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Present status of the BIPM ensemble of mass standards

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CCM

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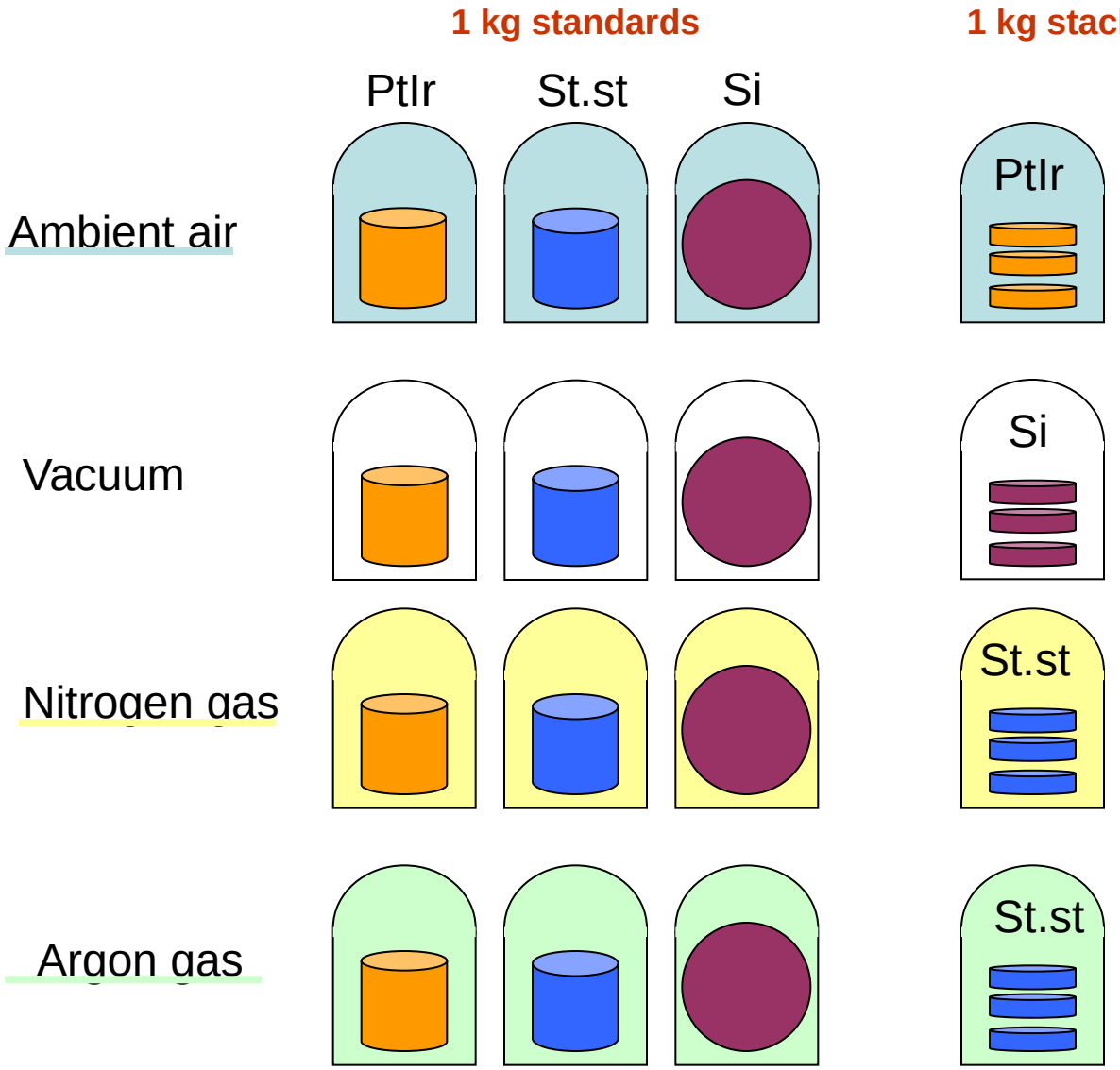
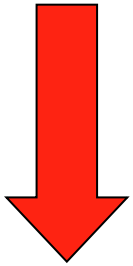
Initial configuration of the ensemble, prior to 2014



Lessons from the *Extraordinary Calibrations* in 2014

- The need of establishing a two/three level hierarchy within the *ensemble*, where the frequency of measurement would decrease with the hierarchichal position to detect an eventual wear.
- The great stability of the IPK and *témoins* within 1993-2014, all of them being standards stored in air.



- The structure of the ensemble has been revisited to incorporate a hierarchy.
- The place of the standards stored in air has been enforced.

