
eBeam
Initiative

eBeam Initiative Meeting

Solving the Impossible 80 Hour Mask Problem

Aki Fujimura
CEO – D2S, Inc.
Managing Sponsor – eBeam Initiative
BACUS Update – September 14, 2010

Welcome to New Members at BACUS

34 Member Companies & Advisors

eBeam Initiative

www.ebeam.org

aBeam technologies

ADVANTEST

alchip

Altos Design Automation

ADVANCED MASK TECHNOLOGY CENTER

cadence

D2S

DNP Dai Nippon Printing

EQUIcon

Marty Deneroff
Consultant

eShuttle

eSilicon

FASTRACK DESIGN

Fraunhofer CNT

FUJITSU

GenISys

GLOBALFOUNDRIES

Jack Harding
eSilicon

HOYA

JEOL

KLA-Tencor
Accelerating Yield

cea leti

MAGMA

NuFlare

Colin Harris
PMC-Sierra

PETERSEN ADVANCED LITHOGRAPHY INC.

SAMSUNG

SYNOPSYS

Riko Radojcic
Qualcomm

Tela Innovations

TOOL

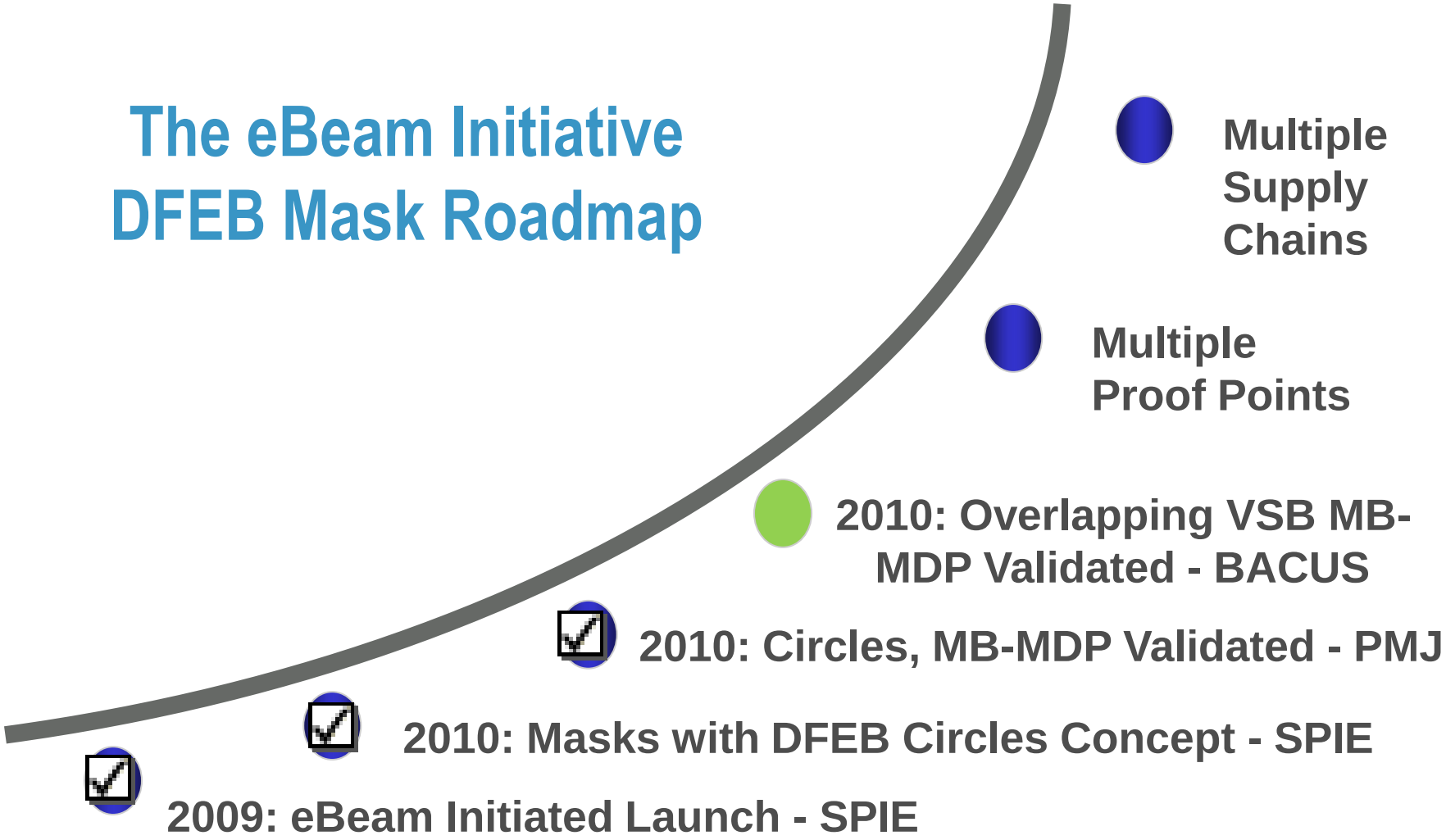
TOPPAN

Jean-Pierre Geronimi
ST

VIRAGE LOGIC

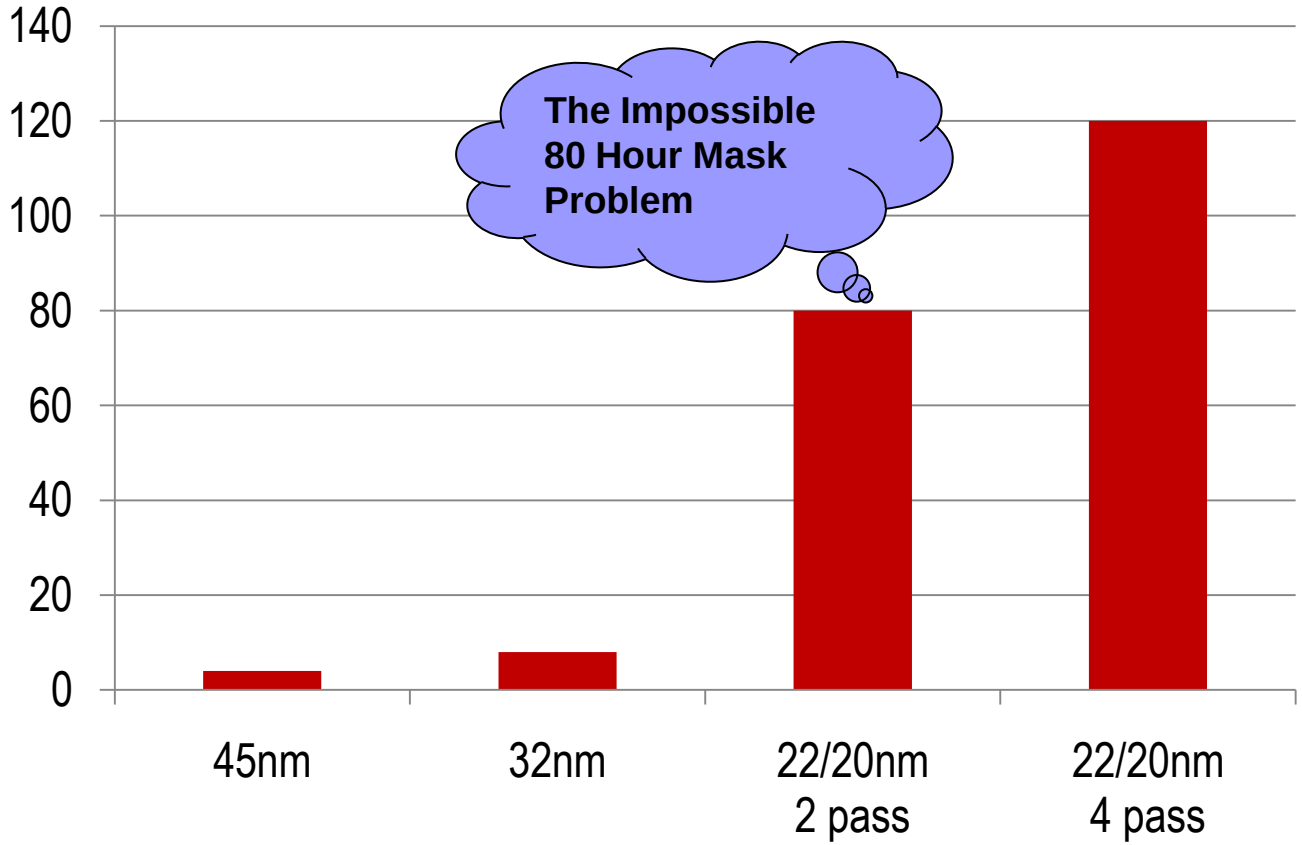
Vistec

The eBeam Initiative DFEB Mask Roadmap



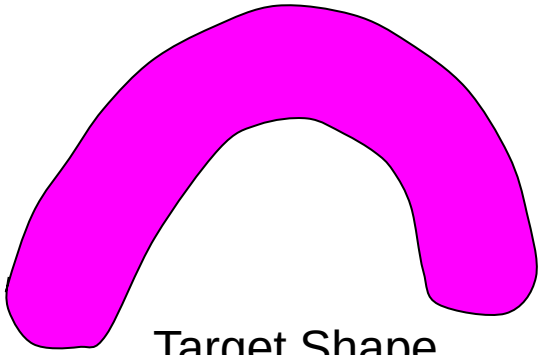
193i at 22/20nm Requires Complex Masks

Write times (in hours) required with complex masks with complex SRAF shapes for 22/20nm

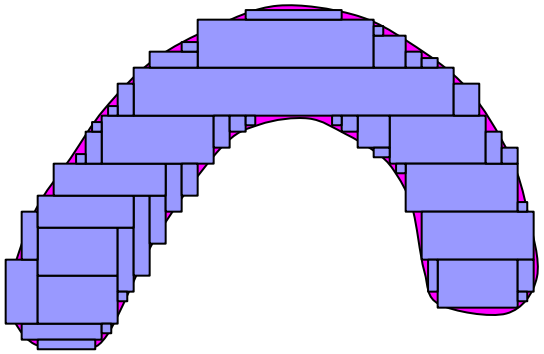


Source: D2S, Inc. projection of write times from shot counts projected in BACUS

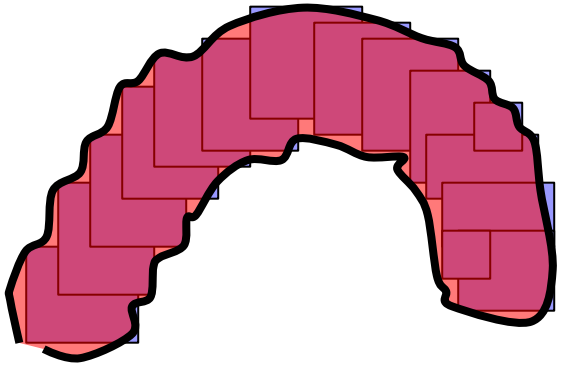
DFEB Mask Addresses the 80 Hour Mask by Using Overlapping VSB and Circle Shots



