

EUV Source Metrology Roadmap (planned)

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Background

Source is the #1 risk in whole EUVL development

- ➔ Suitable metrology procedures are needed to monitor status and progress of EUVL source development with respect to the various source requirements in the α - β - and γ - phases.

Objectives

In order to meet end-users and source developers demands in time, the requirements of source metrology must be specified exactly:

- what tools / procedures are required?
- when tools / procedures are required?

Consensus within the EUVL community is need to specify the requirements of EUV source metrology.

Objectives

Once the requirements are specified including the respective timelines they will be picked up in the source metrology roadmap.

The source metrology roadmap will be the guideline for the development of source metrology.

We need your feedback on the EUV Source Metrology requirements to draft the first version of the source metrology roadmap.

Everybody is welcome to give input!

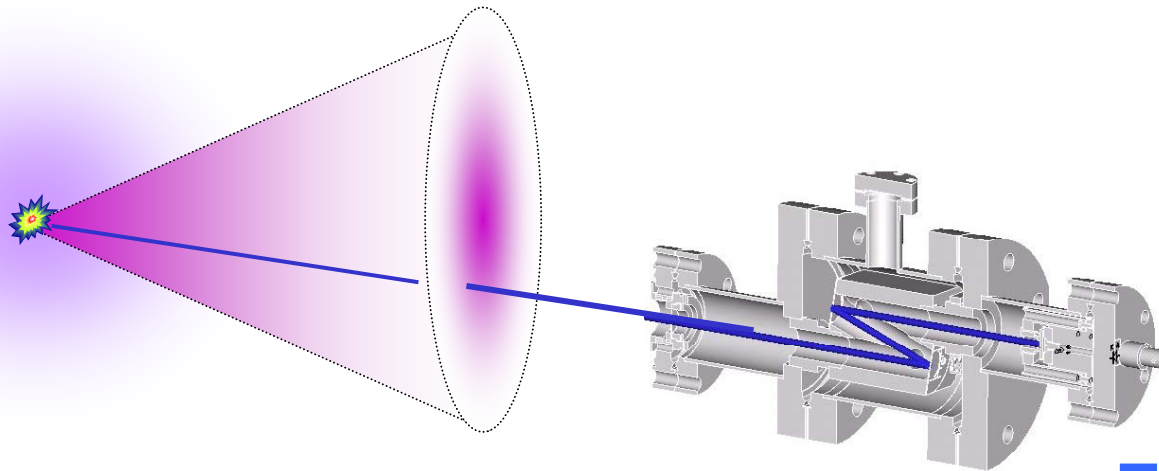
Status Quo of Source Metrology (Incomplete Survey)

Various tools for source metrology are in use:
(R&D institutes, commercial suppliers, self-made by users)

- Inband power sensors
- EUV Spectrographs
- Imaging tools (pinhole / slit, spherical mirror)
- Out of band sensors
- Deduced tools (isotropy, lifetime experiments, stability,...)
- ...

