Quantum Cascade Lasers:

Well-timed next avenue for lightsource R&D?

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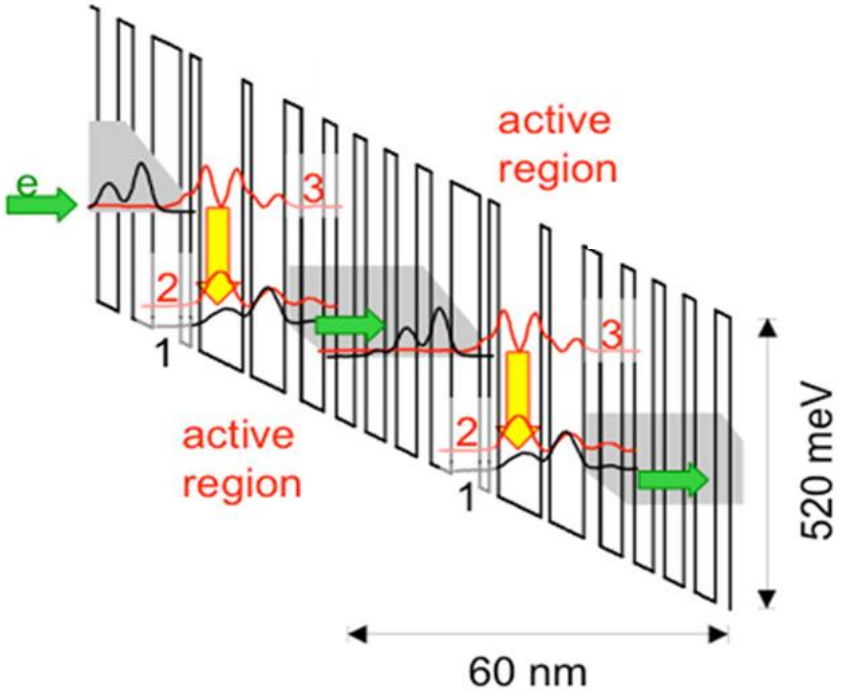
Scope of report

- **Established laser manufacturer with no history of QCL manufacture**
- **Assess if should launch R&D for a QCL-based platform**
- **Main focus on IP conditions and timing**

Working principle

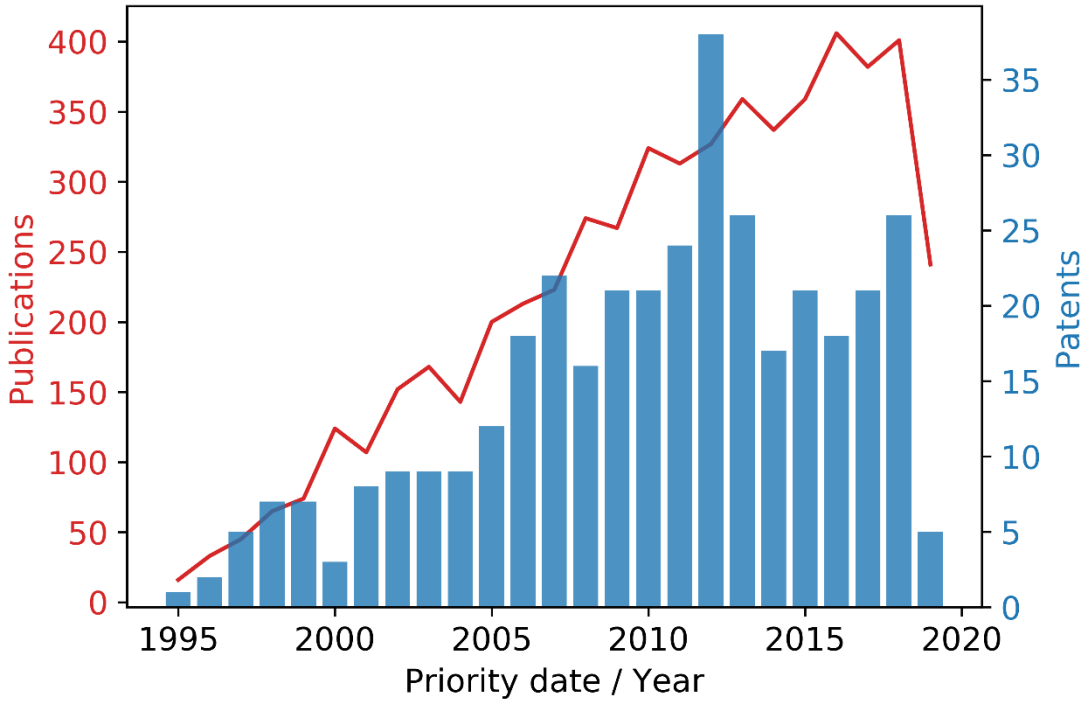
- Unipolar
- Multiple photons from single electron
- Complicated layer stack
- Intense infrared emission
- Applications:
  - ultrasensitive sensing
  - medical diagnostics
  - industrial quality control



History

- 1994 – QCL invented by Capasso and team at Bell Labs
- 1995 – Expiry of patent US3982207A covering Quantum Well Lasers
- 1997 – Patent US5936989A covers core QCL design
- 2006 – Patent US7535656B2 covers multiple wavelength emission
- 2017 – Expiry of original QCL patent

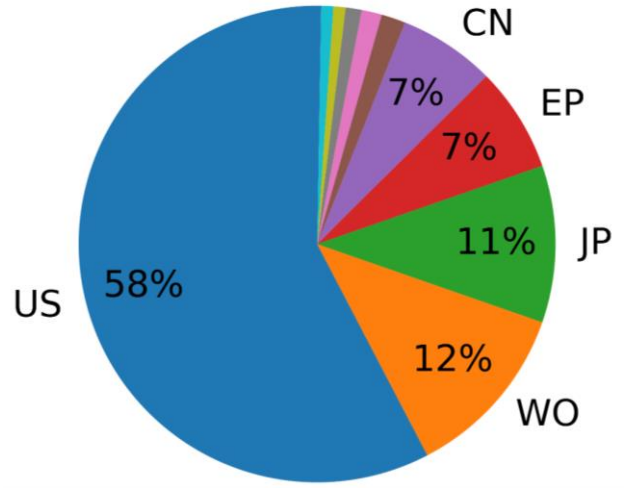
Patent trends



- **Total of 366 patents on QCL-platform development**

Key players

Company	Country	Patents held
SUMITOMO ELECTRIC INDUSTRIES	JP	36
HAMAMATSU PHOTONICS KK	JP	26
LUCENT TECHNOLOGIES INC	US	18
DAYLIGHT SOLUTIONS INC	US	16
CANON KK	JP	11
THALES SA	FR	9
AGILENT TECHNOLOGIES INC	US	7



Inventor	Country	Patents held
CAPASSO, FEDERICO	US	34
EDAMURA, TADATAKA	JP	25
FAIST, JEROME	CH	21
HASHIMOTO, JUN-ICHI	JP	20
AKIKUSA, NAOTA	JP	18

Recommendations

- **Original QCL patent expired in April 2017**
- **Similar situation to QCL inventors in 1990s with recently expired Quantum Well Laser patent**

- **Bulk of innovation covers layer optimisation**
- **Can be achieved by relatively cheap simulation**

- **IP landscape recently opened up – best time to enter is now**