/ reconstruction**

Experimental Setup: HP TPC

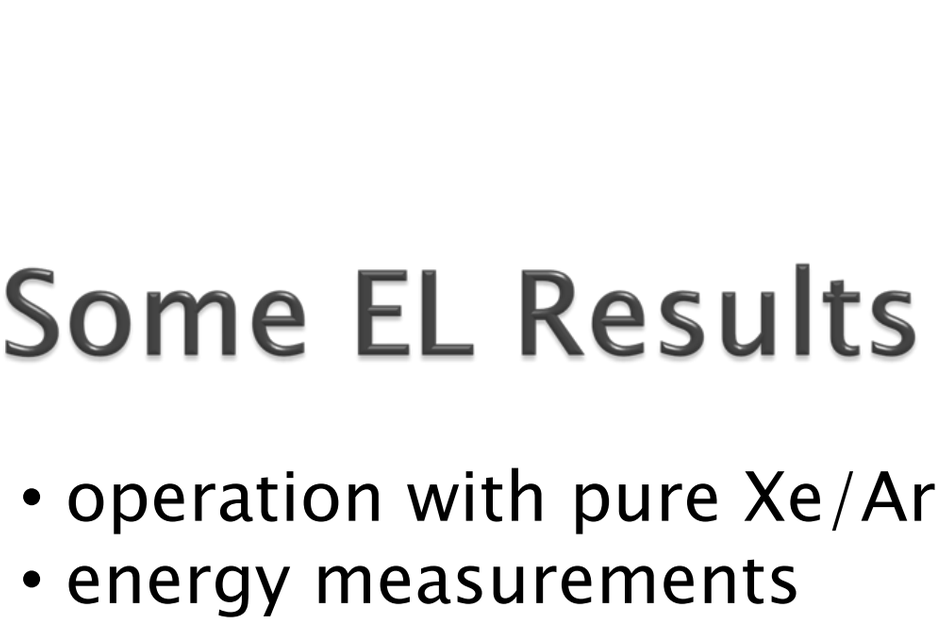




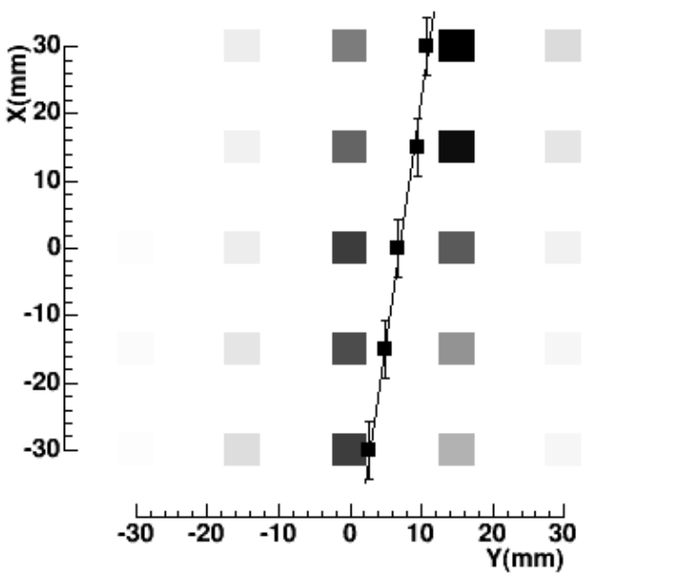
Some EL Results

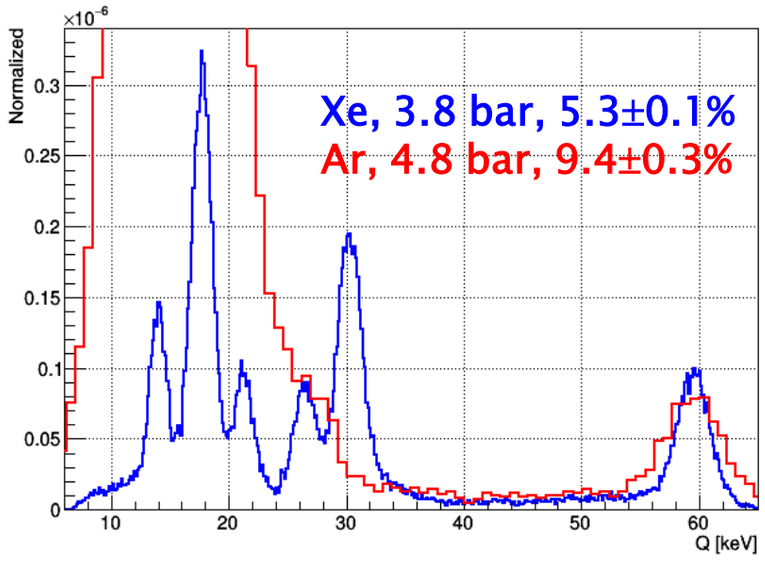
- operation with pure Xe/Ar
- energy measurements

2 tracks



Event display



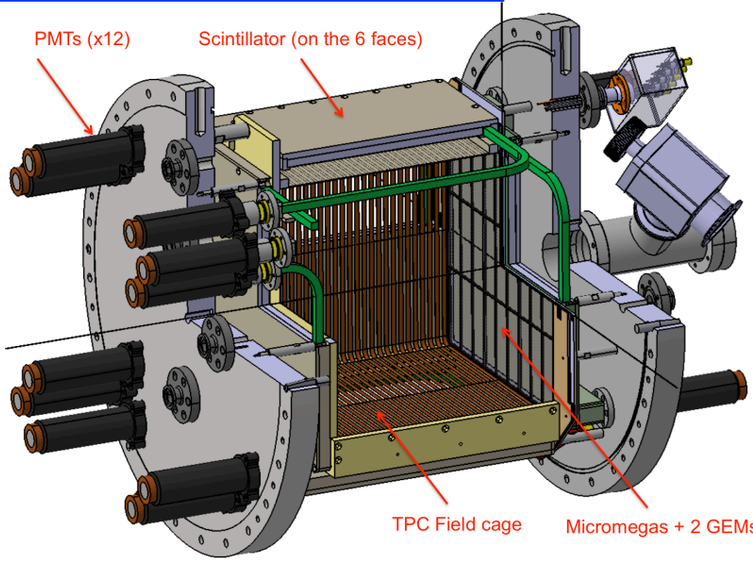


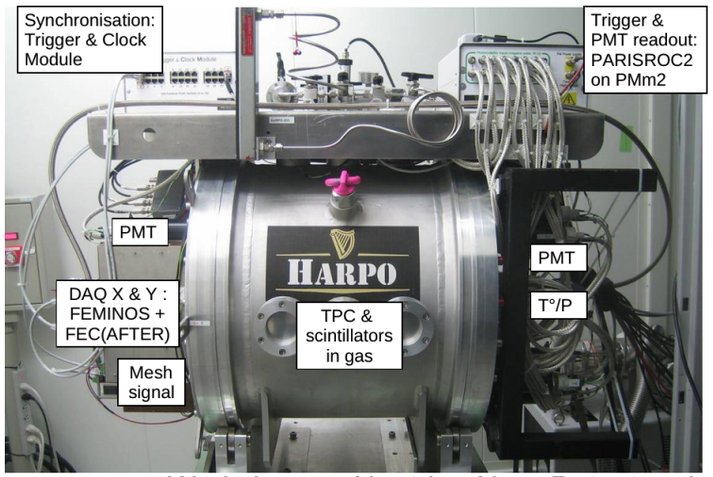
THE HARPO (Hermetic ARgon POlarimeter) TPC DEMONSTRATOR VESSEL

