STRAS-ONE

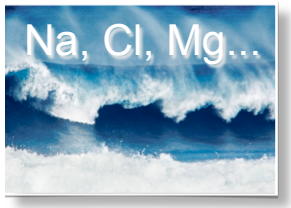
Size and Time Resolved Aerosol Sampler for PM1

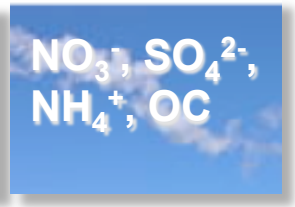
G. Calzolai

Source apportionment

Different sources emit different elements with characteristic ratios that do not change during transport.

Markers



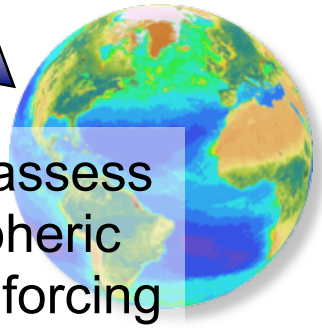


Measured PM mass and composition at the sampling site (receptor)

Receptor models

Aerosol source apportionment (identification of sources and their contribution to PM)

Pollution abatement policies to improve air quality



Climate models to assess the role of atmospheric aerosols in climatic forcing

INFN FIRENZE

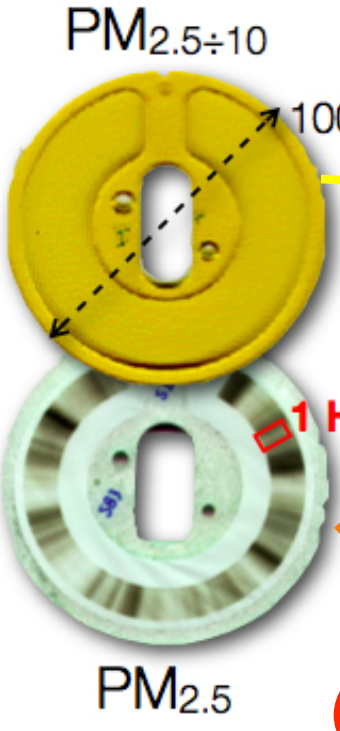
Time resolution

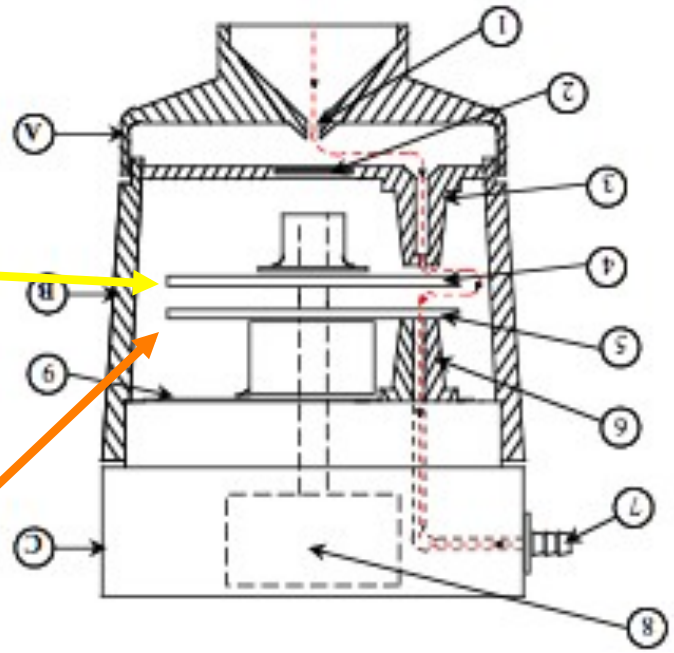
- In most of the field campaigns PM is collected with a 24-h time resolution
- However, many particulate emissions change within few hours (industrial emissions, traffic rush hours, construction works, …)
- Moreover, as many meteorological parameters, like wind intensity and direction, change within a 1-h time scale and the boundary layer evolution shows strong diurnal patterns, atmospheric transport and dilution processes change within few hours
- As a consequence, the aerosol concentration and composition may significantly change within few hours and daily samples are not capable of tracking these rapid changes
- For this reason, the measurement of the PM composition with high time resolution is important to: assess health and environmental effects, understand transport processes and determine source contributions.