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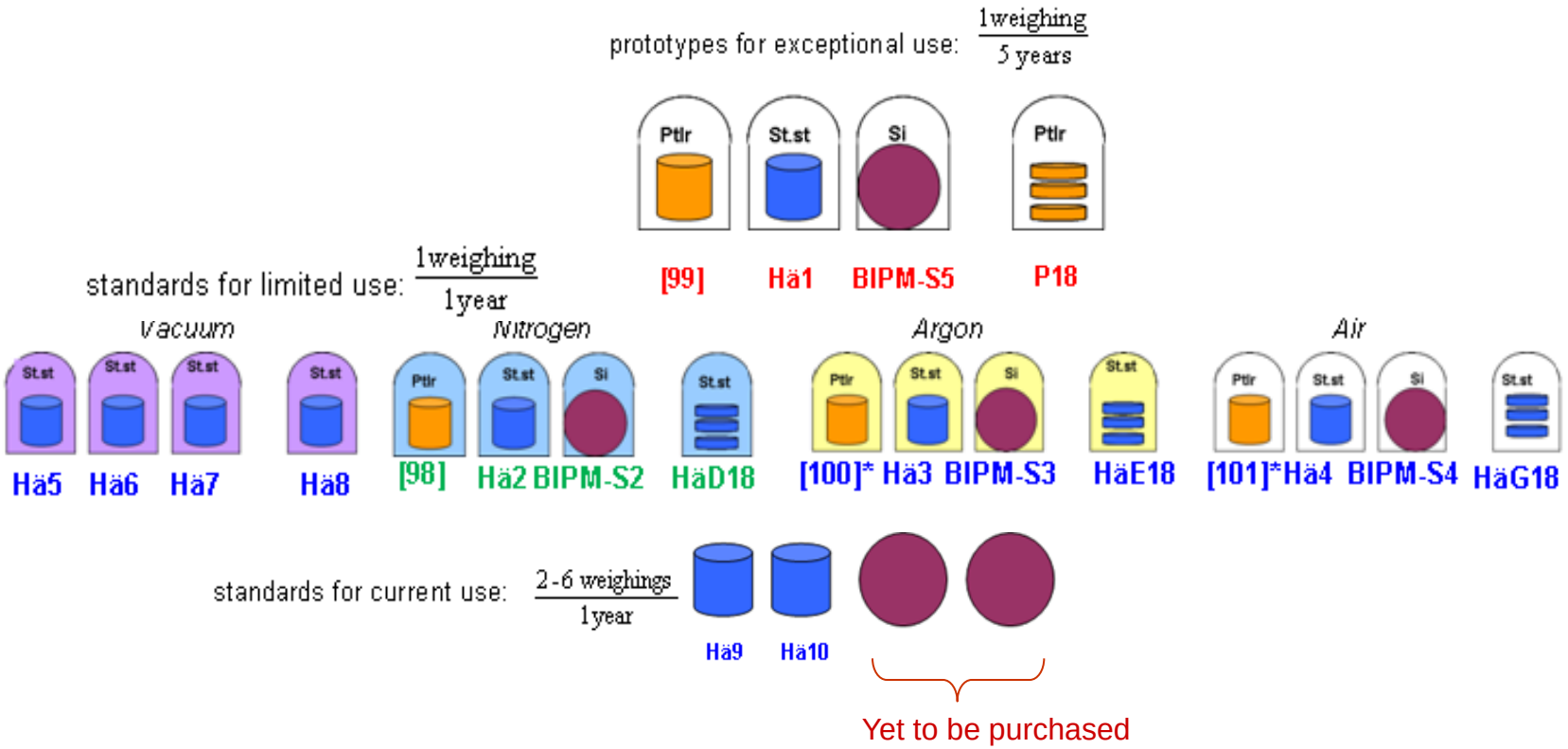
New configuration of the Ensemble (from the end of 2014)



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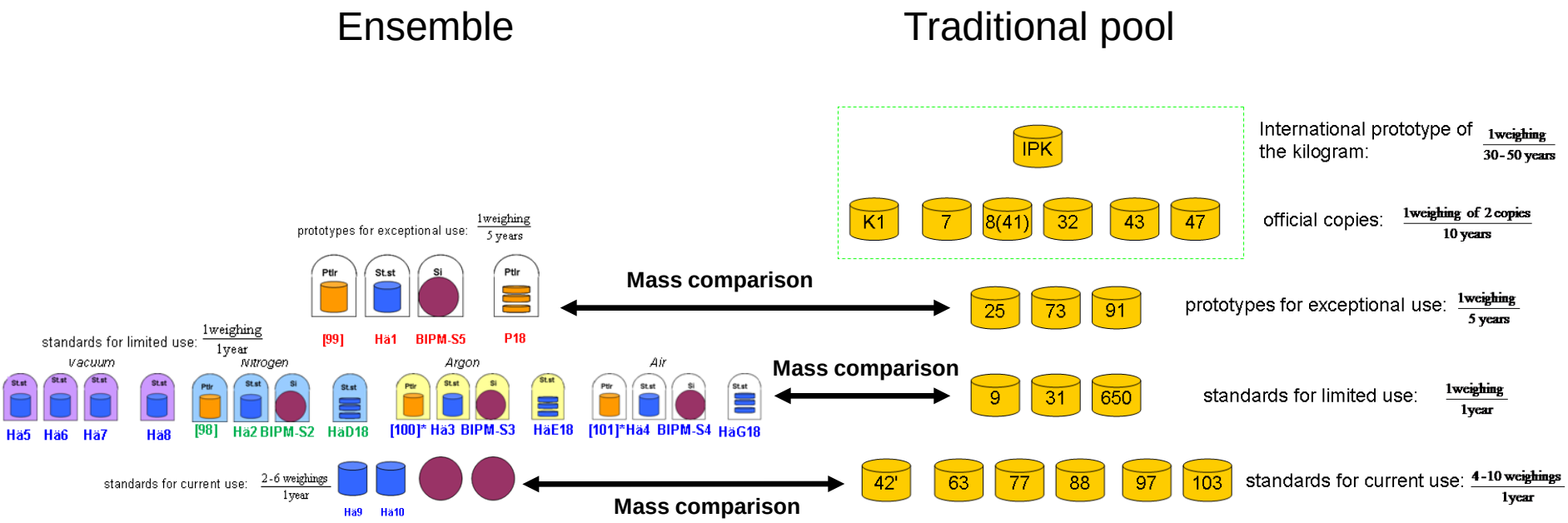
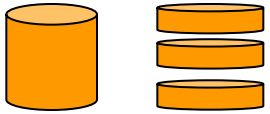
Link between the ensemble and the traditional PtIr BIPM standards