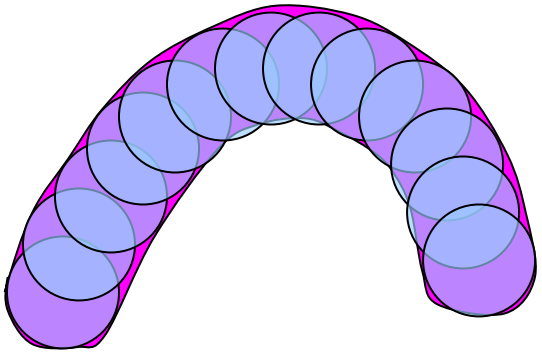
Target Shape



40 Conventional VSB Shots

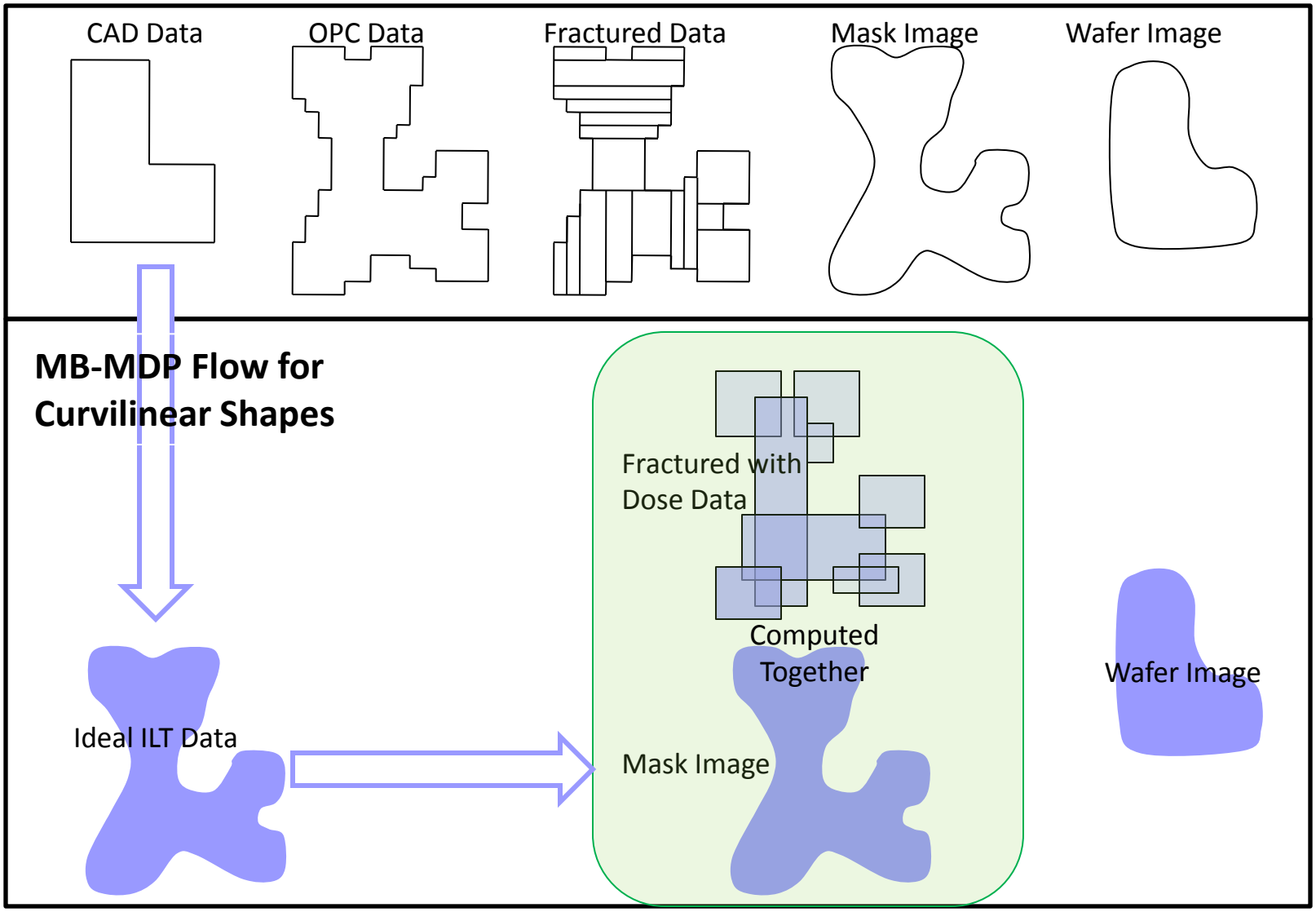


15 Overlapping VSB Shots



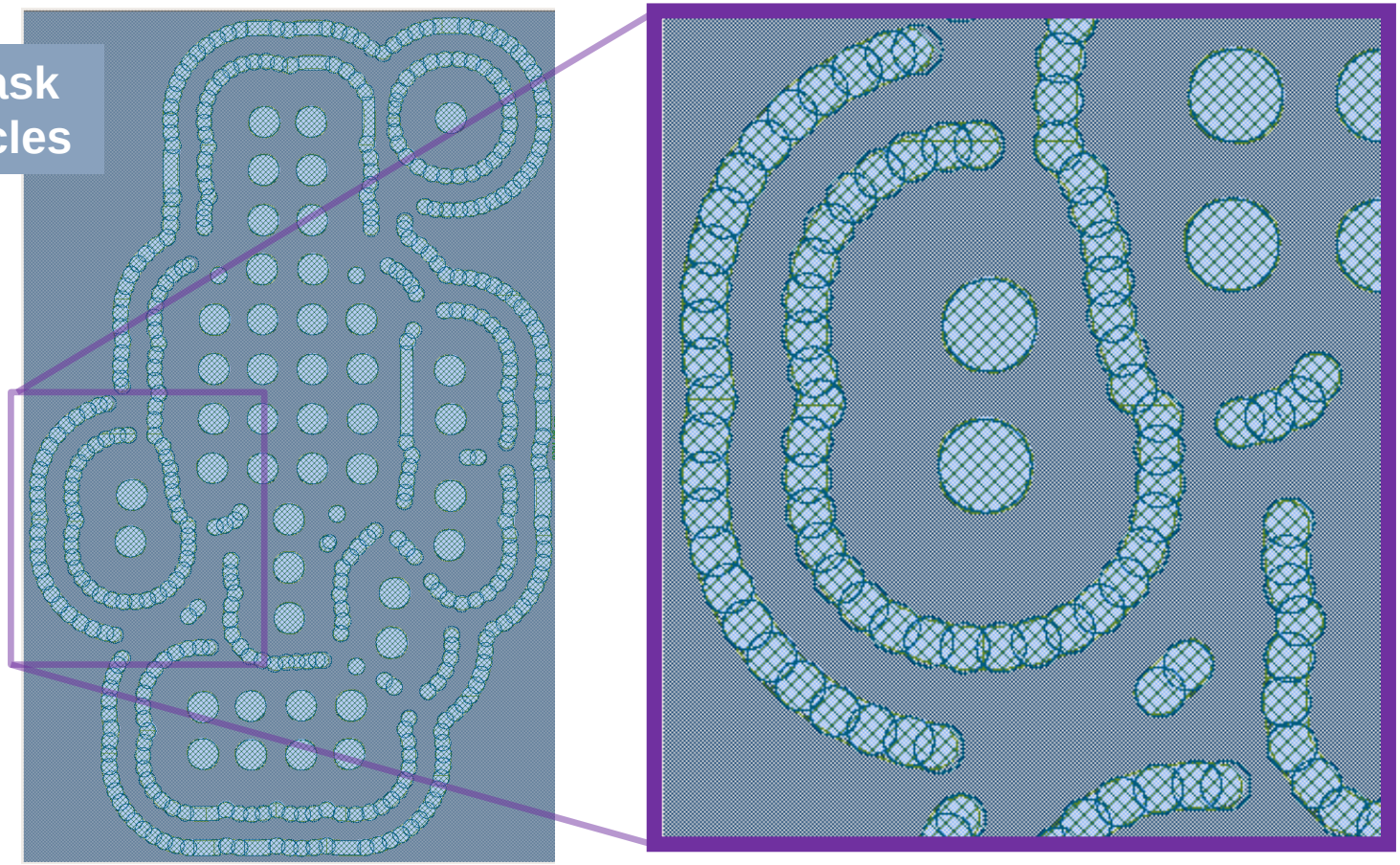
13 Overlapping Circles