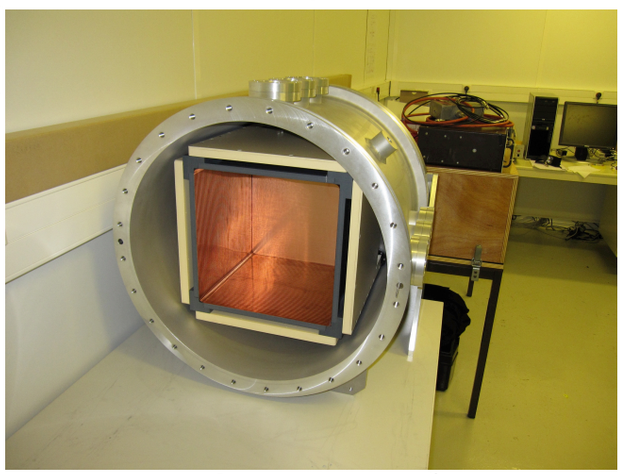
New high-resolution & high sensitivity way to perform MeV-GeV γ-ray astronomy & for the first time polarimetry
Instrumental method : use a Time Projection Chamber for "nuclear" ($\gamma Z \rightarrow Z e^- e^+$) and "triplet" ($\gamma e^- \rightarrow e^- e^+ e^-$) pair production and 3D reconstruction in a "thin" homogeneous pressurized Argon based gas mixture

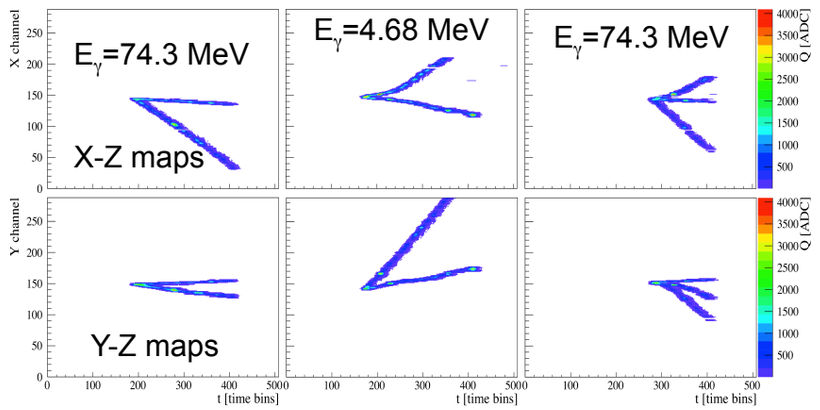
- ✓ A $(30\ cm)^3$ TPC filled with Ar+5% iC_4H_{10}
- ✓ Can be pressurized and operated at up to 5 bars
- ✓ 6 scintillators + wavelength Shifters + PMTs
- ✓ A cubic electric field cage with 3 mm width strips spaced with a 5 mm pitch
- ✓ Charge readout with a micromegas + 2 GEMs
- ✓ Electronic readout with 2 x T2K FEC+FEMINOS
- ✓ Stable operation over a month of data taking on the NEW-SUBARU (Spring 8) γ beam (no gas refresh)