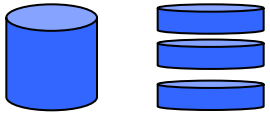


Transfer standards (in addition to the ensemble) used to link the different environments

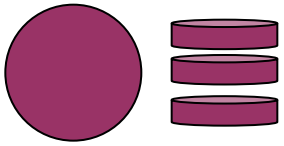
Couple standard + stack in PtIr



Couple standard + stack in SS

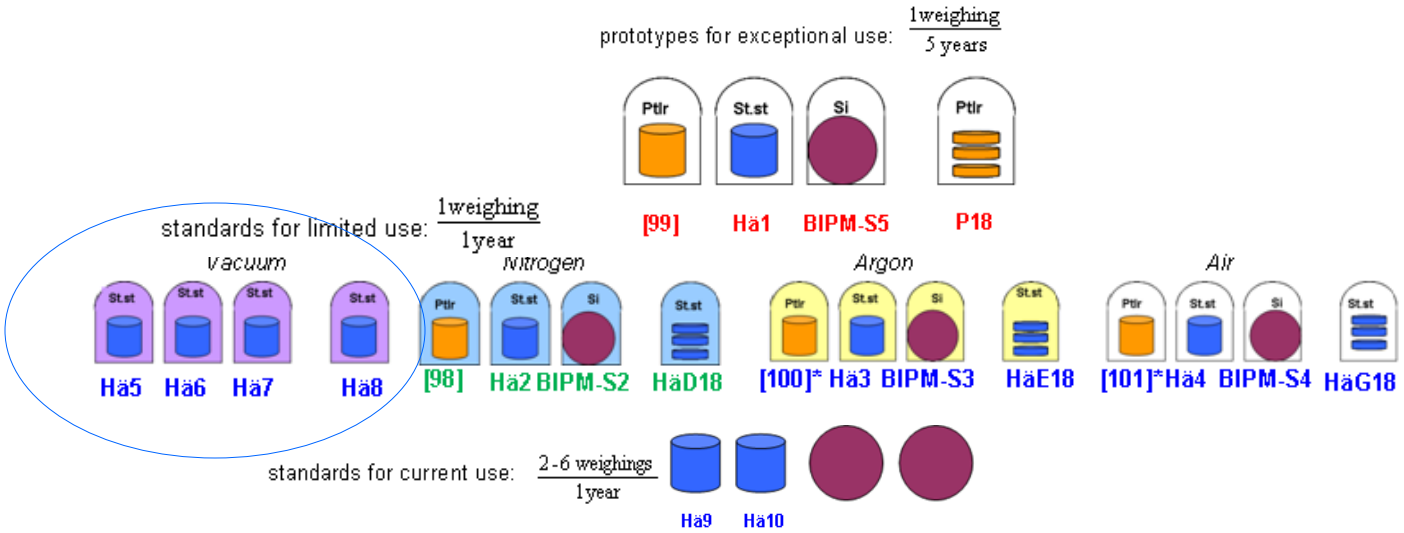


Couple standard + stack in Silicon

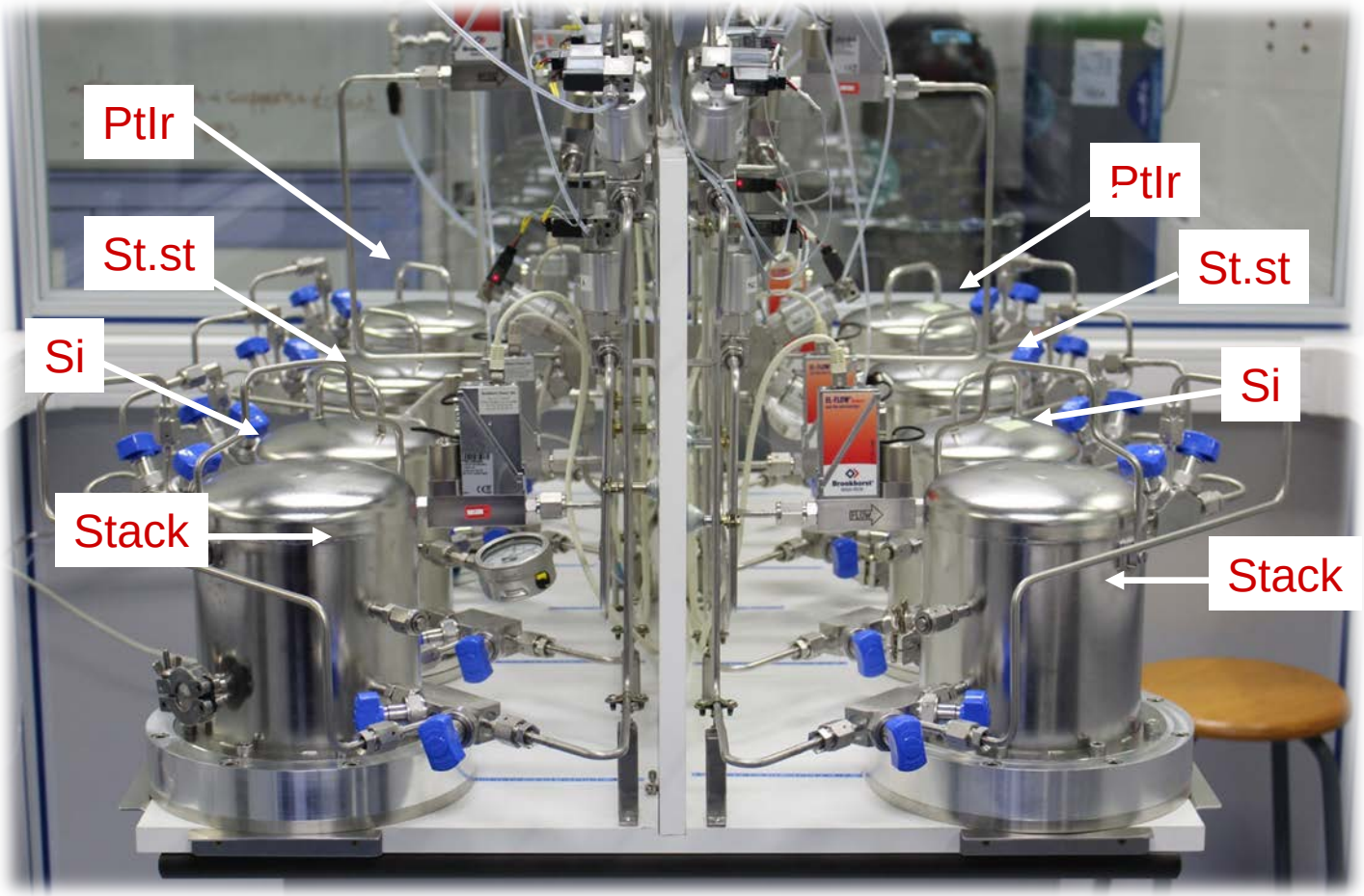


Present status of the ensemble

- All standards are now in their designated containers in their assiged environment
- The air, nitrogen and argon networks are fully operational for several months
- The vacuum network is fully operational since early this week



Argon and Nitrogen networks



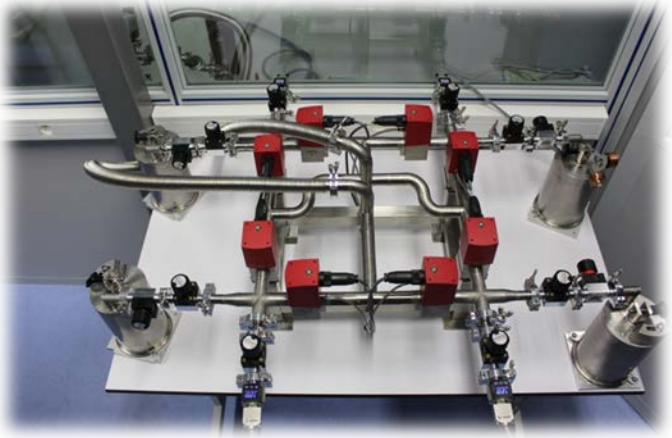
Argon network

Nitrogen network

Vacuum network

First version of the vacuum network

Second version of the vacuum network



Third version of the vacuum network

Conexions: al metallic

New vacuum containers compatible with our new Mone Vacuum Transfer System

Standards stored in air

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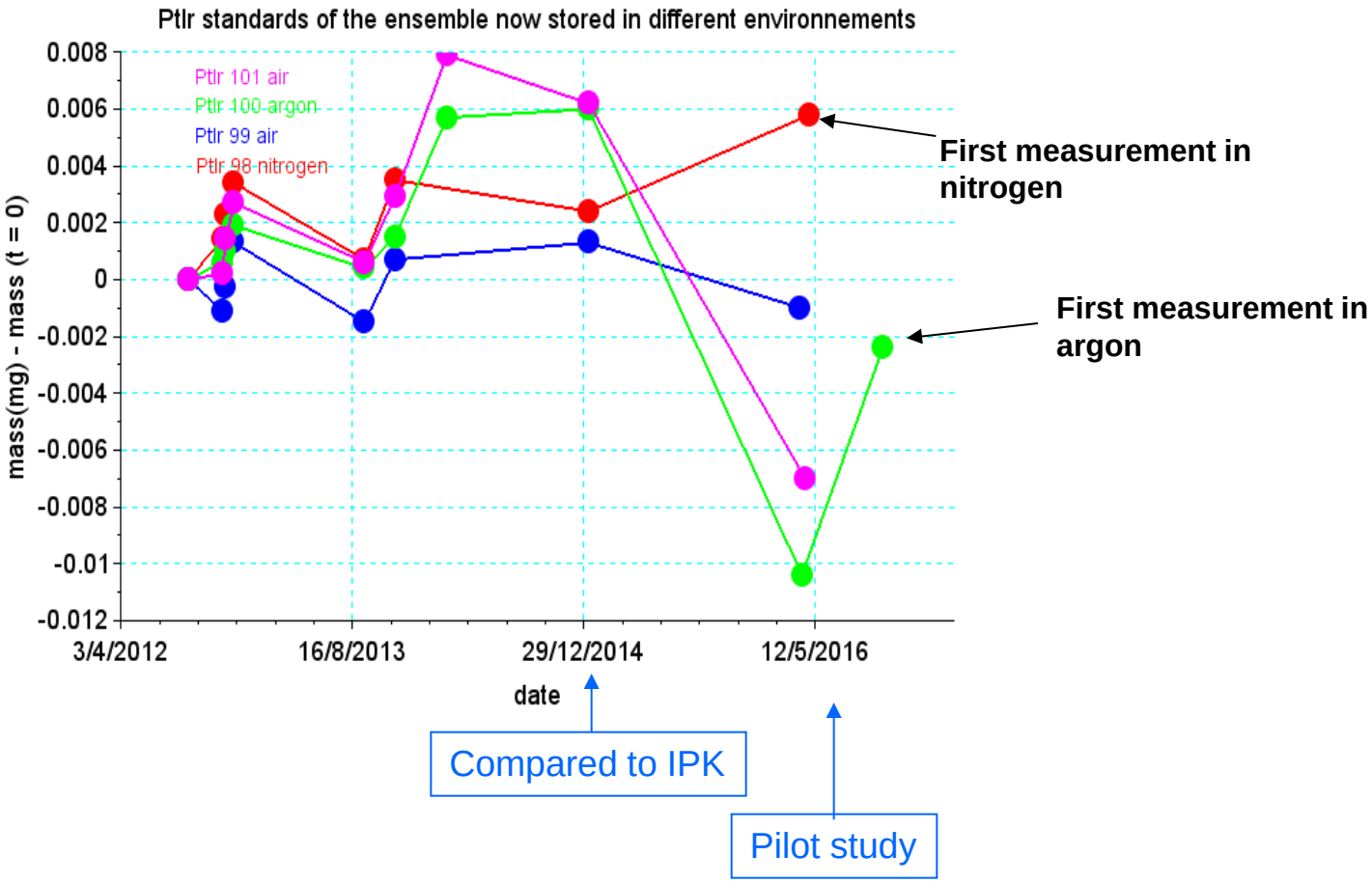
Mass evolution of the standards of the ensemble (I)