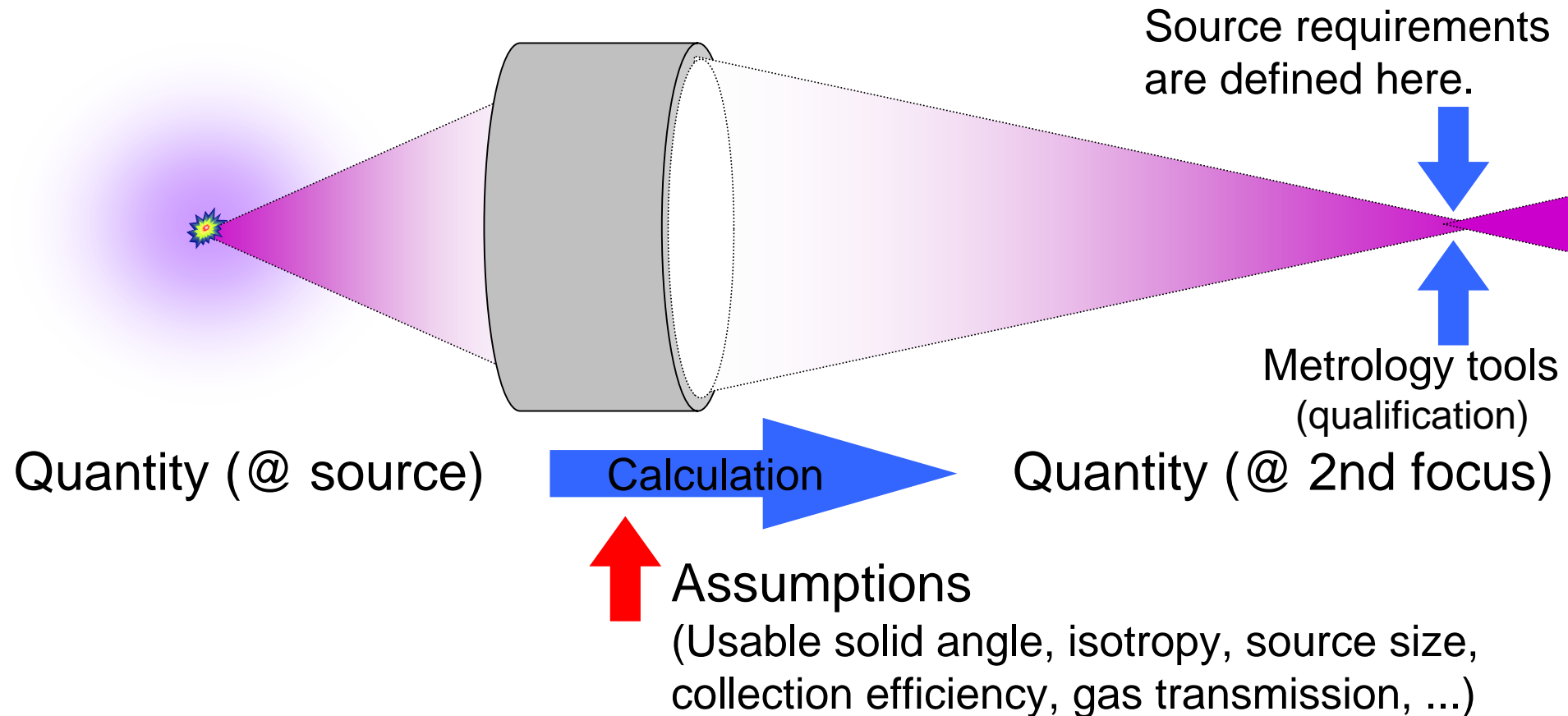
Status Quo of Source Metrology

Most tools designed for direct source measurements



Quantity
(valid for the experimental
conditions)

Status Quo of Source Metrology



(Direct) Metrology for the Intermediate Focus (IMF)

First SOCOMOs are setup now!

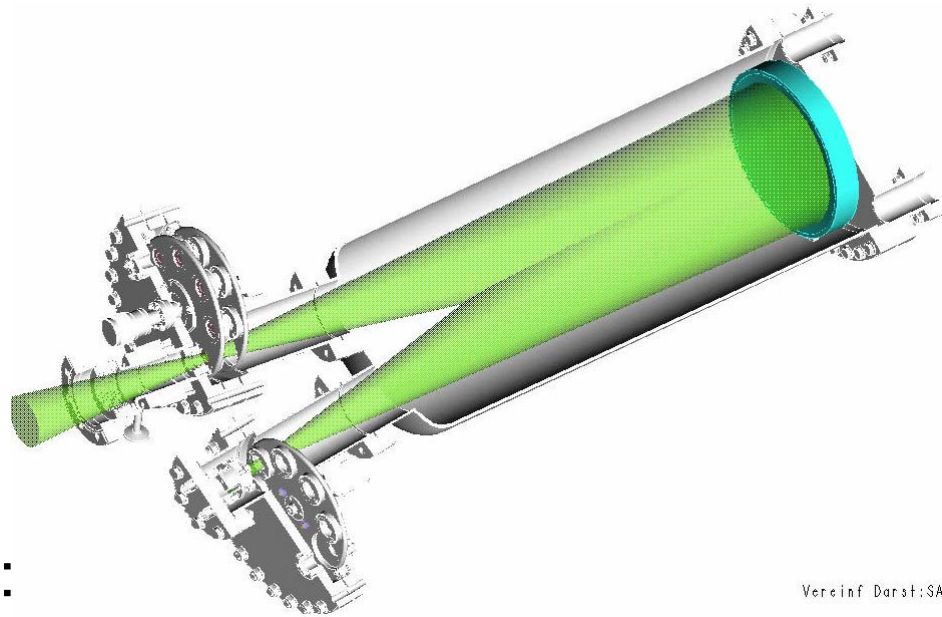
What do we need to know about the IMF?

- Inband power and stability
 - Inband intensity distribution and stability
 - Out of band power
 - Etendue
 - Interfaces
 - ...
- Required accuracy?



Development of suitable metrology concepts & tools

(Direct) Metrology for the Intermediate Focus (IMF)