Samples with hourly resolution

Continuos “streaker” sampler
(*PIXE International*)

Kapton foils
Nuclepore filters



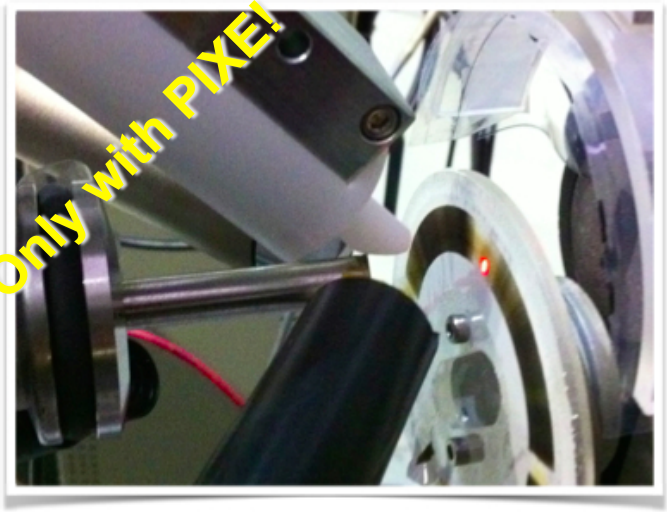


1 week of sampling
=
168 (x2) hourly samples!

The role of PIXE in aerosol research

PIXE must be used when its application can give unique information or can give final results in a far simpler way with respect to other competing techniques.

- Very short measuring time
  (~ 60 s vs. several m or h)
- Analysis of very low mass samples
  high time resolution samples (e.g. 1h)
- Detection of all soil related elements
  study of dust episodes
- No sample pre-treatment
  fundamental for very low mass samples (e.g remote sites aerosol)

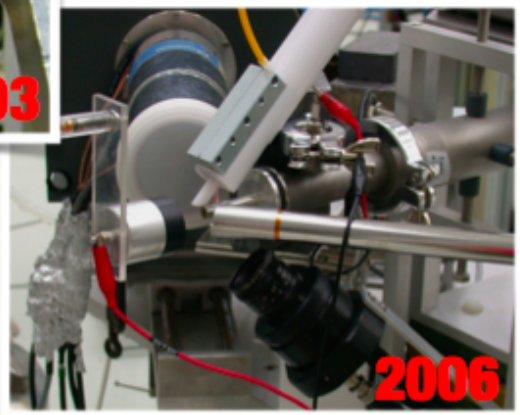


beam size (1 x 2 mm^2) corresponding to 1h point

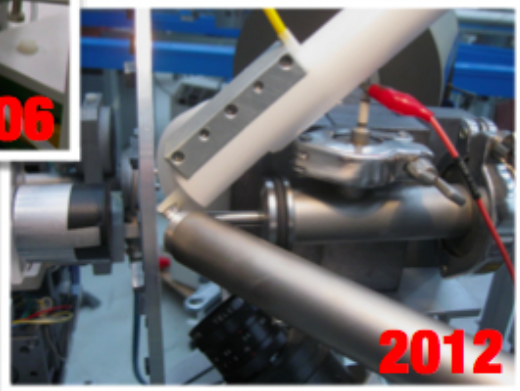
A prerequisite is the use of a proper experimental set-up which fully exploits PIXE potentialities

Evolution of PIXE set-up for aerosols

2 Si(Li):
10 mm^2, 3 mm
80 mm^2, 5 mm

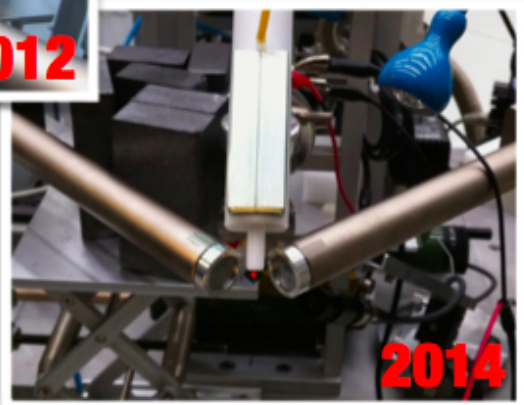


SDD: 7 mm^2, 0.3 mm
Si(Li): 80 mm^2, 3 mm



2 SDDs: 7 mm^2, 0.3 mm
80 mm^2, 0.5 mm

Funded by INFN grants (NUTELLA, NUMEN, MASAI) and EU LIFE+ AIRUSE project



3 SDDs:
30 mm^2, 0.5 mm
2x 80 mm^2, 0.5 mm

+ “best energy”
+ “best sampling substrata”