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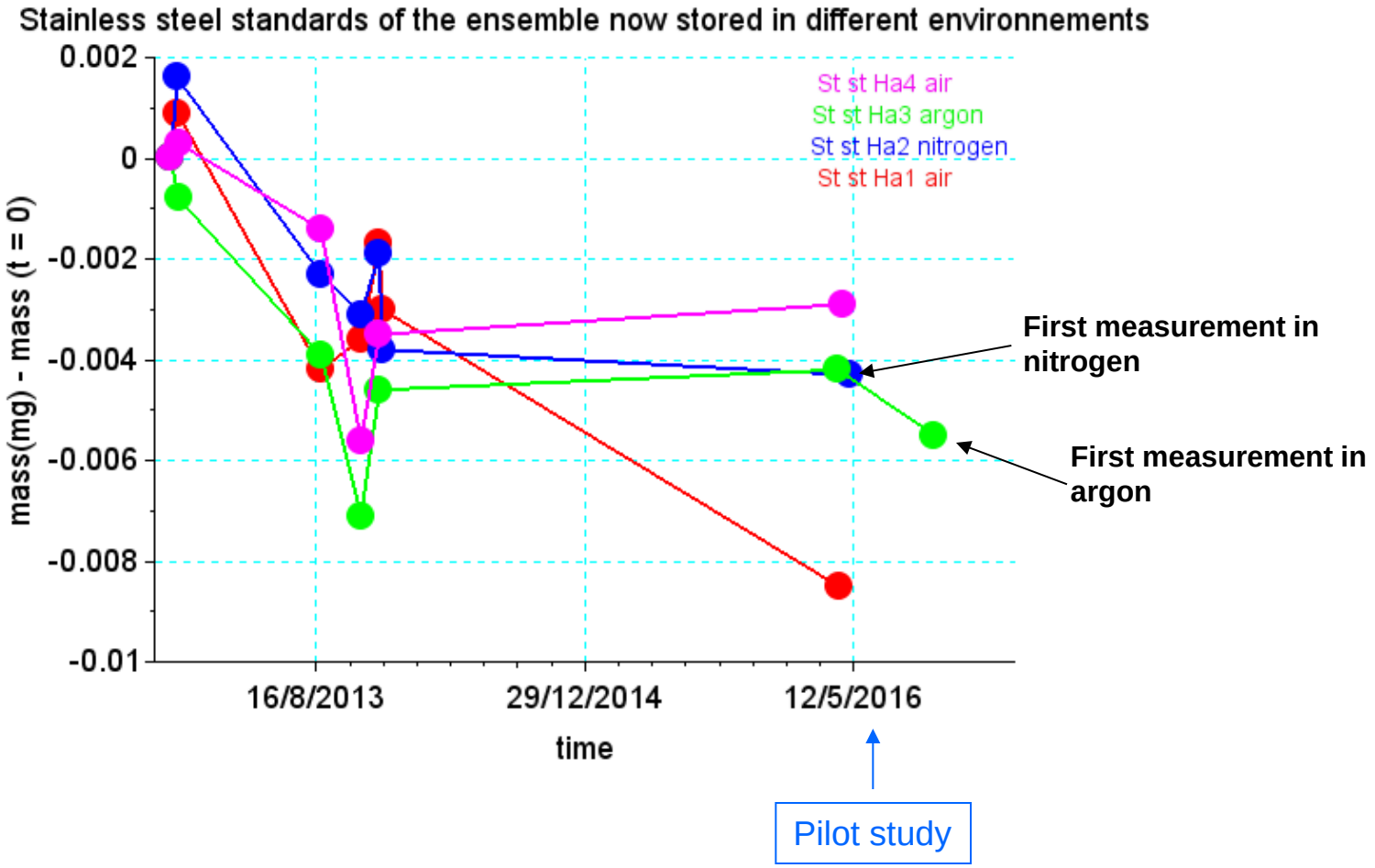
Mass evolution of the standards of the ensemble (II)



