

# SPETTROMETRIA ATOMICA DI EMISSIONE CON SORGENTI A PLASMA

Questo tipo di spettroscopia atomica di emissione sfrutta le elevate temperature (6000 – 10000 K) realizzabili con sorgenti a plasma. Molti strumenti usano un plasma ad accoppiamento induttivo (ICP-AES: Inductively Coupled Plasma - Atomic Emission Spectrophotometry).

**Flusso Ar:** 11 – 17 L/min

**Potenza:** 2 kW a circa 27 MHz

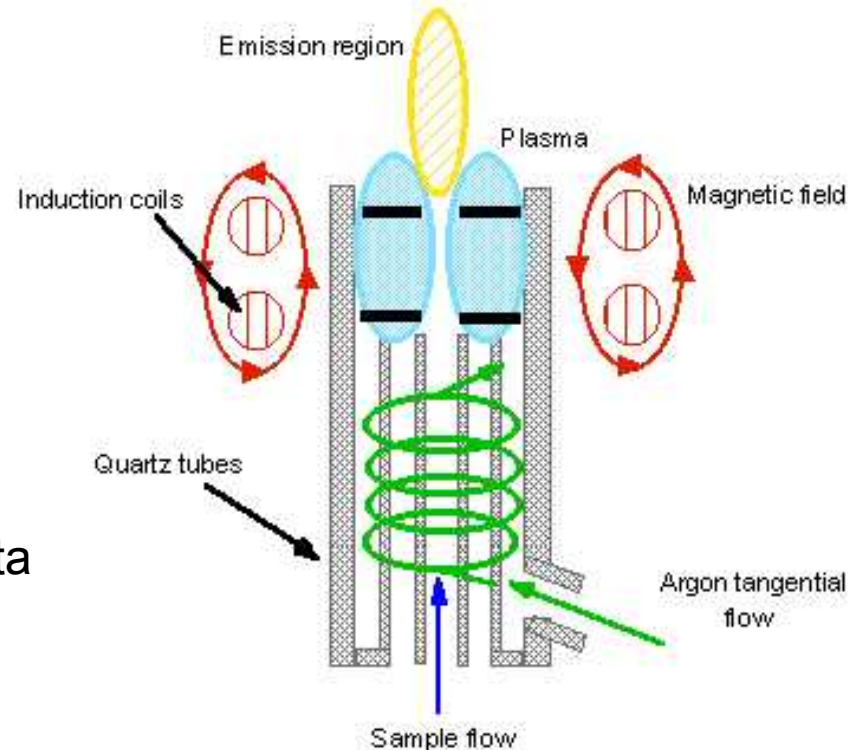
**Ignizione:** piezoelettrica

**Iniezione analita:** come