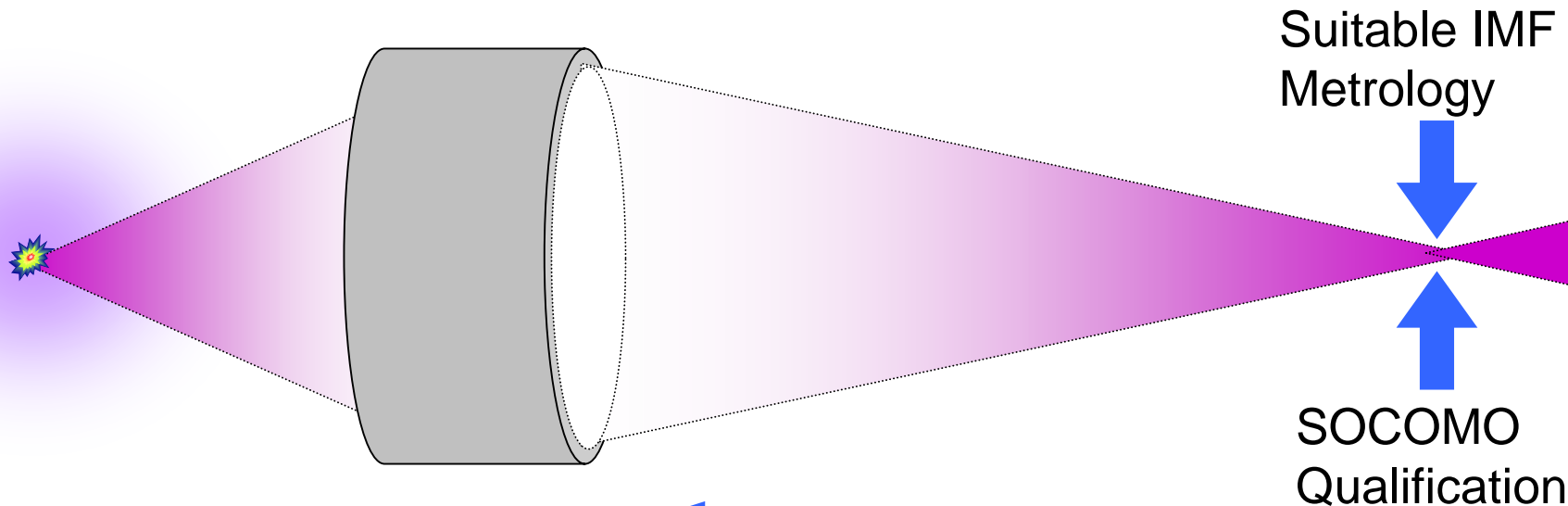


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Challenging:

- Divergence of Radiation
- Broad band Radiation
- High flux (> 2kW total for 100W inband)

Transfer of Specifications



Requirements (@ source) ← **Transfer** Requirements (@ IMF)

System features ↑

(Collector, debris mitigation system, SP filter, gas transmission, ...
Features are source specific and interacting: → no one-to-one relation of specs)

Specifications & Responsibilities

- General (source / SOCOMO independent) requirements can be defined @ the IMF only. ← Source supplier is responsible for.

- Source (as part of system) = SOCOMO.
SOCOMO requirements.

IMF metrology requirements
(Source suppliers, system integrators)

↓ Transfer

Source metrology requirements
(source suppliers)

(Direct) source requirements.

Source- / SOCOMO-type individual, different in nature (compared to IMF),
but useful (essential) for source R&D and process control.

Questions to Audience

- 1) All: Do we want to change the definition of inband?

- 2) System integrators:
What do you need to know exactly about the beam profile at / behind IMF at minimum?

- 3) Source suppliers:
What do you need to know exactly about the beam profile in front / at / behind IMF?

- 4) All: Are there other needs for source / SOCOMO metrology?

1) All:

Change definition of inband?

Currently:

13.5 nm 2% BW

Box: $13.365 \text{ nm} < \lambda < 13.635 \text{ nm}$

Physically well defined.

Requires spectral correction
(For ML based inband sensors).

Alternative:

Normalise to wafer level

Transmission of EUVL system

Adapt ML coating of tools

→ No spectral correction

More practical definition.

Pre-condition:

Transmission of EUVL system

known and standardised

→ Optical design must be fixed.

2) System integrators:

What do you need to know exactly about the beam profile at / behind IMF at minimum?

- Inband power:

Total (accepted) beam profile or solid angle increment?

Integral stability?

Required Accuracy (absolute, relative)?

- Intensity distribution in beam profile:

Inband or broad band EUV?

Where (at IMF and / or behind)?

Wavefront?

Stability (centre of mass, full picture)?

Stability (time scale)?

Required accuracy / resolution?

2) System integrators:

What do you need to know exactly about the beam profile at / behind IMF at minimum?

- Definition of Interfaces

Distance to IMF, space, flanges, acceptable beam profile?

- Out of band power

Bands (X-ray, EUV, VUV, UV, VIS, IR)?

Dangerous bands (resist)? Maximal allowed power?

Spectral resolution?

Intensity distribution (in profile)?

Required accuracy (for the different bands)?

- Additional parameters for SOCOMO qualification?

Simultaneous measurement of parameters / measurement procedures?

...

3) Source suppliers:

What do you need to know exactly about the beam profile in front / at / behind IMF?

- Different / additional requirements
(Compared to system integrators)

- Inband power

Total beam profile (not only acceptable by illuminator)?

- ...

2) & 3) System integrators / source suppliers:

When the procedures / tools are needed?

4) All:

Are there other needs for
source / SOCOMO metrology?

- Direct source metrology?
- Metrology for in-SOCOMO process control?
- Lifetime, contamination, debris?
- ...

Thank You!

Acknowledgement

Vivek Bakshi 

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