Calzolai et al., NIM B B 249 (2006) 928
Lucarelli et al., NIM B 318 (2014) 55

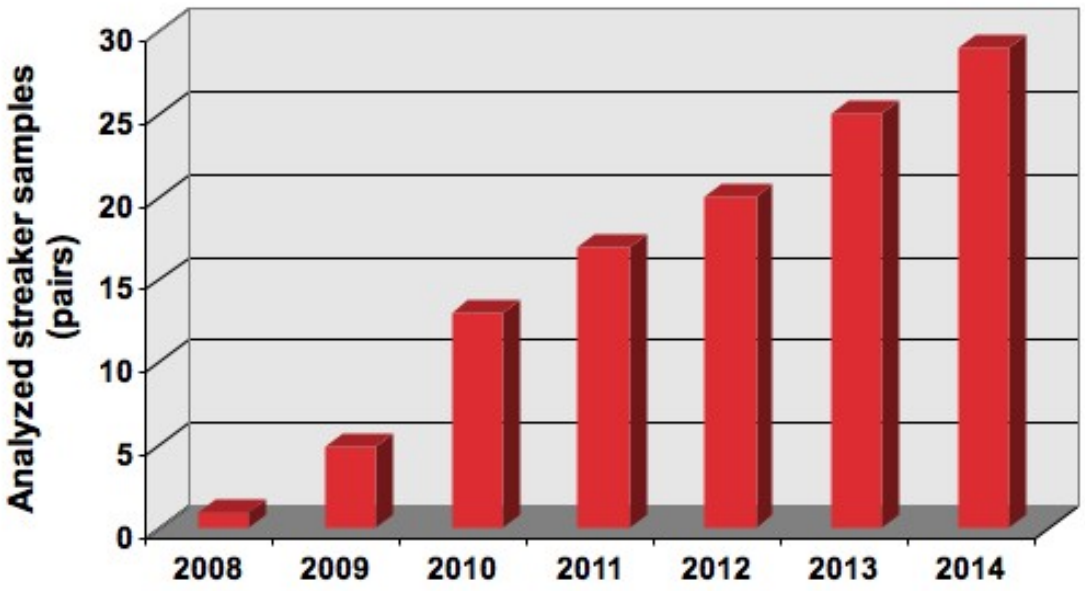
And so...

Optimized analytical capability

+

Aerosol research request for hourly data

=



but...

- **No more streaker samplers available on the market**

- **Commercial samplers do not cope with many applications (low sensitivity)**

TRACCIA
Time Resolved Aerosol Characterization: Challenging Improvements and Ambitions

Sezioni partecipanti:

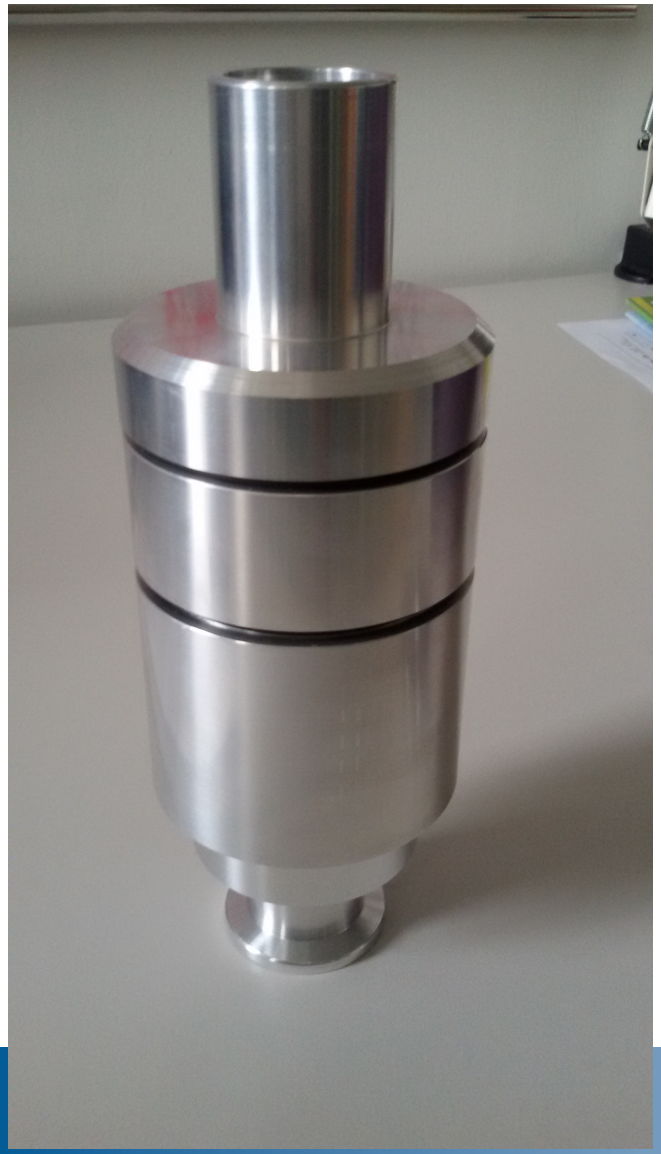
Firenze– Resp. Naz. Franco Lucarelli
Genova
Milano

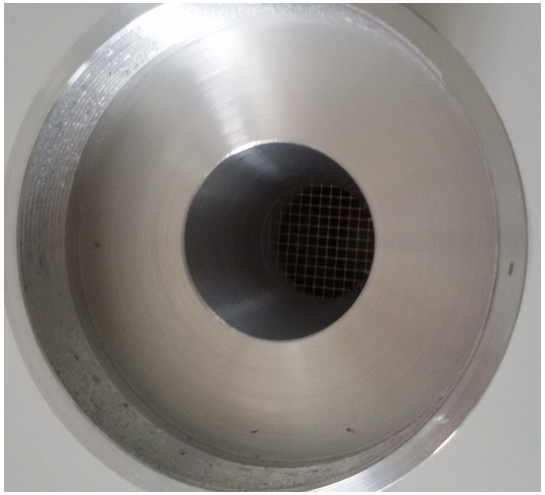
L'esperimento si inserisce nella linea di ricerca basata sull'uso di tecniche di analisi con fasci di ioni (e non solo !) per lo studio del particolato atmosferico che, nel corso del tempo, si è concretizzata nelle sigle di CSN5:

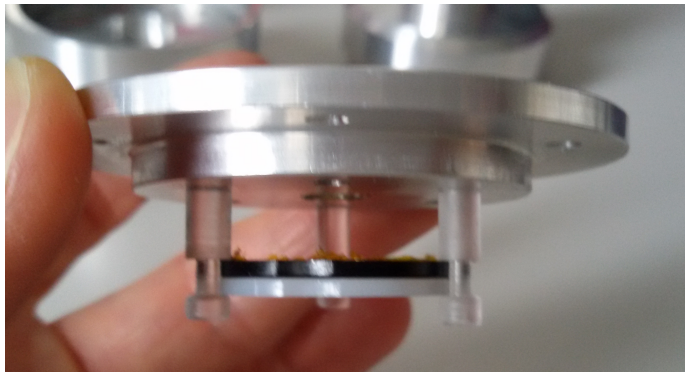
SCRIBA, MASAI, NUTELLA, NUMEN, MANIA, DEPOTMASS.

Il gruppo INFN si è affermato come riferimento mondiale per le analisi composizionali ad alta risoluzione temporale (~ 1 ora) che, specie in aree antropizzate, consentono di distinguere processi variabili nel tempo che sfuggono agli approcci tradizionali e/o riferiti alle norme per il controllo della qualità dell'aria (che prescrivono analisi su base giornaliera).

Prototype

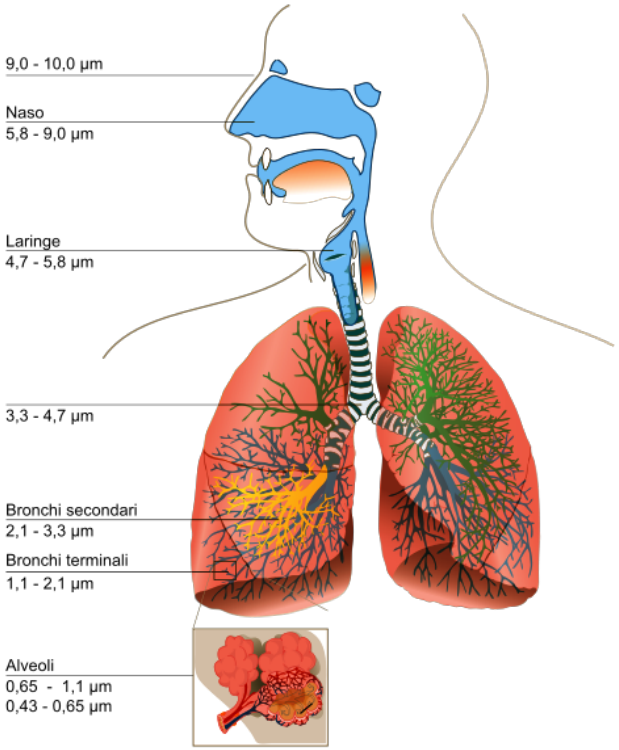






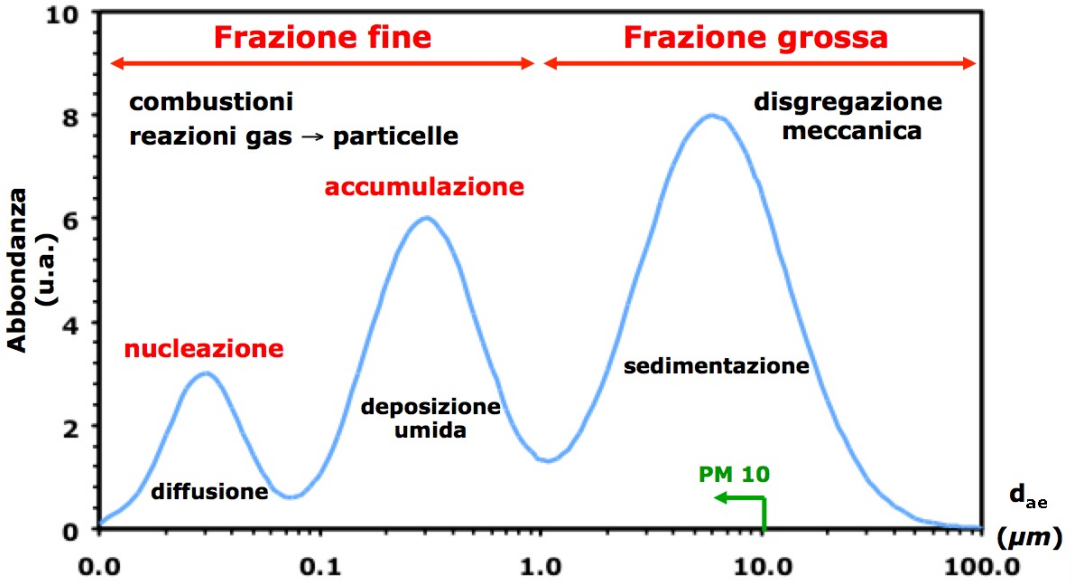
PM2.5 or PM1?

While current metrics for ambient PM pollution focus on either PM10 or PM2.5 and involve sample collection on a daily basis,
evidences suggest the PM1 is more representative separation between coarse and fine modes.



STRAS-ONE

Including the sampling of PM1



Richieste finanziarie

- Inventariabile: 10 kE
- Consumo: 2 kE
- Missioni: 8 kE
- Ulteriori richieste: 2 mesi uomo officina

Progetti futuri

- Altissima richiesta per questo tipo di studi; 2017-2018:
  CARE (Roma)
  AIRPOLL – Beijing
  ASAP – Delhi
  Elche (Spagna)

Next stop:
West Africa?

- In futuro: possibili studi epidemiologici e studi in aree remote (segregazione dimensionale utile per comprendere fenomeni di trasporto e formazione aerosol)
- Tematiche importanti sia per bandi italiani sia internazionali, e nell'ottica di progetti europei


1952 – The great smog of London


2018 – Pechino

A long way...

INFN FIRENZE