Today, we will:

- Continue discussing filter and face mask classification, and discuss **pleated air filters**
- Discuss **baghouses** and various ways to remove dust cakes from the bags
- Briefly discuss **electrostatic precipitators** (**ESP**s)

Face mask classification:

N95, N99, and N100 Face Masks:

N95 N99 N100

United States NIOSH standards define the following categories of particulate filters (from http://en.wikipedia.org/wiki/Respirator):

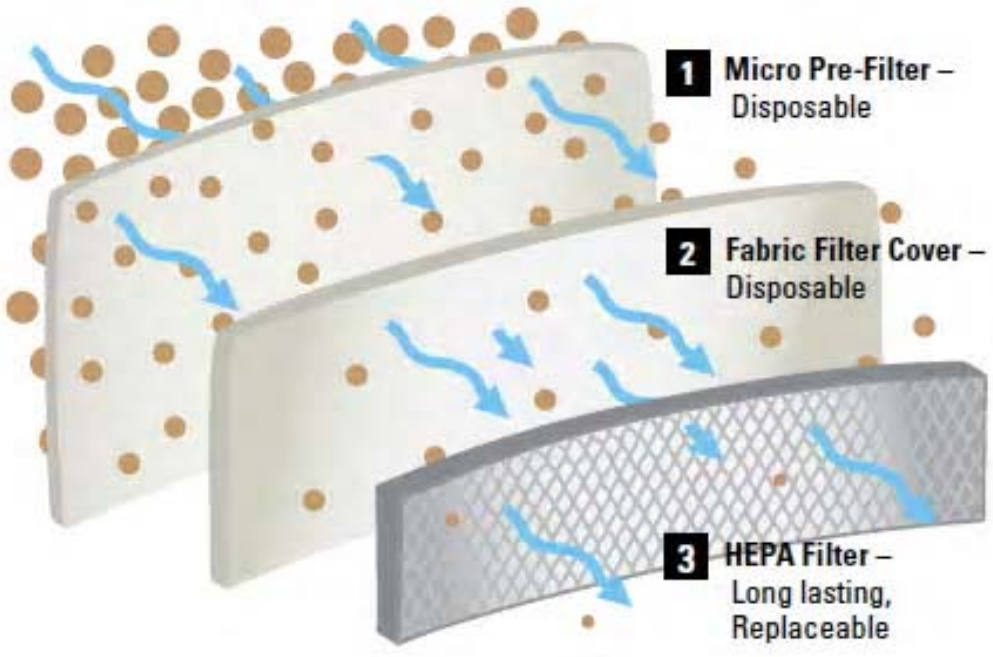
Oil resistance	Rating	Description
Not oil resistant	N95	Filters at least 95% of airborne particles
	N99	Filters at least 99% of airborne particles
	N100	Filters at least 99.97% of airborne particles
Oil Resistant	R95	Filters at least 95% of airborne particles
	R99	Filters at least 99% of airborne particles
	R100	Filters at least 99.97% of airborne particles
Oil Proof	P95	Filters at least 95% of airborne particles
	P99	Filters at least 99% of airborne particles
	P100	Filters at least 99.97% of airborne particles

What size range

These measurements of removal efficiency are typically for particles in the "dip", usually particles with $0.1 < D_p < 0.3$ μm. However, some studies us a different range to cover the entire "dip", namely $0.04 < D_p < 1.3$ μm. ↘ This range is right in the "dip" for filters

Example of a pleated filter: (from http://www.onlinevacshop.com/Fantom-HEPA-Filter.php)