Web site : http://polywww.in2p3.fr/-harpo-





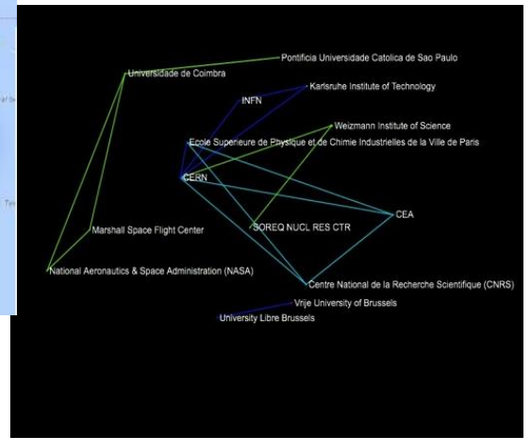


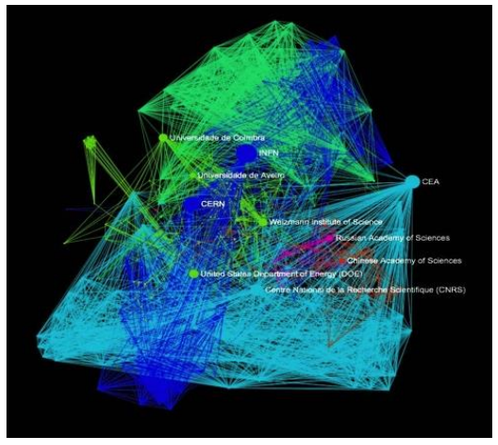


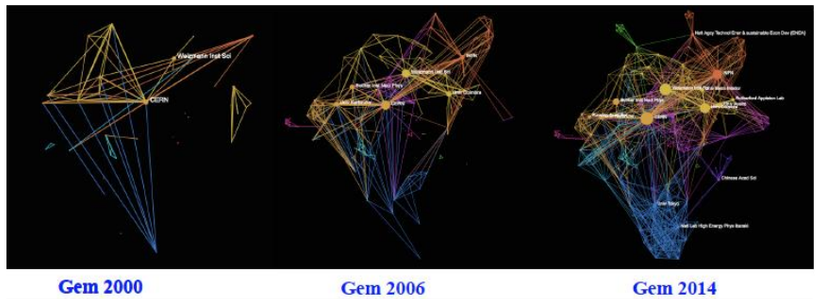
The RD51 Collaboration

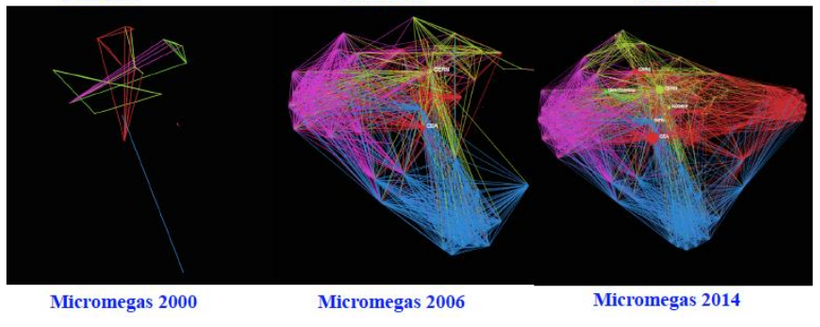
Main objectives:

- MPGD technological development
  - Provide the collaboration framework
  - Develop common simulation packages
  - Develop common read out electronics
- Access to “MPGD know-how”
- Foster Industrial production









Map: **RD51**	
Current year:	1998
Organisations:	40/717
Clusters:	5
Publications:	35/1059

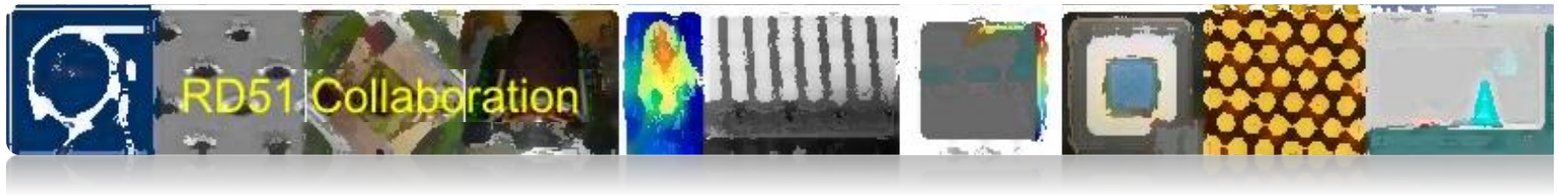
Map: **RD51**	
Current year:	2015
Organisations:	717
Clusters:	12
Publications:	1059

→ huge growth in interest in the MPGD technologies

Collaboration Spotting Software: http://collspotting.web.cern.ch/)

RD51

- Several following talks
  - Example GEM system
  - Readout system
  - Test facilties
- Lots of expertise here



Outcome

Suggestions

0. write a note to ourselves and CERN management
   summarizing the workshop to express
   -- attendance and interest of community
   -- identify a number of synergies
   -- needs in terms of likely test beam, ancillary measurements, technical supports

1. LOI to SPSC for ND280 upgrade
2. LOI to SPSC for HPTPC test beam etc….

or should we have only one common LOI?

3. should we have a next workshop on this theme? where? and when?

4. EU funding request (ITN, Federico)

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