DFEB Mask Uses Model-based Mask Data Prep



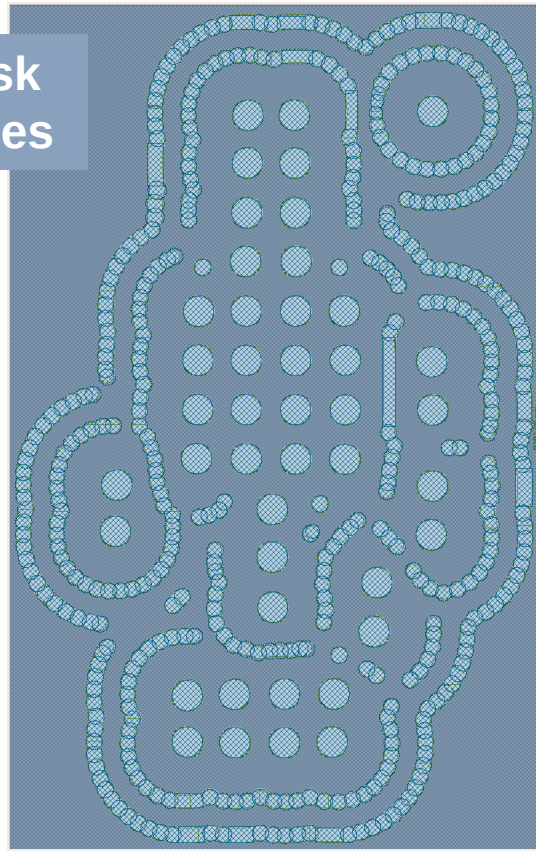
PMJ 2010: First Proof of Circular Shots

Ideal Mask with Circles



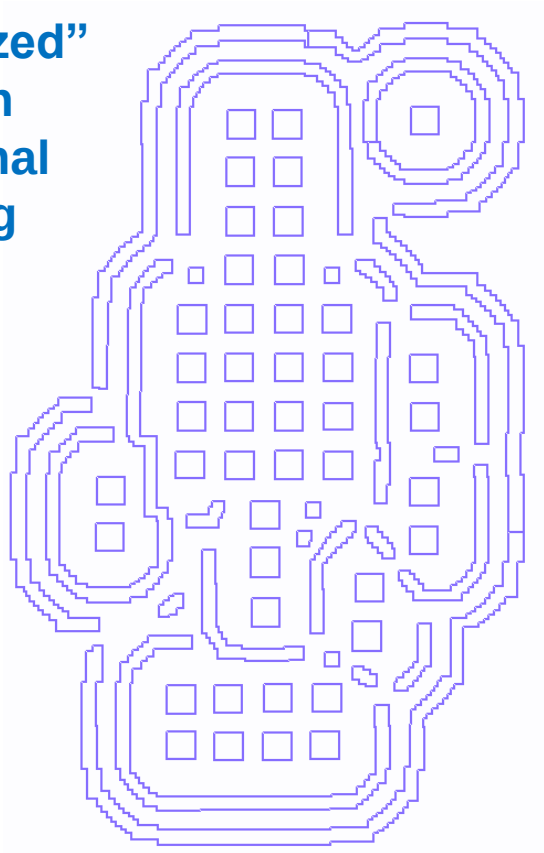
PMJ 2010: JEOL & D2S
30% Shot Count Reduction