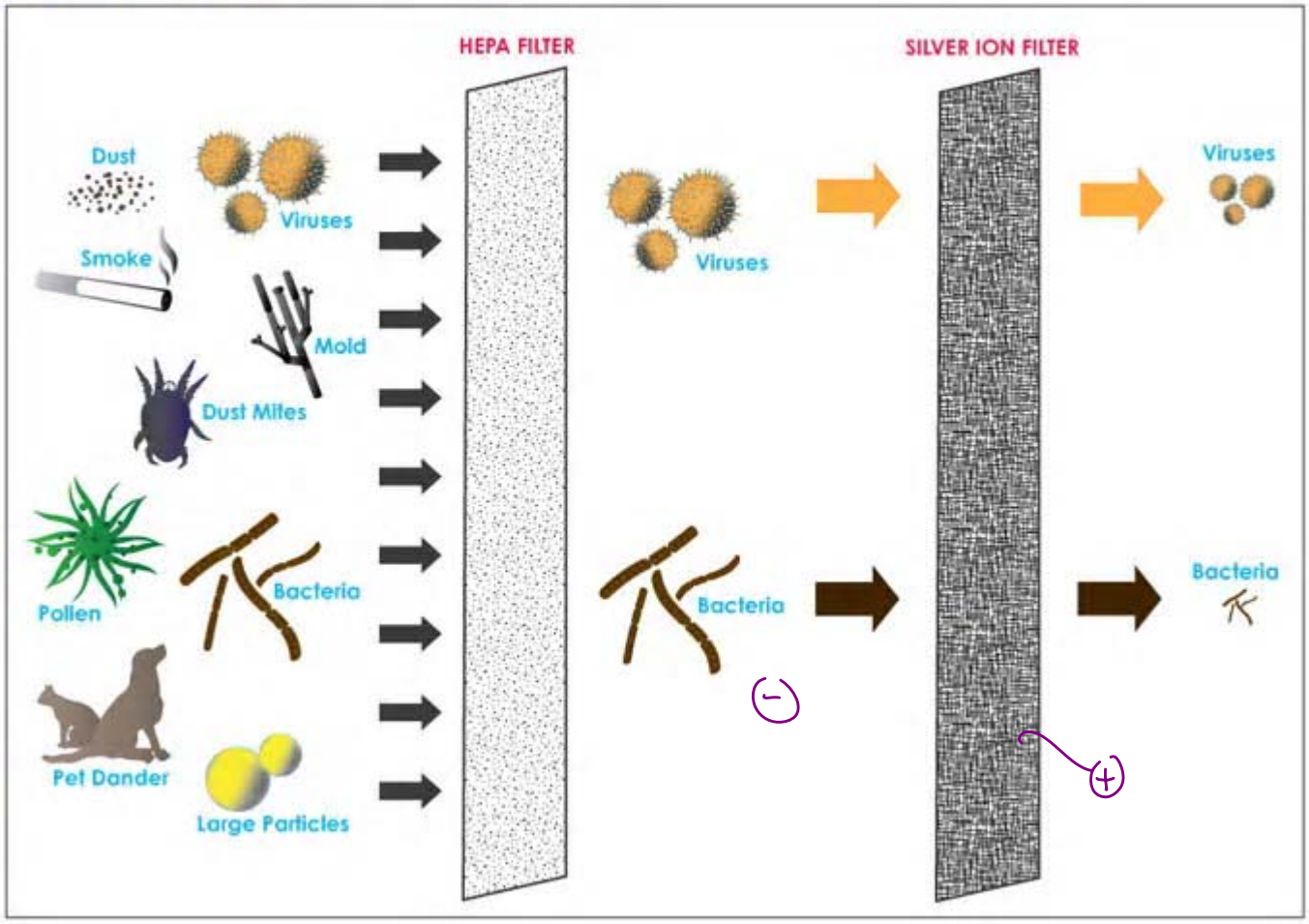
Some images from filter manufacturers:
From http://certifiedhepafilter.com/ :



From http://www.cleancraft.com/Alen_A350_Replacement_Silver_HEPA_Air_Filter_p/ap-aa350f-silv.htm :

HEPA with Silver Ion Filtration

The HEPA filter eliminates over 99% of airborne allergens while the addition of the Silver Ion filter eliminates 98% of bacteria and half of airborne viruses.

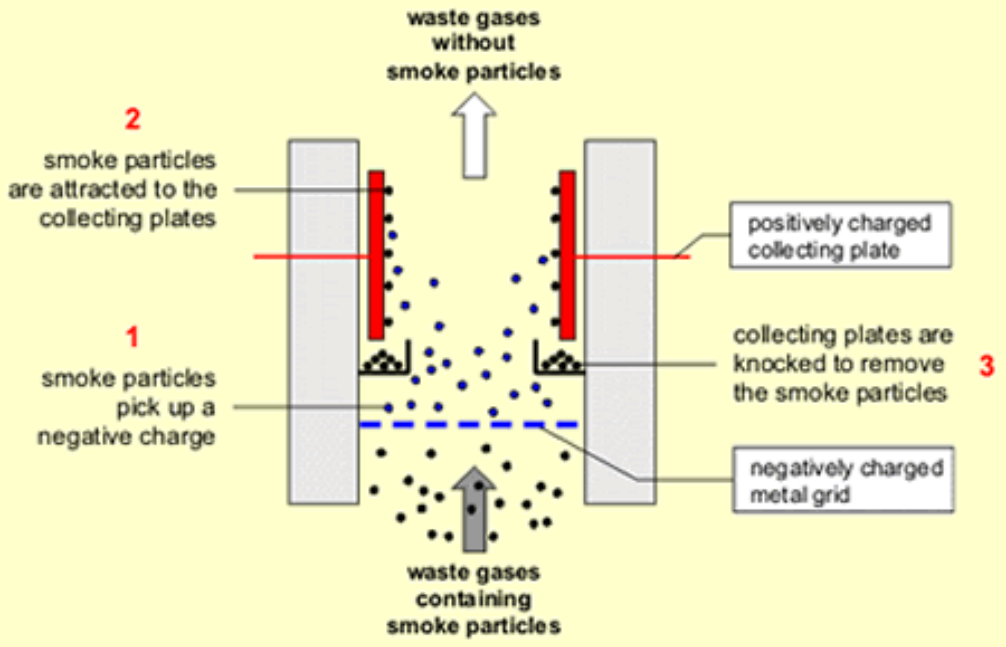


Ionizer (Ionizing air filters)

- Ionize the air by generating electrons → electrons attach to molecules of air → create ions (ionized air) ⊖ve charge
- dust particles attach to these ions (static electricity)
- Put ⊕ charge on the metal filter → attracts the dust particles

Some ionizers work the opposite → ⊖ve charge on the filter
⊕ve charged particles

Ionizer. From http://air-purifier-reviewsite.com/blog/types-of-air-purifier-technology-that-is-best-for-allergies/ :



- Activated Carbon (Charcoal filter) — see pdf file on website

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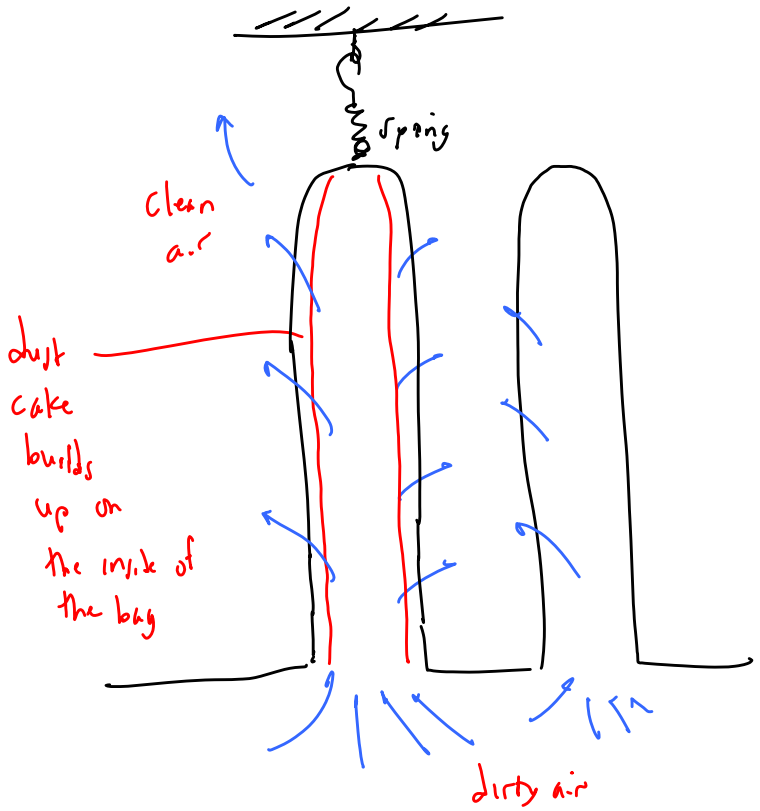
Large-scale application of filter

- Baghouse



"Friable"

dust cake is easy to break apart.