aerosol

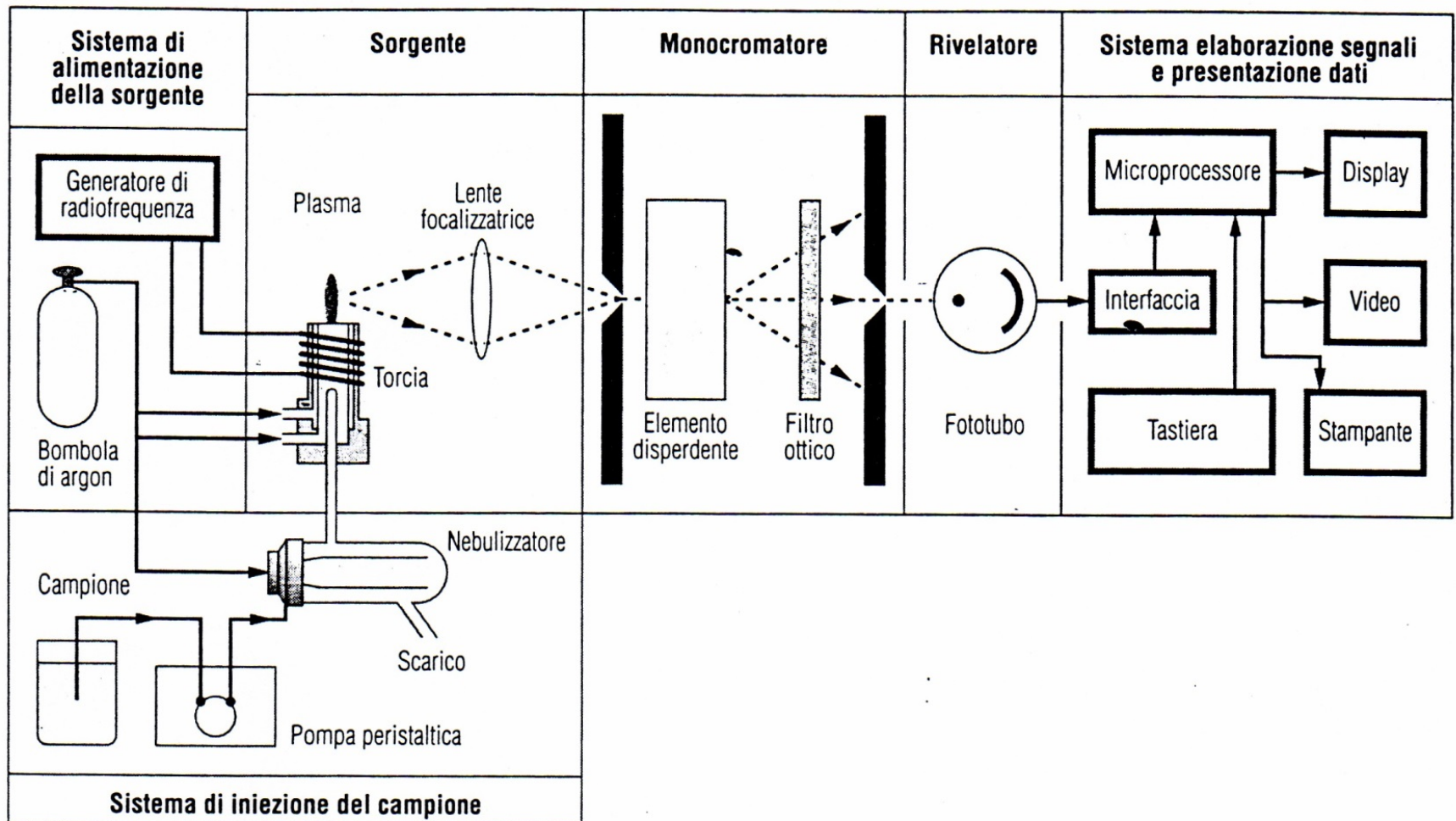
**Interferenze:** scarse

**Ionizzazione:** ridotta a causa dell'elevata concentrazione di ioni  $\text{Ar}^+$

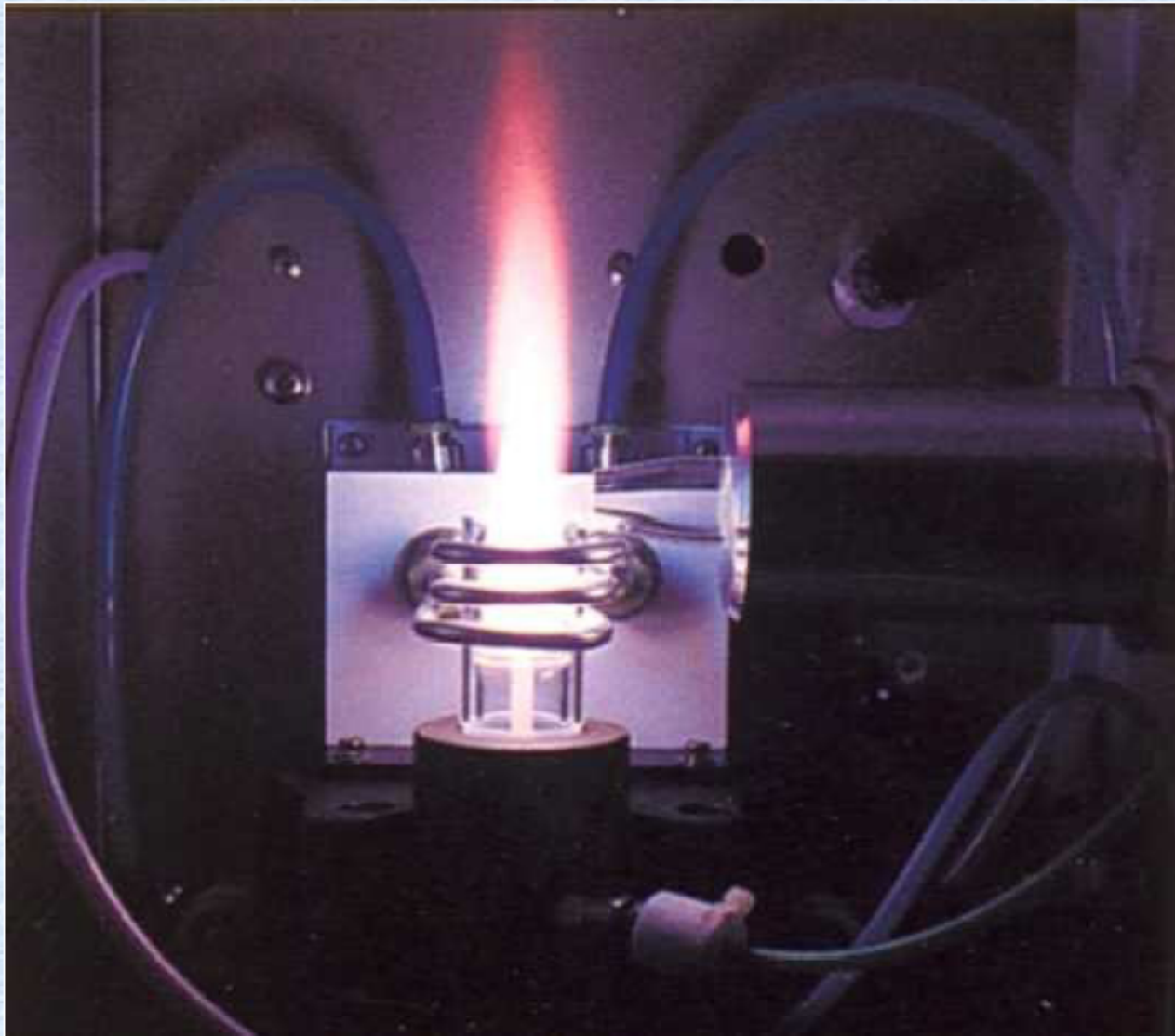
**Range lineare:** 3-5 ordini di grandezza