Ideal Mask with Circles



484 (Circle + VSB) Shots
Better CDU with Circular Main Features

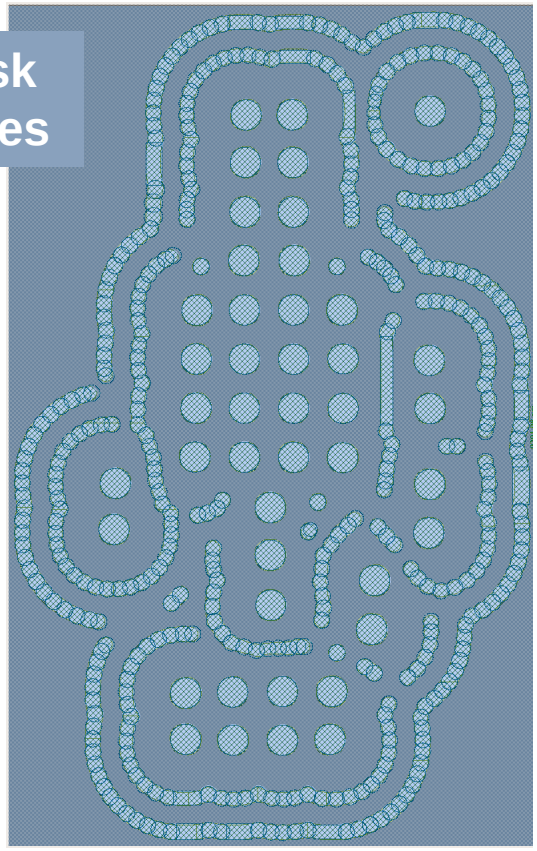
"Manhattanized" Mask with Conventional Fracturing