(dust cake must be dry)

To remove the dust cake,

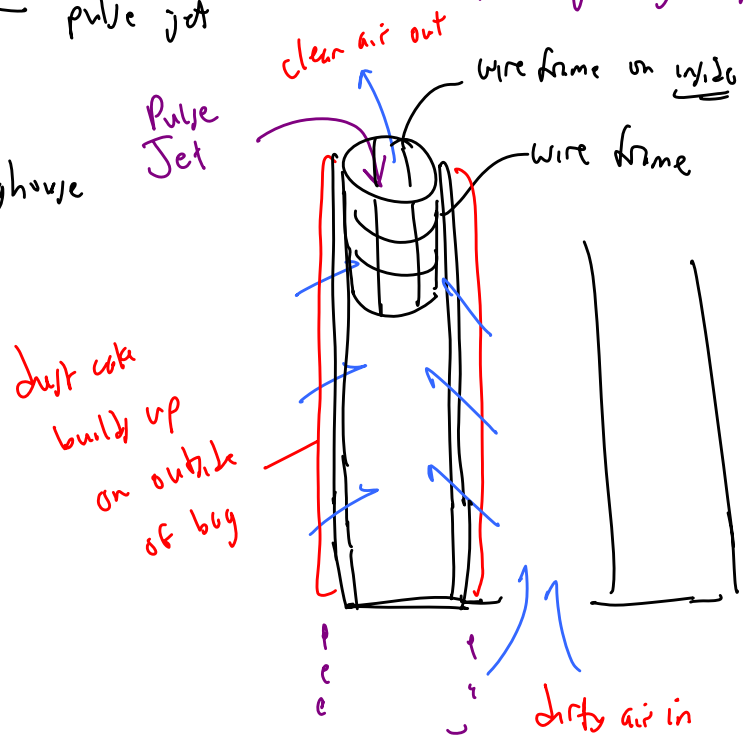
1) Temporarily shut off the flow

Cleaning process { 2) → Shake the bag — Shaker bag house → clean every few hours

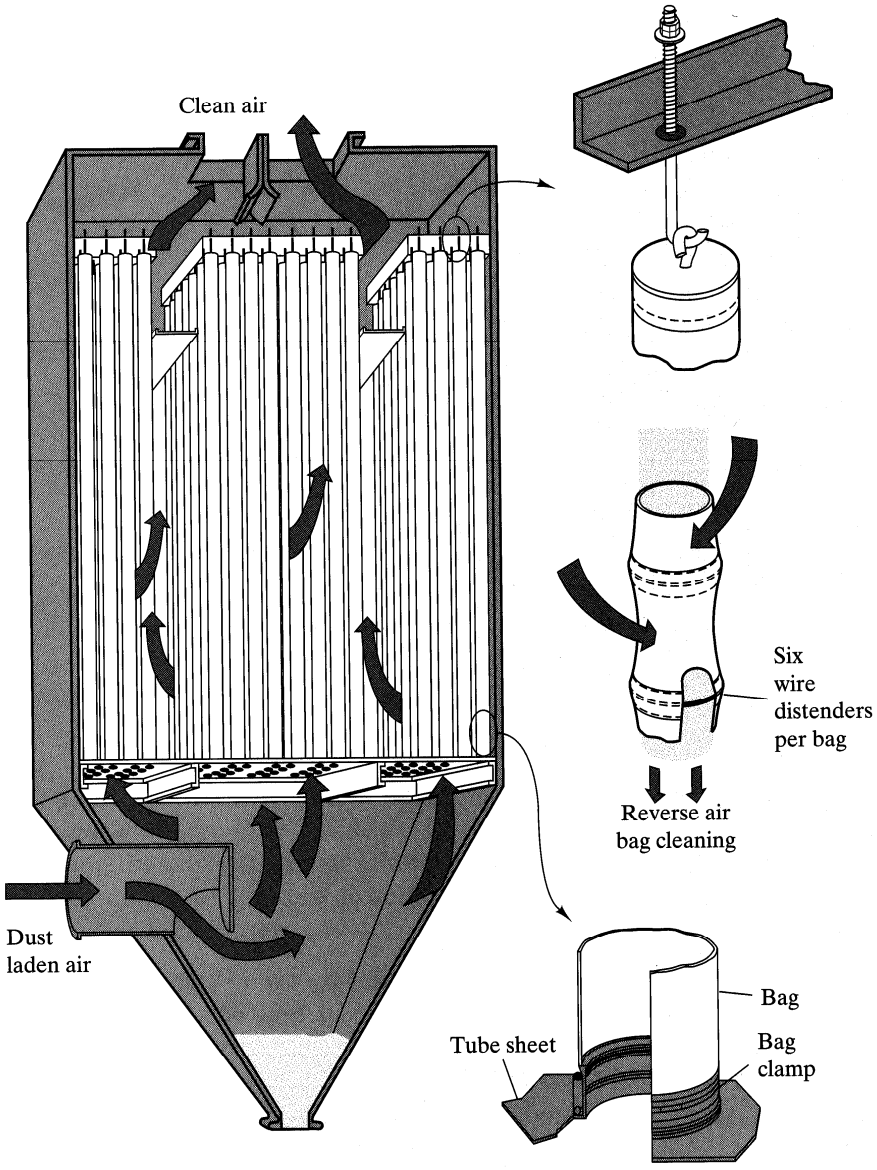
or → reverse flow — reverse flow bag house