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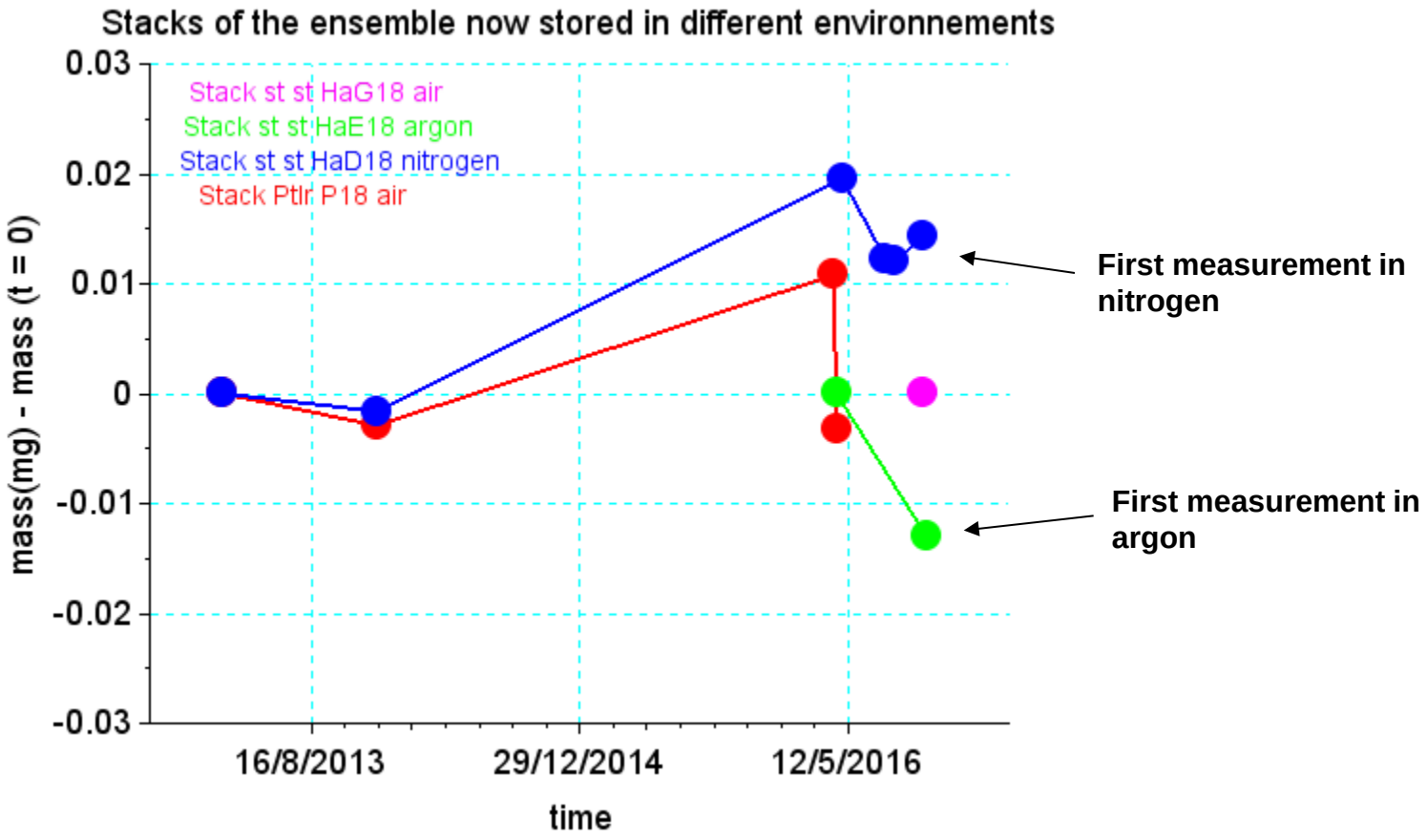
Mass evolution of the standards of the ensemble (III)



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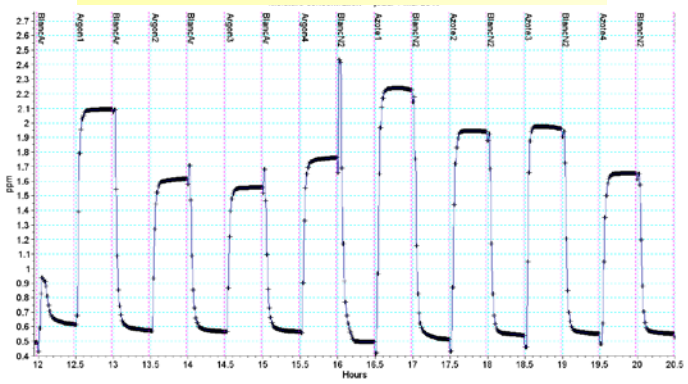
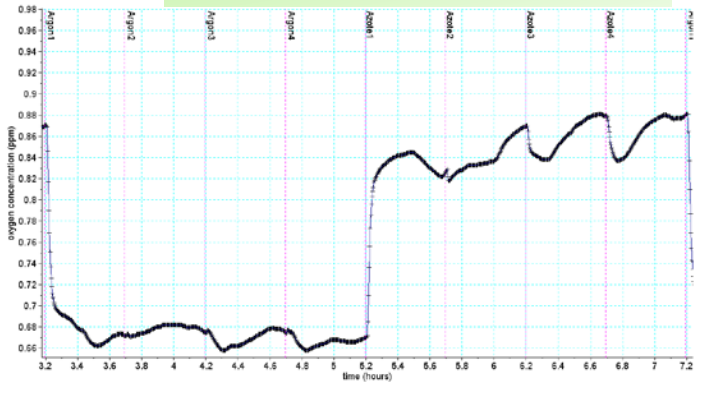
Typical measurements