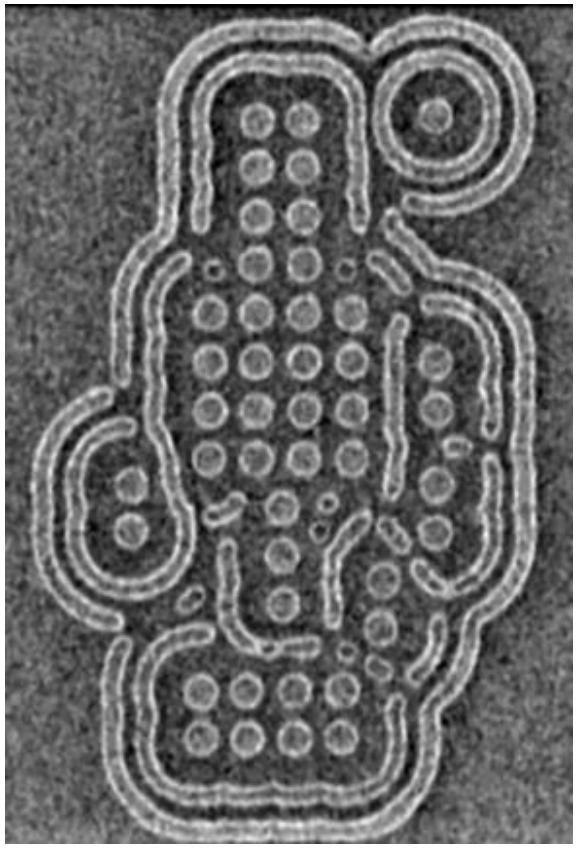


~620 conventional VSB shots

PMJ 2010: JEOL & D2S
Test Exposed with JBX-3200MV

Ideal Mask with Circles

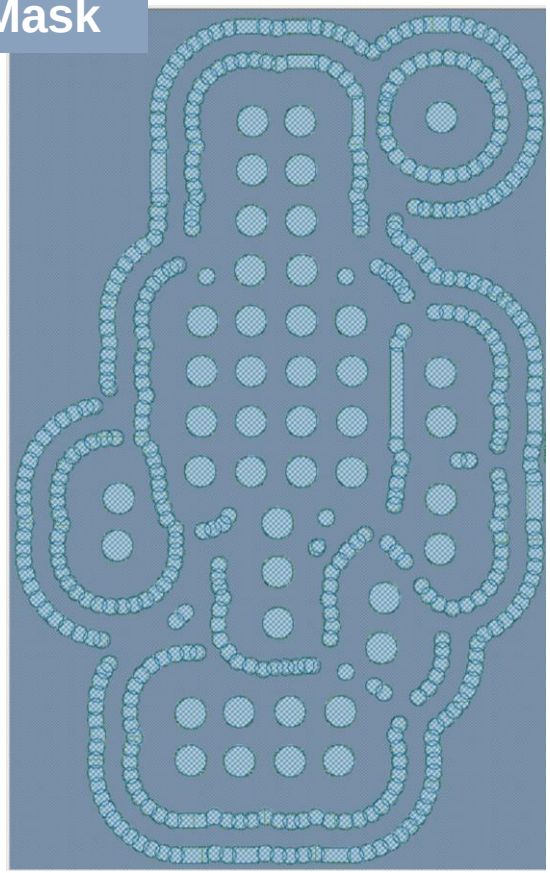




CD-SEM of ideal ILT using DFEB Mask

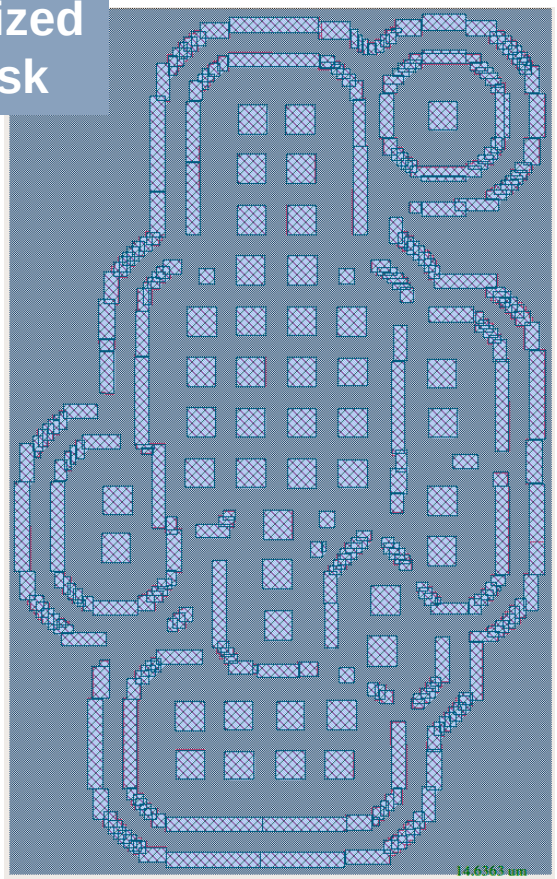
New for BACUS 2010: VSB-only solution

Ideal Mask



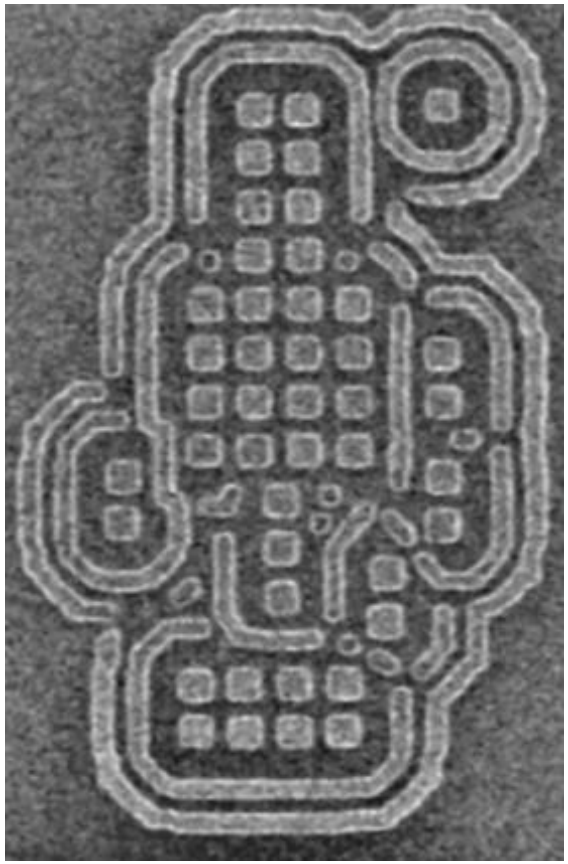
484 Circle + VSB Shots
Better CDU with Circular Main Features

D2S Optimized DFEB Mask

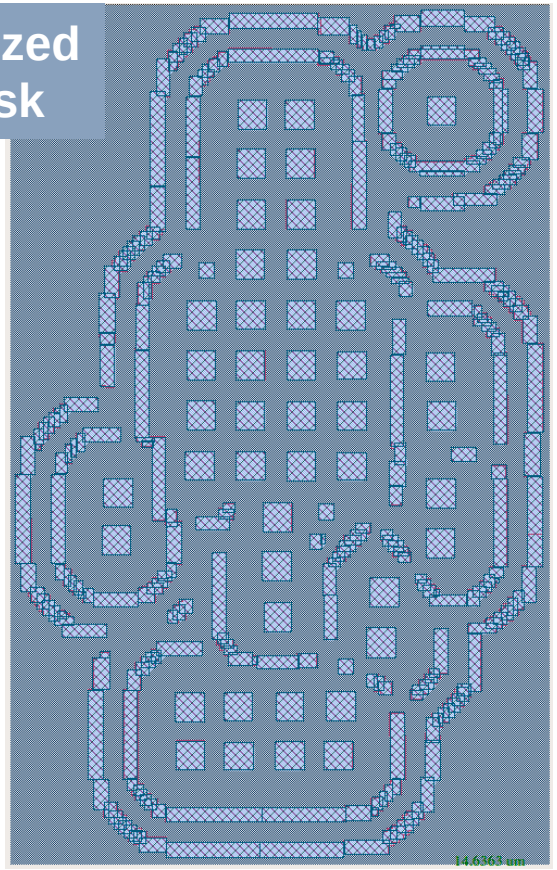


402 Overlapped VSB Shots (unassigned dose)
vs. ~620 conventional shots

DFEB Mask Improves Contacts: ILT with 9 VSB shots per contact



D2S Optimized DFEB Mask

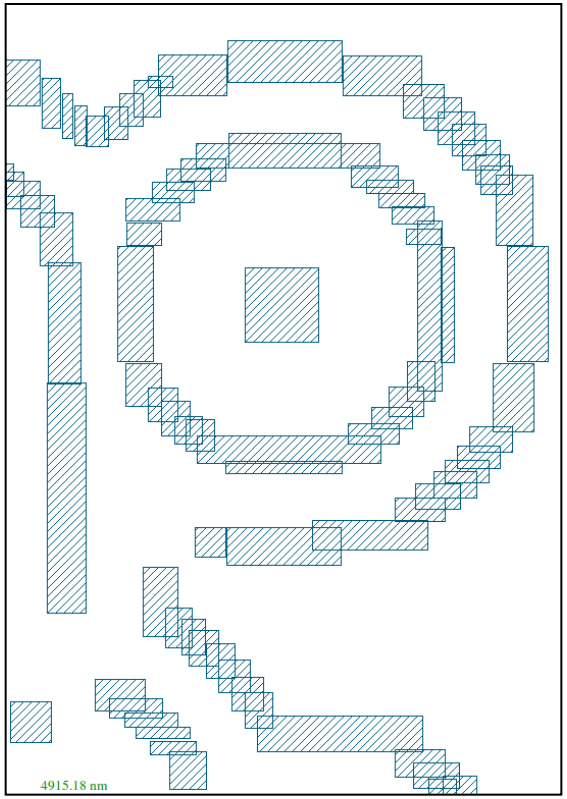


Test Printed on JEOL JBX 3200-MV

402 Overlapped VSB Shots (unassigned dose) vs. ~620 conventional shots

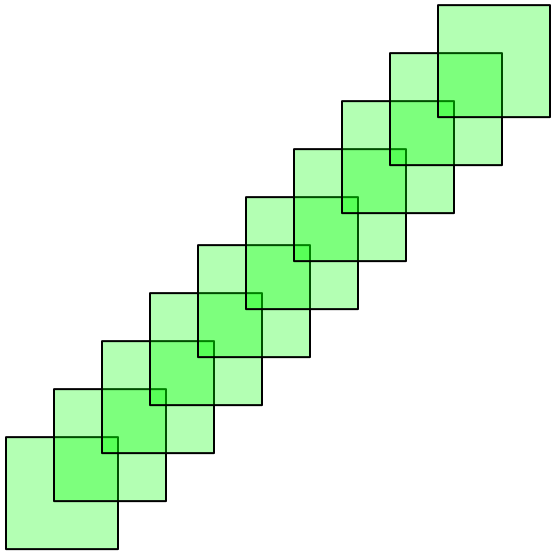
CD-SEM courtesy JEOL, Ltd.