or — pulse jet — pulse-jet bag house — clean every few minutes

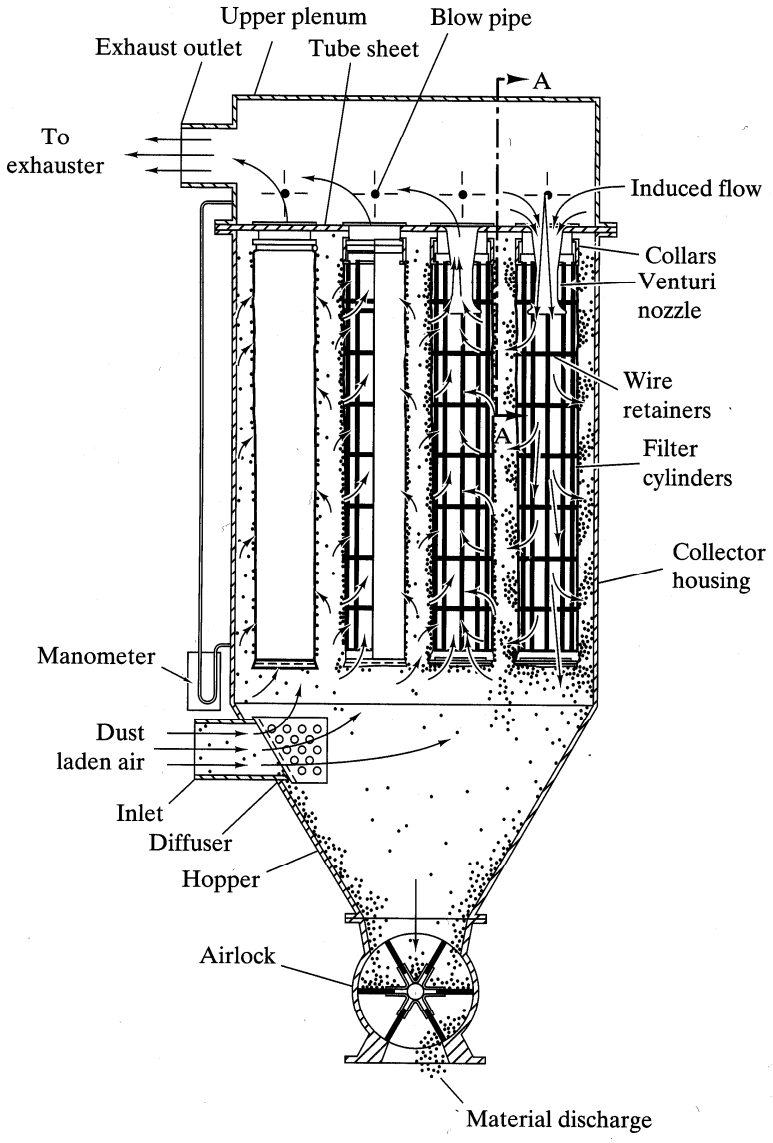
Pulse jet baghouse



Reverse-flow baghouse:



Pulse-jet baghouse:



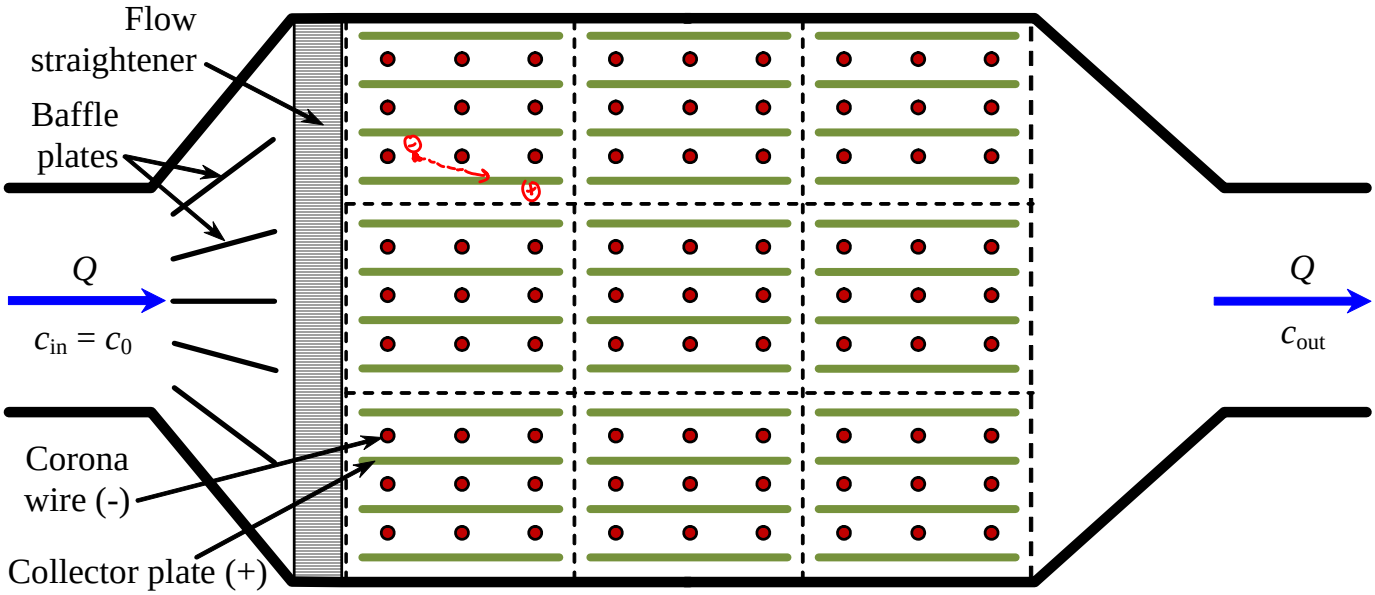
Electrostatic Precipitators (ESPs):

Do not work by inertial separation → not affected by the "dip" (0.1 to 0.3 μm)

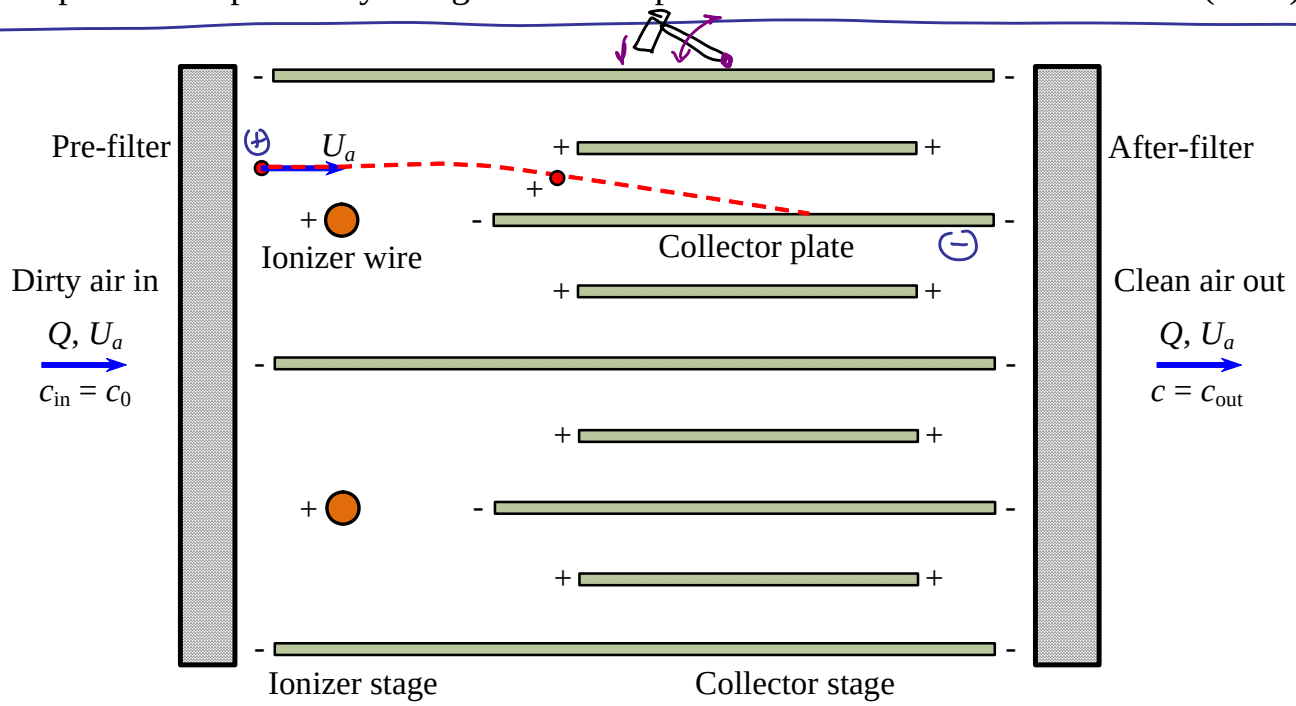
→ Corona wire – causes particles to acquire a ⊖ ve charge