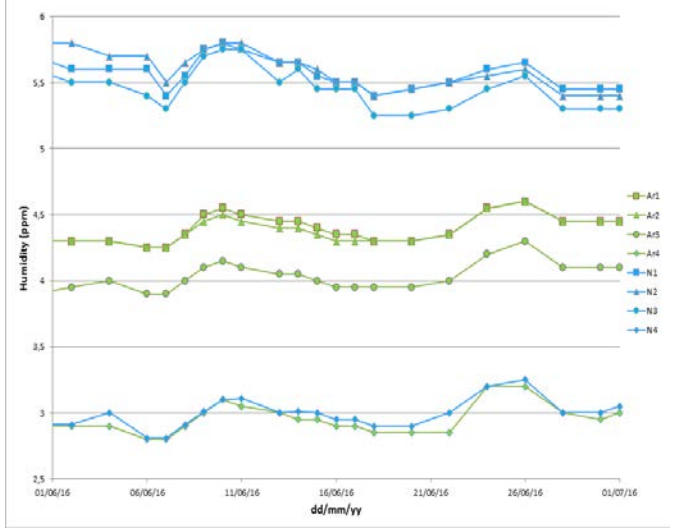
Humidity over one day



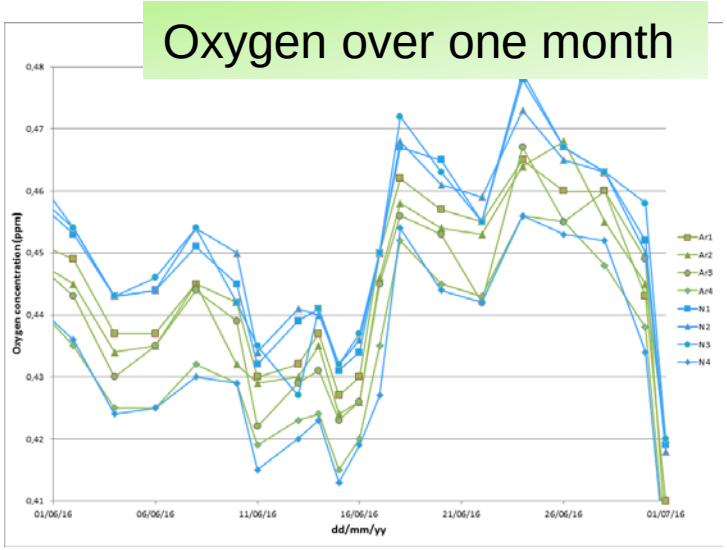
Oxygen over one day



Humidity over one month



Oxygen over one month



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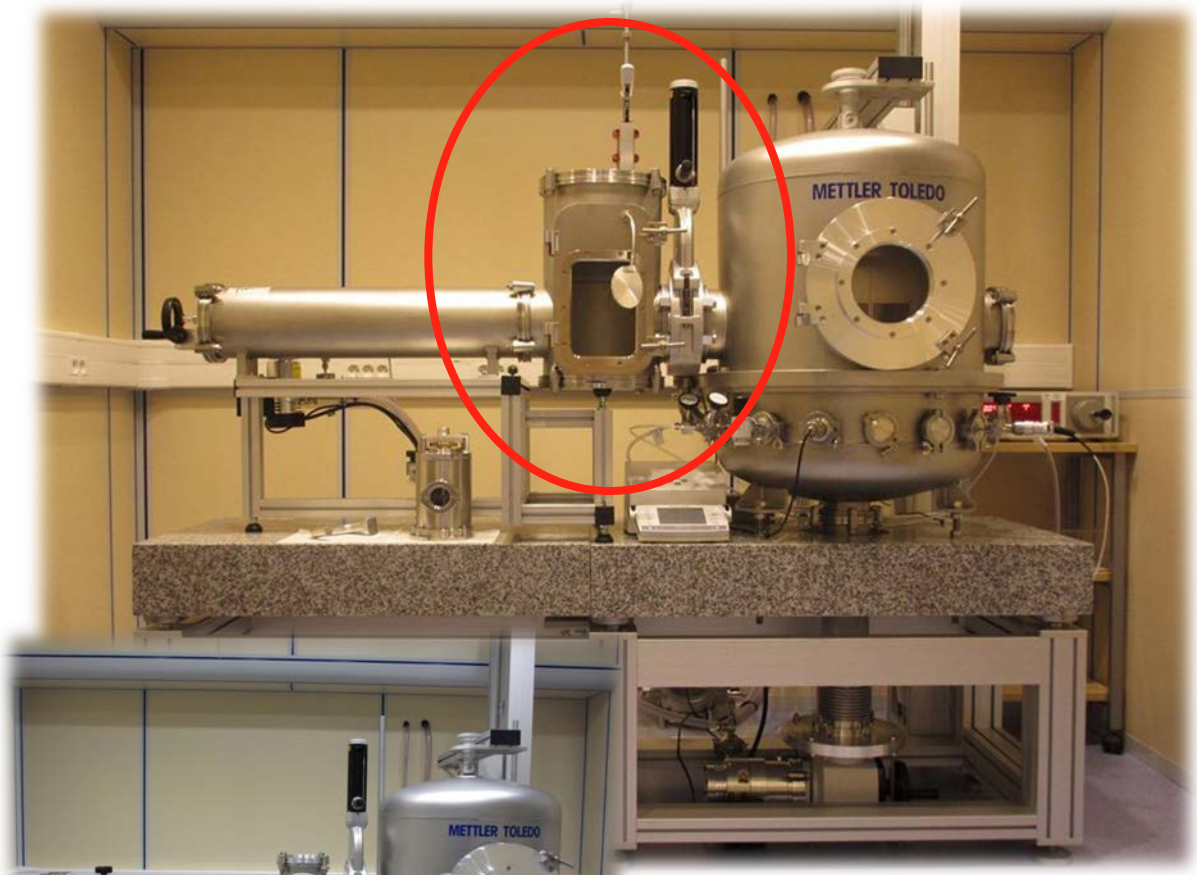
New Vacuum Transfer System in our M-one mass comparator



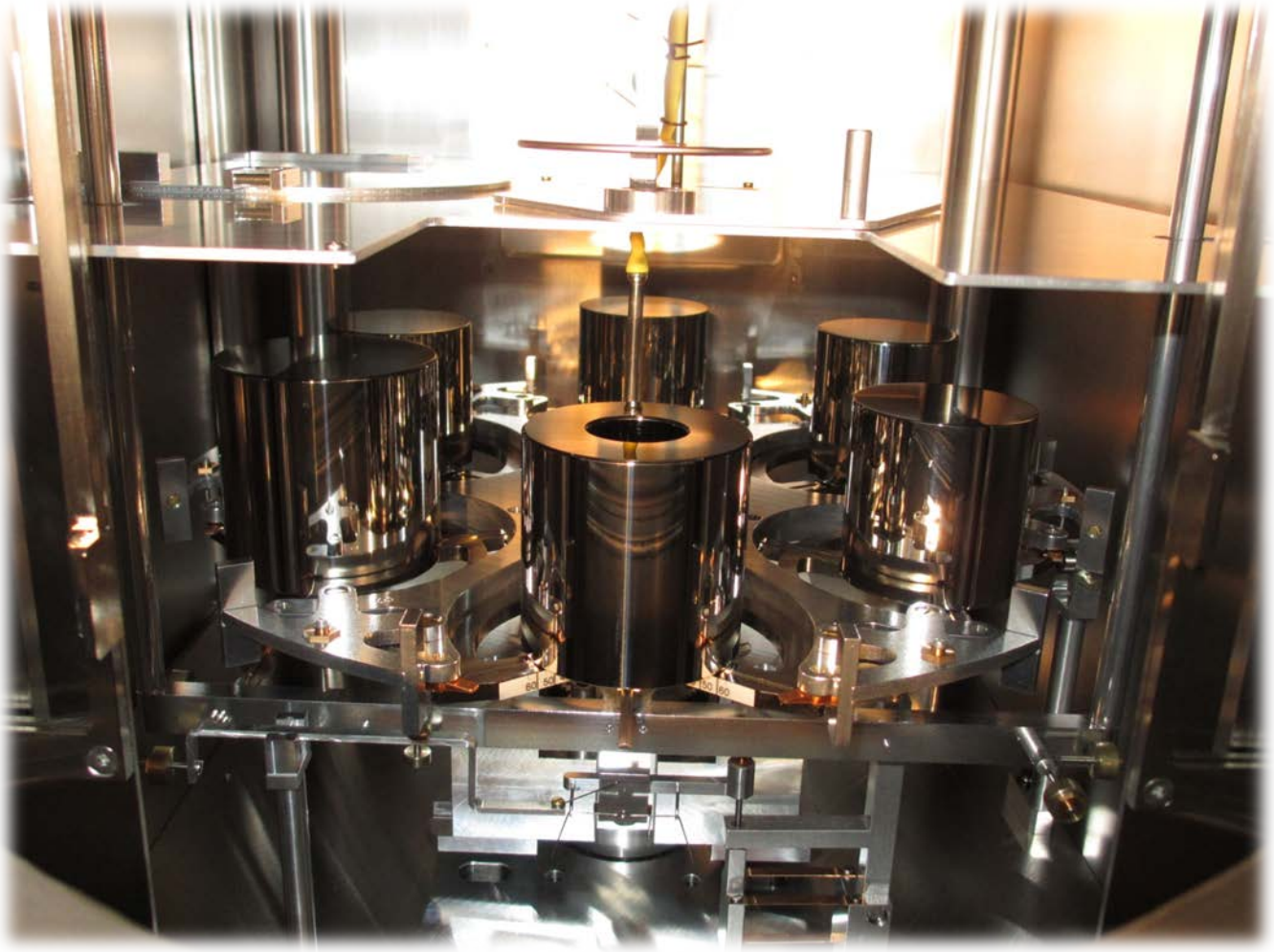
before

This mass comparator can now weigh in air, in vacuum and in gas.

Specific mass containers have been designed to be compatible with the VTS system.

The vacuum network of the ensemble is stored in these kind of containers to allow direct transfer into the balance

Inside view of the Mone



Planned mass data analysis

- For both the standards from the ensemble and those from the traditional PtIr group, the general equation for the evolution of the mass of each standard will be assumed to be

$$m_i(t) = m_i(t=0) + \alpha_i t + \gamma_i \sqrt{t - t_{\mathrm{NL}_i}} + \sum_{mass.comp.} \omega_{i,mass.comp} N_{i,mass.comp.}(t)$$

α: linear drift coeficient
ω : wear coefficient
N : number of weighings in a given comparator
γ_i : parameter charaterizing mass increase after cleaning and washing
t_{NL} : time of last cleaning and washing

Input data from standards from the ensemble will be given at the beginning a lower weighing coeficient to account for their recent introduction to the group

When calibrations from primary realizations are available we will have supplementary equations

$$m_{\mathrm{BIPM}}(t) = m_{\mathrm{transferFromPrimReal}}(t) + \Delta m(t)$$

Conclusions and Perspectives

- The BIPM ensemble of mass standards is now fully operational. Each standard is now stored in its assigned environment.

- Periodic weighings in the storage conditions will continue to be carried out. They may allow in the future to discriminate the best combination of material and environment for mass stability