Manhattanized ILT with DFEB Mask Using VSB-only MB-MDP

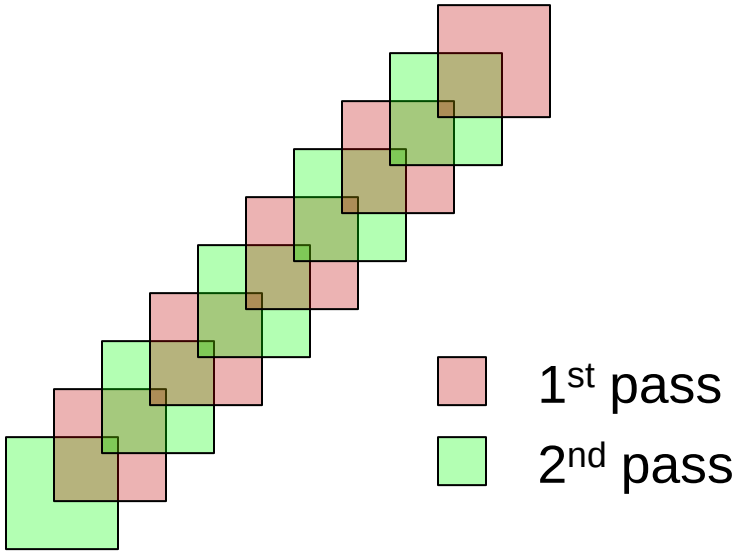


Zoomed in pictures of overlapped shots and the CD-SEM of the printed mask

New for BACUS 2010: Further 25% reduction for SRAF writing

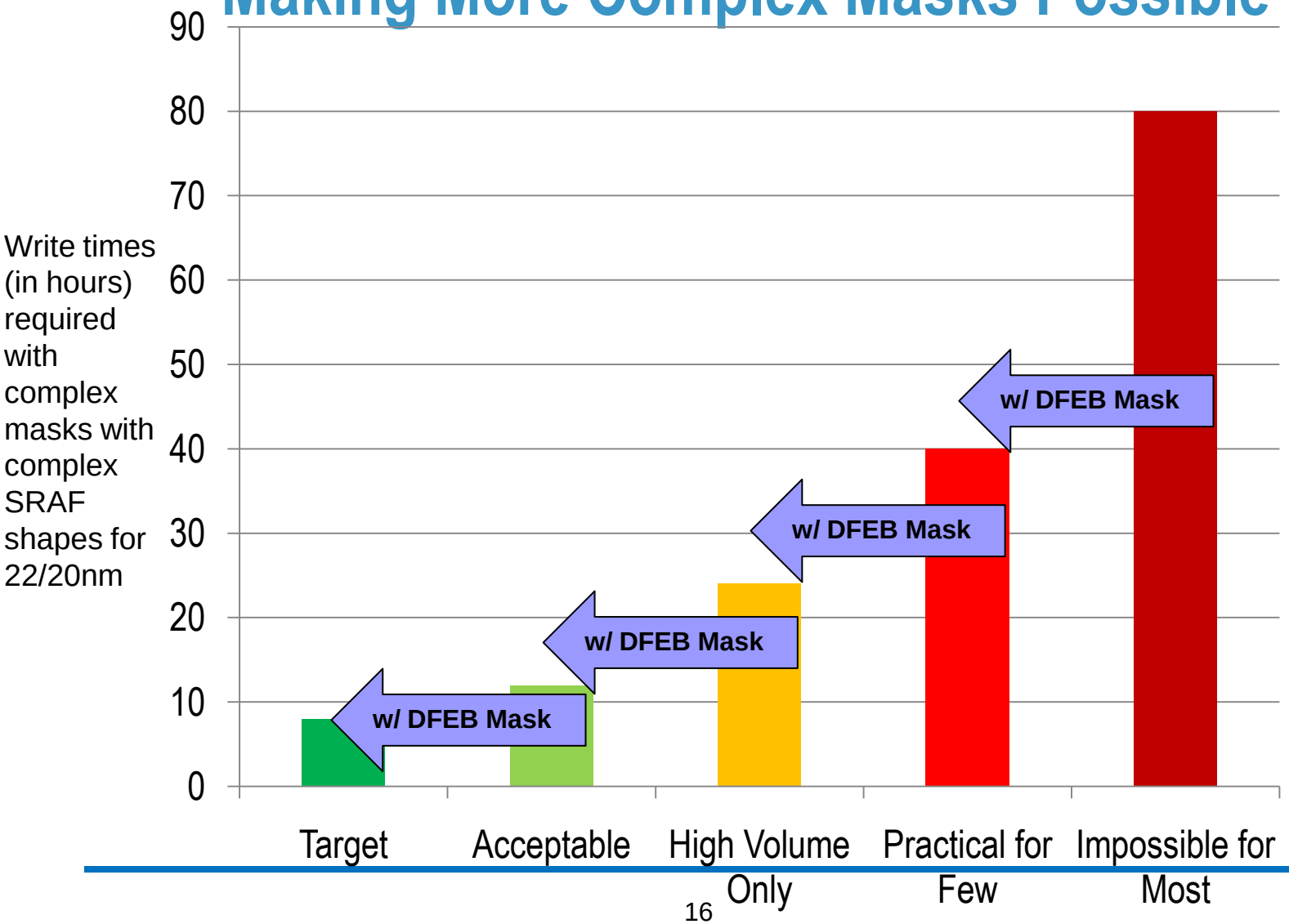


Before:
All shots with ½ dose in 2 passes or ¼ dose in 4 passes

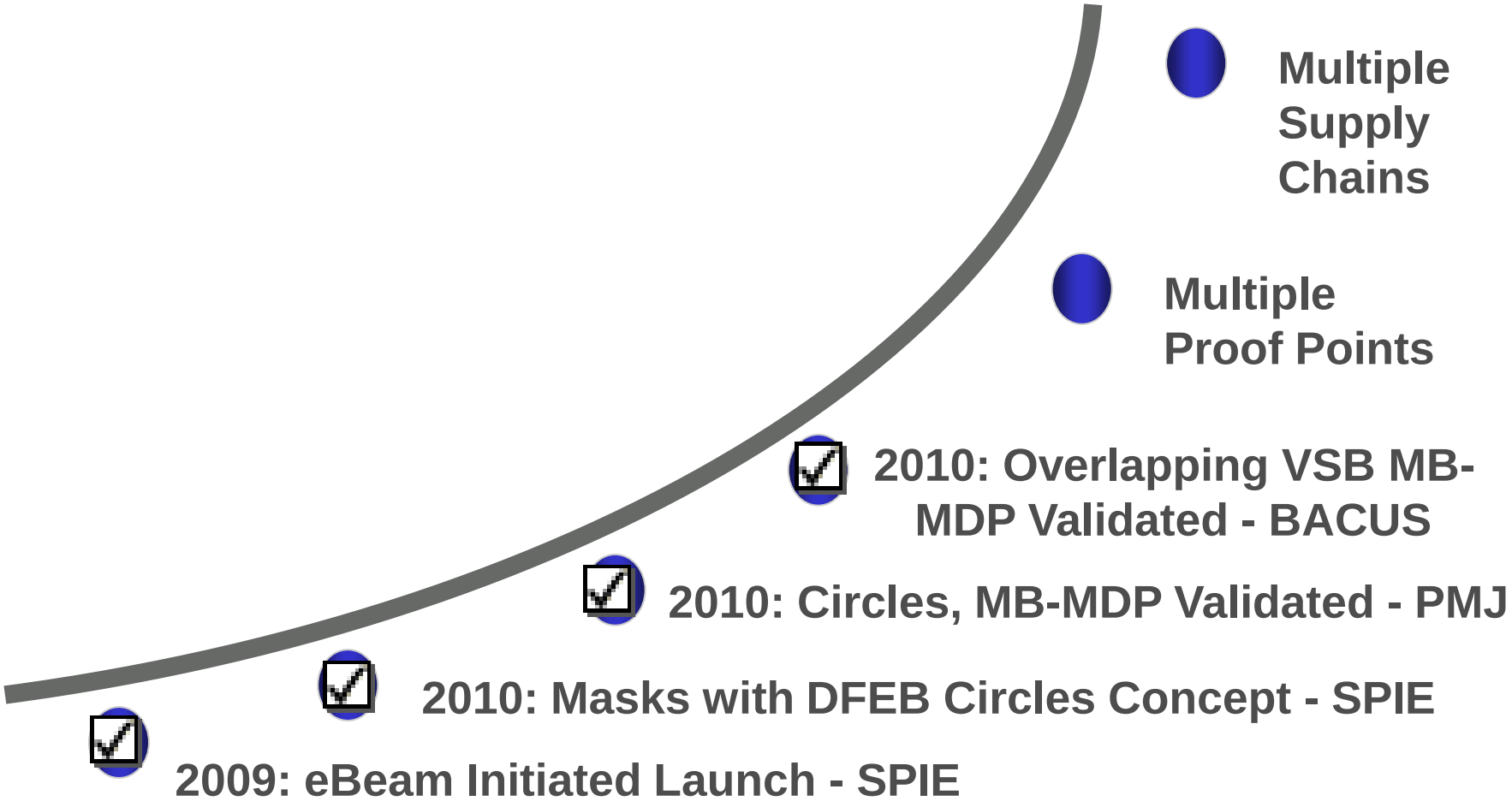


New:
Every other shot with full dose per pass saves 50% of blanking time
(Only for SRAF writing)

Summary: DFEB Mask Reduces Write Times Making More Complex Masks Possible



Summary: Steady Progress Towards Solving the "Impossible" 80 Hour Mask



Thanks to Members for BACUS Papers

- **September 14**
  - Session 2: Pattern Generation - Improvement of Mask Write Time for Curvilinear Assist Features at 22nm
  - Session 6: Mask Data Preparation - Writing 32nm-hp Contacts with Curvilinear Assist Features
  - Session 8: Optical Proximity Correction - Impact of Model-Based Fracturing on Proximity Effect Correction Methodology
- **September 15**
  - 8:00am, Steinbeck Forum – Special Session on E-Beam Direct Write


eBeam
Initiative