– plates are ⊕ ve charge – attract the particles

1000's of volts

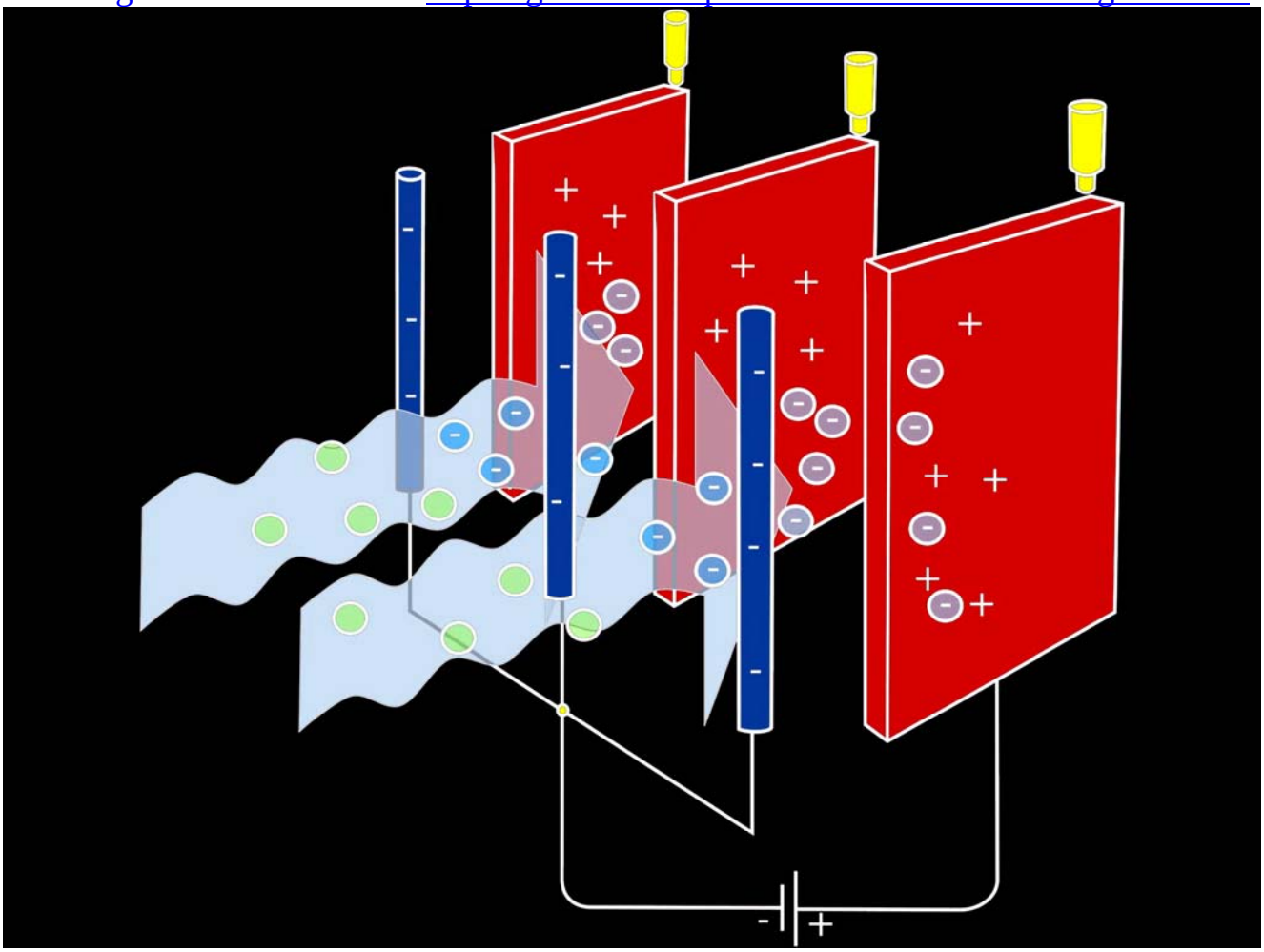


Top view of a negative ionization, single-stage, plate-wire ESP, with three parallel legs, each of which has three modules in series; circles represent the negatively charged corona wires, lines represent the positively charged collector plates. From Heinsohn and Cimbala (2003).

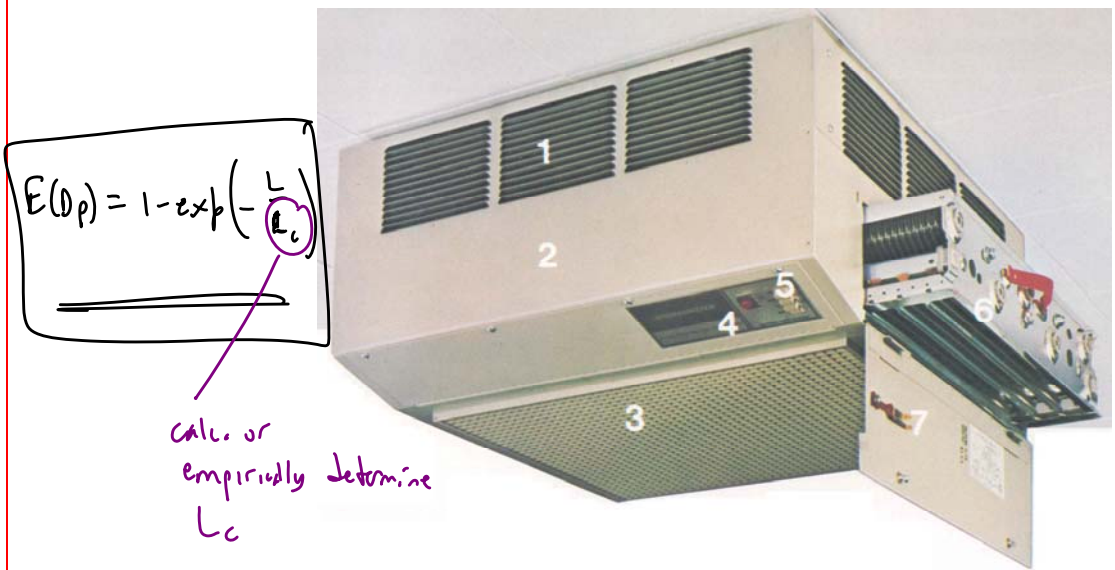


Schematic diagram of a positive ionization, two-stage, plate-wire ESP; dashed line indicates a particle trajectory. From Heinsohn and Cimbala (2003).

Nice diagram of an ESP from https://gsf165.wordpress.com/2013/04/13/flue-gas-filters/ :



Ceiling mounted ESP for restaurants and other public places:



Smokemaster ceiling-mounted two-stage electrostatic precipitator that removes smoke, fume and small particles from public places; 1 – discharge louvers, 2 – housing, 3 – prefilters and grille, 4 – indicator lamp, 5 – speed control, 6 – ESP cells, 7 – access door. From Heinsohn and Cimbala (2003).