# SCHEMA A BLOCCHI ICP-AES



## Sorgenti ICP

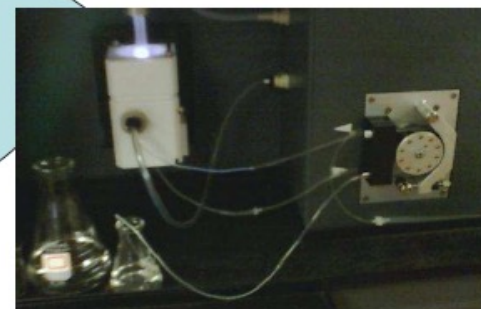


# ICP-AES: ANALISI SIMULTANEA E/O SEQUENZIALE

## Varian Vista CCD Simultaneous ICP-AES



**73 elementi in 35 secondi**



# LIMITI DI RIVELABILITA' PER DIVERSI ELEMENTI IN F-AAS, GF-AAS, F-AES, ICP-AES

Limiti di rivelabilità in analisi di spettroscopia atomica per alcuni elementi\*

Elemento	Assorbimento in fiamma**	Assorbimento elettrotermico***	Emissione in fiamma**	Emissione ICP**†
Al	30	0.005	5	2
As	100	0.02	0.0005	40
Ca	1	0.02	0.1	0.02
Cd	1	0.0001	800	2
Cr	3	0.01	4	0.3
Cu	2	0.002	10	0.1
Fe	5	0.005	30	0.3
Hg	500	0.1	0.0004	1
Mg	0.1	0.00002	5	0.05
Mn	2	0.0002	5	0.06
Mo	30	0.005	100	0.2
Na	2	0.0002	0.1	0.2
Ni	5	0.02	20	0.4
Pb	10	0.002	100	2
Sn	20	0.1	300	30
V	20	0.1	10	0.2
Zn	2	0.00005	0.0005	2

\* Tutti i valori in nanogrammo/millilitro =  $10^{-3} \mu\text{g/mL} = 10^{-3} \text{ ppm}$ .

\*\* Da V. A. Fassell e R. N. Kniseley, *Anal. Chem.*, **1974**, *46*, 1111A. Per gent. conc. Copyright 1974 American Chemical Society.

\*\*\* Da C. W. Fuller, *Electrothermal Atomization for Atomic Absorption Spectroscopy*, pp. 65-83. Londra: The Chemical Society, 1977. Per gent. conc. della Royal Society of Chemistry.

† ICP = Plasma da accoppiamento induttivo.

# LIMITI DI RIVELABILITA' PER DIVERSI ELEMENTI IN ICP-MS

Limits of detection in parts per billion (ng/ml)

Quadrupole ICP-MS  
High-Resolution ICP-MS

Values reflect actual experimental data gathered over more than 1 year and are calculated from 3 sigma of an aqueous blank.

H																	He				
Li 0.4 0.002	Be 0.04 0.003															B 0.5 0.28	C	N	O	F	Ne
Na 0.4 1.1	Mg 0.06 0.07															Al 0.02 0.2	Si N/A 0.6	P N/A 0.5	S N/A 1.1	Cl N/A 159	Ar
K N/A 0.15	Ca N/A 0.3	Sc 0.2 4E-04	Ti 1.3 0.04	V 0.001 0.001	Cr 0.2 0.004	Mn 0.01 0.03	Fe N/A 0.05	Co 9E-04 0.005	Ni 0.2 0.08	Cu 0.01 0.03	Zn 0.02 0.04	Ga 0.001 0.002	Ge 0.01 0.009	As 0.1 0.02	Se 0.3 0.01	Br	Kr				
Rb 0.003 0.007	Sr 4E-04 0.005	Y 1E-04 1E-04	Zr 0.001 0.001	Nb 2E-04 1E-09	Mo 7E-04 0.006	Tc	Ru 0.001 1E-04	Rh 1E-04 0.003	Pd 0.001 1E-04	Ag 9E-04 0.003	Cd 0.003 0.002	In 3E-04 5E-04	Sn 0.002 0.008	Sb 6E-04 6E-04	Te 0.009 1E-04	I	Xe				
Cs 0.001 1E-04	Ba 0.002 0.002	La 1E-04 1E-04	Hf 5E-04 1E-04	Ta 2E-04 3E-05	W 7E-04 0.001	Re 2E-04 0.001	Os 3E-04 0.001	Ir 2E-04 0.001	Pt 5E-04 1E-05	Au 0.002 3.1	Hg 0.6 0.06	Tl 2E-04 1E-04	Pb 0.001 0.009	Bi 3E-04 5E-04	Po	At	Rn				
Fr	Ra	Ac	Not measured by ICP-MS																		
Ce 2E-04 0.001	Pr 2E-04 1E-04	Nd 4E-04 2E-04	Pm	Sm 5E-04 1E-04	Eu 2E-04 2E-05	Gd 9E-04 1E-04	Tb 1E-04 1E-05	Dy 3E-04 1E-04	Ho 2E-04 1E-04	Er 3E-04 1E-04	Tm 1E-04 1E-04	Yb 4E-04 2E-05	Lu 2E-04 1E-05								
Th 1E-04 2E-05	Pa	U 2E-04 3E-04	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr								