of discriminant 5 to the canonical form *X2* $+$ *XY* $-$ *Y2*, where s5 is the odd root of *x2* = 5 mod *p*.

This reduction algorithm, outlined by Gauss and cleverly reported in Buell [3], was described in a masterly fashion in Mathews’ book [13], and thus it will be referred to as Mathews’ reduction. It can be applied to any quadratic form of a non-perfect square discriminant. The square root s5 may be computed with deterministic polynomial complexity by distinguishing whether *p* is congruent 3 or 1 modulo 4. In the first case, s5 is one of the two square roots $\pm 5^{\frac{p+1}{4}}$ mod *p*, and the computation clearly has deterministic polynomial complexity. In the second case Schoof’s algorithm [18, 21] is applied to compute both $\sqrt{-1}$ and $\sqrt{-5}$ modulo *p*, thus s5 is one of the two values $\pm \sqrt{-1}\sqrt{-5}$ mod *p*. Schoof’s algorithm evaluates a square root modulo p in a number of arithmetical operations of order *O(logt p)* with t $\leq $ 10, that is with deterministic polynomial complexity [18]. A description of Schoof’s algorithm can be found in the original paper [18] or in Washington’s book [21], and is based on properties of elliptic curves that are briefly summarized.

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1. **Representation of primes in Z(**$ω$**)**

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1. **Computational remarks**

The representations of primes $π$$\in $ *Q(*$ω$*)* as the sums of two squares, established by Theorems 2 and 3, are computed with deterministic poly-nomial complexity using procedures that will be described separately for the different cases.

1. *Primes* *p* $≡$ 13, 17 mod 20

The representation p = a2 + b2 does not need any further comment, since p = 1 mod 4 is the sum of two integer squares by Fermat’s theorem, and its computation was shown in Section 2.

1. *Primes p*

$+$ *y0F2k+1*)

......

1. **Conclusions**

The representation of primes as sums of two squares in Z($ω$) allows us to formulate a theorem concerning the representation of any integer in Z($ω$):

**Theorem 4.** *In the field Q(*$ω$*), any totally positive integer*

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The computation of the two-square representation of any element in Z($ω$) is equivalent to factoring, as in Z, therefore at the present time only the two-square representations of primes can be computed with deterministic polynomial complexity.

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